6-30-1987

Agricultural Research Division 101st Annual Report, July 1, 1986, to June 30, 1987

Follow this and additional works at: http://digitalcommons.unl.edu/ardnews

Part of the Agriculture Commons

http://digitalcommons.unl.edu/ardnews/361

This Article is brought to you for free and open access by the Agricultural Research Division of IANR at DigitalCommons@University of Nebraska - Lincoln. It has been accepted for inclusion in Agricultural Research Division News & Annual Reports by an authorized administrator of DigitalCommons@University of Nebraska - Lincoln.
Annual Report

University of Nebraska
Agricultural Research Division
July 1, 1986 to June 30, 1987

Agricultural Research Division
University of Nebraska
Institute of Agriculture and Natural Resources
Irvin T. Omtvedt, Dean and Director

The Nebraska Agricultural Research Division provides information and educational programs to all people without regard to race, color, national origin, sex or handicap.
The Nebraska Agricultural Research Division provides information and educational programs to all people without regard to race, color, national origin, sex or handicap.
In compliance with the intent of the law of the State of Nebraska that established the Nebraska Agricultural Experiment Station on March 31, 1887, it is a pleasure to compile this 101st Annual Report. This publication contains lists of current faculty, active projects, refereed journal publications, brief descriptions of research in selected areas and the financial report for the period July 1, 1986 through June 30, 1987.

Agriculture has changed tremendously both at the state and national levels since the U. S. Congress approved the establishment of an Agricultural Experiment Station in each state and with the passage of the Hatch Act, but the need for continued investment in agricultural research remains critical to Nebraska’s future. Our goal is to address current needs and to expand the knowledge base for addressing future developments. The continued funding base provided through State and Federal appropriations has permitted us to address high risk, long-term projects that do not lend themselves to grants and contracts.

Faculty conducting research in agriculture, home economics and natural resources in the University of Nebraska Institute of Agriculture and Natural Resources carry research appointments in the Agricultural Research Division. Most faculty are on joint appointments with teaching responsibilities in the College of Agriculture or the College of Home Economics or serve as Extension Specialists with appointments in the Cooperative Extension Service. As of June 30, 1987, the 138 full-time equivalents in the Agricultural Research Division were distributed among 257 faculty. These faculty are located on the East Campus of the University of Nebraska-Lincoln and at District Research and Extension Centers at Clay Center, Concord, North Platte and Scottsbluff. The University of Nebraska Agricultural Research and Development Center near Mead serves as a primary site for projects involving livestock or field plots for faculty located on the East Campus.

Although surpluses of agricultural commodities are currently an economic problem for U. S. agriculture, continued investment in agricultural research is essential to the long-term profitability of agriculture and the economic well-being of Nebraska. Our goal is to conduct research that will enhance our ability to provide quality food and agricultural products with consumer acceptance that are competitive in the world marketplace. This means that we must continue to invest in research that will result in reducing input costs in an effort to enhance profitability. Increased emphasis has been given to research involving processing, utilization and marketing. Utilization of rapid advancements in science, such as biotechnology, is becoming commonplace in the research projects of the Agricultural Research Division. Although the number of researchers and personnel involved in agricultural research has declined at the University of Nebraska in recent years, the program is more focused on targeted areas.

Conservation of natural resources and enhancement of environmental quality are also priority research areas for the Agricultural Research Division. There has been an increase in research emphasis directed toward expanding the knowledge base for future developments in production, processing and distribution of agricultural products through more basic approaches. The Agricultural Research Division continues to provide research results to enhance quality of life opportunities for all Nebraskans.

Results derived from various projects are published in scientific journals, trade journals, bulletins, university publications, and in departmental reports. The research results then become an information base for educational programs and publications prepared by the Nebraska Cooperative Extension Service. Reprints of most journal articles may be obtained by writing directly to the authors.

Researchers in the Agricultural Research Division are a part of a national network of Agricultural Experiment Station scientists located at Land-Grant universities across the United States. Nebraska researchers are currently involved in approximately 60 regional projects where they cooperate with scientists at other universities in addressing priority problems of regional importance. High priority is given to working cooperatively with USDA and U. S. Forest Service researchers with similar responsibilities. There are currently about 30 federally supported scientists located on the East Campus and approximately the same number at the Roman L. Hruska U. S. Meat Animal Research Center at Clay Center who work jointly with IANR researchers. Several faculty in the Agricultural Research Division are also involved in cooperative programs with the University of Nebraska at the Medical Center and on the City Campus.

For additional information regarding the Agricultural Research Division program, contact the Office of the Dean and Director, 109 Agricultural Hall, University of Nebraska, Lincoln, Nebraska 68583-0704.

Irvin T. Omtvedt
Dean for Agricultural Research and
Director, Nebraska Agricultural Experiment Station
University of Nebraska - Lincoln
# TABLE OF CONTENTS

<table>
<thead>
<tr>
<th>Section</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>Foreword</td>
<td>v</td>
</tr>
<tr>
<td>Administrative Personnel</td>
<td>vii</td>
</tr>
<tr>
<td>Administrative Units</td>
<td>viii</td>
</tr>
<tr>
<td>Organizational Chart</td>
<td>viii</td>
</tr>
<tr>
<td>Faculty</td>
<td>1</td>
</tr>
<tr>
<td>Research Highlights</td>
<td>13</td>
</tr>
<tr>
<td>Research Projects</td>
<td>33</td>
</tr>
<tr>
<td>Publications</td>
<td>45</td>
</tr>
<tr>
<td>Map of Research Sites</td>
<td>64</td>
</tr>
<tr>
<td>Research Budget</td>
<td>67</td>
</tr>
</tbody>
</table>
University of Nebraska

Board of Regents

Donald C. Fricke, Lincoln
Kermit Hansen, Elkhorn
Nancy Hoch, Nebraska City
Robert R. Koefoot, Grand Island
James H. Moylan, Omaha
John W. Payne, Kearney
Margaret Robinson, Norfolk
Don Blank, McCook

Jay Bansal, UNMC
R. L. Kerrigan, UNO
Andy Pollock, UNL

Administrative Officers

Ronald W. Roskens, President, University of Nebraska
Martin A. Massengale, Chancellor, University of Nebraska - Lincoln
Roy G. Arnold, Vice Chancellor, Institute of Agriculture and Natural Resources

Agricultural Research Division

Irvin T. Omtvedt, Dean and Director
Dale H. Vanderholm, Associate Dean and Associate Director
Karen E. Craig, Assistant Director for Home Economics
William L. Powers, Assistant Director for Water Research
Warren W. Sahs, Assistant Director for Operations
Administrative Units Reporting To Deans And Directors

Institute of Agriculture and Natural Resources
The University of Nebraska - Lincoln

June 1987

Agricultural Academic Program Units
(Extension, Research and Teaching)

AGRICULTURAL BIOCHEMISTRY
Herman W. Knoche

AGRICULTURAL COMMUNICATIONS
Gary Vacin

AGRICULTURAL ECONOMICS
William L. Miller

AGRICULTURAL ENGINEERING
William E. Splinter

AGRONOMY
Darrell W. Nelson

ANIMAL SCIENCE
Elton D. Aberle

BIOMETRICS AND INFORMATION SYSTEMS CENTER
Walt Stroup

CENTER FOR AGRICULTURAL METEOROLOGY AND CLIMATOLOGY
Blaine Blad

ENTOMOLOGY
Roger E. Gold

ENVIRONMENTAL PROGRAMS
Roger E. Gold

FOOD PROCESSING CENTER
Glenn Froning

FOOD SCIENCE AND TECHNOLOGY
Glenn Froning

FORESTRY, FISHERIES AND WILDLIFE
Gary L. Hergenrader

HORTICULTURE
Paul Read

PLANT PATHOLOGY
Anne K. Vidaver

VETERINARY SCIENCE
John A. Schmitz

Home Economics Departments
(Extension and Research)

CONSUMER SCIENCE AND EDUCATION
Gwendolyn Newkirk

HUMAN DEVELOPMENT AND THE FAMILY
William Meredith

HUMAN NUTRITION AND FOOD SERVICE
MANAGEMENT
Hazel M. Fox

TEXTILES, CLOTHING AND DESIGN
Joan M. Laughlin

Off-Campus Centers
(Extension and Research)

NORTHEAST RESEARCH AND EXTENSION CENTER,
Concord
Donald B. Hudman

WEST CENTRAL RESEARCH AND EXTENSION CENTER,
North Platte
Lavon J. Sumption

PANHANDLE RESEARCH AND EXTENSION CENTER,
Scottsbluff
Robert D. Fritschen

SOUTHWEST RESEARCH AND EXTENSION CENTER,
Clay Center
Charles L. Stonecipher

SOUTHEAST RESEARCH AND EXTENSION CENTER,
Lincoln
Loyd L. Young

AGRICULTURAL RESEARCH AND DEVELOPMENT CENTER,
Mead
Warren W. Sahs

Organizational Chart
Institute of Agriculture and Natural Resources The University of Nebraska-Lincoln
Faculty

101st Annual Report

University of Nebraska Agricultural Research Division
July 1, 1986 to June 30, 1987

Agricultural Research Division
University of Nebraska
Institute of Agriculture and Natural Resources
Irvin T. Omtvedt, Dean and Director

The Nebraska Agricultural Research Division provides information and educational programs to all people without regard to race, color, national origin, sex or handicap.
### Agricultural Research Division
#### Faculty

<table>
<thead>
<tr>
<th>Rank</th>
<th>Rsch</th>
<th>Ext</th>
<th>Tch</th>
<th>Other</th>
<th>Area of Responsibility</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Agricultural Biochemistry</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Herman W. Knoche</td>
<td>0.80</td>
<td>0.20</td>
<td></td>
<td></td>
<td>Head, Lipid Biochemistry</td>
</tr>
<tr>
<td>Raymond Chollet</td>
<td>0.90</td>
<td>0.10</td>
<td></td>
<td></td>
<td>Photosynthesis</td>
</tr>
<tr>
<td>Richard Dam</td>
<td>0.84</td>
<td>0.16</td>
<td></td>
<td></td>
<td>Nutritional Biochemistry</td>
</tr>
<tr>
<td>Robert M. Hill</td>
<td>0.80</td>
<td>0.20</td>
<td></td>
<td></td>
<td>Protein Biochemistry</td>
</tr>
<tr>
<td>Robert V. Klucas</td>
<td>0.90</td>
<td>0.10</td>
<td></td>
<td></td>
<td>Nitrogen Fixation</td>
</tr>
<tr>
<td>Ricky J. Krueger</td>
<td>0.85</td>
<td>0.15</td>
<td></td>
<td></td>
<td>Molecular Endocrinology</td>
</tr>
<tr>
<td>John P. Markwell</td>
<td>0.90</td>
<td>0.10</td>
<td></td>
<td></td>
<td>Plant Biochemistry</td>
</tr>
<tr>
<td>Robert L. Ogden</td>
<td>1.00</td>
<td></td>
<td></td>
<td></td>
<td>Alalfa Processing</td>
</tr>
<tr>
<td>Robert J. Spreitzer</td>
<td>0.85</td>
<td>0.15</td>
<td></td>
<td></td>
<td>Plant Molecular Genetics</td>
</tr>
<tr>
<td>Fred W. Wagner</td>
<td>0.90</td>
<td>0.10</td>
<td></td>
<td></td>
<td>Enzymes</td>
</tr>
<tr>
<td><strong>Agricultural Communications</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Gary Vacin(^2)</td>
<td>0.19</td>
<td>0.53</td>
<td>0.19</td>
<td>0.09</td>
<td>Head</td>
</tr>
<tr>
<td>DeLoris R. Clouse</td>
<td>0.10</td>
<td>0.90</td>
<td></td>
<td></td>
<td>Educational Media</td>
</tr>
<tr>
<td>Richard L. Fleming</td>
<td>0.25</td>
<td>0.57</td>
<td>0.18</td>
<td></td>
<td>Marketing</td>
</tr>
<tr>
<td>James W. King</td>
<td>0.20</td>
<td>0.80</td>
<td></td>
<td></td>
<td>Special Projects</td>
</tr>
<tr>
<td>Kathleen L. Kline(^1)</td>
<td>0.10</td>
<td>0.90</td>
<td></td>
<td></td>
<td>Publications</td>
</tr>
<tr>
<td>Daniel B. Lutz</td>
<td>0.10</td>
<td>0.80</td>
<td>0.10</td>
<td></td>
<td>News</td>
</tr>
<tr>
<td>Terrence Meisenbach</td>
<td>0.22</td>
<td>0.78</td>
<td></td>
<td></td>
<td>Publications</td>
</tr>
<tr>
<td>Charlotte Murphy</td>
<td>0.10</td>
<td>0.90</td>
<td></td>
<td></td>
<td>News</td>
</tr>
<tr>
<td>David E. Parrish</td>
<td>0.20</td>
<td>0.60</td>
<td>0.20</td>
<td></td>
<td>News</td>
</tr>
<tr>
<td>James K. Randall</td>
<td>0.10</td>
<td>0.90</td>
<td></td>
<td></td>
<td>Radio</td>
</tr>
<tr>
<td>Edward F. Vitzthum</td>
<td>0.25</td>
<td>0.75</td>
<td></td>
<td></td>
<td>Environmental Programs</td>
</tr>
<tr>
<td>Myra Wilhite</td>
<td>0.10</td>
<td>0.80</td>
<td>0.10</td>
<td></td>
<td>Visual Aids/Educational Media</td>
</tr>
<tr>
<td><strong>Agricultural Economics</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>William L. Miller</td>
<td>0.40</td>
<td>0.30</td>
<td>0.30</td>
<td></td>
<td>Head</td>
</tr>
<tr>
<td>J. David Aiken</td>
<td>0.55</td>
<td>0.35</td>
<td>0.10</td>
<td></td>
<td>Water Law</td>
</tr>
<tr>
<td>Dale G. Anderson</td>
<td>0.60</td>
<td>0.40</td>
<td></td>
<td></td>
<td>Marketing</td>
</tr>
<tr>
<td>Maurice E. Baker</td>
<td>0.70</td>
<td></td>
<td>0.30</td>
<td></td>
<td>Resource Economics</td>
</tr>
<tr>
<td>Richard Clark(^2)</td>
<td>0.25</td>
<td>0.75</td>
<td></td>
<td></td>
<td>Management and Marketing</td>
</tr>
<tr>
<td>Allen L. Frederick</td>
<td>0.30</td>
<td>0.70</td>
<td></td>
<td></td>
<td>Public Policy Economics</td>
</tr>
<tr>
<td>Paul H. Gessaman</td>
<td>0.10</td>
<td>0.90</td>
<td></td>
<td></td>
<td>Agricultural Finance</td>
</tr>
<tr>
<td>James B. Hassler(^1)</td>
<td>0.60</td>
<td>0.40</td>
<td></td>
<td></td>
<td>Marketing and Price Analysis</td>
</tr>
<tr>
<td>Glenn A. Helmers</td>
<td>0.60</td>
<td>0.40</td>
<td></td>
<td></td>
<td>Farm Management and Production</td>
</tr>
<tr>
<td>Bruce B. Johnson</td>
<td>0.47</td>
<td>0.53</td>
<td></td>
<td></td>
<td>Resource Economics</td>
</tr>
<tr>
<td>H. Douglas Jose</td>
<td>0.20</td>
<td>0.80</td>
<td></td>
<td></td>
<td>Farm Management</td>
</tr>
<tr>
<td>James G. Kendrick</td>
<td>0.20</td>
<td>0.80</td>
<td></td>
<td></td>
<td>Marketing and Agricultural Policy</td>
</tr>
<tr>
<td>Dean A. Linsenmeyer(^1)</td>
<td></td>
<td>1.00</td>
<td></td>
<td></td>
<td>Marketing</td>
</tr>
</tbody>
</table>

\(^1\) Ended research appointment during 1986-87

\(^2\) Began research appointment during 1986-87

(continued)
<table>
<thead>
<tr>
<th>Rank</th>
<th>Rsch</th>
<th>Ext</th>
<th>Tch</th>
<th>Other</th>
<th>Area of Responsibility</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lynn H. Lutgen</td>
<td>Associate Professor</td>
<td>0.30</td>
<td>0.70</td>
<td></td>
<td>Marketing</td>
</tr>
<tr>
<td>Emilio Pagoulatos</td>
<td>Professor</td>
<td>0.85</td>
<td>0.15</td>
<td></td>
<td>Marketing and International Trade</td>
</tr>
<tr>
<td>George H. Pfeiffer</td>
<td>Associate Professor</td>
<td>0.25</td>
<td>0.75</td>
<td></td>
<td>Farm and Ranch Management</td>
</tr>
<tr>
<td>James Robb</td>
<td>Assistant Professor</td>
<td>0.50</td>
<td>0.50</td>
<td></td>
<td>Farm Management</td>
</tr>
<tr>
<td>Roger Selley</td>
<td>Associate Professor</td>
<td>0.25</td>
<td>0.75</td>
<td></td>
<td>Financial Management</td>
</tr>
<tr>
<td>Raymond J. Supalla</td>
<td>Professor</td>
<td>0.75</td>
<td>0.25</td>
<td></td>
<td>Resource Economics</td>
</tr>
<tr>
<td>Michael S. Turner</td>
<td>Professor</td>
<td>0.35</td>
<td>0.65</td>
<td></td>
<td>Marketing</td>
</tr>
<tr>
<td>John F. Yanagida</td>
<td>Associate Professor</td>
<td>0.70</td>
<td>0.30</td>
<td></td>
<td>Quantitative Methods</td>
</tr>
</tbody>
</table>

### Agricultural Education

<table>
<thead>
<tr>
<th>Rank</th>
<th>Rsch</th>
<th>Ext</th>
<th>Tch</th>
<th>Other</th>
<th>Area of Responsibility</th>
</tr>
</thead>
<tbody>
<tr>
<td>Osmund S. Gilbertson</td>
<td>Professor</td>
<td>0.20</td>
<td>0.15</td>
<td>0.65</td>
<td>Head</td>
</tr>
<tr>
<td>Allen G. Blezek</td>
<td>Associate Professor</td>
<td>0.25</td>
<td>0.25</td>
<td>0.25</td>
<td>Curriculum Programs and Advanced Studies</td>
</tr>
<tr>
<td>Roy B. Dillon</td>
<td>Professor</td>
<td>0.50</td>
<td>0.50</td>
<td></td>
<td></td>
</tr>
<tr>
<td>James T. Horner</td>
<td>Professor</td>
<td>0.50</td>
<td>0.25</td>
<td>0.25</td>
<td>Advanced Studies</td>
</tr>
</tbody>
</table>

### Agricultural Engineering

<table>
<thead>
<tr>
<th>Rank</th>
<th>Rsch</th>
<th>Ext</th>
<th>Tch</th>
<th>Other</th>
<th>Area of Responsibility</th>
</tr>
</thead>
<tbody>
<tr>
<td>William E. Splinter</td>
<td>Professor</td>
<td>0.50</td>
<td>0.30</td>
<td>0.20</td>
<td>Head, George Holmes Distinguished Professor</td>
</tr>
<tr>
<td>Ramaswamy C. Anantheswaran</td>
<td>Assistant Professor</td>
<td>0.20</td>
<td></td>
<td>0.80</td>
<td>Food Engineering</td>
</tr>
<tr>
<td>Leonard Bashford</td>
<td>Professor</td>
<td>0.65</td>
<td>0.35</td>
<td></td>
<td>Power and Machinery</td>
</tr>
<tr>
<td>Gerald R. Bodman</td>
<td>Associate Professor</td>
<td>0.25</td>
<td>0.75</td>
<td>USDA</td>
<td>Modeling Animal Physiology Processes</td>
</tr>
<tr>
<td>Y. R. Chen</td>
<td>Associate Professor</td>
<td>0.25</td>
<td>0.75</td>
<td>USDA</td>
<td>Livestock Environment</td>
</tr>
<tr>
<td>James A. DeShazer</td>
<td>Professor</td>
<td>0.75</td>
<td>0.25</td>
<td>USDA</td>
<td>Livestock Environment</td>
</tr>
<tr>
<td>Elbert C. Dickey</td>
<td>Associate Professor</td>
<td>0.25</td>
<td>0.75</td>
<td>USDA</td>
<td>Soil and Water Conservation</td>
</tr>
<tr>
<td>Conrad B. Gilbertson</td>
<td>Associate Professor</td>
<td>0.75</td>
<td>0.25</td>
<td>USDA</td>
<td>Irrigation Engineering</td>
</tr>
<tr>
<td>James R. Gilley</td>
<td>Professor</td>
<td>0.75</td>
<td>0.25</td>
<td>USDA</td>
<td>Soil and Water Conservation</td>
</tr>
<tr>
<td>John E. Gilley</td>
<td>Assistant Professor</td>
<td>0.25</td>
<td>0.75</td>
<td>USDA</td>
<td>Power and Machinery</td>
</tr>
<tr>
<td>Robert D. Grisso</td>
<td>Assistant Professor</td>
<td>0.25</td>
<td>0.75</td>
<td>USDA</td>
<td>Animal Calorimetry</td>
</tr>
<tr>
<td>G. L. Hahn</td>
<td>Professor</td>
<td>0.57</td>
<td>0.23</td>
<td>USDA</td>
<td>Modeling Animal Physiology Processes</td>
</tr>
<tr>
<td>Milford A. Hanna</td>
<td>Professor</td>
<td></td>
<td>0.23</td>
<td>USDA</td>
<td>Tractor Testing</td>
</tr>
<tr>
<td>A. G. Hashimoto</td>
<td>Professor</td>
<td></td>
<td>0.23</td>
<td>USDA</td>
<td>Irrigation Engineering</td>
</tr>
<tr>
<td>Louis I. Levitcus</td>
<td>Professor</td>
<td>1.00</td>
<td>0.28</td>
<td>USDA</td>
<td>Biological Engineering</td>
</tr>
<tr>
<td>Derrel L. Martin</td>
<td>Assistant Professor</td>
<td>0.72</td>
<td>0.28</td>
<td>USDA</td>
<td>Animal Calorimetry</td>
</tr>
<tr>
<td>George E. Meyer</td>
<td>Associate Professor</td>
<td>0.75</td>
<td>0.25</td>
<td>USDA</td>
<td>Crop Processing</td>
</tr>
<tr>
<td>Jack A. Nienaber</td>
<td>Associate Professor</td>
<td>0.20</td>
<td>0.80</td>
<td>USDA</td>
<td>Structures, Processing</td>
</tr>
<tr>
<td>Richard Pierce</td>
<td>Assistant Professor</td>
<td>0.67</td>
<td>0.33</td>
<td>USDA</td>
<td>Electrical Safety</td>
</tr>
<tr>
<td>Dennis D. Schulte</td>
<td>Professor</td>
<td></td>
<td>0.33</td>
<td>USDA</td>
<td></td>
</tr>
<tr>
<td>LaVerne Stetson</td>
<td>Professor</td>
<td></td>
<td>0.33</td>
<td>USDA</td>
<td></td>
</tr>
<tr>
<td>Thomas L. Thompson</td>
<td>Professor</td>
<td>0.70</td>
<td>0.30</td>
<td>USDA</td>
<td>Product Processing and System</td>
</tr>
<tr>
<td>Kenneth Von Bargen</td>
<td>Professor</td>
<td>0.55</td>
<td>0.45</td>
<td>USDA</td>
<td>Systems Engineering</td>
</tr>
<tr>
<td>Howard D. Wittmuss</td>
<td>Associate Professor</td>
<td>0.53</td>
<td>0.47</td>
<td>USDA</td>
<td>Soil and Water Conservation</td>
</tr>
<tr>
<td>Agronomy</td>
<td>Rank</td>
<td>Rsch</td>
<td>Ext</td>
<td>Tch</td>
<td>Other</td>
</tr>
<tr>
<td>----------------------------------------------</td>
<td>-----------------</td>
<td>------</td>
<td>------</td>
<td>------</td>
<td>------------------</td>
</tr>
<tr>
<td>Darrell W. Nelson</td>
<td>Professor</td>
<td>0.40</td>
<td>0.30</td>
<td>0.30</td>
<td>Head</td>
</tr>
<tr>
<td>Bruce E. Anderson</td>
<td>Assistant Professor</td>
<td>0.40</td>
<td>0.60</td>
<td></td>
<td>Forage Management</td>
</tr>
<tr>
<td>David J. Andrews</td>
<td>Professor</td>
<td>0.25</td>
<td></td>
<td></td>
<td>0.75 Millet and Sorghum Breeding</td>
</tr>
<tr>
<td>Roger J. Assmus</td>
<td>Assistant Instructor</td>
<td>0.23</td>
<td>0.77</td>
<td></td>
<td>Soil Chemistry/Fertility</td>
</tr>
<tr>
<td>P. Stephen Baenziger</td>
<td>Associate Professor</td>
<td>0.75</td>
<td>0.25</td>
<td></td>
<td>USDA Sorghum Physiology</td>
</tr>
<tr>
<td>Ralph B. Clark</td>
<td>Professor</td>
<td></td>
<td></td>
<td></td>
<td>USDA Soil Biochemistry</td>
</tr>
<tr>
<td>Max Clegg</td>
<td>Associate Professor</td>
<td></td>
<td>0.15</td>
<td></td>
<td>USDA Soil Biochemistry</td>
</tr>
<tr>
<td>William A. Compton</td>
<td>Professor</td>
<td>0.80</td>
<td></td>
<td></td>
<td>USDA Soil Biochemistry</td>
</tr>
<tr>
<td>John W. Doran</td>
<td>Associate Professor</td>
<td></td>
<td>0.20</td>
<td></td>
<td>USDA Soil Biochemistry</td>
</tr>
<tr>
<td>August F. Dreier</td>
<td>Professor</td>
<td>0.74</td>
<td>0.26</td>
<td></td>
<td>USDA Soil Biochemistry</td>
</tr>
<tr>
<td>Jerry D. Eastin</td>
<td>Professor</td>
<td>0.85</td>
<td></td>
<td>0.15</td>
<td>USDA Soil Biochemistry</td>
</tr>
<tr>
<td>James R. Ellis</td>
<td>Associate Professor</td>
<td></td>
<td></td>
<td></td>
<td>USDA Soil Biochemistry</td>
</tr>
<tr>
<td>Charles A. Francis</td>
<td>Professor</td>
<td>0.25</td>
<td>0.75</td>
<td></td>
<td>USDA Soil Biochemistry</td>
</tr>
<tr>
<td>Byron C. Gabrielsen</td>
<td>Assistant Professor</td>
<td></td>
<td></td>
<td></td>
<td>USDA Forage Physiology</td>
</tr>
<tr>
<td>Charles O. Gardner</td>
<td>Professor</td>
<td>0.70</td>
<td></td>
<td>0.30</td>
<td>USDA Forage Physiology</td>
</tr>
<tr>
<td>Herman J. Gorz</td>
<td>Professor</td>
<td></td>
<td></td>
<td></td>
<td>USDA Forage Physiology</td>
</tr>
<tr>
<td>Robert Graybosch</td>
<td>Assistant Professor</td>
<td></td>
<td></td>
<td></td>
<td>USDA Forage Physiology</td>
</tr>
<tr>
<td>Francis A. Haskins</td>
<td>Professor</td>
<td>0.80</td>
<td>0.20</td>
<td></td>
<td>USDA Forage Physiology</td>
</tr>
<tr>
<td>Michael D. Jawson</td>
<td>Assistant Professor</td>
<td>0.65</td>
<td>0.35</td>
<td></td>
<td>USDA Forage Physiology</td>
</tr>
<tr>
<td>Alice J. Jones</td>
<td>Assistant Professor</td>
<td>0.50</td>
<td>0.50</td>
<td></td>
<td>USDA Forage Physiology</td>
</tr>
<tr>
<td>Lowell Klepper</td>
<td>Associate Professor</td>
<td>1.00</td>
<td></td>
<td></td>
<td>USDA Forage Physiology</td>
</tr>
<tr>
<td>Delno Knudsen</td>
<td>Professor</td>
<td>0.50</td>
<td>0.50</td>
<td></td>
<td>USDA Forage Physiology</td>
</tr>
<tr>
<td>David T. Lewis</td>
<td>Professor</td>
<td>0.40</td>
<td>0.60</td>
<td></td>
<td>USDA Range Weed Control</td>
</tr>
<tr>
<td>Jerry Maranville</td>
<td>Professor</td>
<td>0.83</td>
<td>0.17</td>
<td></td>
<td>USDA Range Weed Control</td>
</tr>
<tr>
<td>Alexander Martin</td>
<td>Professor</td>
<td>0.33</td>
<td>0.67</td>
<td></td>
<td>USDA Range Weed Control</td>
</tr>
<tr>
<td>Stephen C. Mason</td>
<td>Assistant Professor</td>
<td>0.25</td>
<td>0.75</td>
<td></td>
<td>USDA Range Weed Control</td>
</tr>
<tr>
<td>Robert A. Masters</td>
<td>Assistant Professor</td>
<td>1.00</td>
<td></td>
<td></td>
<td>USDA Range Weed Control</td>
</tr>
<tr>
<td>Paul J. Mattern</td>
<td>Professor</td>
<td>1.00</td>
<td></td>
<td></td>
<td>USDA Range Weed Control</td>
</tr>
<tr>
<td>Dennis McCallister</td>
<td>Assistant Professor</td>
<td>0.30</td>
<td>0.70</td>
<td></td>
<td>USDA Range Weed Control</td>
</tr>
<tr>
<td>Lloyd N. Mielke</td>
<td>Associate Professor</td>
<td></td>
<td></td>
<td></td>
<td>USDA Range Weed Control</td>
</tr>
<tr>
<td>Richard Mills</td>
<td>Professor</td>
<td>1.00</td>
<td></td>
<td></td>
<td>USDA Range Weed Control</td>
</tr>
<tr>
<td>M. Rosalind Morris</td>
<td>Professor</td>
<td>0.64</td>
<td>0.36</td>
<td></td>
<td>USDA Range Weed Control</td>
</tr>
<tr>
<td>David A. Mortensen</td>
<td>Assistant Professor</td>
<td>0.75</td>
<td>0.25</td>
<td></td>
<td>USDA Range Weed Control</td>
</tr>
<tr>
<td>Lowell E. Moser</td>
<td>Professor</td>
<td>0.18</td>
<td>0.82</td>
<td></td>
<td>USDA Range Weed Control</td>
</tr>
<tr>
<td>John Norman</td>
<td>Professor</td>
<td>0.80</td>
<td>0.20</td>
<td></td>
<td>USDA Range Weed Control</td>
</tr>
<tr>
<td>Edwin J. Penas</td>
<td>Associate Professor</td>
<td>0.25</td>
<td>0.75</td>
<td></td>
<td>USDA Cereal Quality</td>
</tr>
<tr>
<td>C. James Peterson</td>
<td>Assistant Professor</td>
<td></td>
<td></td>
<td></td>
<td>USDA Cereal Quality</td>
</tr>
<tr>
<td>James F. Power</td>
<td>Professor</td>
<td></td>
<td></td>
<td></td>
<td>USDA Cereal Quality</td>
</tr>
<tr>
<td>Donald H. Sander</td>
<td>Professor</td>
<td>0.50</td>
<td>0.50</td>
<td></td>
<td>USDA Cereal Quality</td>
</tr>
<tr>
<td>James S. Schepers</td>
<td>Associate Professor</td>
<td></td>
<td></td>
<td></td>
<td>USDA Cereal Quality</td>
</tr>
<tr>
<td>Patrick J. Shea</td>
<td>Associate Professor</td>
<td>0.70</td>
<td>0.30</td>
<td></td>
<td>USDA Cereal Quality</td>
</tr>
<tr>
<td>Joseph H. Skopp</td>
<td>Associate Professor</td>
<td>0.48</td>
<td>0.52</td>
<td></td>
<td>USDA Cereal Quality</td>
</tr>
<tr>
<td>Robert C. Sorensen</td>
<td>Professor</td>
<td>0.25</td>
<td>0.75</td>
<td></td>
<td>USDA Cereal Quality</td>
</tr>
<tr>
<td>James E. Specht</td>
<td>Professor</td>
<td>0.80</td>
<td>0.20</td>
<td></td>
<td>USDA Cereal Quality</td>
</tr>
</tbody>
</table>

(continued)
### Faculty

<table>
<thead>
<tr>
<th>Rank</th>
<th>Rsch</th>
<th>Ext</th>
<th>Tch</th>
<th>Other</th>
<th>Area of Responsibility</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>(Agronomy....)</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Paul E. Staswick</td>
<td>0.75</td>
<td>0.25</td>
<td></td>
<td>Molecular Genetics</td>
<td></td>
</tr>
<tr>
<td>James Stubbendieck</td>
<td>0.50</td>
<td>0.50</td>
<td></td>
<td>Range Ecology and</td>
<td>Management</td>
</tr>
<tr>
<td>Charles Y. Sullivan</td>
<td></td>
<td></td>
<td></td>
<td>USDA Crop Physiology</td>
<td></td>
</tr>
<tr>
<td>Dale Swartzendruber</td>
<td>0.70</td>
<td>0.30</td>
<td></td>
<td>Soil Physics</td>
<td></td>
</tr>
<tr>
<td>Beth A. Swisher</td>
<td>0.50</td>
<td>0.50</td>
<td></td>
<td>Weed Physiology</td>
<td></td>
</tr>
<tr>
<td>Mary Thomas-Compton²</td>
<td>1.00</td>
<td></td>
<td></td>
<td>Popcorn Breeding</td>
<td></td>
</tr>
<tr>
<td>Gary E. Varvel</td>
<td></td>
<td></td>
<td></td>
<td>USDA Soil Management</td>
<td></td>
</tr>
<tr>
<td>Kenneth P. Vogel</td>
<td>0.70</td>
<td>0.30</td>
<td></td>
<td>USDA Grass Breeding</td>
<td></td>
</tr>
<tr>
<td>Steven S. Waller</td>
<td>0.50</td>
<td>0.50</td>
<td></td>
<td>Range Management and Improvement</td>
<td></td>
</tr>
<tr>
<td>Elizabeth Walter-Shea²</td>
<td>1.00</td>
<td></td>
<td></td>
<td>Water Resources and Crop Modeling</td>
<td></td>
</tr>
<tr>
<td>Daniel T. Walters</td>
<td>0.35</td>
<td>0.65</td>
<td></td>
<td>Soil Management</td>
<td>USDA Crop Physiology</td>
</tr>
<tr>
<td>Wallace W. Wilhelm</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### Animal Science

<table>
<thead>
<tr>
<th>Rank</th>
<th>Rsch</th>
<th>Ext</th>
<th>Tch</th>
<th>Other</th>
<th>Area of Responsibility</th>
</tr>
</thead>
<tbody>
<tr>
<td>Elton D. Aberle</td>
<td>0.35</td>
<td>0.34</td>
<td>0.31</td>
<td>Head</td>
<td></td>
</tr>
<tr>
<td>William T. Ahlschwede</td>
<td>0.30</td>
<td>0.70</td>
<td></td>
<td>Swine Production</td>
<td></td>
</tr>
<tr>
<td>Mary M. Beck</td>
<td>0.70</td>
<td>0.30</td>
<td></td>
<td>Poultry Physiology</td>
<td>USDA Breeding</td>
</tr>
<tr>
<td>Gary L. Bennett</td>
<td>0.30</td>
<td>0.70</td>
<td></td>
<td>Ruminant Nutrition</td>
<td>USDA Nutrition</td>
</tr>
<tr>
<td>Dennis R. Brink</td>
<td>0.70</td>
<td>0.30</td>
<td></td>
<td>Ruminant Biochemistry</td>
<td></td>
</tr>
<tr>
<td>Robert A. Britton</td>
<td>0.70</td>
<td>0.30</td>
<td></td>
<td>Meats</td>
<td>USDA Physiology</td>
</tr>
<tr>
<td>Chris R. Calkins</td>
<td>0.70</td>
<td>0.30</td>
<td></td>
<td></td>
<td>USA Meats</td>
</tr>
<tr>
<td>Ronald K. Christenson</td>
<td>0.70</td>
<td>0.30</td>
<td></td>
<td></td>
<td>USDA Breeding</td>
</tr>
<tr>
<td>John D. Crouse²</td>
<td>0.70</td>
<td>0.30</td>
<td></td>
<td></td>
<td>USDA Animal Breeding and Genetics</td>
</tr>
<tr>
<td>Larry V. Cundiff</td>
<td>0.70</td>
<td>0.30</td>
<td></td>
<td></td>
<td>USA Nutrition</td>
</tr>
<tr>
<td>Gordon E. Dickerson</td>
<td>0.75</td>
<td>0.25</td>
<td></td>
<td>Dairy Breeding</td>
<td>USDA Nutrition</td>
</tr>
<tr>
<td>Joan H. Eisenmann²</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>USA Physiology</td>
</tr>
<tr>
<td>Calvin L. Ferrell</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>USDA Nutrition</td>
</tr>
<tr>
<td>J. Joe Ford</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>USDA Physiology</td>
</tr>
<tr>
<td>Earl W. Gleaves</td>
<td>0.25</td>
<td>0.75</td>
<td></td>
<td>Poultry Production</td>
<td>USDA Breeding</td>
</tr>
<tr>
<td>Keith E. Gregory</td>
<td></td>
<td></td>
<td></td>
<td>Beef Nutrition</td>
<td></td>
</tr>
<tr>
<td>Paul Q. Guyer¹</td>
<td>0.05</td>
<td>0.75</td>
<td>0.20</td>
<td></td>
<td>USDA Breeding</td>
</tr>
<tr>
<td>Thomas G. Jenkins</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>USDA Breeding</td>
</tr>
<tr>
<td>Rodger K. Johnson</td>
<td>0.60</td>
<td>0.40</td>
<td></td>
<td>Swine Breeding</td>
<td></td>
</tr>
<tr>
<td>Steven J. Jones</td>
<td>0.50</td>
<td>0.50</td>
<td></td>
<td>Meats</td>
<td></td>
</tr>
<tr>
<td>Jeffrey F. Keown</td>
<td>0.30</td>
<td>0.70</td>
<td></td>
<td>Dairy Management</td>
<td></td>
</tr>
<tr>
<td>James E. Kinder</td>
<td>0.60</td>
<td>0.40</td>
<td></td>
<td>Beef Physiology</td>
<td></td>
</tr>
<tr>
<td>Roger J. Kittok</td>
<td>0.85</td>
<td>0.15</td>
<td></td>
<td>Reproductive Physiology</td>
<td></td>
</tr>
<tr>
<td>Terry J. Klopfenstein</td>
<td>0.70</td>
<td>0.30</td>
<td></td>
<td>Ruminant Nutrition</td>
<td></td>
</tr>
<tr>
<td>Robert M. Koch</td>
<td>1.00</td>
<td></td>
<td></td>
<td>Research Geneticist</td>
<td></td>
</tr>
<tr>
<td>Larry L. Larson</td>
<td>0.50</td>
<td>0.50</td>
<td></td>
<td>Dairy Physiology</td>
<td></td>
</tr>
<tr>
<td>Austin J. Lewis</td>
<td>0.70</td>
<td>0.30</td>
<td></td>
<td>Swine Nutrition</td>
<td></td>
</tr>
<tr>
<td>Kreg A. Leymaster</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>USDA Breeding</td>
</tr>
<tr>
<td>Michael D. MacNeil²</td>
<td>0.60</td>
<td>0.40</td>
<td></td>
<td></td>
<td>USDA Breeding</td>
</tr>
<tr>
<td>Roger W. Mandigo</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>USDA Breeding</td>
</tr>
<tr>
<td>Rank</td>
<td>Rsch</td>
<td>Ext</td>
<td>Tch</td>
<td>Other</td>
<td>Area of Responsibility</td>
</tr>
<tr>
<td>-----------------</td>
<td>------</td>
<td>------</td>
<td>------</td>
<td>----------------------------</td>
<td>------------------------</td>
</tr>
<tr>
<td>Merlyn K. Nielsen</td>
<td>Professor</td>
<td>0.60</td>
<td>0.40</td>
<td>Beef Breeding</td>
<td>USDA Nutrition</td>
</tr>
<tr>
<td>Robert R. Oltjen</td>
<td>Professor</td>
<td>0.40</td>
<td>0.45</td>
<td>Dairy Nutrition</td>
<td>Swine Nutrition</td>
</tr>
<tr>
<td>Foster G. Owen</td>
<td>Professor</td>
<td>0.55</td>
<td>0.15</td>
<td>USDA Nutrition</td>
<td></td>
</tr>
<tr>
<td>Ernest R. Peo, Jr.</td>
<td>Professor</td>
<td>0.65</td>
<td>0.35</td>
<td>USDA Nutrition</td>
<td></td>
</tr>
<tr>
<td>Wilson G. Pond</td>
<td>Associate Professor</td>
<td>0.50</td>
<td>0.50</td>
<td>USDA Nutrition</td>
<td></td>
</tr>
<tr>
<td>Bruce D. Schanbacher</td>
<td>Associate Professor</td>
<td>0.65</td>
<td>0.33</td>
<td>USDA Nutrition</td>
<td></td>
</tr>
<tr>
<td>Steven C. Seideman¹</td>
<td>Assistant Professor</td>
<td>0.70</td>
<td>0.30</td>
<td>USDA Breeding</td>
<td></td>
</tr>
<tr>
<td>Rick A. Stock</td>
<td>Assistant Professor</td>
<td>0.50</td>
<td>0.50</td>
<td>USDA Nutrition</td>
<td></td>
</tr>
<tr>
<td>Thomas W. Sullivan</td>
<td>Professor</td>
<td>0.65</td>
<td>0.35</td>
<td>USDA Nutrition</td>
<td></td>
</tr>
<tr>
<td>John K. Ward</td>
<td>Professor</td>
<td>0.50</td>
<td>0.50</td>
<td>USDA Nutrition</td>
<td></td>
</tr>
<tr>
<td>Thomas H. Wise</td>
<td>Associate Professor</td>
<td>0.25</td>
<td>0.75</td>
<td>USDA Nutrition</td>
<td></td>
</tr>
<tr>
<td>Jong-Tseng Yen</td>
<td>Associate Professor</td>
<td>0.25</td>
<td>0.75</td>
<td>USDA Nutrition</td>
<td></td>
</tr>
<tr>
<td>Lawrence D. Young</td>
<td>Assistant Professor</td>
<td>0.35</td>
<td>0.65</td>
<td>USDA Nutrition</td>
<td></td>
</tr>
<tr>
<td>Dwane R. Zimmerman</td>
<td>Professor</td>
<td>0.50</td>
<td>0.50</td>
<td>USDA Nutrition</td>
<td></td>
</tr>
</tbody>
</table>

**Biometrics and Information Systems Center**

<table>
<thead>
<tr>
<th>Rank</th>
<th>Rsch</th>
<th>Ext</th>
<th>Tch</th>
<th>Other</th>
<th>Area of Responsibility</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wilfred M. Schutz¹</td>
<td>Professor</td>
<td>0.10</td>
<td>0.10</td>
<td>0.70</td>
<td>Head</td>
</tr>
<tr>
<td>James G. Emal</td>
<td>Associate Professor</td>
<td>0.25</td>
<td>0.75</td>
<td>USDA Nutrition</td>
<td>Microcomputer Specialist</td>
</tr>
<tr>
<td>Stephen Lowry¹</td>
<td>Associate Professor</td>
<td>0.35</td>
<td>0.65</td>
<td>USDA Nutrition</td>
<td>Statistical Consultant</td>
</tr>
<tr>
<td>Robert F. Mumm</td>
<td>Professor</td>
<td>0.67</td>
<td>0.33</td>
<td>USDA Nutrition</td>
<td>Statistical Consultant</td>
</tr>
<tr>
<td>Anne Parkhurst</td>
<td>Associate Professor</td>
<td>0.70</td>
<td>0.30</td>
<td>USDA Nutrition</td>
<td>Statistical Consultant</td>
</tr>
<tr>
<td>Ronald L. Roeber</td>
<td>Assistant Professor</td>
<td>0.25</td>
<td>0.75</td>
<td>USDA Nutrition</td>
<td>Microcomputer Specialist</td>
</tr>
<tr>
<td>Walter W. Stroup</td>
<td>Associate Professor</td>
<td>0.35</td>
<td>0.65</td>
<td>USDA Nutrition</td>
<td>Statistical Consultant</td>
</tr>
</tbody>
</table>

**Center for Agricultural Meteorology and Climatology**

<table>
<thead>
<tr>
<th>Rank</th>
<th>Rsch</th>
<th>Ext</th>
<th>Tch</th>
<th>Other</th>
<th>Area of Responsibility</th>
</tr>
</thead>
<tbody>
<tr>
<td>Norman Rosenberg¹</td>
<td>Professor</td>
<td>0.90</td>
<td>0.10</td>
<td>0.22</td>
<td>Director</td>
</tr>
<tr>
<td>Blaine Blad</td>
<td>Professor</td>
<td>0.78</td>
<td>0.22</td>
<td>USDA Nutrition</td>
<td>Director</td>
</tr>
<tr>
<td>Kenneth Hubbard</td>
<td>Associate Professor</td>
<td>0.25</td>
<td>0.25</td>
<td>USDA Nutrition</td>
<td>Director</td>
</tr>
<tr>
<td>Shashi Verma</td>
<td>Professor</td>
<td>0.77</td>
<td>0.23</td>
<td>USDA Nutrition</td>
<td>Agricultural Meteorology</td>
</tr>
<tr>
<td>Albert Weiss</td>
<td>Associate Professor</td>
<td>1.00</td>
<td>0.23</td>
<td>USDA Nutrition</td>
<td>Agricultural Meteorology</td>
</tr>
<tr>
<td>Donald Wilhite²</td>
<td>Associate Professor</td>
<td>0.50</td>
<td>0.15</td>
<td>USDA Nutrition</td>
<td>Agricultural Meteorology</td>
</tr>
</tbody>
</table>

**Consumer Science and Education**

<table>
<thead>
<tr>
<th>Rank</th>
<th>Rsch</th>
<th>Ext</th>
<th>Tch</th>
<th>Other</th>
<th>Area of Responsibility</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gwendolyn Newkirk</td>
<td>Professor</td>
<td>0.17</td>
<td>0.12</td>
<td>0.71</td>
<td>Chairman</td>
</tr>
<tr>
<td>E. Raedene Combs</td>
<td>Associate Professor</td>
<td>0.50</td>
<td>0.50</td>
<td>USDA Nutrition</td>
<td>Family Economics and Housing</td>
</tr>
<tr>
<td>Jean Memken¹</td>
<td>Assistant Professor</td>
<td>0.37</td>
<td>0.63</td>
<td>USDA Nutrition</td>
<td>Housing</td>
</tr>
</tbody>
</table>

**Entomology**

<table>
<thead>
<tr>
<th>Rank</th>
<th>Rsch</th>
<th>Ext</th>
<th>Tch</th>
<th>Other</th>
<th>Area of Responsibility</th>
</tr>
</thead>
<tbody>
<tr>
<td>Roger E. Gold</td>
<td>Professor</td>
<td>0.59</td>
<td>0.26</td>
<td>USDA Nutrition</td>
<td>Shelterbelt Insects</td>
</tr>
<tr>
<td>Mary Ellen Dix</td>
<td>Associate Professor</td>
<td>0.80</td>
<td>0.20</td>
<td>USDA Nutrition</td>
<td>Crop Insects and Spidermites</td>
</tr>
<tr>
<td>Thomas O. Holtzer</td>
<td>Associate Professor</td>
<td>0.80</td>
<td>0.20</td>
<td>USDA Nutrition</td>
<td>Insect Ecology</td>
</tr>
<tr>
<td>Tony Joern</td>
<td>Associate Professor</td>
<td>0.40</td>
<td>0.60</td>
<td>USDA Nutrition</td>
<td>Shelterbelt Insects</td>
</tr>
<tr>
<td>J. Ackland Jones</td>
<td>Associate Professor</td>
<td>0.40</td>
<td>0.60</td>
<td>USDA Nutrition</td>
<td>USDA Forage Crops Insects</td>
</tr>
<tr>
<td>S. Dean Kindler</td>
<td>Professor</td>
<td>0.80</td>
<td>0.20</td>
<td>USDA Nutrition</td>
<td>USDA Forage Insect Investigations</td>
</tr>
<tr>
<td>George R. Manglitz</td>
<td>Professor</td>
<td>0.80</td>
<td>0.20</td>
<td>USDA Nutrition</td>
<td>Cyto genetics of Greenbugs</td>
</tr>
<tr>
<td>Z B Mayo</td>
<td>Professor</td>
<td>0.80</td>
<td>0.20</td>
<td>USDA Nutrition</td>
<td></td>
</tr>
</tbody>
</table>

(continued)
<table>
<thead>
<tr>
<th>Name</th>
<th>Rank</th>
<th>Rsch</th>
<th>Ext</th>
<th>Tch</th>
<th>Other Area of Responsibility</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lance J. Meinke</td>
<td>Assistant Professor</td>
<td>0.80</td>
<td>0.20</td>
<td>Corn Insects</td>
<td></td>
</tr>
<tr>
<td>James J. Petersen</td>
<td>Professor</td>
<td></td>
<td></td>
<td>USDA Livestock Entomology</td>
<td></td>
</tr>
<tr>
<td>Kenneth P. Pruess</td>
<td>Professor</td>
<td>0.80</td>
<td>0.20</td>
<td>Aquatic Insects</td>
<td></td>
</tr>
<tr>
<td>Brett C. Ratcliffe</td>
<td>Associate Professor</td>
<td></td>
<td></td>
<td>1.00 Insect Curator</td>
<td></td>
</tr>
<tr>
<td>Gustave D. Thomas</td>
<td>Professor</td>
<td></td>
<td></td>
<td>USDA Livestock Entomology</td>
<td></td>
</tr>
<tr>
<td>Environmental Programs</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Shripat T. Kamble</td>
<td>Associate Professor</td>
<td>0.25</td>
<td>0.75</td>
<td>Environmental Programs</td>
<td></td>
</tr>
<tr>
<td>Food Science and Technology</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Glenn W. Froning</td>
<td>Professor</td>
<td>0.40</td>
<td>0.34</td>
<td>Interim Head and Poultry Products</td>
<td></td>
</tr>
<tr>
<td>Charles E. Walker</td>
<td>Professor</td>
<td>0.70</td>
<td>0.30</td>
<td>Interim Head and Cereal Technology</td>
<td></td>
</tr>
<tr>
<td>R. C. Anantheswaran²</td>
<td>Assistant Professor</td>
<td>0.80</td>
<td>0.20</td>
<td>Food Engineering</td>
<td></td>
</tr>
<tr>
<td>Lloyd B. Bullerman</td>
<td>Professor</td>
<td>0.60</td>
<td>0.10</td>
<td>Food Microbiology</td>
<td></td>
</tr>
<tr>
<td>Susan B. Cuppett</td>
<td>Assistant Professor</td>
<td>0.60</td>
<td>0.40</td>
<td>Food Lipids</td>
<td></td>
</tr>
<tr>
<td>Michael B. Lieven</td>
<td>Assistant Professor</td>
<td>0.30</td>
<td>0.70</td>
<td>Food Microbiology</td>
<td></td>
</tr>
<tr>
<td>R. Burt Maxcy</td>
<td>Professor</td>
<td>0.30</td>
<td>0.20</td>
<td>Food Microbiology</td>
<td></td>
</tr>
<tr>
<td>John Rupnow</td>
<td>Associate Professor</td>
<td>0.55</td>
<td>0.45</td>
<td>Food Biochemistry</td>
<td></td>
</tr>
<tr>
<td>Khem M. Shahani</td>
<td>Professor</td>
<td>0.45</td>
<td>0.05</td>
<td>Food Chemistry</td>
<td></td>
</tr>
<tr>
<td>Randy L. Wehling</td>
<td>Assistant Professor</td>
<td>0.50</td>
<td>0.20</td>
<td>Food Processing</td>
<td></td>
</tr>
<tr>
<td>Michael G. Zeece</td>
<td>Assistant Professor</td>
<td>0.75</td>
<td>0.25</td>
<td>Food Protein Chemistry</td>
<td></td>
</tr>
<tr>
<td>Forestry, Fisheries and Wildlife</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Gary L. Hergenrader</td>
<td>Professor</td>
<td>0.17</td>
<td>0.16</td>
<td>0.50 Head</td>
<td></td>
</tr>
<tr>
<td>James R. Brandle</td>
<td>Associate Professor</td>
<td>0.90</td>
<td>0.10</td>
<td>Forestry</td>
<td></td>
</tr>
<tr>
<td>Ronald M. Case</td>
<td>Professor</td>
<td>0.40</td>
<td>0.60</td>
<td>Wildlife</td>
<td></td>
</tr>
<tr>
<td>Stephen G. Ernst</td>
<td>Assistant Professor</td>
<td>0.75</td>
<td>0.25</td>
<td>Forestry</td>
<td></td>
</tr>
<tr>
<td>Mark O. Harrell</td>
<td>Associate Professor</td>
<td>0.15</td>
<td>0.17</td>
<td>Nebraska Forest Service</td>
<td></td>
</tr>
<tr>
<td>Ronnie J. Johnson</td>
<td>Associate Professor</td>
<td>0.31</td>
<td>0.43</td>
<td>0.26 Wildlife</td>
<td></td>
</tr>
<tr>
<td>Michael R. Kuhns</td>
<td>Assistant Professor</td>
<td>0.25</td>
<td>0.75</td>
<td>Forestry</td>
<td></td>
</tr>
<tr>
<td>Edward J. Peters</td>
<td>Associate Professor</td>
<td>0.40</td>
<td>0.60</td>
<td>Wildlife</td>
<td></td>
</tr>
<tr>
<td>David F. VanHaverbeke</td>
<td>Professor</td>
<td></td>
<td></td>
<td>USDA Forestry</td>
<td></td>
</tr>
<tr>
<td>Horticulture</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Roger D. Uhlinger</td>
<td>Professor</td>
<td>0.43</td>
<td>0.33</td>
<td>0.24 Head</td>
<td></td>
</tr>
<tr>
<td>Dermot P. Coyne</td>
<td>Professor</td>
<td>0.96</td>
<td>0.04</td>
<td>Vegetable Breeding</td>
<td></td>
</tr>
<tr>
<td>Jay B. Fitzgerald</td>
<td>Associate Professor</td>
<td>0.21</td>
<td>0.34</td>
<td>0.45 Ornamentals</td>
<td></td>
</tr>
<tr>
<td>William A. Gustafson</td>
<td>Associate Professor</td>
<td>0.25</td>
<td>0.75</td>
<td>Fruit and Nut Crops</td>
<td></td>
</tr>
<tr>
<td>Edward J. Kinbacher</td>
<td>Professor</td>
<td>0.50</td>
<td>0.50</td>
<td>Turf Physiology</td>
<td></td>
</tr>
<tr>
<td>Ralph E. Neild</td>
<td>Professor</td>
<td>0.39</td>
<td>0.66</td>
<td>Horticulture</td>
<td></td>
</tr>
<tr>
<td>Ellen T. Paparozzi</td>
<td>Associate Professor</td>
<td>0.50</td>
<td>0.50</td>
<td>Ornamentals</td>
<td></td>
</tr>
<tr>
<td>Terrance P. Riordan</td>
<td>Associate Professor</td>
<td>0.89</td>
<td>0.11</td>
<td>Turf Breeding</td>
<td></td>
</tr>
<tr>
<td>Sotero S. Salac</td>
<td>Associate Professor</td>
<td>0.81</td>
<td>0.19</td>
<td>Ornamentals</td>
<td></td>
</tr>
<tr>
<td>Robert C. Shearman</td>
<td>Associate Professor</td>
<td>0.59</td>
<td>0.25</td>
<td>Turf</td>
<td></td>
</tr>
<tr>
<td>Rank</td>
<td>Rsch</td>
<td>Ext</td>
<td>Tch</td>
<td>Other</td>
<td>Area of Responsibility</td>
</tr>
<tr>
<td>----------------------</td>
<td>------</td>
<td>-----</td>
<td>-----</td>
<td>-------</td>
<td>-------------------------------------------------------------</td>
</tr>
<tr>
<td><strong>Human Development and the Family</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>William N. Meredith 2</td>
<td>Assistant Professor</td>
<td>0.25</td>
<td>0.10</td>
<td>0.65</td>
<td>Chairman</td>
</tr>
<tr>
<td>Helen Sulek 1</td>
<td>Associate Professor</td>
<td>0.25</td>
<td>0.10</td>
<td>0.65</td>
<td>Interim Chairman</td>
</tr>
<tr>
<td>John D. DeFrain</td>
<td>Associate Professor</td>
<td>0.50</td>
<td></td>
<td>0.50</td>
<td>Rural Family Crisis</td>
</tr>
<tr>
<td>Violet Kalyan-Masih</td>
<td>Professor</td>
<td>0.59</td>
<td></td>
<td>0.41</td>
<td>Cognitive Development (Piaget)</td>
</tr>
<tr>
<td>Patricia Knaub</td>
<td>Associate Professor</td>
<td>0.27</td>
<td></td>
<td>0.73</td>
<td>Dual Career Families - Remarriage</td>
</tr>
<tr>
<td>Lois D. Schwab</td>
<td>Professor</td>
<td>0.75</td>
<td></td>
<td>0.25</td>
<td>Rehabilitation of Handicapped Women</td>
</tr>
<tr>
<td>John C. Woodward</td>
<td>Professor</td>
<td>0.48</td>
<td></td>
<td>0.52</td>
<td>Loneliness and Solitude</td>
</tr>
<tr>
<td><strong>Human Nutrition and Food Service Management</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Hazel Fox</td>
<td>Professor</td>
<td>0.50</td>
<td>0.10</td>
<td>0.40</td>
<td>Chairman</td>
</tr>
<tr>
<td>Nancy M. Betts</td>
<td>Assistant Professor</td>
<td>0.35</td>
<td></td>
<td>0.65</td>
<td>Nutrition</td>
</tr>
<tr>
<td>Anna M. Brenner</td>
<td>Associate Professor</td>
<td>0.25</td>
<td></td>
<td>0.75</td>
<td>Food Service Management</td>
</tr>
<tr>
<td>Audrey L. Hay</td>
<td>Assistant Professor</td>
<td>0.30</td>
<td></td>
<td>0.70</td>
<td>Food Service Management</td>
</tr>
<tr>
<td>Constance Kies</td>
<td>Professor</td>
<td>0.70</td>
<td></td>
<td>0.30</td>
<td>Nutrition</td>
</tr>
<tr>
<td>Phyllis Staats</td>
<td>Associate Professor</td>
<td>0.32</td>
<td></td>
<td>0.68</td>
<td>Foods</td>
</tr>
<tr>
<td><strong>Northeast Research and Extension Center</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Donald B. Hudman</td>
<td>Professor</td>
<td>0.23</td>
<td>0.69</td>
<td>0.08</td>
<td>Director</td>
</tr>
<tr>
<td>John F. Witkowski</td>
<td>Professor</td>
<td>0.50</td>
<td>0.50</td>
<td></td>
<td>Animal Science</td>
</tr>
<tr>
<td>Michael C. Brumm</td>
<td>Associate Professor</td>
<td>0.50</td>
<td>0.50</td>
<td></td>
<td>Animal Science</td>
</tr>
<tr>
<td>William L. Kranz</td>
<td>Assistant Professor</td>
<td>0.25</td>
<td>0.75</td>
<td></td>
<td>Animal Science</td>
</tr>
<tr>
<td>Terry L. Mader</td>
<td>Associate Professor</td>
<td>0.50</td>
<td>0.50</td>
<td></td>
<td>Animal Science</td>
</tr>
<tr>
<td>Russell S. Moomaw</td>
<td>Professor</td>
<td>0.49</td>
<td>0.51</td>
<td></td>
<td>Agronomy</td>
</tr>
<tr>
<td>Charles Shapiro</td>
<td>Assistant Professor</td>
<td>0.50</td>
<td>0.50</td>
<td></td>
<td>Agronomy</td>
</tr>
<tr>
<td>David P. Shelton</td>
<td>Associate Professor</td>
<td>0.50</td>
<td>0.50</td>
<td></td>
<td>Ag. Engineering</td>
</tr>
<tr>
<td><strong>Panhandle Research and Extension Center</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Robert D. Fritschenn</td>
<td>Professor</td>
<td>0.42</td>
<td>0.50</td>
<td>0.08</td>
<td>Director and Animal Science</td>
</tr>
<tr>
<td>Burton A. Weichenthal</td>
<td>Professor</td>
<td>0.50</td>
<td>0.50</td>
<td></td>
<td>Associate Director and Animal Science</td>
</tr>
<tr>
<td>Frank N. Anderson</td>
<td>Associate Professor</td>
<td>0.50</td>
<td>0.50</td>
<td></td>
<td>Agronomy</td>
</tr>
<tr>
<td>Dale M. Grotelueschen</td>
<td>Assistant Professor</td>
<td>0.50</td>
<td>0.50</td>
<td></td>
<td>Diagnostic Veterinary Science</td>
</tr>
<tr>
<td>Arthur F. Hagen</td>
<td>Associate Professor</td>
<td>0.25</td>
<td>0.75</td>
<td></td>
<td>Entomology</td>
</tr>
<tr>
<td>Eric D. Kerr</td>
<td>Professor</td>
<td>0.50</td>
<td>0.50</td>
<td></td>
<td>Plant Pathology</td>
</tr>
<tr>
<td>Duane A. Martin 2</td>
<td>Assistant Professor</td>
<td>0.50</td>
<td>0.50</td>
<td></td>
<td>Agronomy</td>
</tr>
<tr>
<td>Lenis Nelson</td>
<td>Professor</td>
<td>0.75</td>
<td>0.25</td>
<td></td>
<td>Agronomy</td>
</tr>
<tr>
<td>David S. Nuland</td>
<td>Assistant Professor</td>
<td>0.25</td>
<td>0.75</td>
<td></td>
<td>Horticulture</td>
</tr>
<tr>
<td>Robert O'Keefe</td>
<td>Professor</td>
<td>0.80</td>
<td>0.20</td>
<td></td>
<td>Horticulture</td>
</tr>
<tr>
<td>Patrick E. Reece</td>
<td>Assistant Professor</td>
<td>0.50</td>
<td>0.50</td>
<td></td>
<td>Agronomy</td>
</tr>
<tr>
<td>James G. Robb</td>
<td>Assistant Professor</td>
<td>0.50</td>
<td>0.50</td>
<td></td>
<td>Agricultural Economics</td>
</tr>
<tr>
<td>Ivan G. Rush</td>
<td>Professor</td>
<td>0.25</td>
<td>0.75</td>
<td></td>
<td>Animal Science</td>
</tr>
<tr>
<td>John A. Smith</td>
<td>Assistant Professor</td>
<td>0.50</td>
<td>0.50</td>
<td></td>
<td>Agricultural Engineering</td>
</tr>
<tr>
<td>Robert G. Wilson</td>
<td>Professor</td>
<td>0.50</td>
<td>0.50</td>
<td></td>
<td>Agronomy</td>
</tr>
<tr>
<td>C. Dean Yonts</td>
<td>Assistant Professor</td>
<td>0.50</td>
<td>0.50</td>
<td></td>
<td>Agricultural Engineering</td>
</tr>
</tbody>
</table>

(continued)
<table>
<thead>
<tr>
<th>Faculty</th>
<th>Rank</th>
<th>Rsch</th>
<th>Ext</th>
<th>Tch</th>
<th>Other Area of Responsibility</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Plant Pathology</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Anne K. Vidaver</td>
<td>Professor</td>
<td>0.75</td>
<td>0.15</td>
<td>0.10</td>
<td>Head</td>
</tr>
<tr>
<td>Michael G. Boosalis</td>
<td>Professor</td>
<td>0.66</td>
<td>0.19</td>
<td>0.15</td>
<td>Root Diseases and Mycorrhizae</td>
</tr>
<tr>
<td>Myron K. Brakke</td>
<td>Professor</td>
<td></td>
<td></td>
<td></td>
<td>USDA Virus Diseases</td>
</tr>
<tr>
<td>Stan G. Jensen</td>
<td>Associate Professor</td>
<td>0.85</td>
<td>0.15</td>
<td></td>
<td>USDA Corn and Sorghum Diseases</td>
</tr>
<tr>
<td>Leslie C. Lane</td>
<td>Associate Professor</td>
<td>0.80</td>
<td>0.20</td>
<td></td>
<td>USDA Tree Diseases</td>
</tr>
<tr>
<td>Willem G. Langenberg</td>
<td>Professor</td>
<td></td>
<td></td>
<td></td>
<td>USDA Tree Diseases</td>
</tr>
<tr>
<td>James Partridge</td>
<td>Associate Professor</td>
<td>0.85</td>
<td>0.15</td>
<td></td>
<td>Nematology</td>
</tr>
<tr>
<td>Glenn W. Peterson</td>
<td>Professor</td>
<td></td>
<td></td>
<td></td>
<td>USDA Virus Diseases</td>
</tr>
<tr>
<td>Thomas O. Powers</td>
<td>Assistant Professor</td>
<td>0.85</td>
<td>0.15</td>
<td></td>
<td>Corn and Sorghum Diseases</td>
</tr>
<tr>
<td>Jerry W. Riffle</td>
<td>Professor</td>
<td></td>
<td></td>
<td></td>
<td>USDA Tree Diseases</td>
</tr>
<tr>
<td>Gurmel S. Sidhu</td>
<td>Assistant Professor</td>
<td>0.90</td>
<td>0.10</td>
<td></td>
<td>Epidemiology of Vegetable Diseases</td>
</tr>
<tr>
<td>James R. Steadman</td>
<td>Associate Professor</td>
<td>0.90</td>
<td>0.10</td>
<td></td>
<td>Microbial Physiology</td>
</tr>
<tr>
<td>James L. Van Etten</td>
<td>Professor</td>
<td></td>
<td></td>
<td></td>
<td>Small Grains, Turf and Alfalfa</td>
</tr>
<tr>
<td>John E. Watkins</td>
<td>Associate Professor</td>
<td>0.25</td>
<td>0.75</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>South Central Research and Extension Center</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Charles L. Stonecipher</td>
<td>Professor</td>
<td>0.14</td>
<td>0.78</td>
<td></td>
<td>Director</td>
</tr>
<tr>
<td>Benjamin L. Doupnik, Jr.</td>
<td>Professor</td>
<td>0.50</td>
<td>0.50</td>
<td></td>
<td>Plant Pathology</td>
</tr>
<tr>
<td>Dean E. Eisenhauer</td>
<td>Associate Professor</td>
<td>0.49</td>
<td>0.51</td>
<td></td>
<td>Agricultural Engineering</td>
</tr>
<tr>
<td>Roger Elmore</td>
<td>Assistant Professor</td>
<td>0.50</td>
<td>0.50</td>
<td></td>
<td>Agronomy</td>
</tr>
<tr>
<td>Richard Ferguson</td>
<td>Assistant Professor</td>
<td>0.50</td>
<td>0.50</td>
<td></td>
<td>Agronomy</td>
</tr>
<tr>
<td>Donald G. Levis</td>
<td>Associate Professor</td>
<td>0.25</td>
<td>0.75</td>
<td></td>
<td>Animal Science</td>
</tr>
<tr>
<td>Leroy Peters</td>
<td>Professor</td>
<td>0.50</td>
<td>0.50</td>
<td></td>
<td>Entomology</td>
</tr>
<tr>
<td>Fred W. Roeth</td>
<td>Professor</td>
<td>0.50</td>
<td>0.50</td>
<td></td>
<td>Agronomy</td>
</tr>
<tr>
<td>Roger Selley</td>
<td>Associate Professor</td>
<td>0.25</td>
<td>0.75</td>
<td></td>
<td>Agricultural Economics</td>
</tr>
<tr>
<td><strong>Southeast Research and Extension Center</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Loyd L. Young</td>
<td>Professor</td>
<td>0.05</td>
<td>0.87</td>
<td></td>
<td>Director</td>
</tr>
<tr>
<td><strong>Textiles, Clothing and Design</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Joan Laughlin</td>
<td>Professor</td>
<td>0.37</td>
<td>0.11</td>
<td></td>
<td>Chairman, Textiles</td>
</tr>
<tr>
<td>Patricia Cox Crews</td>
<td>Assistant Professor</td>
<td>0.25</td>
<td></td>
<td>0.75</td>
<td>Textile Conservation and Science</td>
</tr>
<tr>
<td>Rita C. Kean</td>
<td>Assistant Professor</td>
<td>0.25</td>
<td></td>
<td>0.75</td>
<td>Apparel Merchandising and Economic Development</td>
</tr>
<tr>
<td><strong>Veterinary Science</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>John A. Schmitz</td>
<td>Professor</td>
<td>0.65</td>
<td>0.15</td>
<td>0.20</td>
<td>Head</td>
</tr>
<tr>
<td>Gary A. Anderson</td>
<td>Assistant Professor</td>
<td>0.90</td>
<td>0.10</td>
<td></td>
<td>Research Pathology</td>
</tr>
<tr>
<td>Edgar Clemens</td>
<td>Associate Professor</td>
<td>0.50</td>
<td>0.50</td>
<td></td>
<td>Physiology</td>
</tr>
<tr>
<td>Earl O. Dickinson</td>
<td>Professor</td>
<td>0.75</td>
<td>0.25</td>
<td></td>
<td>Diagnostic/Research Pathology</td>
</tr>
<tr>
<td>Alan R. Doster</td>
<td>Associate Professor</td>
<td>0.93</td>
<td>0.07</td>
<td></td>
<td>Diagnostic Pathology</td>
</tr>
<tr>
<td>Gerald E. Duhamel</td>
<td>Assistant Professor</td>
<td>0.85</td>
<td>0.15</td>
<td></td>
<td>Diagnostic/Research Pathology</td>
</tr>
<tr>
<td>E. Denis Erickson</td>
<td>Professor</td>
<td>0.90</td>
<td>0.10</td>
<td></td>
<td>Diagnostic Bacteriology</td>
</tr>
<tr>
<td>Donald L. Ferguson</td>
<td>Professor</td>
<td>0.86</td>
<td>0.14</td>
<td></td>
<td>Parasitology</td>
</tr>
<tr>
<td>Merwin L. Frey</td>
<td>Professor</td>
<td>0.69</td>
<td>0.06</td>
<td></td>
<td>Research Virology</td>
</tr>
<tr>
<td>Alex Hogg</td>
<td>Professor</td>
<td>0.07</td>
<td>0.88</td>
<td>0.05</td>
<td>Swine Diseases</td>
</tr>
</tbody>
</table>
### Faculty

(Veterinary Science....)

<table>
<thead>
<tr>
<th>Rank</th>
<th>Rsch</th>
<th>Ext</th>
<th>Tch</th>
<th>Other</th>
<th>Area of Responsibility</th>
</tr>
</thead>
<tbody>
<tr>
<td>Clayton L. Kelling</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Research Virology</td>
</tr>
<tr>
<td>Rodney A. Moxley</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Diagnostic/Research Pathology</td>
</tr>
<tr>
<td>Rebecca Nicholson1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Physiology</td>
</tr>
<tr>
<td>Fernando Osorio</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Diagnostic/Research Virology</td>
</tr>
<tr>
<td>Marvin B. Rhodes</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Immunochemistry</td>
</tr>
<tr>
<td>Duane N. Rice</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Dairy and Beef Cattle Diseases</td>
</tr>
<tr>
<td>Daniel L. Rock2</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Research Virology</td>
</tr>
<tr>
<td>Norman R. Schneider</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Diagnostic/Research Toxicology</td>
</tr>
<tr>
<td>S. Srikumaran</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Immunology</td>
</tr>
<tr>
<td>R. Gene White1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Feedlot Management Diseases and Director, Institutional Animal Care Program</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### West Central Research and Extension Center

<table>
<thead>
<tr>
<th>Rank</th>
<th>Rsch</th>
<th>Ext</th>
<th>Tch</th>
<th>Other</th>
<th>Area of Responsibility</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lavon J. Sumption</td>
<td></td>
<td></td>
<td></td>
<td>0.07</td>
<td>Director</td>
</tr>
<tr>
<td>John B. Campbell</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Entomology (Livestock Insects)</td>
</tr>
<tr>
<td>Donald C. Clanton</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Animal Science (Beef)</td>
</tr>
<tr>
<td>Richard Clark</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Agricultural Economics</td>
</tr>
<tr>
<td>David M. Danielson</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Animal Science (Swine)</td>
</tr>
<tr>
<td>Gene H. Deutscher</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Veterinary Science</td>
</tr>
<tr>
<td>Gary W. Hergert</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Agronomy (Soil Science)</td>
</tr>
<tr>
<td>Jerre Johnson</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Horticulture</td>
</tr>
<tr>
<td>Norman L. Klocke</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Agricultural Engineering</td>
</tr>
<tr>
<td>Dale T. Lindgren</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Agronomy (Range Management)</td>
</tr>
<tr>
<td>James T. Nichols</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Agronomy (Sorghum Breeding)</td>
</tr>
<tr>
<td>Paul T. Nordquist</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Agronomy (Weed Science)</td>
</tr>
<tr>
<td>Gail A. Wicks</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
The Nebraska Agricultural Research Division provides information and educational programs to all people without regard to race, color, national origin, sex or handicap.
Agricultural Biochemistry

Biotechnology, molecular biology and biochemical techniques have been used to alter a key enzyme in photosynthesis by an experimental unicellular model plant called *Chlamydomonas*.

Photosynthesis involves a number of complex processes which may be subdivided into two categories: the *light reactions*, where the energy of sunlight is trapped and converted to a form of chemical energy useful to a plant, and *carbon fixation* where a plant takes carbon dioxide from the air and makes sugars and starch from it using the energy generated by the light reactions. All of the carbon-containing structures of a plant—grain, leaves, roots, etc.—are derived from the products of carbon fixation.

The first step in part of the sugar-producing process is a chemical reaction caused by an enzyme called ribulose 1,5-biphosphate carboxylase-oxygenase (Rubisco). For carbon fixation, Rubisco is a key enzyme because it starts the sugar-producing process.

In many plants, such as wheat, oats, soybeans, alfalfa and brome grass, Rubisco is also a key enzyme for a seemingly wasteful process called *photorespiration*. Effectively, photorespiration "undoes" carbon fixation. When oxygen, which is present in the air at much higher levels than carbon dioxide, binds to Rubisco instead of carbon dioxide, it impairs the chemical process for sugar production.

The process that occurs, either carbon fixation or photorespiration, depends on whether Rubisco binds carbon dioxide or oxygen. Thus, there is a competition between carbon dioxide and oxygen to bind Rubisco and the relative concentrations of carbon dioxide and oxygen and their affinities for Rubisco determine the ratio of reactions for the two processes.

The critical question being addressed by the Agricultural Biochemistry department’s projects is: Would it be possible to increase the affinity of Rubisco for carbon dioxide or decrease Rubisco’s affinity for oxygen? Either reaction should increase the rate at which a plant fixes carbon and produces sugars and starch. In crop plants, an increased production of these products should result in a higher yield of grain and/or forage.

Using genetic and molecular biological techniques, it has been possible to identify and characterize a genetically-altered strain of *Chlamydomonas* whose Rubisco has an altered specificity for carbon dioxide and oxygen. These results are expected to provide critical insight for the eventual genetic engineering of important crop plants. Such an accomplishment should give agriculture a "quantum jump" in crop productivity.

Agricultural Economics

Research faculty examined the profitability and variability of income for four types of Nebraska Sandhills ranch organizations. These factors were analyzed for the period 1975 through 1984. Under high levels of management, yearling cattle operations were found to have the highest net income and the highest variability of income. Cow-calf/yearling operations were found to be more profitable and less risky than cow-calf operations. Under low levels of management, yearling operations became no more profitable than cow-calf operations, but considerably more risky.

Research faculty examined and compared the trends in farm product price variability and uncertainty during the pre- and post-Staggers Rail Deregulation Act of 1980. Results indicate that there has been no significant change in the level of either variability or uncertainty of corn prices between the pre- and post-Staggers periods. This suggests that some factors contributing to uncertainty in the pre-Staggers periods, such as seasonal shortages of transportation equipment, may have been replaced by new uncertainties in the post-Staggers period which keep the level of price uncertainty unchanged. Two such factors were the shipper/carrier contracts permitted by the Act, and the emergence of a chronic surplus of rail carrying capacity.

Agricultural Engineering

Microwave Popcorn

With an increasing number of households that have a microwave oven, microwave popcorn has become very popular with consumers. Agricultural engineers at UNL are investigating methods of improving the popping performance of popcorn in a microwave oven.

The present study indicates that improvement in product quality of microwave popcorn can be achieved by selection of the appropriate variety of popcorn at optimum moisture content. The popping performance can be considerably improved by frozen storage of the product until it is ready for use.

The presence of any surface damage or stress cracks on the kernels decreased the popping performance significantly. Hence, the processor needs to be very careful during harvest and handling of popcorn to ensure minimum damage to the kernels.

Tractor Performance

A new track type agricultural tractor has been introduced to the market. The Challenger 65, a crawler equipped with a rubber-belted track and manufa
tured by Caterpillar Tractor, has the speed and mobility comparable to large four-wheel drive agricultural tractors. Performance of the new tractor has been evaluated and compared to a similar sized four-wheel drive tractor. Tests were conducted on three different soil conditions. Comparisons in performance indicated that the rubber-belted track tractor had a higher tractive efficiency over a wider range of dynamic tractive ratios than the four-wheel drive tractor. As the tractive conditions deteriorated, performance differences between the two tractors increased. Changes in soil bulk density, resulting from the use of the two tractors, indicated that use of the track tractor resulted in lower soil bulk densities than from the wheel tractor.

Performance evaluations of a front-wheel drive assist tractor equipped with singles or duals on the rear drive axles have been completed. No apparent differences in tractor performance were observed between single and duals. The only reason for using duals on these tractors may be for flotation or additional weight carrying capacity.

Rainfall Simulation and Soil Erosion

Agricultural engineers have been using a rainfall simulator to evaluate the erosion control potential of various soil conservation practices. Originally developed in Nebraska in 1965, the rotating boom rainfall simulator applies water at rates comparable to typical rainfall in eastern Nebraska. Generally, water is applied until the runoff rate from research areas reaches equilibrium conditions.

Results from this research show fields having 20% of the soil surface covered with crop residue will have 50% less erosion than cleanly tilled fields. No-till planting systems which leave the greatest amount of residue cover can reduce soil loss by 95%.

The type of crop grown and farming direction also influences the erosion process. Rainfall simulation research has shown that farming around, rather than up and down, the hill can reduce soil loss by 50%. Also, erosion from fields where soybeans were grown the previous year can be more than double that from where corn was grown, even though identical tillage systems were used.

Current rainfall simulation research projects are evaluating soil losses and runoff from tillage practices which use a subsoiler or other implement to enhance water storage at or near the soil surface. The mechanics of soil erosion and improving soil loss predictions are also current research projects using rainfall simulation techniques.

Image Processing

Electronic image processing provides a method of sensing surface and geometric properties of agricultural materials, in a way that spatial variance can be properly evaluated. Various basic tools of image processing have been developed. Complete analytical systems use small computers and user-interactive software. An analog television signal (black-and-white or NTSC color) is digitized, stored in computer memory, and redisplayed in a digital form.

Several applications of local image process being used by agricultural engineers, agronomists, and horticulturalists included stress wood and plant microstructure analysis, in-situ measurement of plant growth, canopy architectural characteristics, soil surface residue measurement for erosion control, and animal behavioral analysis. An eight-bit digitizer and a pair of solid-state (CCD) cameras were used to classify leaf shapes and canopy architectural dimensions in three dimensions, using parallax techniques. The extent of stress wood in young maples was accomplished by digitizing 35-mm slides of microscopic sections of plant material.

Crop residue has been traditionally measured using a projected image of the soil surface and counting the residue fragments intersecting a 200-node grid. Electronic image analysis extends the count sensitivity up to 200,000 nodes. With color image processing, soil and residue is separated on the basis of the red 600 - 640 millimicron waveband. Scientists and engineers are studying animal postural behavior using imagery. Animal postures are indicative of environmental stress conditions.

Livestock Vocalization

Understanding the vocalization of livestock could provide an early indicator of the well-being of the animal and thus allow the producer to correct problems before production is affected. This is one aspect of the vocalization research group effort at the ARD. Other potential applications of the research consist of using animal sounds to activate an alarm system to alert the manager to the existence of an intruder, fire or sow farrowing, to evaluate husbandry practices and housing systems, to determine if interference exists between farm machine noise and livestock communication, and to create sounds for efficiently moving livestock or modifying their behavior. Sound could be the measurement of the future to improve the well-being of both livestock and the producer.

Agronomy

Wheat Breeding Program

Nebraska hard red winter wheat is synonymous with productivity and quality. Currently, 75% of the wheat grown in Nebraska has been developed by collaborative efforts between the University of Nebraska
and the United State Department of Agriculture. The releases in 1986 of ‘Cody’ (the first high-yielding, high-quality wheat for Nebraska with tolerance to *Cephalosporium* stripe, a new disease in Nebraska) and ‘Redland’ (a selection from ‘Brule’, the most widely grown wheat in Nebraska, with improved resistance to stem rust, historically a devastating disease) are the most recent examples of the continued success of this effort. Both varieties have been developed using traditional plant breeding methods which required over ten years of breeding research and end-use quality evaluation before their release.

To maintain a competitive edge for the Nebraska wheat growers, millers, bakers and exporters, the wheat improvement program searches worldwide for new genes (determinants of varietal characteristics) and incorporates those genes into new varieties adapted to Nebraska. Agronomic productivity and end-user quality are evaluated throughout the variety development program. For example, ‘Siouxland’, released in 1984, has genes for disease resistance and productivity from ‘Kavkaz’, an Eastern European wheat. However, Kavkaz has poor quality and extensive efforts were needed to develop Siouxland which has acceptable hard wheat quality. As Siouxland became a more widely grown variety, various baking technologies were evaluated in 1987 to ensure the end-product quality.

Newer breeding and quality evaluation methods are constantly being explored to determine if they may be more efficient in developing improved wheat varieties. This effort includes the initiation of tissue culture methods and the refinement of kernel hardness tests. Tissue culture is being used to develop plants from immature pollen grains. This technique has the capability of reducing the ten years it takes to develop a variety, allowing the plant breeding effort to be more responsive to the changing needs of Nebraska. Kernel hardness tests will help predict end-use quality and will ensure that hard red winter wheat, which receives a premium in the marketplace, is properly classified in the domestic and export trade channels.

The wheat improvement program is an integrated, applied effort that develops new scientific concepts, technology, and varieties. The source of genes and the methods may change, but the tradition of improving Nebraska’s ability to compete as a producer of premium hard red winter wheat remains the same.

**Corn Breeding Program**

The Nebraska corn crop is often affected by environmental stresses such as cold wet soils following planting, sub-freezing temperatures in early growth stages, and heat and drought during the hot summer months, particularly at pollination time. If tolerant hybrids are not planted, poor stands and reduced yields are likely to result.

Corn seeds and seedlings have been subjected to cold and freeze stresses in growth chambers where the most tolerant genetic types can be identified and selected for further evaluation under early spring planting (late March or early April). The most resistant genetic types are then intermated to produce new genetic types for further testing, evaluation and selection. This has been continued on a cyclic basis over several years to produce three breeding populations which now have a high level of cold tolerance. There has also been some indication that these populations possess heat and drought tolerance. These should be valuable sources of new inbred lines for use in hybrids.

Applications of a biotechnology technique known as electrophoresis has been used to study changes in isoenzyme patterns in cold and freeze tolerant populations compared to original unselected ones. Investigations are now underway to evaluate the use of isoenzyme genotypes as a possible selection criterion to increase efficiency of selection for cold tolerance in corn. Preliminary results are encouraging.

**Popcorn Breeding Program**

The market for popcorn in the U.S. has tripled in the past ten years, stimulated in part by consumer demands for more natural snack foods, the convenience of air-poppers and more recently the highly popular microwave popcorn. Nebraska has been a principle supplier of popcorn for this rapidly expanding market and currently is second only to Indiana in popcorn production. The two states combined account for just over 50% of the total production of popcorn in the U.S.

Compared to field corn, the research effort that has been spent on improving popcorn has been minimal. The hybrid most widely grown in Nebraska was developed over 20 years ago. To maintain Nebraska's principle role in popcorn production, new hybrids adapted to this region are desperately needed. Responding to this need the Popcorn Institute is supporting an accelerated breeding program that takes advantage of two growing seasons a year with a summer breeding nursery in Nebraska and a nursery in Florida during the winter. Since its inception five years ago the breeding program has released two germplasm source populations for commercial breeding purposes and two new inbred lines are in the final year of testing for release as parents of new hybrids.

Applied and basic research are closely integrated and take advantage of the increased knowledge and improved genetic resources in field (dent) corn. For example, stalk lodging is a major problem in popcorn and is being addressed by incorporating dent corn (continued)
germplasm into popcorn. Maintaining and enhancing popping quality during this process, however, is difficult and has required theoretical studies of the genetic control of quality, stalk strength and other agronomic characteristics to design the most efficient breeding strategy.

Earlier maturity in the fall is another important characteristic. For popcorn grown in Nebraska, an early hard freeze in September can greatly reduce popping quality if the popcorn has not dried down sufficiently. Several different sources of earliness genes are being introduced into popcorn from both North and South American corn germplasm.

Most of the popcorn hybrids grown today possess a genetic mechanism that prevents the pollination of popcorn by dent corn. This is important during hybrid seed production when contamination with dent corn greatly reduces popping quality. The mechanism involved is believed to be predominantly controlled by a single gene. However, it is not always possible to transfer this characteristic into certain popcorn lines and other types of corn, indicating more complex control. Molecular techniques are being applied in combination with traditional genetic analysis to identify the biochemical process involved in the mechanism, and hence the gene(s). Enzyme markers and DNA clone probes are also being investigated as aids in transferring this 'dentsterile' characteristic to new lines and germplasm source populations in the breeding program. Easier and more effective manipulation of dent sterility will also be of considerable importance for other specialty corns such as sweet corn, white corn and high lysine corn which need to be isolated from dent corn contamination to maintain quality.

Soil Erosion and Productivity

Soil erosion is a natural process of land formation. However, since the introduction of mechanized crop production and expansion of crop acreages onto steeper land, erosion rates have drastically increased. Soil losses on many hillside can exceed 30 to 40 tons per acre per year. Unseen damages occur on the farm when soil is eroded off the landscape. Damages include loss of nutrient-rich topsoil, plant available water-holding capacity and optimum rooting depth. The long-term result of erosion is a potential loss of crop production. This loss has gone unnoticed because of technological advances that have steadily improved yields. In recent years, technology has provided only small increases in crop yields. As a result, the decline in crop production on eroded soils is becoming more evident.

The extent to which crop growth on eroded landscapes is reduced depends not only on the degree of erosion present but also soil type, the crop being grown, climatic conditions and management practices. Scientists from the Department of Agronomy have initiated an intensive research program to quantify the relationship between soil erosion, soil productivity and crop response on many farm fields across eastern Nebraska. They have already determined that percent slope, slope length, and thickness of the topsoil directly affect crop yields.

Nutrients lost from the land do not seem to deter production because our soils sustain their fertility quite well, and cultural practices generally include the application of fertilizer in quantities great enough for optimum plant growth. Corn, soybeans and sorghum do show a preference for better production on some parts of a hillside. Sorghum, for example, has performed best on the upper portion of the hill while soybeans performed best at the base of the hill. The researchers hope to expand this program to include a wider array of erosion levels, soil types, climatic conditions, and cropping systems. Continuation of this research will lead to the development of more profitable strategies for cropping eroded lands. These strategies would promote the selective planting of a crop on that portion of the hillside where the economic returns from that crop are greatest. Those portions of the field that have poor economic return may be diverted to crops that have few inputs or be included in a government program.

Animal Science

Escape Protein

Protein is a relatively expensive nutrient for ruminants beef and dairy cattle and sheep. Ruminants, because of the micro-organisms in their rumen, can utilize nonprotein nitrogen sources such as urea for much, if not all, of their protein needs. Urea is much less costly than protein feeds such as soybean meal. However, additional protein is needed, above that supplied by the rumen bacteria, when cows or ewes are lactating or young animals are growing rapidly. This protein is supplied to the animal in the form of escape (or bypass) protein. Escape protein is not degraded in the rumen by the micro-organisms.

Conventional protein sources such as soybean meal are highly degraded in the rumen and, therefore, are low in escape protein. Several byproduct protein sources have been shown by Nebraska research to be high in escape protein. These include animal by-products, blood meal, meat meal and feather meal and grain byproducts, distillers grains and corn gluten meal. Now a method has been developed whereby degradable protein sources such as soybean meal can be
treated to enhance the bypass of the protein. This process appears to increase the escape protein value of soybean meal by 2 to 2-1/2 times.

**Beef Cow Milk Production**

Beef calves receive a large proportion of their energy intake from birth to weaning from milk provided by their dams. Variation in calf growth results from variation in level of milk provided by dams. An experiment was conducted at the Dalbey-Halleck Farm near Virginia, Nebraska, to evaluate reproductive performance and energy utilization of three groups of crossbred beef cows which were similar in size and growth potential but differed in milk production. Calf growth and energy utilization were also measured. Under the favorable forage resources at the Dalbey-Halleck Farm, there have not been significant differences in the reproductive performance of the three groups of cows. Calf growth has been enhanced with higher milk producing dams, and a large proportion of the advantage at weaning time has been maintained to slaughter when the calves have been fed to gain rapidly to slaughter at 15 to 16 months of age. Energy requirements for maintenance (about 70 to 75% of the total for beef production) were significantly lower for the low milk producing group, in cows as well as in their calves. In overall efficiency of beef output to feed energy input, there were little differences due to milk level of cows since the higher output of the higher milking cows was offset by the higher energy requirements of the cows and their progeny.

**Meat Modification**

A major goal of the beef industry must be to increase the value of under-utilized parts of the beef carcass. The beef chuck, comprising more than 25% of the total carcass, seldom returns its potential value because the muscles are less tender, special cooking procedures are required to produce acceptable tenderness, and many small muscles are present. The beef chuck requires special manufacturing and processing procedures to make restructured steak products that can be cooked rapidly and are tender, juicy and very palatable. A major problem lies with the amount and kind of connective tissue, often called "gristle" by consumers, found in the beef chuck. This connective tissue, vital to the living animal for its role in holding muscles to each other and in locomotion, detracts from meat palatability and acceptability. Since the connective tissue is protein, removing it and throwing it away is unacceptable. Emphasis of Animal Science Department research has been to modify the connective tissue, allowing it to remain a part of the total nutritious beef product, while minimizing its negative effect on palatability. Two procedures have been developed to remove the connective tissue: motorized rotary knife and a skinning machine. Modification of connective tissue is then achieved by grinding or high speed chopping while it is frozen. Modified connective tissue can then be reincorporated into the restructured steak by uniform mixing at proper temperatures. Taste panel studies indicate reincorporation of between 67 and 100% of the connective tissue removed earlier and modified improved the overall palatability and consumer acceptance of restructured beef steaks. While some additional labor and processing are required, the payback is a product that can be treated similarly to the much higher priced broiling steaks from the loin and, at the same time, reduce the impact of the connective tissue. Thus, much of the beef chuck can be upgraded in palatability. The value added through processing can represent a major increase in value of the beef animal. Implementation of the technology in the industry can strengthen the competitive role for beef, reduce concerns about palatability and allow more of the beef carcass to be manufactured and processed into new, consumer acceptable products.

**Grain Sorghum for Poultry**

The nutritional value of grain sorghum for poultry is influenced by test weight, protein content, fiber level, tannin content, variety and possibly other factors. In 1985, seven commercial varieties of grain sorghum including full-yellows, hetero-yellows (bronze) and bird resistant (BR) were produced under the same environmental conditions at the Agricultural Research and Development Center, Mead, Nebraska. Nine varieties were similarly produced in 1986, and seven will be produced in 1987. Following harvest and drying to 14 and 15% moisture, all sorghums were analyzed for nutrient composition. Feeding trials with broilers and laying chickens have subsequently been conducted. Gross energy values, crude protein and phosphorus levels were similar in these sorghums. Amino acid and fat levels were somewhat variable among varieties. Fiber levels were highest in BR sorghums and lower in yellow and bronze varieties. The yellow pigment, xanthophyll, was quite low in all sorghum grains, varying from 1.1 and 1.5 mg/kg, as compared to 14.4 and 30.6 mg/kg in yellow corn and alfalfa meal, respectively. Results of feeding trials indicate certain yellow and bronze sorghums are equivalent to or slightly exceed yellow corn in feeding value. Metabolizable energy values are being determined for grain sorghums produced in 1985 and 1986. This research should aid in the nutritional improvement of grain sorghum and more efficient utilization of this important feed grain in poultry rations.

(continued)
Research Highlights

Biometrics and Information Systems Center

Improved Statistical Methods

A continuing concern to agricultural researchers is the cost of experiments. Unwarranted cost cutting seriously reduces the chance of achieving useful results. At the same time, researchers cannot afford the luxury of using more resources than necessary. Procedures for improving the cost-efficiency of experiments have been developed by theoretical statisticians but, unfortunately, have not been very practical. Recent advances in computer technology have changed this.

As part of a regional project, the Biometrics and Information Systems Center is studying advanced, computer-intensive methods of data analysis which use information from experimental designs more comprehensively than "traditional" procedures. Called mixed model methods, they facilitate the use of highly efficient designs which, in the past, researchers tended to avoid because of their complexity. In some cases, using these techniques can result in up to 50 percent reduction in the cost of an experiment with no loss in the quality of information.

A regional publication is being prepared which will serve as a text for researchers learning to use these procedures. The next step is to design computer-based expert systems to aid the researcher in the selection of a most efficient design.

Microcomputer Technology Assists Interdisciplinary Research

At the West Central Research and Extension Center in North Platte, a group of scientists from agronomy, ag engineering, and ag economics are investigating a cropping systems approach to reducing ground water depletion and degradation by agricultural chemicals. Using Lotus 1-2-3 as the electronic notebook, the researchers are able to take measurements from the field using hand-held computers or instruments that record data electronically and place them directly into a spreadsheet format on microcomputers using Lotus Measure software. The data are automatically checked for accuracy, then summarized and graphically displayed literally minutes after collection. Soil moisture levels are used in irrigation scheduling decisions for the various treatments on the same day the readings were taken. The Center is also tied into the IANR mainframe computer via the PrairieLink Data Network which provides the opportunity for timely access to statistical analysis software. The implementation of microcomputer technology has provided the scientist the opportunity to analyze and interpret data during instead of after the growing season.

New Maize Lines and Hybrids

A method was devised to facilitate the extraction of new maize inbred lines and hybrids from crosses of elite lines. A diallel set of double cross hybrids among the crosses of 10 elite lines to each of Mo17 and B73 has been evaluated. Several double crosses were found to yield as well as the average of a set of commercially available hybrids. The parents of these double crosses are now being selfed and F2 progeny are being crossed to the other parent for evaluation. The selected F2's from each side of the double cross will again be intercrossed as sister-line single crosses for further evaluation. Eventually a sister-line double cross hybrid will be produced.

Center for Agricultural Meteorology and Climatology

International Drought Symposium

In 1986, Dr. Donald Wilhite was the principal organizer of an International Symposium and Workshop on Drought, held on the campus of the University of Nebraska. The purpose of the symposium was to review and assess current knowledge of drought and to determine what research and information is needed to improve national and international capacity to cope with drought. These issues were considered for both developed and developing nations. Approximately 150 scientists and policy makers from 26 nations attended the symposium.

Sixty symposium participants from more than 20 drought-prone nations participated in a post-symposium workshop. The ultimate goal of the workshop was progress toward a "plan of action" for national governments and international organizations to follow to improve society's capability to assess and respond to future drought in a more timely and effective manner.

The symposium and workshop was sponsored by the Institute of Agriculture and Natural Resources of the University of Nebraska and the Department of Energy and Natural Resources of the State of Illinois. Proceedings of the symposium and workshop will be published by Westview Press in August 1987. The recommendations and "plan for action" emanating from the workshop will be presented to federal agencies and to U.S. and foreign government and nongovernment donor organizations during late 1987 and early 1988. The recommendations are also expected to stimulate cooperative research and planning efforts with scientists at other universities and with government policy makers in the United States and overseas.

Dew Formation and Plant Disease

Several experiments that focus on different aspects of dew are currently being conducted. Using field experiments and a crop simulation model, Dr. Albert Weiss and Dr. John Norman are studying dew forma-
tion in a row crop under semi-arid conditions. Initial results indicate the importance of irrigation in controlling the plant microclimate. A second year of field experiments to predict cercospora leaf spot in a sugar beet field near Lyman, Nebraska, has begun. An automated weather station collects the necessary data required for the cercospora leaf spot prediction model. Disease predictions will be disseminated via the local media. A follow up survey will evaluate the effectiveness of this information.

A chamber that creates dew by creating conditions similar to those for dew formation under natural conditions, is being used to study dew duration on different bean cultivar leaves and at the interface of the leaf and a bean blossom. Small leaf wetness sensors were developed that can be attached directly to a leaf to monitor dew formation under chamber and field conditions.

Consumer Science and Education

Housing Design to Meet the Future Needs of Nebraskans

Professionals in home economics, architecture, agricultural engineering, construction management, and horticulture at the University of Nebraska and at the University of Hanover, Germany, came together to share their expertise in energy efficient housing design, barrier-free design, affordability considerations, and manufactured housing possibilities. This knowledge base, combined with information acquired from a random survey of 732 Nebraska residents and from representatives of government and the housing industry, was used to develop housing prototypes designed to meet the future needs of Nebraska residents.

Consequences of the Housing Decisions of Rural Families

Housing researchers in six North Central states have collected data to analyze consequences of housing decisions for rural families. The decisions of interest are those related to financing, energy use and conservation, type and location of housing, and remodeling or retrofitting of the dwelling. It is anticipated that these findings will be of use to extension agents as they interact with the public regarding housing decisions, to builders as they identify potential markets for different housing types, structures, location; and to loan officers as they evaluate their policies regarding creative financing.

Entomology

Greenbug Resistance

Laboratory and field studies of pesticide resistance in greenbug populations on sorghum have provided evidences for induction and gene amplification. The results of this work indicate that exposure of greenbugs to selected insecticides can result in an increase in resistance of 200-400 fold in the following generation. The enzyme involved in the resistance mechanisms is carboxyl esterase. Not only are the progeny of the treated greenbugs able to resist the effects of the pesticide, but they are larger and appear to have increased reproductive capabilities. There is evidence that once the pesticide pressure is reduced on the population that resistance drops off to near normal levels within a few generations. This work with insect resistance to insecticides will have major consequences in understanding the response of insect populations to sublethal doses of these chemical control agents.

Spider Mites

Spider mites continue to be important economic pests on corn and other crops in Nebraska. A simulation computer model has been developed that correlates the relationship between temperature, development rate, and mortality of the mite egg stage. The model accounts for microenvironmental changes occurring in drought-stressed corn and has provided insights into the relationships between plant water stress and spider mite outbreaks. In another aspect of this study, it was determined that mites from Nebraska are more susceptible to pesticides than those from surrounding states where pesticide use is heavier.

Corn Rootworms

The concept of encapsulating corn rootworm semiochemicals (attractants and feeding stimulants) and small amounts of insecticide into a corn flour-borate granule has been studied. The results of initial tests indicated that a volatile corn rootworm attractant can be successfully encapsulated in the granule and that the granule will still attract corn rootworm adults after storage for one year. The use of this formulation of semiochemicals will reduce the amount of insecticide introduced into the environment and give greater flexibility in integrated pest management systems.

Environmental Programs

Groundwater Quality

IANR scientists are in their third year of a five-year research-demonstration project launched to examine the effects of crop production practices on groundwater quality. The project is funded through a $1 million grant from the Burlington Northern Foundation. One of the chief concerns is chemigation, the application of agricultural chemicals (fertilizers and pesticides) through irrigation systems, particularly center pivot systems. The effects of different tillage,
Research Highlights

(Ecological Programs...)

New processing technology is being studied as an alternative means for selectively extracting lipids components such as cholesterol from various foods such as eggs, dairy products and meat in the Department of Food Science and Technology. A supercritical fluid is produced when the temperature of a gas is raised above the critical point and is then subjected to high pressure. As pressure is applied to a gas above the critical temperature, the gas will take on liquid properties and act as an excellent extracting agent. Carbon dioxide is currently being used as the supercritical fluid. It imparts no color, flavor or contaminants to the food product. Currently, supercritical carbon dioxide is being used commercially to decaffeinate coffee.

Another new processing technology presently being studied in the Department of Food Science and Tech-

Food Science and Technology

Applying Biotechnology in Food Science and Technology

The work in Food Science and Technology employs many biotechniques in researching bioprocessing solutions for fuels, chemicals and feeds. Food Science and Technology research on the use of cheese whey, a waste product of the cheese industry, has resulted in a novel mixed substrate fermentation process for ethanol production. Employing enzymes and special yeast strains, the unusually long fermentation time normally resulting for a combined whey-corn mash has been shortened by about one-half. Because of the low to negative value of the cheese whey, corn-based ethanol production is enhanced by the addition of the cheese whey as the liquid portion during mashing. The whey sugar, lactose, makes up 25 to 30% of the fermentable sugars in a whey-corn mash and boosts the yields up from 2.6 gal/bu of corn to 3.5 gal/bu. The methods used to develop the process considered the entire ethanol process from starch conversion to fermentation time.

By using commercially available enzymes to direct a disaccharide fermentation strategy employing a mixed yeast inoculum, the normal cook process remains unchanged and the fermentation time falls within those of commercial ethanol processes. The process has been demonstrated at pilot scale and in a commercial ethanol plant. This design accommodates existing ethanol processes and reduces the initial capital cost for equipment. Work is proceeding on a continuous fermentation system to reduce the process time another 50%, as well as work on an immobilized culture system.

Research activities in 1986 included work with recombinant DNA technologies and its uses for development of diagnostic DNA probes for detection of foodborne microorganisms. Major steps were accomplished in the development of a DNA probe for detection of Listeria monocytogenes. Listeria has become an organism of major concern to the dairy industry with several major foodborne disease outbreaks and many product recalls of dairy products being attributed to the organism. At present, no satisfactory method exists for rapid or consistent detection of the organism in food. A library of Listeria DNA has been constructed by cloning restriction fragments of chromosomal DNA. Several clones have been further identified which appear to contain DNA sequences unique to Listeria chromosomal DNA and one excellent candidate to use as DNA probes for rapid identification of the organism in food. A novel non-radioactive DNA label has also been perfected which has sensitivity equivalent to radioactive labels. A non-radioactive label will allow use of DNA probes in the food industry.

New Processing Technology

Supercritical fluid technology is being studied as an alternative means for selectively extracting lipids components such as cholesterol from various foods such as eggs, dairy products and meat in the Department of Food Science and Technology. A supercritical fluid is produced when the temperature of a gas is raised above the critical point and is then subjected to high pressure. As pressure is applied to a gas above the critical temperature, the gas will take on liquid properties and act as an excellent extracting agent. Carbon dioxide is currently being used as the supercritical fluid. It imparts no color, flavor or contaminants to the food product. Currently, supercritical carbon dioxide is being used commercially to decaffeinate coffee.

Another new processing technology presently being studied in the Department of Food Science and Tech-
ology is ultrafiltration. Ultrafiltration can be used to concentrate food products. Ultrafiltration removes mostly water but may remove other components such as sugars and minerals depending on the pore size of the filter. Large compounds such as proteins are not removed. For example, egg white can be partially concentrated by ultrafiltration thereby decreasing energy needed during the total drying process. With respect to eggs, primarily water is removed, but also about half of the glucose is removed. Since glucose is removed from most dried egg whites to prevent browning, this is a further advantage. Ultrafiltration is also being used in concentration of milk products and for the removal of lactose from whey products.

Forestry, Fisheries and Wildlife

Woody Plants

The biggest obstacle to the genetic improvement of woody plants are the long generation intervals common to most trees and shrubs. Therefore, the crosses required to “package” desirable genes into a single plant or variety are generally not completed. Knowing which genes are involved in producing a given trait, and how those genes are regulated, will enable scientists to select very rapidly those individuals which possess the desired gene, even if not yet expressed (e.g., in a seedling). Also, once the genes for a trait are identified, they can be transferred into another plant which already has several additional desirable characteristics. This has already been accomplished in another laboratory, in which a gene that confers some tolerance to glyphosate has been transferred into a variety of hybrid poplar.

Eastern cottonwood, the state tree of Nebraska, is being propagated through tissue culture. Tissue culture, gene cloning and gene transfer will be used in a series of experiments with eastern cottonwood to better understand how important traits in woody plants are controlled at the gene level. This will be accomplished by mutating genes of eastern cottonwood using known sequences of DNA, screening those mutations to determine those genes associated with desirable traits, and cloning the gene of interest.

Eastern redecedar and Rocky Mountain juniper are the most extensively planted tree species in Nebraska. However, very little is known about the genetics and physiology of either species. It is believed the two species hybridize in nature. Work is underway to identify unique base sequences in the chloroplast DNA of each species to determine if the two species do hybridize. This will aid in later studies to determine how each species is adapted to the different sites and growing conditions found in Nebraska.

Pine Moths

Pine moths are among the most serious insects pests of pine windbreaks, plantations and ornamental plantings in western and central Nebraska. In cooperation with the Nebraska State Forest Service, two species of pine moths which are causing severe damage at the Nebraska National Forest near Halsey are being investigated to determine whether they are hybridizing or maintaining themselves as separate species. Larvae of both species are often found at the same branch junction, and sometimes occur in the same larval cavity. Because the two species have very different life cycles, this study will allow control efforts to be timed for maximum impact. Preliminary data using isoenzyme markers indicate the two species are not hybridizing.

Fisheries Biology

Simulation model use in fisheries biology and fisheries management has increased in recent years. One important group of simulation models includes the Habitat Suitability Index models and the Instream flow models. These have been developed to evaluate the quality of aquatic habitats. However, these models require more detailed information about many fish species than is generally available.

Since 1985, studies have been underway at UNL to test and refine several habitat suitability models and to develop suitability index curves for instream flow models. The primary species of interest are the channel catfish and several other species of river fish and invertebrates which provide food for catfish and other gamefish species in Nebraska.

Habitat conditions such as water depth, water velocity, etc. are measured at the points where small fish and invertebrates are collected. For large fish, like channel catfish, radio transmitters are implanted in the fish. The fish are then located with directional radio receivers and habitat characteristics are measured at the origin of the signals.

Habitat preference information for each species is being used in instream flow simulations to predict how water management practices can benefit water-based recreation and aquatic life.

Horticulture

Buffalograss

Horticulturists are involved in a cooperative project to develop new buffalograss (Buchloe dactyloides) cultivars for use in turf situations. Buffalograss is a warm-season grass which requires little mowing, little fertilization, and very little supplemental irrigation.

Progress has been made in selecting turf-type plants which have excellent low growth and good color, but still have some of the advantages of reduced mowing, (continued)
fertilization, and watering. It is possible that scientists will be able to reduce by approximately 50% the energy required to maintain a healthy, vigorous, aesthetic lawn.

Currently, breeding schemes are being used to combine the characteristics of the more outstanding selections. This is an interesting project because buffalo-grass plants are either male or female. This is not the typical situation with any of the other turfgrasses that would be used in a lawn situation.

During 1987, some of the more outstanding lines are being distributed for evaluation throughout the United States. The objective of this testing is to find out how extensive the area of adaptation would be for a buffalograss turfgrass.

**Drought Avoidance in Turf**

Turfgrass water use rate and rooting are two important factors contributing to their drought avoidance characteristics. Nine cool-season turfgrasses and 16 Kentucky bluegrass cultivars were studied for water use rate and rooting responses under limiting and non-limiting moisture conditions. Turfgrass species differed in water use by 56% and in rooting responses by 60%. Interestingly, Kentucky bluegrass cultivars varied similarly, with differences of 64% in water use rate and 68% in rooting responses. These results suggest that variation in water use rates and rooting responses between species may be as great among cultivars within a species. Opportunities exist to make selections for improved drought avoidance through proper cultivar use. Further drought avoidance enhancement may be developed through use of these selections as parental lines in turfgrass breeding programs, much as that being conducted in the department of horticulture at UNL.

**Effects of Planting Dates and Growth Regulators on Liatris**

The effects of dates of planting and growth regulators on flowering of *Liatris pycnostachya* and *L. spicata* were evaluated in a field study. Blooming of both species was extended significantly by dates of planting, but those planted on June 15 and later dates produced poor quality flower. Plants treated with gibberellic acid had tall stems and poor quality flower spikes with light-green leaves. Plants treated with B-nine had short stems and excellent quality flower spikes with dark-green leaves.

**Clematis Result Demonstration**

Horticulture research is being conducted on the ornamental woody vine *Clematis*. Recently, there has been an increased interest in *Clematis* by many homeowners. This interest has encouraged the development of a research project to obtain information/data for use in an extension publication on the care, culture, and cultivar selection of *Clematis* in Nebraska.

The research/result demonstration planting consists of 20 cultivars. These plants are trellised and are watered with a drip irrigation system. A long-term study is being planned to evaluate proper pruning and propagation techniques of the 20 *Clematis* cultivars.

**Northern Pecan Flowering**

The University of Nebraska-Lincoln Pecan Research Planting has set its first pecan crop since its establishment in 1981. This spring, data on pollen shedding and stigma receptivity has been collected on 14 northern pecan clones for evaluation. The northern pecan clones presently developing a nut crop are: C. L. McElroy Rock, Perduque, Lucas, Mullahy, Devore, Snodgrass, Shoals West, James, Gibson, Green Island Hackberry, Boltens S-24, Witte, Major, and Starking Hardy.

The research plantings were started from seed in 1981 and grafted to superior clones in 1983. Many of the three-year-old grafted trees have attained heights over 20 feet.

**Genetic Resistance to Iron Deficiency and Induced Leaf Chlorosis in Dry Beans**

Iron deficiency leaf chlorosis is a problem affecting dry bean production on calcareous soils. It has been difficult to obtain satisfactory control by iron sprays. Varieties of dry beans with high genetic resistance to this mineral stress were identified. Chlorosis was more severe under lower temperatures. Some varieties showed a differential response to varying temperature regimes but other varieties maintained high resistance even at low temperatures. Resistance was determined by two complementary dominant genes in a wide array of crosses between resistant and susceptible varieties. In a grafting experiment the rootstock of beans controlled the uptake of iron.

**New Decorative High Quality Small-Fruited Hubbard and Marrow Type Winter Squash**

New highly decorative, high quality (baking) small-fruited Hubbard and Marrow type winter squash lines and F1 hybrids were developed through selection in a variable heirloom winter squash population. These will be released in 1988 or 1989. The original squash was grown by the Sioux (Lakota) Indians in Nebraska and was reported to have produced large, elongated fruits of high edible quality with attractive orange and green variegated patterns on the fruit. This landrace was later grown by settlers in western Nebraska and became cross-pollinated by other squashes. Seed of this outcross population was provided later to the University of Nebraska. The variegated pattern (orange/green) of the fruit was very variable and was determined by a single unstable gene. Even though the inbred lines showed considerable variation in the color
patterns it is expected that the public will be interested in growing and using them for decorative purposes. The variegated pattern was much more uniform in the F1 hybrids and this may be desired by some people. The edible quality of the baked squash is excellent. The smaller hubbard squash should be more acceptable to the public because of the smaller size of present day families.

New Multiple Disease-Resistant Dry Bean Lines with High Seed Quality

Two new Great Northern dry bean lines with multiple disease resistance and high seed quality have been developed for release as varieties in 1988. These lines are the first to combine high resistance to rust, moderate resistance to common bacterial blight, avoidance of the white mold disease and a uniform bright white seed coat. The avoidance of the white mold disease was accomplished through the development of a more upright and more open plant habit, thus creating a dryer microclimate in the plant less favorable for the pathogen. The use of these lines by growers should assist in stabilizing production and provide a competitive edge in overseas markets because of their attractive seed qualities.

Human Development and the Family

Trauma of Infant Death

One in 100 babies is stillborn in the U.S. Thirty-three thousand families each year, thus, are traumatized by the death and spend months and even years repeating the question “Why?”

Recent research in the area of human development and the family indicates that more than one in four mothers “seriously consider” suicide after their baby is stillborn. And, nearly one in five fathers also contemplate ending their lives because of the grief they feel for the loss of the child.

The researchers based their conclusions on interviews and written testimony from 350 parents. They conclude that many parents would find a great deal of comfort in attending meetings of support groups formed by bereaved parents to help each other.

A related study of Sudden Infant Death Syndrome (SIDS) and its effects on grandparents revealed that the death is a “devastating” experience for extended family members also. Feelings expressed by the 80 grandmothers and grandfathers in the study included anger, disbelief, guilt, anxiety, depression, concern, exhaustion, and bitterness. Five percent of the grandmothers (3 out of 61) thought about killing themselves because of the baby’s death.

Family Strengths

Research on family strengths funded by the Institute of Agriculture and Natural Resources at UNL was presented on two different occasions to Congressional committees on Capitol Hill.

The House of Representatives Sub-Committee on Children, Youth, and Families has formed a National Family Strengths Project to promote the development of healthy families across the country. The idea for the project was heavily influenced by research conducted at UNL in which 3,000 strong family members have been involved over the past decade.

UNL researchers described the studies to the Congress, and offered a number of recommendations which could enhance the quality of marriage and family life in this country. The researchers were also interviewed during the year by a variety of newspapers, magazines, television and radio stations around the country, including media in Los Angeles, Kansas City, Schenectady, Miami, Pittsburgh, Oklahoma City, Portland, Boston, the Cable News Network, USA Today, Good Housekeeping, Reader’s Digest, and Voice of America in five Western European cities.

Farm Families

Farm families are among the highest of all occupational groups in describing themselves as satisfied with their lives and particularly so with their work. However, the 1980’s brought an abrupt halt to prosperity in the agricultural sector of the United States. As a result, farm families have increasingly found themselves in both economic and financial distress and in response, many farm women have taken off-farm jobs. Nebraska husbands and wives were asked to respond to questionnaires which assessed the impact of these changes.

Although farm couples reported high satisfaction with their lifestyle (70.7% of wives and 67.2% of husbands), stress was a frequently reported experience. Among farm wives, 40% reported that they were under stress often or most of the time; 39% of farm men say their experience with stress is often or most of the time. Employed farm wives reported significantly higher stress levels than those wives not employed off the farm. Those women reporting higher stress also indicated lower lifestyle satisfaction. Husbands reported that the depressed farm economy was a major stressor (55%) followed by various concerns about the farm operation such as marketing decisions, machinery breakdowns and long hours (37%) as well as various financial concerns including bankruptcy (27%). Likewise, farm wives reported that the depressed economy and financial concerns were the major cause of stress (67%) as were various family concerns such as child care, and multiple role demands (28%).

For the most part, the farm couples reported that they tried to handle their stress alone. Many were not
Research Highlights

(Human Development and the Family....) able to share their stresses with their spouses (54% of husbands and 61% of wives). Also, it would appear that wives absorb most of the stress of off-farm employment. Both findings point to the need for informational and counseling services directly targeted to those experiencing or at risk of experiencing high stress relative to the farm economy.

Families and Disabled Persons

As “deinstitutionalization” has become the approach to services for individuals with disabilities over the past 20 years, the family of origin or preference has become the mainstay for the care and concern of persons with disabilities. Two studies have examined the relationships between the various family members and that member having a physical or mental disability. The relationships include: perceived strengths of the family, helpfulness of various activities, and marital relationships between the husband and wife.

The study of the family members brought out how the individual with the disability becomes the central focus of all family activities. The care of the individual with a disability became the major responsibility of the female members of the family. Male members had the broader concerns for the welfare of the family. Family members with the mentally disabled individual expressed close relationships with the professionals assisting them.

Perceptions of family were given by the family members with a physical disability. These individuals expressed that their families had strengths which aided them in their rehabilitation/habilitation programs. Helpful activities for coping with the disability were given.

In both studies, the individuals with disabilities and their families expressed a shared love and concern.

Rural Loneliness

Loneliness has been a research interest of Dr. John C. Woodward for the past twenty years, studying over 15 different populations. Currently his research is focused on rural populations.

Loneliness has been defined as a feeling of being alone and disconnected or alienation from positive persons, places, or things.

Results of the current research show that persons living in rural Nebraska as compared to past populations studied are more lonely. Out of all the populations studied, rural adolescents ranked the second most lonely and the rural adults the third most lonely.

Coping strategies used to relieve their feelings of loneliness include for the adolescents listening to music, keeping busy, and watching TV. The rural adults used keeping busy, reading the newspaper, and doing activities with their spouse.

Human Nutrition and Food Service Management

Nutrition Education

Nutrition messages for the most part may be described as “sender oriented”, i.e., designed by experts to communicate what they believe needs to be taught. An alternative approach would be to communicate information based on what the people to be educated believe they need to know in their particular situations, or “receiver oriented”.

As part of a North Central Regional Research project, 305 adolescents, 14-16 years of age, in six states were interviewed using Dervin’s sense-making approach. Major areas of concerns about nutrition included general nutritional health, weight loss and physical fitness issues. Four distinct ways adolescents viewed situations involving nutrition concerns were identified. Two groups of adolescents were action-oriented, that is, they perceived themselves as having the ability to make nutrition-related decisions. The other two groups perceived barriers to action. The groups varied as to whether or not they thought nutrition information would be helpful in solving their problems. They also differed in their reactions to the opinions of others with some adolescents being very sensitive to the way they were viewed by other people while others had little concern for the opinions of others.

The results of the research will be used to evaluate the effectiveness of “sender-oriented” and “receiver oriented” nutrition messages developed for an adolescent population.

Metabolic Nutrition

One of the benefits associated with consumption of vegetarian diets is that these diets usually have a lower fat and cholesterol content and a more favorable polyunsaturated to saturated fatty acid ratio than do the diets containing animal products. While these diets are generally believed to decrease the risk of cardiovascular disease, they may have some detrimental attributes, particularly with regard to the use of minerals. Effects of two levels of dietary fat (approximately 30 and 40% of the calories) and two levels of cholesterol (approximately 300 and 600 mg/day) were investigated in human feeding trials employing constant controlled diets and using healthy, young adult subjects. Absorption of calcium, manganese, zinc and iron was higher on the fat diet; likewise absorption of these minerals was similarly improved on diets containing 600 mg cholesterol compared to those containing 300 mg cholesterol. Preliminary studies with adolescent boys indicated that calcium was better absorbed when fat was provided from safflower oil, a highly unsaturated fat, than from beef tallow, a saturated fat. Absorption of
calcium from diets containing corn oil and buttermilk did not differ significantly, suggesting that length of carbon chains as well as the saturation of fatty acids may influence the effect on fat or mineral availability. These results suggest mineral status of persons may be compromised on diets low in fat and cholesterol.

Foods

Energy consumption, cooking times, drip losses and sensory qualities of 4-5 lb. turkey rolls roasted in conventional, microwave, convection and combination microwave/convection ovens were compared. Energy consumption was highest by the conventional oven followed by the combination microwave/convection, convection and microwave ovens. Cooking time in the microwave and combination ovens was approximately one-half that in the conventional and convection ovens. Percentage drop loss was highest for turkey rolls roasted in the convection oven followed by microwave, combination and conventional ovens. The sensory panel found the turkey was desirable in color, equally acceptable turkey rolls.

Northeast Research and Extension Center

Weed Control and Crop Production

Research spanning 15 years continues to develop weed control programs for various conservation tillage systems. A new phase of this research is to look at various grasses and legumes which could be underseeded in soybeans as cover crops and subsequently regulated the next year in no-till corn. Reduced soil erosion potential, enhanced weed control, and improved soil fertility are potential benefits of the program. Initial research has identified potential cover crops to use and ways to more effectively establish them in growing soybeans. Research continues with both ridge and slot planted corn to improve weed control programs. A new phase of double crop research was initiated to determine if other short growing season crops could be utilized in northeast Nebraska. Crops like oilseed rape, buckwheat, millets, sunflower, dwarf corn, soybeans, and grain sorghum will be evaluated for planting after cereal grain harvest. Leafy spurge continues to increase as a serious pasture and rangeland weed. Evaluation of herbicides continues to find more effective treatments for leafy spurge.

Management of Weaned Pigs

Researchers have demonstrated that constant, currently recommended warm temperatures may not be the best management practice for 3- to 4-week-old weaned pigs. Beginning one week after weaning, turning the temperature down 10°F for 12 hours at night resulted in utility cost savings of over 15%. In addition, pigs subjected to reduced nighttime temperatures consumed 8% more feed and gained weight 6% faster, with no differences in feed conversion efficiency or mortality. Further, there were no differences in gain, feed conversion, or mortality during the subsequent grower-finisher phase due to nursery environment.

Crop Residue and Soil Erosion Control

Crop residue left on the soil surface after planting is among the least costly and most effective soil erosion control practices. However, retaining adequate residue cover following soybeans is difficult, since soybean residue is very fragile and easily destroyed by tillage. For example, researchers found that just a single pass with either a chisel plow or a tandem disk destroyed over 65% of the soybean residue on the soil surface, and left less than 25% of the surface covered with residue. Even a till-planter used in previously undisturbed soybean residue left more than 80% of the soil surface without residue cover. No-till planting did leave a 62% residue cover, indicating that the opportunity exists to achieve acceptable soil erosion control following soybeans, provided that the commonly used soil and residue disturbing implements are not included in the tillage and planting system.

Alternative Methods of Growing Feedlot Cattle

With the recent decline in corn price and availability of cheap grain, relative to roughage, beef cattle research has concentrated on alternative methods for growing cattle in the feedlot. Among these are limit or restricted feeding of high energy diets. In this program, growing calves were fed a 70 to 80% corn diet at 80% of ad libitum. Gains and conversions of steers managed under this program were economically competitive to those of steers managed under traditional high roughage diets.

Implant Systems

Implant (growth promotant) systems were another major area of beef cattle research at NEREC. Studies to date have shown that the subsequent performance response to implants may be decreasing if the cattle had received implants previously (pre-weaning). Additional data would suggest that optimum gain and efficiency was achieved when cattle, which were destined for slaughter, received all implants postweaning, preferably when they were being fed high concentrate diets.

Swine Research

Scientists demonstrated the importance of adequate drinking space on the performance of newly weaned pigs. Beginning at weaning, 16 pigs weighing 10-15 pounds were housed in 4 x 8 feet nursery pens with either 1 or 2 nipple drinkers. Pigs housed in pens with only 1 nipple drinker for 16 pigs grew slower and

(continued)
Research Highlights

(Northeast Research and Extension Center....)

were less uniform in weight after a 4-week period than those given access to 2 nipple drinkers separated 4 feet.

Commingled feeder pigs were offered receiving diets for 3 weeks after arrival that contained 1, 2 or 3 times the 1979 NRC requirements for vitamins and all trace minerals except selenium. The addition of vitamins and trace minerals at levels 2 and 3 times higher than the established requirement did not improve the rate of gain, feed conversion efficiency or death loss of commingled feeder pigs, either for the 3-week post arrival period or until slaughter.

In ongoing research with scientists at the University of Missouri, the effects of an altered market management regime were investigated in an attempt to reduce the 10-15% shrink commonly associated with commingled pigs transported long distances. Upon arrival at a southern Missouri auction market, commingled pigs were given access to feed and water, water only, or no feed and no water. Although pigs given feed and water lost the least weight in the marketing and transport process, there was no effect on overall performance to slaughter weight.

Comparing Soil Test Results

Recognition from the Nebraska Cooperative Extension Service, Excellence in Programming Award and the USDA Distinguished Service Award were given to the Soil Fertility Panel of the Agronomy Department for its efforts in comparing soil test results and recommendations. This program validated many years of research efforts that together make the University of Nebraska’s fertilizer recommendations cost effective. Since the program began in the early 1970’s, a research site was located at the Northeast Center. George Rehm started the research at the Northeast Center and Charles Shapiro has continued it since 1984.

Insect Research Programs

The bean leaf beetle is a relatively new insect pest of soybeans and producers are not accustomed to seeing its feeding damage on the foliage and pods. Nebraska data are not available correlating level of feeding damage with yield loss. Research efforts are now underway to quantify five levels of simulated leaf loss (0, 17.5%, 33%, 66%, and 100% during the early reproductive stages of the plant) with soybean yield. Data collected in 1986 show a significant yield loss only following the 66% or greater foliage loss. This is in concert with present extension recommendations for controlling insects pests in soybeans.

The application of insecticides through overhead center pivot irrigation systems is becoming a common practice in Nebraska. Little is known regarding the effects of the practice to non-target organisms. A research project was initiated to quantify the seasonal abundance of ground beetles as measured by pitfall traps following applications of chlorpyrifos 4EC applied through an overhead irrigation system directed at controlling the European corn borer in corn. Nine generations of ground beetles (Carabidae) have been identified and these will be used as indicators throughout the year. Additional analysis is incomplete and the study will be conducted a second year.

Pesticide Applicator Safety

Since chemigation is becoming a common practice in Nebraska for controlling some insect pests, questions have arisen regarding applicator safety during the loading and calibration process and safety of repairman entering the field in the event of a pivot breakdown during an application, field scouts entering the treated field, etc. Preliminary studies were begun in 1986 to outline a protocol to measure insecticide residues remaining in the air and on plant foliage that may be intercepted by individuals entering a field at selected time intervals following a chemigation application. A protocol using gauge patches attached to protective clothing worn by individuals and analyzed by gas chromatography has been developed and initial studies will begin in 1987.

Irrigation Runoff

Runoff from center pivot irrigated fields can be reduced or eliminated by supplying enough soil surface storage to temporarily store water applied in excess of the soil's infiltration rate. Tillage practices aimed at creating water storage capacity on the soil surface are being evaluated to quantify the amount of surface storage created, the resulting runoff, and the soil erosion losses which occur. Preliminary field application and yield data were collected at two locations during the 1986 season while the simulation machine was being constructed and field tested. Tillage practices will be subjected to water application simulating application by a low-pressure spray nozzle package.

Video image analysis is being investigated as a means of monitoring the soil surface during water application. If successful, the impact of tillage practices upon soil infiltration rate might be possible. In-depth investigations using this new technology are planned for the 1987 growing season.

Panhandle Research and Extension Center

Sugarbeet Transplanting in Nebraska

Several area sugarbeet growers approached the University in late 1981 and expressed interest in the Japanese practice of transplanting sugarbeets instead of the conventional direct seeding method. The University conducted an "exploratory" study in 1982 to assess the applicability of sugarbeet transplanting in
Nebraska. Results were favorable. A multidisciplinary team, comprised of five faculty members at the Panhandle Research and Extension Center, was formed to conduct in-depth research on a system of transplanting sugar beets in Nebraska. Funding for this project was provided by local agribusinesses, financial institutions, sugarbeet commodity groups, sugar processing companies, community foundations, and the University of Nebraska. At the end of the three-year comprehensive study, results indicated that transplanted sugar beets offered distinct advantages over direct seeding—improved weed control, improved stand without thinning, lower cost nematode control, and increased yield (25%).

In response to these favorable research findings, a Scottsbluff business was originated in late 1984 to raise sugarbeet seedlings and to transplant for individual growers. This business, Agritech, Inc., transplanted 300 A of sugar beets in 1985, 850 A in 1986 and 825 A in 1987. In addition to initiating a new production practice and a new local industry, this multidisciplinary team has also generated internationally recognized research on sugarbeet transplanting.

Reduced Tillage System

Five years ago, reduced tillage was used on less than 5% of the total irrigated acres in the Panhandle. Reduced tillage practices were not used because farmers lacked the experience and knowledge concerning results and methods. Irrigated acres in the Nebraska Panhandle total 764,000. The moldboard plow was the primary tillage tool for preparing the seedbed for all irrigated crops.

Research and extension efforts during the past five years have addressed areas of concern and incorporated the results into educational programs. Farming with residue on the soil surface was addressed by demonstrating that it was not only possible to do and economically sound, but, that it was also an acceptable practice in the eyes of peers. Producers now have the opportunity to rely on their own experience, a neighbor’s experience, or assistance from University specialists when developing a reduced tillage system for their farms.

In five years, the acres planted to corn using some form of reduced tillage have increased from 13,000 to nearly 110,000 in the Panhandle. The increase in reduced tillage corn acres continues with the process starting for other major crops such as dry beans and sugar beets.

Plant Pathology

Virus Isolation

Plant pathologists have isolated a number of large double-stranded DNA-containing viruses which infect certain species of unicellular green algae. These are the first viruses infecting any plant which can be used conveniently to study the molecular events associated with plant virus replication. Virus-infected cells also provide a model system for determining how genes are turned on and off.

A completely unexpected finding was the discovery that cells infected with these viruses produce enzymes which have identical properties to the enzymes used for DNA splicing, i.e., genetic engineering experiments. These enzymes have previously only been found in bacteria.

Soybean Cyst Nematode

Soybean cyst nematode is a major pest of soybeans in the United States. The primary control procedure, the use of resistant cultivars, is dependent on accurate identification of the nematode. Current identification procedures which require nematode culturing are time consuming and labor intensive.

Plant pathologists at UNL are using the tools of biotechnology to develop rapid, reliable, and highly sensitive molecular “probes” for nematode identification. Based on the specificity of a target organism’s DNA, these probes can detect a single microscopic worm in a crude tissue sample.

Molecular probes also serve as genetic markers for nematode populations. For the first time biologists are able to trace the movement and dispersal patterns of these cryptic, underground plant parasites.

South Central Research and Extension Center

Chemigation Safety Equipment

It is estimated that chemicals are applied with 40% of the center pivots in the state of Nebraska. This means that either fertilizers, herbicides, or insecticides are injected directly into the water of approximately 10,000 systems. There is great public concern of the potential of these chemicals backflowing into the water source upon an unexpected and unattended shutdown of irrigation systems. Backflow prevention equipment or safety devices are required by law to prevent direct contamination of the water source due to chemical and water backflow. The purpose of this project is to evaluate chemigation safety equipment and develop suggestions for improvement of these devices if necessary.

The items included in the chemigation safety equipment package are a check valve on the irrigation pipeline, a check valve on the chemical injection line, an automatic low-pressure drain, an inspection port, a vacuum relief valve on the irrigation pipeline, and an interlock between the irrigation pumping plant and the chemical injection pump. Center scientists are (continued)
Research Highlights

(South Central Research and Extension Center....)

evaluating the performance of the irrigation pipeline
check valve, chemical injection line check valve, and
the low-pressure drain. Ultimately plans include
development of a model that will predict the proba-
ibility of failure of these devices and the conse-
quences of failure in terms of the quantity of chemical
backflow. Test methods that regulatory agency inspec-
tors can use to determine the performance of these
devices in the field are also being developed.

Several research results have been applied. First, the
test methods for chemigation line check valves are be-
ing utilized by the local Natural Resource Districts in
their inspection programs. Also, characteristics of ir-
rigation pipeline check valves are useful in interpreting
field inspection results. The test methods and pro-
cedures developed have been provided to the Natural
Resource Districts through training programs
associated with this project.

Shattercane Control

Shattercane is a difficult to control, competitive
weed. In 1986 research, one cane plant per foot of
row reduced soybean yield by 29%. In soybeans a
properly timed postemergence herbicide applied about
five weeks after planting provided complete cane con-
trol and fully protected the soybean yield. In corn
postemergence herbicides are less effective, thus the
burden of shattercane control falls on soil-applied her-
bicides, mechanical control, and cultural practices.
Although continuous corn is a haven for shattercane,
research shows that crop rotation, herbicide rotation,
and a ridge-till planting system can be combined for
better cane control. A ridge-till system will displace 80
to 90% of the cane seed out of the corn row into the
middles where it can be cultivated. If current control
practices can be coupled with a successful search for
an effective postemergence herbicide, shattercane
should become less troublesome to corn growers.

Soybean Variety Selection for Conservation Tillage

Conservation tillage practices are being used on
more acres every year. A recent survey found that
45% of the cropland in the Central Great Plains was
planted with some type of conservation tillage prac-
tice. Yet the soybean varieties farmers are planting
were almost exclusively developed on cleanly tilled
fields. Are the best yielding varieties in cleanly tilled
fields also the best yielding varieties in conservation-
tilled fields?

A recent three-year study in south central Nebraska
evaluated the responses of six soybean varieties to
three tillage systems ranging from conventional till to
no-till. The varieties represented a wide range of
maturities.

The best yielding soybean varieties in conventionally
tilled areas were also the best yielding varieties in no-
till. Farmers should choose soybean varieties based on
long-term yield data from performance tests, disease
resistance, lodging resistance, and other factors im-
portant to their specific operations. Those varieties
should perform the best regardless of tillage system.

Textiles, Clothing and Design

Refurbishing Pesticide-Contaminated Clothing

During the application of pesticides, clothing be-
comes soiled from pesticide contamination. Removal
of contamination from fabrics is not a simple task.
University of Nebraska scientists examined 11
pesticides from three classes: organochlorines, car-
bamates and organophosphates. Even with a laundry
pretreatment specific for oil soils, they reported after-
laundering residues of chlorpyrifos at one-third
(35.8%) of initial contamination of the 11 pesticides
studied. Organic solvents, such as those used for com-
mmercial dry cleaning or pre-spotting before launder-
ing, were studied for effectiveness in removal of
chlorpyrifos residues.

The dry cleaning treatments were more effective
than pre-spotting following by laundering with less
than 1% chlorpyrifos residue remaining on the fabric.
Mechanical agitation was an aid in the removal pro-
cess. Transfer to the uncontaminated fabrics was
minimal, but it is not recommended to use commer-
cial dry cleaning because transfer does occur and sol-
vants, which are recycled, could become contami-
nated. Based on the findings of this study, it is recom-
manded that home launderers use a solvent pretreat-
ment prior to laundering for chlorpyrifos-continuat-
ed clothing. Commercial applicators might investigate
dedicated industrial dry cleaning apparatus for more
effective removal of chlorpyrifos residue.

Commercial Laundering of Chlorpyrifos-
Contaminated Clothing

Contamination of work clothing is an environmen-
tal and health concern. Soils penetrate cotton/
polyester fabrics and become trapped in the lumen of
the cotton fiber and interstitial spaces of both cotton
and polyester. Water temperatures, prewash treat-
ments, detergent types, and dry cleaning solvents
should reduce residue during home laundering proce-
dures. Laundry auxiliaries of starch and fabric soften-
ers and the commercial laundering processes merited
evaluation for contribution to residue removal.

The most significant factor in chlorpyrifos contami-
nation and removal was the soil-repellent (SR) finish.
Initial contamination levels were approximately half
of the unfinished fabric specimens; however, the pesti-
cide was not more completely removed from the SR
specimens. Starch and fabric softer were not shown
to be effective in lowering pesticide residues. No dif-
fferences in commercial laundering were found with or
without the use of starch before or after contamina-
tion. Additional aqueous solutions in commercial laundering did not result in greater residue removal. Use of fabric softener did not affect pesticide soilling or soil removal in home laundering.

Recommendations include: 1) commercial or home laundering of contaminated clothing before a second wearing of the garment; 2) small quantities of starch used by commercial launderers are appropriate since the presence or absence of starch did not affect after-laundering residues and 3) fabric softener use will neither help nor hinder pesticide removal from clothing.

Repeated Contamination of Protective Apparel Fabrics

To date, researchers have examined single applications of pesticide to fabric and made recommendations that clothing be laundered daily. Since it was unknown whether successive wearings and contamination present a hazard, a study was completed 1) to determine build-up of methyl parathion on fabrics contaminated daily for up to five days, and effectiveness of laundry in lowering pesticide residue from repeated contamination of fabrics and 2) to measure the contamination of water in laundering processes.

Initial methyl parathion soilling increased over the five-day period with each additional contamination with pesticide (but no laundry). The soil-repellent finish was effective in lowering absorption of pesticide through two launderings.

Given pesticide levels in the fabric, and the wash and rinse waters, the recommendation to launder protective clothing daily is supported. Pesticide soil builds up with each successive contamination (with no laundering) so that the fabrics and water used in washing the fabric are highly contaminated. Laundering daily produced lowered levels of pesticide soil in the fabric and lowered ppm pesticide in waste waters.

Psychographic Segmentation of Home Sewers

A research project was undertaken to identify underlying orientations for home sewing of items, and to isolate groups of home sewers using the orientations as criteria for group membership. Seven attributes and eight distinct segments were identified. Groups differed from each other as to specific importance of the orientations for home sewing, but not on demographics. This study has implications for both educators and manufacturers of home sewing products. Educators could target instruction to groups based on specific needs, while manufacturers should be cautious of limiting marketing activities based on demographic data alone.

Self-Esteem and Clothing Comfort

A study of the situational importance of clothing among age groups as it relates to self-esteem is under-way. The Clothing Comfort Dimensions Importance by Situation scale was developed by Audrey Newton to determine the physical, social and psychological dimensions of clothing in both public and private situations. To date, data have been collected and analyzed from senior citizens, college students and adolescents. Although public situations appear to have greater impact on the importance of clothing dimensions, there is a trend for leisure situations gaining in importance. Studies such as these provide insight into the impact of clothing in social interaction and its contribution to self-identity.

Veterinary Science

Immune System Research

Lymphokines are molecules produced by white blood cells which help the body fight infection by stimulating the immune system. Interleukin-2, a lymphokine produced by humans and animals, is now being made commercially in large quantities for use as an experimental drug to help fight infections. For example, human Interleukin-2 can be made by inserting human Interleukin-2 genes into bacteria. As the bacteria grow, they produce large quantities of the lymphokine which is collected and purified. It is now called human recombinant Interleukin (HrIL)-2. HrIL-2 is currently being used to test its effect against several human cancers.

Recently, HrIL-2 was used in an experiment to test its effect when used with a vaccine in protecting pigs from Haemophilus pleuropneumoniae infection. H. pleuropneumoniae is a bacterium which causes a severe pneumonia-like respiratory disease and results in significant economic loss to the pig industry. Before infection with H. pleuropneumoniae, one group of pigs was given HrIL-2 plus vaccine, one group received vaccine alone, one group received HrIL-2 alone, and one group received neither HrIL-2 or vaccine. The group of pigs that received HrIL-2 plus vaccine had a higher weight gain and fewer symptoms of the disease than any of the other groups. This demonstrates that HrIL-2 can enhance protection in pigs vaccinated against H. pleuropneumoniae infections and suggests that it could be used to help fight other infections found in animals.

Lymphocyte Analysis

Animals fight various disease-causing agents with antibodies that circulate in the blood. Antibodies are protein molecules produced by a type of white blood cell known as the B-lymphocyte. Different classes of antibodies fight infections by different mechanisms and, hence, differ in their efficiency to fight a particular disease. One B-lymphocyte is capable of producing all classes of antibodies. B cell differentiation factors (which are protein molecules produced by (continued)
Research Highlights

(Veterinary Science....)

another type of white blood cell known as the T-lymphocyte) regulate the production of different classes of antibodies by the same B-lymphocyte. Several T-lymphocyte clones from cattle have been adapted to grow outside the animals' bodies and are being tested for the production of B cell differentiation factors.

The identification of those T-cell subsets that produce these factors, and the understanding of the mechanisms by which these factors control the production of different classes of antibodies, should enable the development of better vaccines that will help animals produce the most appropriate class of antibodies against a particular infection.

West Central Research and Extension Center

Late Season Selection of Sorghum for Improved Stalk Strength

A study, partially funded by the Nebraska Grain Sorghum Development, Utilization and Marketing Board, was initiated in 1983 to select sorghum germplasm for improved stalk strength by selecting parents and hybrids after allowing them to stand in the field over winter. This proved highly successful in screening germplasm for improved stalk quality with no sacrifice in yield. Two female lines, KS57 having good stalk strength and Tx623 having poor stalks, were used as tester female lines. Half the plots were harvested in the fall for yield determination and the remainder left in the field for stalk strength determinations. The last reading of stalk strength on the 1986 plantings was made in early April of 1987. At that time there were 22 hybrids with less than 10% lodging on hybrids with yield levels approaching 90 bushels per acre. At that time the hybrid Tx623 x N64 was lodged less than 5%. Each 1% reduction in stalk lodging could save the Nebraska farmers 1 to 2 million dollars. Based on this work, 19 pollinator lines with good combining ability for yield and with improved stalk quality were formally released to the seed industry. The lines were released early enough to permit industry to have experimental hybrids with them planted in 1987.

Cropping Systems For Improved Water Use Efficiency

The Cropping Systems Research Unit at North Platte is developing limited irrigation technology combined with no-till methods and crop rotations to conserve water and soil in an attempt to extend aquifer life, improve environmental quality and reduce dependence on high levels of irrigation combined with the goal of increasing profitability. The no-till cropping systems being studied under 1) continuous dryland, 2) limited irrigation (6"/crop/yr) and 3) full irrigation include continuous corn, wheat-soybean rotation, wheat-corn-soybean rotation and wheat-corn-sorghum rotation. Up to six center scientists are involved, including agronomists, an ag engineer, economist and hydrologist.

Various cultural practices are evaluated within crop rotations to gain information required for decisions on fertilization, variety selection, plant populations and irrigation timing. Results can be used by both farmers and water management agencies to achieve improved irrigation management, soil and water conservation and net profitability.

Crop yields and irrigation water use efficiency for all crops in continuous no-till systems for limited irrigation treatments have exceeded expectations. Preliminary results show how farmers in areas of declining water tables can extend existing water supplies, use moderate resource inputs and achieve economical yields.
Research Projects

101st Annual Report

University of Nebraska
Agricultural Research Division
July 1, 1986 to June 30, 1987

Agricultural Research Division
University of Nebraska
Institute of Agriculture and Natural Resources
Irvin T. Omtvedt, Dean and Director

The Nebraska Agricultural Research Division provides information and educational programs to all people without regard to race, color, national origin, sex or handicap.
Research Projects

Research projects are listed by departments. An asterisk (*) indicates that the project was discontinued in fiscal 1986-1987.

Administration

01-001 General administration of federal fund research (I. T. Omtvedt)
01-004 Regional research coordination, North Central Region (I. T. Omtvedt)

Agricultural Biochemistry

15-022 Cellular photosynthetic processes and the regulation of photosynthesis (R. Chollet)
15-030 Factors affecting functional leghemoglobin in legume nodules (R. V. Klucas)
15-031 Structure, chemistry and metabolism of compounds toxic to plants (H. W. Knoche)
15-034 Composition, architecture and functional role of the photosynthetic membrane (J. P. Markwell)
15-035 Proteolytic enzymes in plant senescence and molecular studies on metalloproteases (F. W. Wagner)
15-036 Factors limiting biological nitrogen fixation: leghemoglobin and nickel (R. V. Klucas)
15-037 Soybean nodule senescence (F. W. Wagner)
15-039 Associative nitrogen fixation in nonleguminous plants (R. V. Klucas)
15-040 Cellular photosynthetic processes and the regulation of photosynthesis (J. P. Markwell)
15-041 Genetic manipulation of RuBP carboxylase/oxygenase (R. J. Spreitzer)
15-042 Identification of host resistance or susceptibility to toxins (H. W. Knoche)
15-043 Genetic modification of RuBP carboxylase/oxygenase in Chlamydomonas reinhardii (R. J. Spreitzer)
15-044 Regulation of pyruvate, pi dikinase activity (R. Chollet)
15-045 Factors affecting fermentation technology of crop materials and by-products (R. L. Ogden)
15-046 Investigation of some nitrogenous constituents of selected plants (R. M. Hill)
15-047 Characterization of the ACTH receptor: polypeptide structure and life cycle (R. J. Krueger)

Agricultural Communications

10-001 Dissemination of research information (G. L. Vacin, J. P. Holman)

Agricultural Economics

10-071 Effect of changes in transportation on performance of the U. S. Agricultural Transportation System (D. G. Anderson, J. B. Hassler)
10-077 Reporting and analyzing farm real estate values and market developments in Nebraska (B. B. Johnson, R. J. Hanson)
*10-083 Organization and performance of the U. S. Food production and distribution system (L. H. Lutgen, E. Pagoulatos)
*10-086 Performance of the U. S. grain marketing system in changing economic and policy environment (D. A. Linsenmeyer, J. B. Hassler)
*10-087 Evaluating financial markets for agriculture (P. H. Cessman, G. A.Helmers)
10-089 Evaluating risk management strategies for Nebraska farmers (H. D. Jose)
10-090 Economic analysis of water management strategies in Nebraska (R. J. Supalla, J. B. Hassler)
*10-092 Analysis of food and agricultural policies in an uncertain economic environment (G. A. Helmers, J. G. Kendrick, R. Frederick)
10-093 Nebraska water allocation law and policy (J. D. Aiken)
10-094 Economics of range beef cattle production systems in Nebraska (G. H. Pfeiffer)
10-096 Economic analysis of factors associated with financial success of farmer cooperatives (M. S. Turner)
10-097 Economics of uncertain water supplies for irrigation (M. E. Baker, G. A. Helmers)
10-098 Evaluation of consumption, production and marketing changes in the crop/livestock sectors (J. F. Yanagida)
10-099 Economic analysis of the potential for production and marketing of grain sorghum in the philippines (D. G. Anderson, G. Pfeiffer)
10-100 International trade and the macroeconomics of agriculture (E. Pagoulatos)
10-102 Domestic and international marketing strategies for western beef (J. F. Yanagida)

(continued)
Research Projects

Agricultural Education

24-019 Preservice evaluation of student teachers and of student teaching centers (R. D. Dillon)

Agricultural Engineering

11-001 Evaluation of performance of new tractors (L. I. Leviticus)
11-008 Engineering phases of tillage, land treatment and crop management for conservation of soil and water (H. D. Wittmuss)
11-044 Improvement of thermal processes for food (M. A. Hanna)
11-053 Adaptive, physiological crop production models with controlled and natural environments (G. E. Meyer)
*11-060 Hybrid solar systems for young pigs (G. R. Bodman, D. D. Schulte, J. A. DeShazer)
*11-061 Development and evaluation of conservation tillage system (H. D. Wittmuss, E. C. Dickey)
*11-064 Soybean production and management simulation models (G. E. Meyer)
*11-065 Study rural electric demands and provide electrical load management mechanisms for management of rural power (L. E. Stetson)
*11-066 Harvesting, processing and utilization of sweet sorghum and oil crops as energy sources for power (L. L. Bashford)
11-067 Irrigation scheduling methods for efficient water and energy use (J. R. Gilley, D. L. Martin)
*11-069 Dynamic simulation of soybean/weed competition and effects on crop performance (G. E. Meyer)
11-070 Vegetable oils as an alternative fuel for diesel engines (M. A. Hanna)
11-071 Mechanics of soil erosion deposition and sediment transport on croplands (J. E. Gilley, L. N. Mielke, J. F. Power)
11-072 Increasing performance efficiency of agricultural tractors and machinery (L. L. Bashford)
11-073 Crop productivity as limited by the rhizosphere and by water and nutrient use efficiencies (D. L. Martin, N. L. Klocke)
11-074 Modeling responses of growing swine to environmental and nutritional conditions (J. A. DeShazer, A. J. Lewis)
11-075 Drying grain to maintain quality and market value (R. O. Pierce)
11-076 Influences of tillage and crop residue on soil erosion (E. C. Dickey, D. P. Shelton, D. E. Eisenhauer)

11-077 Irrigation and farmstead electrical demands, load management and safety (L. E. Stetson)
11-078 Heat transfer in food processing (R. C. Anantheswaran)

Agricultural Research and Development Center

45-001 Field laboratory development (W. W. Sahs)

Agronomy

12-001 Corn breeding and genetics (W. A. Compton, P. T. Nordquist)
12-002 Improvement and evaluation of oats and barley (J. W. Schmidt)
*12-007 Systems of weed control in crop production for eastern Nebraska (A. R. Martin)
*12-008 Forage grass breeding (K. P. Vogel)
12-011 Properties of Nebraska soils as related to soil genesis, classification, survey and land use (D. T. Lewis)
*12-012 Soybean breeding and genetics (J. H. Williams)
12-034 Cytogenetic studies on wheat (M. R. Morris, J. W. Schmidt, P. J. Mattern, V. A. Johnson)
*12-046 Market quality in wheat (P. J. Mattern, V. A. Johnson, J. W. Schmidt)
12-049 Quantitative genetic investigations in plants (C. O. Gardner, M. Thomas-Compton)
12-055 Genetics, breeding and evaluation of common wheats, durums and triticales for Nebraska (J. W. Schmidt, V. A. Johnson, P. J. Mattern)
12-072 Introduction, multiplication, evaluation, preservation, cataloguing and utilization of plant germplasm (D. Andrews, K. P. Vogel)
12-077 Systems for controlling weeds with emphasis on velvetleaf, shattercane and leafy spurge (A. R. Martin)
12-078 Fate of nutrients in the environment as affected by soil and crop management (D. H. Sander, K. D. Frank)
12-080 Chemical aspects of phosphorus movement and availability to plants in sandy soils (R. C. Sorensen)
*12-084 Evaluating plant nutrient needs and product quality (D. Knudsen)
12-089 Integrating crop culture, chemicals, and life cycles to control persistent weeds (B. A. Swisher, R. G. Wilson)
12-091 Soybean physiology in varietal improvement (J. E. Specht)

*12-095 Effects of environment and fertilization practices on mineral element uptake, distribution, and use by sorghum (R. B. Clark)

12-097 Physiological investigations of nutritive value and its improvement in sorghum and millet (J. W. Maranville)

12-100 Nitrogen metabolism and chemical growth regulation of plants (L. A. Klepper)

12-101 Environmental and morphological crop physiology (M. D. Clegg)

12-102 Residue incorporation and soil disturbance effects on crop growth and yield (W. W. Wilhelm)

12-103 Influence of tillage on soil physical characteristics and biological processes (L. N. Mielke)


12-110 Dynamics of water in rigid and swelling soils (D. Swartzendruber)

12-114 Genetics, biochemistry, and breeding of forage sorghum and sudangrass (F. A. Haskins, H. J. Gorz)

12-116 Crop productivity as limited by the rhizosphere and by water and nutrient use efficiencies (C. Y. Sullivan, D. L. Martin)


*12-121 Plant breeding for physiological traits (J. E. Specht, C. O. Gardner, K. P. Vogel, M. D. Clegg)

*12-123 Characterization of Nebraska rangeland vegetation and its improvement through ecologic and agronomic manipulation (J. L. Stubbendieck, W. W. Stroup)

12-125 Modeling the water use and growth of plants (J. M. Norman)

12-126 Chemistry of micaceous and feldspathic soils in Nebraska (D. L. McCallister)

12-127 Crop physiological and morphological characteristics and cultural practices affecting crop yield, water use and metabolic efficiency (J. D. Eastin, J. L. Havlin, L. A. Nelson, M. Witt)

12-128 Relating soil wetness to selected soil and landscape features and to land use decisions (D. T. Lewis)

*12-129 Physical factors controlling microbiological aspects of movement and transformation of solutes in soil (J. M. Skopp)

12-131 Dissipation and bioavailability of herbicides and other pesticides in soil (P. J. Shea)

12-132 Improving the forage quality of grasses (B. C. Gabrielsen, R. A. Britton, K. P. Vogel)

12-133 Ontogenetic and physiological factors in the root bud development of three geophytes (B. A. Swisher)

12-134 Revegetation for increased productivity of abandoned irrigated and dry farm land (J. Stubbendieck, S. S. Waller, J. R. Gilley)

12-135 Soil productivity and erosion (D. T. Lewis)

12-137 Methods to improve production of grazing livestock (B. E. Anderson)

12-139 Nitrogen source utilization in crop and soil management systems (J. S. Schepers, J. F. Powers)

12-140 Fertilizer and crop management techniques for conservation-production systems (G. E. Varvel)


12-142 Influence of production practices on yield and grain quality of maize and winter wheat (S. C. Mason)

12-143 Genetic, physiological, and chemical studies of traits determining nutritional value and agronomic performance in wheat (S. L. Kuhr, C. J. Peterson)

12-144 Winter wheat germplasm development and evaluation (C. J. Peterson, S. L. Kuhr)


12-146 Gene expression and senescence in the soybean leaf (P. Staswick)

12-147 Microbial and nutrient factors affecting crop rotations (M. D. Jawson)

12-148 Morphology and physiology of selected perennial grasses (L. E. Moser)

12-149 Breeding sorghum and pearl millet for USA and developing countries (D. J. Andrews)

12-150 Water and temperature effects on sorghum and millet as related to grain production and breeding (J. D. Eastin, C. Y. Sullivan)

12-151 Tillage influence on crop production and physical properties of the soil surface and rhizosphere (A. J. Jones, L. N. Mielke, J. M. Norman)

12-152 Renovation and improvement of Nebraska range and pasture (S. Waller)

(continued)
### Research Projects

<table>
<thead>
<tr>
<th>Code</th>
<th>Title</th>
<th>Authors/Extensions</th>
</tr>
</thead>
<tbody>
<tr>
<td>12-153</td>
<td>Resource efficient cropping systems for Nebraska (C. A. Francis)</td>
<td></td>
</tr>
<tr>
<td>12-154</td>
<td>Agronomy and cropping systems (M. D. Clegg, S. C. Mason)</td>
<td></td>
</tr>
<tr>
<td>12-155</td>
<td>Perennial forage grass breeding for Nebraska (K. P. Vogel)</td>
<td></td>
</tr>
<tr>
<td>12-156</td>
<td>Integrated weed control in grasslands of the central plains (R. A. Masters)</td>
<td></td>
</tr>
<tr>
<td>12-157</td>
<td>Physical, chemical, and biological interactions between mycorrhiza, soil and plants (J. R. Ellis, M. D. Jawson, L. N. Mielke, P. J. Shea, S. Lowry)</td>
<td></td>
</tr>
<tr>
<td>12-159</td>
<td>Evaluation, management and utilization of maize germplasm and breeding systems (C. O. Gardner, M. A. Thomas-Compton, W. A. Compton)</td>
<td></td>
</tr>
<tr>
<td>12-160</td>
<td>Increasing the efficiency of fertilizer nitrogen and phosphorus for grain crops (D. H. Sander)</td>
<td></td>
</tr>
<tr>
<td>12-161</td>
<td>Impacts of soil management practices on nutrient cycling in the agricultural ecosystem (D. T. Walters)</td>
<td></td>
</tr>
<tr>
<td>12-162</td>
<td>Ecological and agronomical manipulation of Nebraska rangeland vegetation (J. Stubbendieck)</td>
<td></td>
</tr>
<tr>
<td>12-165</td>
<td>Quantitative inheritance, selection theory and methods, and germplasm enhancement in grain sorghum (B. L. Johnson)</td>
<td></td>
</tr>
<tr>
<td>12-166</td>
<td>Sorghum genotype responses to mineral element stresses (R. B. Clark)</td>
<td></td>
</tr>
<tr>
<td>12-201</td>
<td>Maintenance, increase and distribution of elite germ plasm (R. N. Mills)</td>
<td></td>
</tr>
<tr>
<td>47-001</td>
<td>Soil fertility investigations related to corn, sorghum, wheat and soybeans grown in southeast Nebraska (E. J. Penas)</td>
<td></td>
</tr>
</tbody>
</table>

#### Animal Science

<table>
<thead>
<tr>
<th>Code</th>
<th>Title</th>
<th>Authors/Extensions</th>
</tr>
</thead>
<tbody>
<tr>
<td>13-022</td>
<td>Mineral requirements of swine (E. R. Peo, Jr., A. J. Lewis)</td>
<td></td>
</tr>
<tr>
<td>13-029</td>
<td>Genetic improvement of efficiency in the production of quality pork (R. K. Johnson, D. R. Zimmerman, R. J. Kittok)</td>
<td></td>
</tr>
<tr>
<td>13-036</td>
<td>Improving dairy herd management practices (L. L. Larson, F. G. Owen)</td>
<td></td>
</tr>
<tr>
<td>041R</td>
<td>Improving dairy cattle through breeding, with special emphasis on selection (F. E. Eldridge)</td>
<td></td>
</tr>
<tr>
<td>045</td>
<td>Improvement of beef cattle through breeding methods (M. K. Nielsen)</td>
<td></td>
</tr>
</tbody>
</table>

*Note: The numbers 12 and 13 indicate the specific year of the research project.*
<table>
<thead>
<tr>
<th>Code</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>13-075</td>
<td>Factors affecting rumen lactate production and effects of acidosis on nutrient metabolism and absorption (R. A. Britton)</td>
</tr>
<tr>
<td>13-076</td>
<td>Regulation of energy metabolism in the brain of the domestic fowl (M. M. Beck)</td>
</tr>
<tr>
<td>13-077</td>
<td>Selection effectiveness for reproduction and energy utilization in mice (M. K. Nielsen)</td>
</tr>
<tr>
<td>13-078</td>
<td>Estimation of breeding values of reproductive and other performance traits in swine (R. K. Johnson)</td>
</tr>
<tr>
<td>13-079</td>
<td>Evaluation of management practices and traits that influence reproductive efficiency in beef cattle (J. E. Kinder, M. K. Nielsen, W. A. Zollinger)</td>
</tr>
<tr>
<td>13-080</td>
<td>Factors regulating protein turnover and growth in skeletal muscle (S. J. Jones, C. R. Calkins, R. A. Britton, J. E. Kinder, M. G. Zeece)</td>
</tr>
<tr>
<td>13-081</td>
<td>Effect of energy source and feed additives on energy utilization by swine (E. R. Poo, Jr., A. J. Lewis)</td>
</tr>
<tr>
<td>13-082</td>
<td>Optimum use of rangeland, pasture and crop residues in beef production systems (T. J. Klopfenstein)</td>
</tr>
<tr>
<td>13-083</td>
<td>Improving the profitability of dairy cattle production by use of DHIA records (J. F. Keown)</td>
</tr>
<tr>
<td>13-084</td>
<td>Meat manufacturing, restructuring and processing (R. W. Mandigo, C. R. Calkins)</td>
</tr>
<tr>
<td>13-085</td>
<td>Hormonal regulation of pituitary gonadotropin secretion in the bovine female (J. E. Kinder, B. D. Schanbacher)</td>
</tr>
<tr>
<td>13-086</td>
<td>Economical forage based beef systems (T. J. Klopfenstein, R. A. Stock, R. A. Britton)</td>
</tr>
</tbody>
</table>

**Consumer Science and Education**

<table>
<thead>
<tr>
<th>Code</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>92-011</td>
<td>Relationship of perceptions of solar and earth sheltered systems to behavior of housing intermediaries (E. R. Combs)</td>
</tr>
<tr>
<td>92-012</td>
<td>Residential mobility of rural populations and relocation of the rural elderly (J. A. Memken)</td>
</tr>
<tr>
<td>92-013</td>
<td>Economic, social, psychological and health consequences of the housing decisions of rural families (E. R. Combs, J. A. Memken)</td>
</tr>
</tbody>
</table>

**Entomology**

<table>
<thead>
<tr>
<th>Code</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>17-030</td>
<td>Pest management strategies for leafhoppers, spittlebugs, and aphids on alfalfa (G. R. Manglitz)</td>
</tr>
<tr>
<td>17-032</td>
<td>Biology and integrated control of the greenbug and other arthropods on grain sorghum (S. D. Kindler)</td>
</tr>
<tr>
<td>17-033</td>
<td>Ecology and control of stable flies and horse flies around confined livestock (I. L. Berry, J. J. Petersen, G. D. Thomas, C. B. Gilbertson)</td>
</tr>
<tr>
<td>17-034</td>
<td>Insects affecting tree and shrub plantings in Nebraska (J. A. Jones)</td>
</tr>
<tr>
<td>17-037</td>
<td>Population ecology and management of western bean cutworms and spider mites on corn in western Nebraska (T. O. Holtzer)</td>
</tr>
<tr>
<td>17-038</td>
<td>Integrated pest management of insects associated with the near environment of man (R. E. Gold)</td>
</tr>
<tr>
<td>17-039</td>
<td>Factors affecting the population ecology of a range landscape grasshopper, Phoetaulotes nebrascensis Thomas (A. Joern)</td>
</tr>
<tr>
<td>17-040</td>
<td>Aquatic invertebrates as indicators of water quality in Nebraska streams (K. P. Pruess)</td>
</tr>
<tr>
<td>17-041</td>
<td>Improvement of legume and grass insect control (G. R. Manglitz)</td>
</tr>
<tr>
<td>17-042</td>
<td>Cytogenetic factors associated with the development of aphid biotypes. (Z B Mayo)</td>
</tr>
<tr>
<td>17-043</td>
<td>Ecology and management of soil insects in corn and soybean (L. J. Meinke)</td>
</tr>
<tr>
<td>17-044</td>
<td>European corn borer tunneling, stalk rot, water stress, and corn plant physiology (T. O. Holtzer, J. F. Wikowski, J. M. Norman, D. S. Wysong)</td>
</tr>
<tr>
<td>17-045</td>
<td>Black fly damage thresholds, biology and control (K. P. Pruess)</td>
</tr>
</tbody>
</table>

*(continued)*
### Environmental Programs

- **25-001** Continuing participation in the national agricultural pesticide impact assessment program (R. E. Gold, S. T. Kamble)
- **25-002** Burlington Northern Foundation water quality project (R. E. Gold)

### Food Processing Center

- **19-001** Construction/renovation and equipping of Food Processing Center/Transportation and Marketing Center (D. H. Vanderholm, J. A. Benson, B. Carpenter, H. Schrader, C. E. Walker)

### Food Science and Technology

- **16-027** Food quality and energy usage in food service systems microwave and convection thermal processing (R. B. Maxcy)
- **16-033** Marketing and delivery of quality cereals and oilseeds in domestic foreign markets (L. B. Bullerman)
- **16-036** Utilization of Nebraska grown grains for human and industrial uses (C. E. Walker)
- **16-039** Irradiation of meats for improving the microbial quality (R. B. Maxcy)
- **16-040** Analytical methods for food process control and measurement of processing induced changes (R. L. Wehling)
- **16-041** Factors affecting protein functional and nutritional properties (M. G. Zeece)
- **16-042** Molds and mycotoxins in foods and feeds (L. B. Bullerman)
- **16-043** Occurrence, detection, and control of pathogenic bacteria in foods (M. B. Liewen)
- **16-044** Role of cathepsins H and L in muscle protein degradation (M. G. Zeece)
- **16-045** Enzymatic modification and bioprocessing of food and food wastes (K. M. Shahani)
- **16-046** Studies on naturally occurring substances that affect the nutritional quality of new food plants (J. H. Rupnow)
- **16-047** The isolation and development of antioxidants from plant sources (S. L. Cuppert)
- **16-048** Development of new processes and technologies for the processing of poultry products (G. W. Froning)
- **16-049** Function, nutritive composition quality, stability and efficient production of poultry products (G. W. Froning, R. Dam)

### Forestry, Fisheries and Wildlife

- **20-023** Windbreak shelter effects (J. R. Brandle)
- **20-028** Forest tree improvement - selection, breeding, and seed production (D. F. VanHaverbeke)
- **20-041** Vegetation selection and prescribed burning for fire prevention along railroad rights-of-way (J. R. Brandle)
- **26-001** Impact of erosion silt and sedimentation on fish populations (E. J. Peters)
- **26-003** Biology and control of the Zimmerman pine moth and other insect pests of forests in Nebraska (M. O. Harrell)
- **26-004** Management and biology of birds and rodents in agricultural systems (R. J. Johnson)
- **26-005** The gypsy moth and its natural enemies: behavior and population determinants (M. O. Harrell)
- **26-007** Integrated rodent control in Nebraska (R. M. Timm)
- **26-008** Forest tree improvement—selection, breeding and investigation of gene control and structure (S. G. Ernst)

### Horticulture

- **20-036** Genetics, breeding and cultural interactions of dry edible beans (*Phaseolus vulgaris* L.) (D. P. Coyne, J. R. Steadman, A. K. Vidaver, D. S. Nuland)
- **20-037** Weather and climate research for agricultural decision making in the North Central Region (R. E. Neild)
- **20-039** Improvement, propagation and culture of selected Nebraska wildflowers (S. S. Salac, J. B. Fitzgerald)
- **20-040** Genetic improvement of beans (*Phaseolus vulgaris* L.) for yield, pest resistance and nutritional value (D. P. Coyne, M. L. Schuster, M. R. Steadman)
- **20-044** Breeding turfgrasses for the Central Great Plains (T. P. Riordan)
- **20-045** Cold hardiness evaluation, selection, propagation and production of woody plants for Nebraska (W. A. Gustafson, Jr.)
- **20-046** Growth and development of ornamental plants as influenced by nutritional factors (E. T. Paparozzi)
- **20-047** Turfgrass ET rates, canopy resistance, and drought avoidance mechanisms (R. C. Shearman, E. J. Kinbacher)

### Human Development and the Family

- **93-015** Independent living rehabilitation/habilitation for persons with severe disabilities (L. O. Schwab)
Research Projects

93-016 Stress, coping and adaptation in the middle years of the family life cycle (J. D. DeFrain)
93-017 Cognitive development and cognitive style within cross cultural perspective (V. Kalyan-Masih)
93-018 Farm wives external employment, family economic productivity and family functioning (P. Knaub)
93-019 Strengths and stresses of rural and urban Nebraska families (J. D. DeFrain)
93-020 Rural families and loneliness-incidence, extent, factoral relationship and coping strategies (J. C. Woodward)
93-021 Work and the family: perceptions of rural families and families of remarriage (P. Knaub)
93-022 Familial and environmental support for persons with severe disabilities in non-metropolitan areas of the midwest (L. Schwab)

Human Nutrition and Food Service Management
91-020 Nutrient bioavailability - a key to human nutrition (C. V. Kies, H. M. Fox)
91-025 Modification of human diets designed to affect lipid metabolism (C. V. Kies)
91-026 Communication strategies to improve nutritional practices of adolescents (H. M. Fox)
91-027 Nutrition problems of the elderly in southeast Nebraska and methods of changing food behavior (N. M. Betts, H. M. Fox)
91-028 Changes in dietary intake produced by social environment (H. M. Fox, N. M. Betts)
91-029 Palatability, acceptability and safety of food products and techniques used to prepare and preserve (P. Staats, A. Brenner)
91-030 Development of educational models focusing on the changing management skills needed by practicing dietitians (A. L. Hay, A. M. Brenner)
91-031 Utilization of nutrients in humans as influenced by current and projected dietary practices (C. V. Kies)

Northeast Research and Extension Center
42-003 Biology and control of the european corn borer and other selected insects of agronomic crops (J. F. Witkowski)
*42-005 Influence of certain management regimens on performance of newly purchased feeder pigs (M. C. Brumm, E. R. Peo, Jr.)
42-006 Influence of housing and management regimes on nursery energy utilization and performance of early weaned pigs (M. C. Brumm, D. P. Shelton)

42-007 Beef production alternatives for the farmer-feeder (T. L. Mader, R. A. Britton, H. D. Jose)
42-009 Impact of integrated crop management practices on European corn borer and related stalk boring insects (J. F. Witkowski)
42-010 Improving feeder pig performance (M. C. Brumm)
42-011 Increasing fertilizer use efficiency in northeast Nebraska (C. A. Shapiro)
42-012 Conservation of soil and water utilizing interrow cultivation techniques (W. L. Kranz)
42-013 Integrated crop production systems for northeast Nebraska (R. S. Moomaw)

Panhandle Research and Extension Center
20-034 Quality and nutritive value of processed potatoes (R. B. O'Keefe)
44-004 Fertilizer and manure application for production of continuous corn (F. N. Anderson)
44-005 Testing hybrids and varieties of small grains, corn, sorghum, and other crops as needed for adaptation to western Nebraska (L. A. Nelson)
44-011 Development of dryland cropping systems for western Nebraska (J. L. Havlin)
44-012 Improvement of millet, corn and sorghum production by breeding and cultural studies (L. A. Nelson)
44-016 Weed control for western Nebraska irrigated crops and rangelands (R. G. Wilson, Jr.)
44-020 Efficient use of limited water supplies (C. D. Yonts, J. A. Smith, D. S. Nuland, L. A. Nelson)
44-024 Bionomics and management of selected insect pests in the Nebraska Panhandle (A. F. Hagen)
*44-025 Biology and control of nematodal and fungal plant diseases in the Nebraska Panhandle (E. D. Kerr)
44-026 Vegetation and animal response to a nonselective grazing system on native range in western Nebraska (P. E. Reece)
44-027 Cultural and nutrient investigations for crops of western Nebraska (F. N. Anderson)
44-029 Reduction of corn losses caused by nematodes in the North Central Region (E. D. Kerr, D. S. Wysong)
44-030 The effect of microclimate on plant pests in a semi-arid environment (A. Weiss)

(continued)
Research Projects

(Panhandle Research and Extension Center....)

44-031 Transplanting sugar beets and other vegetable crops (J. A. Smith, C. D. Yonts, R. G. Wilson, E. D. Kerr, J. G. Robb)

44-032 Variety evaluation and culture of selected horticultural crops in western Nebraska (D. S. Nuland)

44-033 Improvement of potatoes for production in Nebraska (R. B. O'Keefe)

44-034 Introduction, maintenance, evaluation, and utilization of plant germplasm (L. A. Nelson)

44-035 Feed resources and beef production systems in western Nebraska to optimize total efficiency (I. G. Rush, B. Weichenthal)

Plant Pathology

21-001 Plant disease survey and special investigations (M. G. Boosalis, D. S. Wysong, J. E. Watkins)

21-003 Detection and control of virus diseases in Nebraska (L. C. Lane)

21-005 Control of cephalosporium stripe of wheat, Rhizoctonia solani of sugar beets and soilborne diseases (M. G. Boosalis, J. E. Watkins, B. L. Doupnik, G. A. Wicks, D. H. Yocom, E. D. Kerr)

21-006 Determine etiology of stem diseases of cottonwood, honeylocust, and pines (M. G. Boosalis, G. W. Peterson, J. W. Riffe)

21-010 Plant pathology outstate testing (M. G. Boosalis, D. S. Wysong, J. E. Watkins)

21-012 Electron microscopy in agricultural research (W. G. Langenberg, M. K. Brakke, E. M. Ball)

21-015 Epidemiology of diseases of bean and other vegetables in Nebraska (J. R. Steadman)

21-021 Characterization and genetics of bacterial plant pathogens and related bacteria (A. K. Vidaver)

21-022 Biological control of soil-borne plant pathogens in integrated crop management systems (M. G. Boosalis, G. Wicks, D. H. Yocom)

21-023 Detection, survival, and control of plant pathogenic bacteria on seeds and other plant parts (A. K. Vidaver)

*21-032 Genetics of stalk rot disease complex in corn and sorghum (G. S. Sidhu)

*21-033 Identification of genes controlling reaction of sorghum to MDMV (S. G. Jensen)

21-034 Genetics and genome of a eukaryotic algal virus (J. L. VanEtten)

21-035 Corynebacterium pathogens of corn and wheat: serology and genetics (A. K. Vidaver)

21-036 Host-parasite interactions between fungal pathogens and their hosts (J. E. Partridge)

21-037 Fungicide management strategies for control of rusts, leaf spots, and blights of grass hosts (J. E. Watkins)

Roman L. Hruska U. S. Meat Animal Research Center

46-001 Development and operation of the U. S. Meat Animal Research Center (R. R. Oltjen)

46-002 Improvement of beef cattle through breeding methods (R. M. Koch, L. V. Cundiff, K. E. Gregory)

46-004 Improvement of beef cattle through breeding methods (germ plasm evaluation) (L. V. Cundiff, R. M. Koch)

46-007 Improvement of beef cattle through breeding methods (K. E. Gregory, L. V. Cundiff, R. M. Koch)

46-009 Genetic improvement of efficiency in the production of quality pork (L. D. Young, G. E. Dickerson, K. A. Leymaster, R. M. Koch)

46-010 Increased efficiency of lamb production (K. A. Leymaster, L. D. Young, G. E. Dickerson, R. M. Koch)


South Central Research and Extension Center

48-003 Field crop arthropod distribution and control in South Central Nebraska (L. L. Peters)

48-004 Occurrence of mycotoxins in feeds and foods and their effects on animal and human health (B. L. Doupnik, N. R. Schneider)

48-005 Biology and control of troublesome weeds in South Central Nebraska (F. W. Roeth)

48-009 Soybean cultural practices and cropping systems for South Central Nebraska (R. W. Eime)

48-010 Neuroendocrine and environmental influences on sexual behavior in male pigs (D. G. Levis, J. J. Ford, R. K. Christenson)

48-011 Water conservation practices for irrigated agriculture in South Central Nebraska (D. E. Eisenhauer)

48-012 Improvement of fertilizer use efficiency for conservation tillage crops in South Central Nebraska (R. B. Ferguson)

Textiles, Clothing and Design

*94-011 Effects of functional textile finishes on comfort and protection of consumers (J. M. Laughlin)

94-012 Limiting pesticide exposure through textile cleaning procedures and selection (J. M. Laughlin, R. E. Gold)
**Research Projects**

<table>
<thead>
<tr>
<th>Project Code</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>94-013</td>
<td>The study of clothing as a contributor to the self-esteem of individuals with special needs (R. Kean, A. Newton)</td>
</tr>
<tr>
<td>94-014</td>
<td>Textile fiber systems for performance, performance, protection and comfort (J. M. Laughlin)</td>
</tr>
</tbody>
</table>

### Veterinary Science

<table>
<thead>
<tr>
<th>Project Code</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>14-001</td>
<td>Diagnostic surveillance of livestock and poultry health problems in Nebraska (E. D. Erickson, A. R. Doster, C. L. Kelling, N. R. Schneider)</td>
</tr>
<tr>
<td>14-009</td>
<td>Prevention and control of enteric diseases of swine (R. Moxley, E. O. Dickinson)</td>
</tr>
<tr>
<td>14-014</td>
<td>Bovine respiratory disease (M. L. Frey, M. B. Rhodes, E. O. Dickinson)</td>
</tr>
<tr>
<td>14-018</td>
<td>Integrated methods of parasite control for improved livestock production (M. B. Rhodes, D. L. Ferguson, E. O. Dickinson)</td>
</tr>
<tr>
<td>14-025</td>
<td>Bovine respiratory syncytial virus: pathogenesis and immune response (M. L. Frey, G. A. Anderson)</td>
</tr>
<tr>
<td>14-028</td>
<td>Bovine viral diarrhea virus and reproduction in cattle (C. L. Kelling, M. L. Frye, A. R. Doster, M. B. Rhodes, S. R. Lowry)</td>
</tr>
<tr>
<td>14-030</td>
<td>Perinatal immune responses during infectious diseases in the bovine (G. A. Anderson)</td>
</tr>
<tr>
<td>14-032</td>
<td>Monoclonal antibodies for characterization of bovine respiratory syncytial virus infections (G. A. Anderson)</td>
</tr>
<tr>
<td>14-033</td>
<td>Nutritional impact on colonic structure and function (E. T. Clemens)</td>
</tr>
</tbody>
</table>

### *43-007*

Sorghum breeding and cultural research under reduced tillage (P. T. Nordquist)

### 43-020

Animal disease surveillance in western Nebraska (J. L. Johnson)

### 43-024

Biology, ecology and control of major insects affecting livestock (primarily bovine) in Nebraska (J. B. Campbell)

### 43-028

Development and culture of herbaceous ornamental plants (D. T. Lindgren)

### 43-031

Optimization of the use of range and complementary forages for red meat production (D. C. Clanton, J. T. Nichols)

### 43-033

Bionomics, vector capabilities and management strategies for face flies (J. B. Campbell)

### *43-034*

Weed control in reduced tillage systems in West Central Nebraska (G. A. Wicks)

### 43-035

Evaluation of management practices to improve reproductive efficiency of beef cattle (G. H. Deutscher, D. C. Clanton)

### 43-037

Characteristics and feed value of barley and western protein supplements for swine (D. M. Danielson)

### 43-038

Nutrition and management of cattle on range and in the feedlot (D. C. Clanton, G. H. Deutscher, I. G. Rush, C. R. Calkins)

### 43-039

Soil evaporation and plant transpiration from irrigated row crops (N. L. Klocke)

### 43-040

Increasing fertilizer nitrogen use efficiency in West Central Nebraska (G. W. Hergert)

### 43-041

Methods of processing differing sources and combinations of fiber and energy for swine (D. M. Danielson)

### 43-042

Sorghum and corn breeding and corn, sorghum, and wheat variety evaluation under central Nebraska environment conditions (P. T. Nordquist)

### 43-043

Evaluation of complementary forage systems (J. T. Nichols)

### 43-044

Weed control in reduced tillage (G. A. Wicks)
The Nebraska Agricultural Research Division provides information and educational programs to all people without regard to race, color, national origin, sex or handicap.
1986 Publications

Agricultural Biochemistry

Journal Articles

Bauwe, H. and R. Chollet.

Budde, R.J.A. and R. Chollet.

Budde, R.J.A., S.M. Ernst and R. Chollet.


Ernst, S.M., R.J.A. Budde and R. Chollet.

Holbrook, G.P. and R. Chollet.

Laughlin, Joan M., Carol B. Easley, and Roger E. Gold and R.M. Hill.

Lee, Keuk-Ki, R.E. Shearman and Robert V. Klucas.

Markwell, J. P.


Sarath, G., H.P. Cohen, and Fred W. Wagner.

Sarath, G., N.E. Pfeiffer, C.S. Sodhi, and Fred W. Wagner.

Storey, R. D. and Fred W. Wagner.

Sundaram, S., R.C. Shearman and R.V. Klucas.

Wagner, Fred W.

Ph.D. Theses

Kim, Shin-Duk.

Agricultural Economics

Journal Articles

Aiken, J. D.

Aiken, J. D.
Insuring no jeopardy under the Nebraska nongame and Endangered Species Conservation Act. Creighton Law Review.


Samples needed for estimation of plant height of pima cotton. Agron. J.

Plant population and plant height effects on pima cotton lint yield. Agron. J.


Sarwar, G. and D. G. Anderson.


(continued)
Publications

(Agricultural Economics....)


Yanagida, John F. and Thomas R. Harris.

M.S. Theses

Henney, Michael.
The economic impact of irrigation development on cattle ranching operations in the Sandhills of Nebraska. (Ray Supalla, Advisor)

Kitawaza, Motoichiro.
Macroeconomic determinants of world agricultural commodity prices. (E. Pagoulatos, Advisor)

Langemeier, Michael.
Selecting the optimal crop rotation in an uncertain environment. (Glen Helmers, Advisor)

Ph.D. Theses

Battal, Hamad S.
Water resources allocation in Saudi Arabia: The case of study of Al Kharj District. (Bruce Johnson, Advisor)

Shalaby, Self.
Latin American countries demand for wheat imports and United States market share. (Jim Hassler, Advisor)

Agricultural Education

Journal Articles

Dillon, Roy D.

Field, Harry and Horner, James T.
Human relations abilities of graduates with implications for mech. ag. curriculum development. NACTA J.

M.S. Theses

Boettcher, Robert D.
A study of the factors which influenced the perception of cooperation between county extension agents and vocational agriculture teachers in Nebraska. (Roy D. Dillon, Advisor).

Ph.D. Theses

Daters, Catherine M.
A comparison between the importance of clothing and self-esteem among adolescents. (Roy D. Dillon, Advisor).

Cole, Dally L.
Personality type differences of nurses—implications for continuing education. (James T. Horner, Advisor).

Field, Harry.
Human relations abilities and needs for mech. ag. graduates. (James T. Horner, Advisor).

Snyder, Ronald.
Implications of personality type and community college employees. (James T. Horner, Advisor).

Agricultural Engineering

Journal Articles

Anantheswaran, R. C., McLellan, M. R. & Nogueira, J. N.

Anantheswaran, R. C., Sastry, S. K., Beelman, R. B., Okereke, A. & Konanayakam, M.
Effect of thermal processing on yield, color, and texture of canned mushrooms. J. Food Sci. 51:1197.

Baldwin, D. R., Anantheswaran, R. C., Sastry, S. K. & Beelman, R. B.

Bashford, L. L. and K. Von Bargen.
Mechanical front-wheel drive research at Nebraska. Transactions of the Society of Automotive Engineering 95(5):710-714.

Bhattacharya, M. and M. A. Hanna.

Bhattacharya, M. and M. A. Hanna.


Chen, Y. R.

Chen, Y. R.
Rheological properties of sieved cattle manure slurry: rheological model and effects of temperature and solids concentration. Agric. Wastes 15(1)31-34.


Runoff and erosion as affected by sorghum and soybean residue. Trans. ASAE 29(5):1605-1610.


Runoff and erosion as affected by corn residue - Part II. Rill and interrill components. Trans. ASAE 29(1):161-164.

Size distribution of sediment as affected by corn residue. Trans. ASAE 29(5):1273-1277.

Heber, Albert J., Thomas L. Thompson and Dennis D. Schulte.

Heber, Albert J., Thomas L. Thompson and Dennis D. Schulte.
Simulation model for on-farm electrical load management. Trans. ASAE 29(5):1405-1412.


M.S. Theses

Burr, Charles A. Tillage influences on soybean residue reduction. (Elbert Dickey, Advisor).


Li, Wangxing. Tractor hydraulic lift capacity. (Lou Leviticus, Advisor).

Stark, Gregory L. Predicting seasonal electric demand of rural residential customers. (LaVerne Stetson, Advisor).

Ph.D. Theses

Bhattacharya, Mrinal. Modeling meat freezing. (Milford Hanna, Advisor).

Feddes, J. J. R. The response of growing pigs to high cyclic and constant temperatures. (James DeShazer, Advisor).

Khan, Liaquat Masood. Design and development of a fruit seed recovery system (Milford Hanna, Advisor).

Thompson, Allen. Sprinkler water droplet evaporation simulated above a plant canopy. (James DeShazer, Advisor).

Agronomy

Journal Articles


Challaiah, O. C. Burnside, G. A. Wicks, and V. A. Johnson. Competition between winter wheat (Triticum aestivum) cultivars and downy brome (Bromus tectorum). Weed Sci. 34:689-693.


(continued)
Publications

(Agronomy....)

Clawson, K. L., B. L. Blad, and J. E. Specht.

Clawson, K. L., J. E. Specht, and B. L. Blad.

Clawson, J. L., J. E. Specht, B. L. Blad, and A. F. Garay.

Evaluation of agronomic and energy traits of Wray sweet sorghum and the NS9 x Wray hybrid. Energy in Agri. 5:49-54.

Crutchfield, D. A., G. A. Wicks, and D. L. Dill.
Effect of winter wheat (Triticum aestivum) straw mulch level on weed control. Weed Sci. 34:110-114.

Registration of four parental inbred lines of maize. Crop Sci. 26:393.

Renovation of seeded warm-season pastures with atrazine. J. Range Manage. 39:72-75.


Evans, A., Jr., and R. C. Sorensen.
The difference of ionic strength and monovalent cation source in growth conditions on phosphorus extractability in a course-textured soil. Soil Science 141:38-42.

Flores, C. I., W. M. Ross, and J. W. Maranville.
Quantitative genetics of agronomic and nutritional traits in related grain sorghum random-mating populations as affected by selection. Crop Sci. 26:29-33.


Francis, C. A., R. S. Moomaw, J. F. Rajewski, and Mohammed Saeed.

Effect on soil pH on degradation, movement, and plant uptake of chlorofuran. Weed Sci. 34:328-332.


Sorghum genotype differences to leaf "red-speckling" induced by phosphorus. J. Plant Nut. 9:1435-1454.

Gabrielsen, B. C.


Testcross evaluation of Mexican maize populations. Crop Sci. 26:99-104.


Hertger, G. W.
Nitrate leaching through sandy soil as affected by sprinkler irrigation management. J. Env. Qual. 15:272-278.

The architecture of a deciduous forest canopy in eastern Tennessee. J. Ecol. 74:635-646.


Allozyme polymorphisms within and among open-pollinated and adapted exotic populations of maize. Theoretical and Applied Genetics 72:592-601.

Registration of Wrangler alfalfa. Crop Sci. 26:646.

Kocher, Eric, and J. Stubbendieck.
Broadcasting grass seed to revegetate sandy soils. J. Range Manage. 39:555-557.

Lueking, M. A., and J. S. Schepers.

Response of field beans (Phaseolus vulgaris) to reduced rates of 2,4-D and dicamba. Weed Sci. 34:953-956.


McCallister, D. L.
Effect of fertilizer phosphorus placement on winter wheat yield.


Nordquist, P. T. and W. A. Compton.

N management and interseed effects on irrigated corn and sorghum and on soil strength. Agron. J. 78:856-862.


Peterson, C. J., V. A. Johnson, and P. J. Mattern.

Mass selection for increased seed protein concentration of wheat based on seed density. Crop Sci. 26:523-527.

Pierson, E. E., R. B. Clark, D. P. Coyne, and J. W. Maranville.
Iron deficiency stress effects on total iron in various leaves and nutrient solution pH in sorghum and beans. J. Plant Nutr. 9:893-907.

Comparison of iron analyses and iron chlorosis in Kentucky bluegrass cultivars. J. Plant Nutr. 9:867-872.

Power, J. F.


Crop residue effects on soil environment and dryland maize and soybean production. Soil & Tillage Research 8:101-111.


Emergence of corn as affected by source and rate of solution fertilizers applied with the seed. J. Fertilizer Issues 3:18-24.

Rehm, G. W.

Rice, J. R., and J. D. Eastin.
Grain sorghum and root responses to water and temperature during reproductive development. Crop Sci. 26:547-551.

Roeth, F. W.


Saeed, M., and C. A. Francis.

Saeed, M., C. A. Francis, and M. D. Clegg.
Yield component analysis in grain sorghum. Crop Sci. 26:346-351.

Shapiro, C. A., T. A. Peterson, and A. D. Flowerday.

Shea, P. J.


Skopp, J.

Skopp, J., and D. McCallister.

Specht, J. E., J. H. Williams, and C. J. Weidenbenner.


Organogenesis of the staminate and pistillate inflorescences of pop and dent corns: Relationship to leaf stages. Crop Sci. 26:712-718.

Exposition on the selection of appropriate experimental design and statistical analysis for pasture improvement research. J. Range Manage. 39:200-207.

Swartzendruber, D.

Swartzendruber, D.
Publications

(Agronomy....)

Comparative detoxification of chlorsulfuron in leaf disks and cell cultures of two perennial weeds. Weed Sci. 34:507-512.


Vogel, K. P., and B. C. Gabrielsen.


Wicks, G. A.

Wicks, G. A., and P. H. Grabouski.
Weed control in no-till sorghum (Sorghum bicolor). Weed Sci. 34:577-581.

Response of winter wheat (Triticum aestivum) to herbicides. Weed Sci. 35:259-262.


Williams, E. P., W. M. Ross, R. B. Clark, G. M. Herron, and M. D. Witt.

Registration of "Fremont" soybean. Crop Sci. 26:648.

Registration of "Logan" soybean. Crop Sci. 26:386-387.

Wilson, R. G.
Weed control in irrigated seedling alfalfa (Medicago sativa). Weed Sci. 34:423-426.


Zaiter, H. Z., D. P. Coyne, R. B. Clark, and D. S. Nuland.

Zemetra, R. S., R. Morris, and J. W. Schmidt.
Gene locations for heading date using reciprocal chromosome substitutions in winter wheat. Crop Sci. 26:531-533.

Effects of plant growth stage on chlorsulfuron suppression of Canada thistle (Cirsium arvense) shoots and roots. Weed Tech. 1:10-13.

Books

Cook, C. W., and J. Stubbendieck.

North American range plants. University of Nebraska Press, Lincoln.

M.S. Theses

Bouchoutrouch, Moustapha A.
Yield response of three durum wheat varieties in a semi-arid environment. (Richard Waldren, Advisor).

Brejda, John J.
Manipulation of Sandhills subirrigated meadow using atrazine and fertilizer. (Lowell E. Moser, Advisor).

Cunningham, Monty K.
Vascular area and anatomy in relation to yield of winter wheat in a field environment. (Max D. Clegg, Advisor).

Galvez, Laris.
Manganese and aluminum interactions with silicon in sorghum grown in nutrient solutions. (Ralph B. Clark, Advisor).

Griffin, Timothy S.
Forage grass establishment using herbicide antidotes. (Lowell E. Moser, Advisor).

Gross, Renee D.
Sorghum genotype by cultural practice interactions and yield stability. (Charles A. Francis and Max D. Clegg, Advisors).

Halman, Jose R. B.
Use of statistical modeling to describe the effect of silicon on manganese toxicity in two sorghum genotypes. (Robert F. Mumm, Advisor).

Hinze, Mark R.
Tillage by variety interaction in corn growth and yield. (Wallace W. Wilhelm, Advisor).

Kinkaid, Bradley D.
Variatel and soil effects on lime-induced chlorosis of soybeans [Glycine max (L.) Merr.]. (Robert C. Sorensen, Advisor).

Kubik, Keith K.
Fluid drilling gel characteristics important for seed survival. (Jerry D. Eastin and Jerry W. Maranville, Advisors).

Leif, J. W. III.
Efficacy of CGA-92194 and flurazole in protecting grain sorghum (Sorghum bicolor) from herbicide injury. (O. C. Burnside and Alex R. Martin, Advisors).

Meyer, Steven J.
Improving Nebraska's near-real time weather based products through user interactions. (Donald A. Wilhite, Advisor).

Miller, Rhonda L.
Genetic Analysis of F1 seed size. (James E. Specht, Advisor).

Myran, Darrel D.
Seasonal trends in forage quality of selected species of Sandhills vegetation. (James T. Nichols, Advisor).

Newman, Peter R.
Seedling root development of forage grasses. (Lowell E. Moser, Advisor).
Peter, Thomas J.
The effect of postemergence herbicides on selective annual grass control in newly seeded forage grasses. (Alex R. Martin and Russell S. Moonaw, Advisors).

Scoby, David L.
The effect of elevated night temperatures on corn yield and yield components. (Jerry D. Eastin, Advisor).

**Ph.D. Theses**

Arkebauer, Timothy J.
Field Measurements and computer simulations of vegetative expansion. (John M. Norman, Advisor).

Atuboyedia, Asime J.
The properties of and production from two soils having slight, moderate and severe erosion. (David T. Lewis, Advisor).

Baumer, Otto W.
The governing partial differential equation for one-dimensional flow of water in a deforming body of soil. (Dale Swartzendruber, Advisor).

Bean, Brent W.
Persistence and evaluation of EPTC and butylate enhanced degradation. (Fred W. Roeth and Alex R. Martin, Advisors).

Blewett, Thomas C.

Dimyati, Ahmad.

Esilaba, Anthony O.
The effect of time on phosphorus availability on two soils as determined by soil analysis and plant uptake. (Donald H. Sander, Advisor).

Gakale, Lucas P.
Complementary effects of grain legumes to sorghum [Sorghum bicolor (L.) Moench] yields, nitrogen nutrition and residual soil mineral nitrogen accumulation in rotation systems. (Max D. Clegg, Advisor).

Hile, Glenn C.
Estimation of genetic effects and the relationship of root morphological traits to vertical-pulling resistance in maize. (William A. Compton, Advisor).

Johnson, Blaine E.
Model for finding the relative weights of traits used in simultaneous multitrait selection. (C. O. Gardner and R. F. Mumm, Advisors).

Mostafa, Mohamed Samy A. E.
Agronomic performance of grain sorghum hybrids [Sorghum bicolor (L.) Moench] under several environments as a function of their male parent selection. (Paul T. Nordquist and Max D. Clegg, Advisors).

Murtadha, Husain M.
Effects of nitrate/ammonium ratio, nitrogen source, temperature, relative humidity, and light intensity on growth and calcium uptake, translocation, and accumulation in sorghum [Sorghum bicolor (L.) Moench]. (Jerry W. Maranville, Advisor).

Mushi, Robert S.
Quantitative genetics of agronomic traits and evaluation of seedlings for drought resistance under stress and nonstress environments and resistance to Periconia Circinata (Mangin Sacc.) in two diverse grain sorghum [Sorghum bicolor (L.) Moench] random mating populations. (William R. Ross, Advisor).

Pier, Paul A.
Adaptation of photosynthesis to drought and high temperature stress in sorghum. (Charles Y. Sullivan, Advisor).

Raju, Pakalpati S.
Vesicular-arbuscular mycorrhizal infection effects on growth and uptake of phosphorus and mineral elements by sorghum. (Ralph B. Clark, Advisor).

Rao, Kondapaneni G.
Water use and irrigation response to defoliated corn with various populations. (A. D. Flowerday and Jerry W. Maranville, Advisors).

Rocheford, Torbert R.
Genetic and cytotgenetic studies on inheritance of susceptibility in maize (Zea mays L.) to Clavibacter (Corynebacterium) michiganense spp. nebraskense. (Charles O. Gardner, Advisor).

Schulze, Larry D.
Influence of irrigation by growth stage and percent of full irrigation on yield components and plant morphological characteristics upon soybeans [Glycine max (L.) Merrill]. (Donald G. Hanway, Advisor).

Smith, Stuart D.
Ecology and control of eastern redcedar. (James Stubbendieck, Advisor).

Spaugh, Elizabeth A.
Some effects of intensive irrigated agriculture on valentine soils in the Nebraska Sandhills. (Robert C. Sorensen, Advisor).

Tadingar, Toloumbaye
Microhistological techniques and internal markers to study the nutrition of grazing cattle. (James Stubbendieck, Advisor).

**Animal Science**

**Journal Articles**

Asche, G. L., J. D. Crenshaw, A. J. Lewis and E. R. Peo, Jr.

Brandt, Jr., R. T. and T. J. Klopfenstein.

Brandt, Jr., R. T. and T. J. Klopfenstein.

Brandt, Jr., R. T. and T. J. Klopfenstein.

Brown, W. F., L. E. Moser and T. J. Klopfenstein.

(continued)
Publications

(Animal Science....)


M.S. Theses

Abreu-Sierra, Jose Enrique. Use of different forms and sources of fat in weanling pig diets. (E. R. Peo, Jr., Advisor).

Anderson, Scott J. Protein and energy supplementation of yearling steers grazing smooth brome pastures. (T. J. Klopfenstein, Advisor).


Green, David A. Starch and fiber utilization in ruminant finishing diets. (R. A. Stock, Advisor).


Kreikemeier, Kelly K. Improving grain utilization in ruminant finishing diets. (R. A. Stock, Advisor).


Stotts, James A. Reproductive management in beef cattle: I. Heifers administered different prostaglandins on day 6 or 11 of the estrous cycle. II. Cows managed with different breeding seasons. (G. H. Deutscher and J. E. Kinder, Advisors).

Ph.D. Theses


Cleale, IV, Ralph M. Nonenzymatically browned soybean meal as a supplemental protein source for growing ruminants. (T. J. Klopfenstein, Advisor).


Holdt, Candace S. Textural changes in ground beef patties during cooking. (R. W. Mandigo, Advisor).


Setshwaelo, Louise Lobisa. Breed effects on components of beef production efficiency in crossbreeds: Cow and calf preweaning traits. (G. E. Dickerson, Advisor; T. G. Jenkins, Co-Advisor).

Biometrics and Information Systems

Journal Articles


(continued)
Publications

(Biometrics...) M.S. Theses

Binns, J. R.
Use of statistical modeling to describe the effect of silicon and manganese toxicity in two sorghum genotypes. (Robert Mumm, Advisor).

Center for Agricultural Meteorology and Climatology

Journal Articles


Turbulence spectra of CO₂, water vapor, temperature and velocity over a deciduous forest. Boundary-Layer Meteorol. 38:81-99.

Azevedo, P. V. and S. B. Verma.

Eddy correlation measurements of carbon dioxide efflux from the floor of a deciduous forest. J. Appl. Ecol. 23:967-975.

Clawson, K. L., J. E. Specht and B. L. Blad.

Clawson, K. L., B. L. Blad and J. E. Specht.

Clawson, K. L., J. E. Specht, B. L. Blad and A. F. Garay.


Hubbard, K. G.
Surface weather monitoring and the development of drought and other climate information delivery systems. Proceedings of the International Drought Symposium and Workshop. Lincoln, NE.

Stigter, C. J. and A. Weiss.


Wilhite, D. A.

Wilhite, D. A.

M.S. Theses

Kim Joon.
Environmental and physiological effects on water use of cereal crops. (S. B. Verma and N. J. Rosenberg, Co-Advisors).

Meyer, S. J.
Improving Nebraska's near-real time weather based products through user interaction. (K. G. Hubbard and D. A. Wilhite, Co-Advisors).

Department of Consumer Science and Education

Journal Articles


Housing costs, housing affordability and residential satisfaction. Communipak.

Research Bulletin

Combs, E.R.
Housing design for the futures. University of Nebraska Department Report. No. 86-1, 37 p.

M.S. Theses

Beihl, Nancy.
Differences in perceptions toward adoption of personal computer systems. (E. Raedene Combs, Advisor).

Cameron, Virginia May.
Adjustments of homemakers when the homemaker returns to school. (Gwendolyn Newkirk and Florence Walker, Advisors).

Clark, Maria.
Perceptions of Costa Rican secondary female students toward education for family life. (Gwendolyn Newkirk, Advisor).
Hutchens, Donna J.  
Consumer education needs of the economical disadvantaged student. (E. Raedene Combs, Advisor).

Lodl, Kathleen Ann.  
Housing adjustments of rural households: Decisions and consequences. (E. Raedene Combs, Advisor).

**Entomology**

**Journal Articles**

Development of alfalfa weevil (Coleoptera: Curculionidae) larvae when reared on perennial glandular-haired medicago species in the greenhouse. Environ. Entomol. 15:396-398.

Guzman, D.R. and J.J. Petersen.  

Guzman, D.R. and J.J. Petersen.  


Kindler, S.D. and S.M. Spomer.  


Petersen, J.J.  
Augmentation of early season releases of filth fly (Diptera: Muscidae) parasites (Hymenoptera: Pteromalidae) with freeze-killed hosts. Environ. Entomol. 15:590-593.

Petersen, J.J.  
Evaluating the impact of pteromalid parasites on filth fly populations associated with confined livestock installations. ESA Miscellaneous Publication 61:52-56.

Petersen, J.J., B.M. Pawson, and D.R. Guzman.  
Discrimination by the pupal parasite Muscidifurax zaraptor for live and freeze-killed house fly pupae. J. Entomol. Sci. 21:52-55.

Rethwisch, M.D. and G.R. Manglitz.  

Schreiber, E.T. and J.B. Campbell.  
Horn fly (Diptera: Muscidae) distribution on cattle as influenced by host color and time of day. Environ. Entomol. 15:1307-1309.

Schreiber, E.T. and J.B. Campbell.  
Parasites of the horn fly in western Nebraska. The Southwestern Entomol. 11:211-214.

Walker, T.W., C.L. Meek, and J.J. Petersen.  
Susceptibility of Psorophora columbiae larvae over time to parasitism by Romanomermis culicivorax. J. of Nematology 18:94-97.

Insect food selection by 2-week-old ring-necked pheasant chicks. J. Wildl. Manage. 50:223-228.

Witkowski, J.F., D.T. Barber, and D.R. Currier.  
Control of first-generation European corn borer (Lepidoptera: Pyralidae) larvae in Nebraska by applying insecticides by center-pivot irrigation systems. J. Econ. Entomol. 79:1595-1598.

**M.S. Theses**

Carter, Mark R.  
Studies on the influence of simple trichomes and other characteristics of an alfalfa plant introduction on the resistance to the spotted alfalfa aphia (Homoptera: Aphididae). (George R. Manglitz, Advisor).

Darrow, Patrick O.  
Substrate and leaf effects on aquatic insects colonizing basket samplers in a southeast Nebraska stream. (Kenneth P. Pruess, Advisor).

Ihlaloui, Saadia.  
Effects of plant resistance, insecticide treatment, and planting dates on Hessian fly infestations in wheat in Morocco. (David L. Keith, Advisor).

Pawson, Barry M.  
Dispersal of mass released Muscidifurax zaraptor, a filth fly parasitoid, on cattle installations in eastern Nebraska. (James J. Petersen, Advisor).

Seymour, Ronald C.  
Predators and parasites of house flies (Musca domestica L.) and stable flies (Stomoxys calcitrans L.) in cattle confinement in Lincoln county, Nebraska. (John B. Campbell, Advisor).

**Ph.D. Thesis**

Sutherland, Tommy A.  
Development of field and laboratory techniques to evaluate the relative attractiveness of corn plants to corn rootworm beetles. (Z B Mayo, Advisor).

**Food Science and Technology**

**Journal Articles**

Anantheswaran, R. C., S. K. Sastry, R. B. Beelman, A. Okereke, and M. Konanayakam, M.  
Effect of processing on yield, color and texture of canned mushrooms. J. Food Sci. 51:1197.


Buck, J. S., C. E. Walker, and M. M. Pierce.  

Ebele, S. E., L. M. Breyer, and C. E. Walker.  
The effects of sucrose ester emulsifiers upon cake batter emulsion characteristics. J. Food Sci. 51(5):1276-1279.
Publications

(Food Science and Technology....)

Glover, J. M., C. E. Walker and P. J. Mattern

Kaup, S. M. and C. E. Walker


Sackett, B. A., G. W. Froning, J. A. DeShazer and F. J. Struwe

Shahani, K. M., and P. J. Whalen

Tan, S. T. and R. B. Maxcy

Watson, K. S. and C. E. Walker

Whalen, P. J. and K. M. Shahani

Whalen, P. J., K. M. Shahani, and S. R. Lowry

Yanez, G. A. and C. E. Walker

M.S. Theses

Yanez, F., Grelda Acela.
Proso millet (Panicum miliaceum): milling characteristics, flour functionality and starch properties. (C. E. Walker, Advisor).

Messinger, Julia K.
Comparison of corn trypsin and subtilisin inhibitors isolated by native and anhydro-modified enzyme affinity chromatography and the effect of partial proteolysis and succinylation on the functionality of corn germ protein isolate. (J. Rupnow, Advisor).

Ph.D. Theses

Lu, Shin.
Sorghum based breakfast cereal. (C. E. Walker, Advisor).

Forestry, Fisheries and Wildlife

Journal Articles

Boes, T.K.


Research Bulletins

Van Haverbeke, David F.

Van Haverbeke, David F.
Twenty-year performances of Scotch, European Black (Austrian), Red, and Jack Pines in eastern Nebraska. USDA Forest Service Research Paper RM-267. Rocky Mountain Forest and Range Experiment Station, Fort Collins, CO.

Van Haverbeke, David F.

M.S. Theses

Boehner, Patricia R.
Effects of pre-burn artificial litter and prescribed burning on smooth brome (Bromus inermis Leyss). (James R. Brandle, Advisor).

Rodekohr, Donn A.
The population biology of Oak Middle Creek Structure 58-B after an experimental stocking with adult fish: A three-year evaluation. (Gary L. Hergenrader, Advisor).

Schleiger, Steve L.
Interspecific interactions of green sunfish (Lepomis cyanellus) and creek chub (Semotilus atromaculatus) in small streams in southeast Nebraska. (Edward J. Peters, Advisor).

Ph.D. Theses

Holland, Richard S.
Biomanipulation of fish communities as an algal control technique in two Nebraska farm ponds. (Gary L. Hergenrader, Advisor).

Horticulture

Journal Articles

Coyne, D. P., J. R. Steadman, D. S. Nuland, C. L. Campbell.
'Monument' small white dry bean. HortSci. 20:542.
Finke, M. Luann, D. P. Coyne and J. R. Steadman.

Lee, K. K., R. C. Shearman and R. V. Klucas.

Iron deficiency stress effects on total iron in various leaves and nutrient solutions pH in sorghum and beans. J. Plant Nutrition 9(3-7):893-907.

Shearman, R. C.

Shearman, R. C.
Kentucky bluegrass and annual bluegrass responses to ethofumesate. HortSci. 21(5):1157-1159.

Thatch accumulation in tall fescue turfs. HortSci. 21(5):1164.


Zaiter, Haytham, D. P. Coyne, R. Clark and D. S. Nuland.

**Human Development and the Family**

**Journal Articles**


**M.S. Theses**

Casa, Canstanza. Family strengths in Latin America. (J. DeFrain, Advisor).


**Ph.D. Theses**

Schulz, Dorris. A study of third culture experience in relation to the psychosocial adjustment of returned Church of Christ missionary families. (J. DeFrain, Co-Advisor).


Wuerffel, Jon. The relationship between humor and family strengths. (J. DeFrain, Advisor).

**Human Nutrition and Food Service Management**

**Journal Articles**


(continued)
Publications

(Human Nutrition and Food Service Management...)

M.S. Theses

Alberry, S.G.
Effect of calcium, phosphorus and manganese on electrolyte balance in humans. (C. Kies, Advisor).

Allison, L.A.
Effect of calcium, phosphorus and manganese on serum lipid levels of human adults. (C. Kies, Advisor).

Al-Shagrawi, R.A.
Effect of level of total fat, cholesterol and manganese on utilization of zinc, iron, copper and lead in humans. (C. Kies, Advisor).

Ariweriokuma, S.
Consumer response to purchase, preparation and storage practices used with poultry. (P. Staats, Advisor).

Boisvert, W.A.
Effect of various calcium salt supplementation on metabolism of selenium in human adults. (C. Kies, Advisor).

Chen, C.A.W.
Urinary ascorbic acid and thiamin excretion as affected by selenium, gaur gum and calcium supplement use. (C. Kies, Advisor).

Cleveland, A.K.
The effects of cooking methods on energy usage and sensory evaluations of turkey rolls. (P. Staats, Advisor).

Enkvetchakul, B.
Effect of calcium, phosphorus and manganese supplements on utilization of iron, copper, lead and zinc by human adults. (C. Kies, Advisor).

Iqbal, S.S.
Effect of level of total fat, cholesterol and manganese on utilization of sodium, potassium and chloride in humans. (C. Kies, Advisor).

Kamberbeek, M.G.H.
Evaluation of the long-range effects of EFNEP training on food and nutrition related knowledge and behavior of the homemaker. (N. Betts, Advisor).

Kipchillat, P.J.

Lynch, K.M.
Nutrition intake, knowledge and habits of Lincoln, Nebraska and Barnum, Iowa high school students. (N. Betts, Advisor).

McDermott, S.D.

Molstad, C.
Time release vs. single dose iron supplements: effect on protein and lipid utilization by humans. (C. Kies, Advisor).

O'Neill, A.
Fecal fiber excretion of humans as affected by alterations in dietary fat and calcium. (C. Kies, Advisor).

Pennington, E.
Effect of calcium, phosphorus and manganese on urinary thiamin and ascorbic acid excretion of humans. (C. Kies, Advisor).

Potter, S.M.

Tsai, L.J.
Short-term usage of high dose ascorbic acid supplements: Holdover effects on niacin and pantothenic acid status. (C. Kies, Advisor).

Vigneau, L.
Effect of total fat, manganese and cholesterol on utilization of magnesium, calcium, manganese and phosphorus in humans. (C. Kies, Advisor).

Weidenbenner, A.E.
A survey of the access to prenatal care and the incidence of perinatal morbidity in the state of Nebraska. (N. Betts, Advisor).

Wu, H.L.
Sodium status of omnivores and lacto-vegetarians fed omnivore, lacto-vegetarian, and vegan diets supplemented with red and white wheat bran. (C. Kies, Advisor).

Yu, B.H.
Neutral and acid detergent fiber excretion of omnivores and vegetarian subjects fed omnivore, lacto-vegetarian and vegan diets with and without red and white wheat bran. (C. Kies, Advisor).

Ph.D. Theses

Ivaturi, R.V.K.
Mineral bioutilization as affected by sugars. (C. Kies, Advisor).

Johnson, J.M.
Manganese and lipid metabolism as affected by dietary manganese and fat. (C. Kies, Advisor).

Stanek, K.L.
Blood pressure of elderly persons and modification of dietary practices in relation to sodium status, potassium and calcium intake. (H. Fox, Advisor).

Northeast Research and Extension Center

Journal Articles


Weed seed decline and buildup in soils under various corn management systems across Nebraska. Agron. J. 78:451-454.

Clemens, E.T., B.D. Schultz, M.C. Brumm, G.W. Jesse and H.F. Mayes.

Francis, C.A., R.S. Moomaw, J.F. Rajewski, and Mohammad Saeed.
Jasa, P.J., E.C. Dickey, and D.P. Shelton.
Soil erosion from tillage and planting systems used in soybean residue: part II - influences of row direction. Trans. ASAE 29(3): 761-766.

Mader, T.L. and G.W. Horn.


Mader, T.L. and R.A. Britton.

Shapiro, C.A., T.A. Peterson, and A.D. Flowerday.

Shelton, D.P., P.J. Jasa, and E.C. Dickey.
Soil erosion from tillage and planting systems used in soybean residue: part I - influences of row spacing. Trans. ASAE 29(3): 756-760.

Shelton, D.P. and M.C. Brumm.

Shelton, D.P. and M.C. Brumm.

Witkowski, J.F., D.T. Barber, and Dr. R. Currier.
Control of first generation European corn borer (Lepidoptera: Pyralidae) larvae in Nebraska by applying insecticides through center pivot irrigation systems. J. Econ. Entomol. 79: 1595-1598.

M.S. Thesis
Burr Charles A.
Tillage influences on soybean residue cover. (David P. Shelton, Co-Advisor).

Panhandle Research & Extension Center

Journal Articles


Weed seed decline and buildup in soils under various corn management systems across Nebraska. Agron. J. 78:451-454.

Lyon, D.J. and R.G. Wilson.
Response of fieldbeans (Phaseolus vulgaris) to reduced rates of 2,4-D and dicamba. Weed Sci. 34:953-956.

Smith, J.A.
Dry edible bean field harvesting losses. Trans. ASAE 29(6):1540-1543.


Wilson, R.G.
Weed control in irrigated seedling alfalfa (Medicago sativa). Weed Sci. 34:423-426.

Transplanted sugarbeet response to irrigation at transplanting. Trans. ASAE 29(5):1254-1258.

Plant Pathology

Journal Articles


Lane, L.C. and R.N. Skopp

Meints, R.H., K. Lee, and J.L. Van Eten.


Smidt, M.L. and A.K. Vidaver.

Smidt, M.L. and A.K. Vidaver.

Smidt, M.L. and A.K. Vidaver.

(continued)
Publications

(Plant Pathology....)

Watkins, J.E., B. Doupnik, and L.V. Coziahr.

Watkins, J.E., B. Doupnik, and E.D. Kerr.

Watkins, J.E., T.P. Riordan, and R.C. Shearman.
Field reaction of Kentucky Bluegrass cultivars to stem rust, 1981. Biological and Cultural Tests 1:59.

Watkins, J.E. and D.H. Steineeger.
Reaction of rose cultivars to black spot and powdery mildew, 1980-82. Biological and Cultural Tests 1:70.

Xia, Y. and J.L. Van Etten.

Xia, Y., D.E. Burbank, and J.L. Van Etten.
Restriction endonuclease activity induced by NV-1A virus infection of a Chlorella-like green alga. Nucleic Acids Res. 14:6017-6030.

M.S. Thesis

Girton, Lois.
The organization of the dsDNA genome of the chlorella algal virus PBCV-1. (J. L. Van Etten, Advisor).

South Central Research and Extension Center

Journal Articles


Weed seed decline and buildup in soils under various corn management systems across Nebraska. Agron. J. 78:451-454.

Levis, D. G. and J. Ford.

Peters, L. L. and B. Doupnik.

Roeth, F. W.


Watkins, J., B. Doupnik, and L. V. Coziahr.


Watkins, J., B. Doupnik, and L. V. Coziahr.
Control of leaf rust, tan spot, and Septoria leaf blotch of winter wheat with sterol-inhibiting fungicides. Phytopathology 76:1060.

Ph.D. Theses

Brent W. Bean.
Persistence and evaluation of EPTC and butylate enhanced degradation. (Fred Roeth, Advisor).

Textiles, Clothing and Design

Journal Articles

Baker, Julie A. and Joan Laughlin.
Care labeling for upholstered furniture: Consumers expressed needs and preferences. J. Consumer Studies and Home Econ. 10:279-289.

Kean, Rita C. and Sally Van Zandt.


Laughlin, J. and R. E. Gold.


M.S. Theses

Asche, Kimberly Kay.
An evaluation of antioxidants for the conservation of museum textiles. (P. Crews, Advisor).

Lamplot, Jana.
Laundry techniques in removal of chlorpyrifos from selected fabrics. (J. Laughlin, Advisor).

Levin, Catherine Ogden.
A psychographic segmentation of home sewers. (R. Kean, Advisor).

Ringenberg, Karen L.
The effectiveness of drycleaning solvent in the refurbishment of chlorpyrifos contaminated clothing. (J. Laughlin, Advisor).

Urigh, Jane Arta.
Maternity dress of Nebraska women, 1886-1910. (P. Crews, Advisor).
Veterinary Science

Journal Articles

Carlson, M.P. and N.R. Schneider

Crenshaw, J.D., E.R. Peo, Jr., A.J. Lewis, and N.R. Schneider

Doster, A.R.; M.J. Tomlinson, E.A. Mahaffey, C. Jordon

Duhamel, G.E., M.L. Kent, N.O. Dybdal, R.P. Hedrick

Guidry, A.J., S. Srikanth, and P.A. Goldsy

Kirkpatrick, C.E., J.P. Dubey, M.H. Goldschmidt, J.E. Saik, and J.A. Schmitz
Sarcosystis sp. in muscles of domestic cats. Veterinary Path. 23:88-90.

Moxley, R.A. and D.H. Francis

Rhodes, M.B. and P.K. Baker


M.S. Theses

Dobesh, Gerald.
Nutritional impact on colonic microstructure and function in swine and dogs. (Edgar T. Clemens, Advisor).

Kendall, Todd.
Investigation into the lysozyme and complement activity within the intestine of healthy and diseased piglets, and determination of their effects on the bactericidal activity of IgG on pathogenic Escherichia coli. (Earl Dickinson, Advisor).

King, Robin.
Urinary indicators of equine monensin toxicosis. (Edgar T. Clemens, Advisor).

Trammer, Michael.
Electrocoagulation in cattle. (Edgar T. Clemens, Advisor).

Varner, Douglas.
The incidence of Cryptosporidium infections in Nebraska dairy calves. (Donald Ferguson, Advisor).

West Central Research and Extension Center

Journal Articles

Weed seed demise in soil in weed-free corn (Zea mays) production across Nebraska. Weed Sci. 34:284-151.

Weed seed decline and buildup in soils under various corn management systems across Nebraska. Agron. J. 78:451-454.


Challal, O.C. Burnside, G.A. Wicks, and V.A. Johnson.
Competition between winter wheat (Triticum aestivum) cultivars and downy brome (Bromus tectorum). Weed Sci. 34:689-693.

Registration of four inbred lines of maize. Crop Sci. 26:393.

Crutchfield, D.A., G.A. Wicks, and O.C. Burnside.
Effect of winter wheat (Triticum aestivum) straw mulch level on weed control. Weed Sci. 34:110-114.

Deutscher, G.H., L.L. Zerfoss and D.C. Clanton.

Effects of various infestation levels of cattle lice (Mallophaga: Trichodectidae and Anoplura: Haematopinidae) on feed efficiency and weight gains of beef heifers. J. Econ. Entomol. 78:1304-1307.

Efficacy of insecticide impregnated tags attached to three body locations on cattle against the stable fly, Stomoxys calcitrans (L.). Proceed. West Cent. Mosquito and Vector Control Assoc. 11:30-36.

Johnson, J.L., Barber, T.L., Frey, M.L. and Nason, G.

Hergert, G.W.
Nitrate leaching through sandy soil as affected by sprinkler irrigation management. J. Envrir. Qual. 15:272-278.


Nordquist, P.T. and W.A. Compton.
Chlorotic variation of experimental maize (Zea mays) hybrids grown on high pH soils. J. Plant Nutr. 9(3-7), 435-442.

Comparison of iron analyses and iron chlorosis in Kentucky bluegrass cultivars. J. Plant Nutr. 9(3-7):867-872.

Schreiber, E.T. and J.B. Campbell.
Parasites of the horn fly western Nebraska. The Southwest. Entomol. 11:211-214.

(continued)
Publications

(West Central Research and Extension Center....)

Whittier, J. C., G. H. Deutscher and D. C. Clanton.


Wicks, G. A. and P. H. Grabouski.
Weed control in no-till sorghum (Sorghum bicolor). Weed Sci. 34:577-581.

Wicks, G. A.

Wicks, G. A.


M.S. Theses

Duncan, P. T.

Myran, Darrel D.
Seasonal trends in forage quality of selected species of Sandhills vegetation. (James T. Nichols, Advisor).
AGRICULTURAL RESEARCH SITES

Panhandle Research and Extension Center, Scottsbluff

Gudmunsen Sandhills Laboratory

Northeast Research and Extension Center, Concord

Genoa Farm (Foundation Seed), Genoa

Agricultural Research and Development Center, Mead

Horning State Farm (Forestry), Plattsmouth

University of Nebraska East Campus, Lincoln

Southeast Research and Extension Center, Lincoln

Dalbey-Halleck Farm, Virginia

High Plains Agricultural Laboratory, Sidney

Northwest Agricultural Laboratory, Alliance

West Central Research and Extension Center, North Platte

South Central Research and Extension Center, Clay Center
The Nebraska Agricultural Research Division provides information and educational programs to all people without regard to race, color, national origin, sex or handicap.
REPORT OF RESEARCH EXPENDITURES  
THE UNIVERSITY OF NEBRASKA  
AGRICULTURAL RESEARCH DIVISION  
July 1, 1986 through June 30, 1987)

FEDERAL FORMULA FUNDS:

<table>
<thead>
<tr>
<th>Program</th>
<th>Amount</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hatch Formula</td>
<td>$1,912,301</td>
</tr>
<tr>
<td>Regional Research</td>
<td>$715,460</td>
</tr>
<tr>
<td>McIntire-Stennis</td>
<td>$85,339</td>
</tr>
<tr>
<td>Animal Health</td>
<td>$213,865</td>
</tr>
<tr>
<td><strong>Total Federal Formula Funds</strong></td>
<td><strong>$2,926,965</strong></td>
</tr>
</tbody>
</table>

STATE APPROPRIATED FUNDS ........................................................... $12,765,260

CONTRACTS AND GRANTS:

<table>
<thead>
<tr>
<th>Type</th>
<th>Amount</th>
</tr>
</thead>
<tbody>
<tr>
<td>USDA Coop Agreements</td>
<td>$2,438,667</td>
</tr>
<tr>
<td>USDA Special &amp; Competitive</td>
<td>$415,120</td>
</tr>
<tr>
<td>Federal Grants - NSF, NIH, HEW, AID</td>
<td>$1,439,730</td>
</tr>
<tr>
<td>Industry Grants</td>
<td>$2,848,048</td>
</tr>
<tr>
<td><strong>Total Grants and Contracts</strong></td>
<td><strong>$7,141,565</strong></td>
</tr>
</tbody>
</table>

Sub-Total ................................................................. $22,833,790

PRODUCT SALES ................................................................. $4,424,822

TOTAL EXPENDITURES ............................................................... $27,258,612