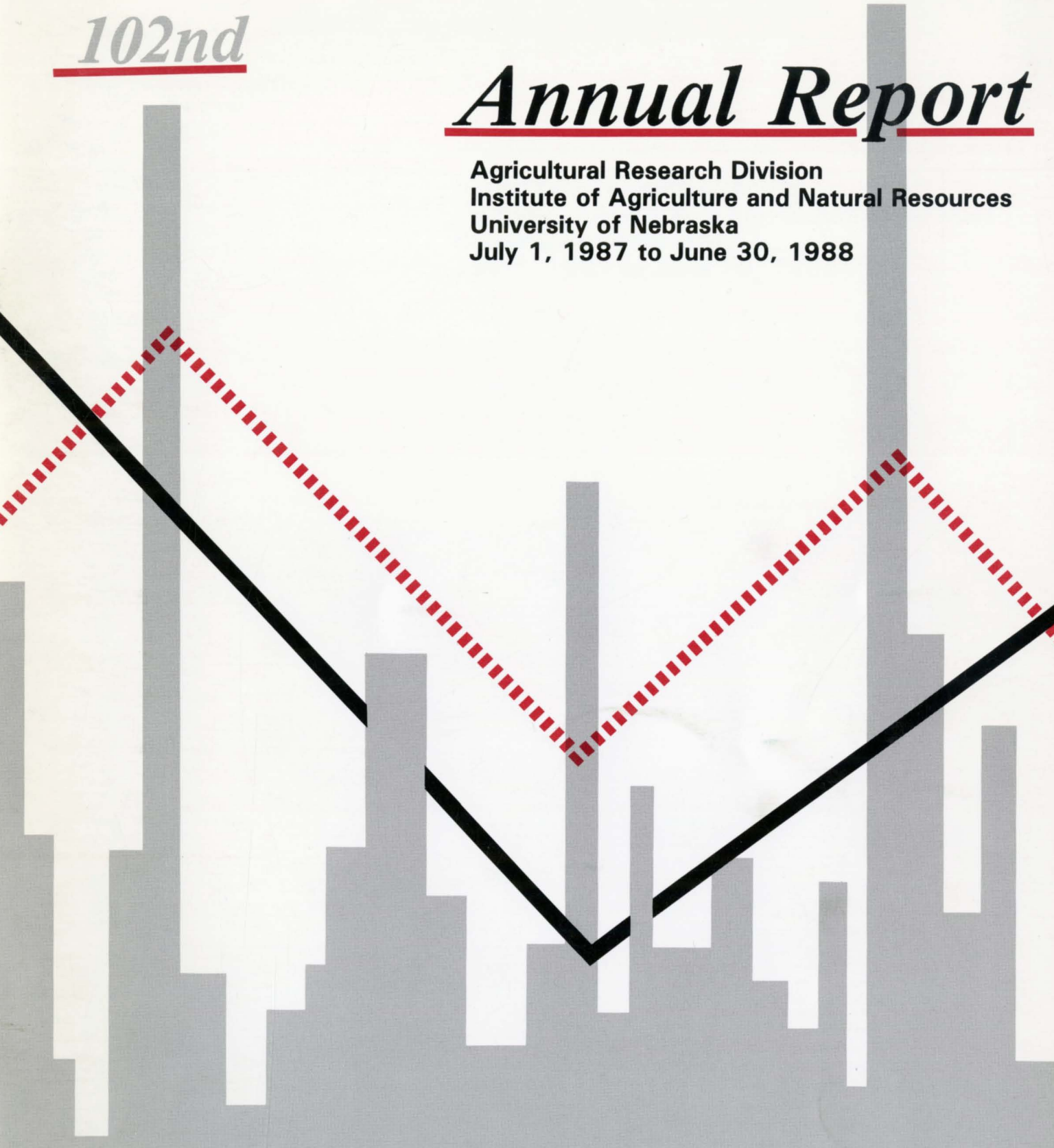
6-30-1988

Agricultural Research Division 102nd Annual Report, July 1, 1987, to June 30, 1988

102nd

Annual Report

Agricultural Research Division
Institute of Agriculture and Natural Resources
University of Nebraska
July 1, 1987 to June 30, 1988



FOREWORD

It is a pleasure to provide the 102nd Annual Report of the UNL Agricultural Research Division. This report contains lists of current faculty, active projects, referred journal articles, books and book chapters, germplasm releases, patents, brief descriptions of research in selected areas, and the financial report for the period of July 1, 1987, through June 30, 1988. This report was compiled in compliance with the intent of the law of the State of Nebraska that established the Nebraska Agricultural Experiment Station on March 31, 1887.

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, 1988, over 140 full-time equivalents in the Agricultural Research Division were distributed among more than 270 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.

The primary program goals for the Agricultural Research Division are:

* To address priority problems facing Nebraska's agricultural and food industries;
* To provide an expanded knowledge base for future developments in production, processing and distribution of agricultural products; and
* To provide research results to advance quality of life opportunities for all Nebraskans.

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.

The number of researchers and personnel involved in agricultural research has declined at the University of Nebraska in recent years, with the program becoming more focused on targeted areas. Increased emphasis has been given to research involving processing, utilization and marketing, both to food products and more recently, to non-food products. Utilization of rapid advancements in science, such as biotechnology, is becoming commonplace in the research projects of the Agricultural Research Division. 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, books, University publications and in departmental reports. The research results then become the 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.

Dale H. Vanderholm, Interim Dean for
Agricultural Research Division and
Interim Director, Nebraska Experiment Station
University of Nebraska-Lincoln

TABLE OF CONTENTS

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

Patrick Hotovy, UNMC

Joe Kerrigan, UNO

Jeff Peterson, UNL

Administrative Officers

Ronald W. Roskens, President, University of Nebraska

Martin A. Massengale, Chancellor, University of Nebraska - Lincoln

Irvin T. Omtvedt, Vice Chancellor, Institute of Agriculture and Natural Resources

Agricultural Research Division

Dale H. Vanderholm, Interim Dean and Director

Karen E. Craig, Assistant Director for Home Economics

James DeShazer[2], Assistant Dean and Assistant Director

Roger Gold[1], Assistant Dean for Water Programs

William L. Powers[1], Assistant Director for Water Research

Warren W. Sahs, Assistant Director for Operations

James Stubbendieck[2], Assistant Dean and Assistant Director

[1]Appointment for part of the year
[2]Temporary appointment

Administrative Units Reporting To Deans And Directors

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

June 1988

Agricultural Academic Program Units (Extension, Research and Teaching)

AGRICULTURAL BIOCHEMISTRY
Herman W. Knoche
AGRICULTURAL COMMUNICATIONS
Gary Vacin
AGRICULTURAL ECONOMICS
Michael Turner (William L. MIller[1])
AGRICULTURAL ENGINEERING
James Gilley (William E. Splinter[1])
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
Z B Mayo (Roger E. Gold[1])
ENVIRONMENTAL PROGRAMS
Roger E. Gold
FOOD PROCESSING CENTER
Steven Taylor
FOOD SCIENCE AND TECHNOLOGY
Steven Taylor
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
Lois Schwab
TEXTILES, CLOTHING AND DESIGN
Joan M. Laughlin

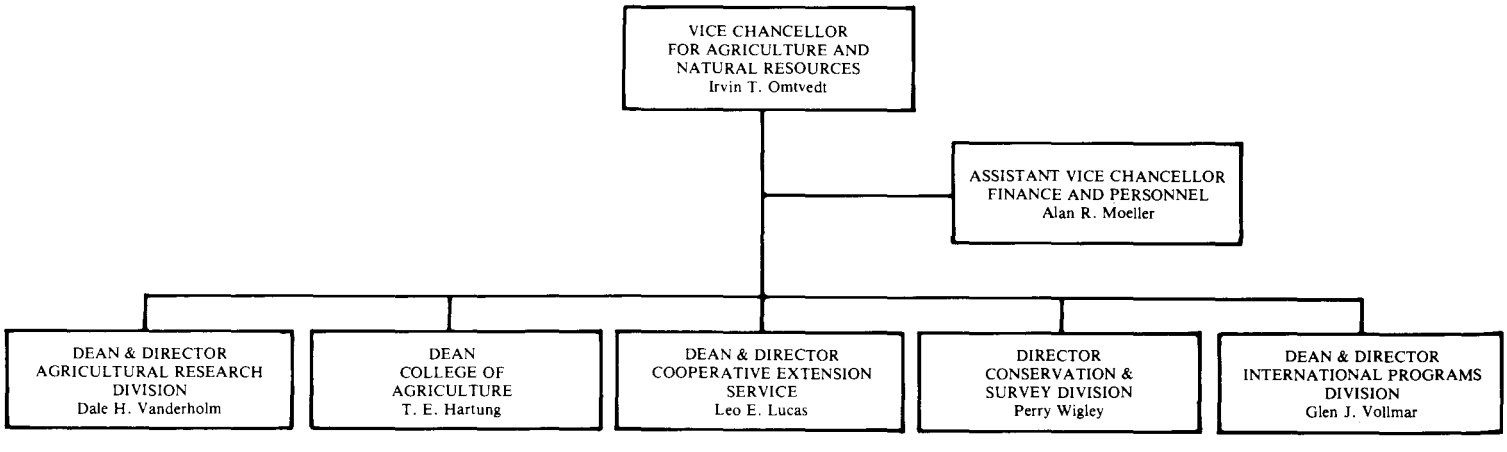
Off-Campus Centers (Extension and Research)

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
SOUTH CENTRAL 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

[1]Appointment for part of the year

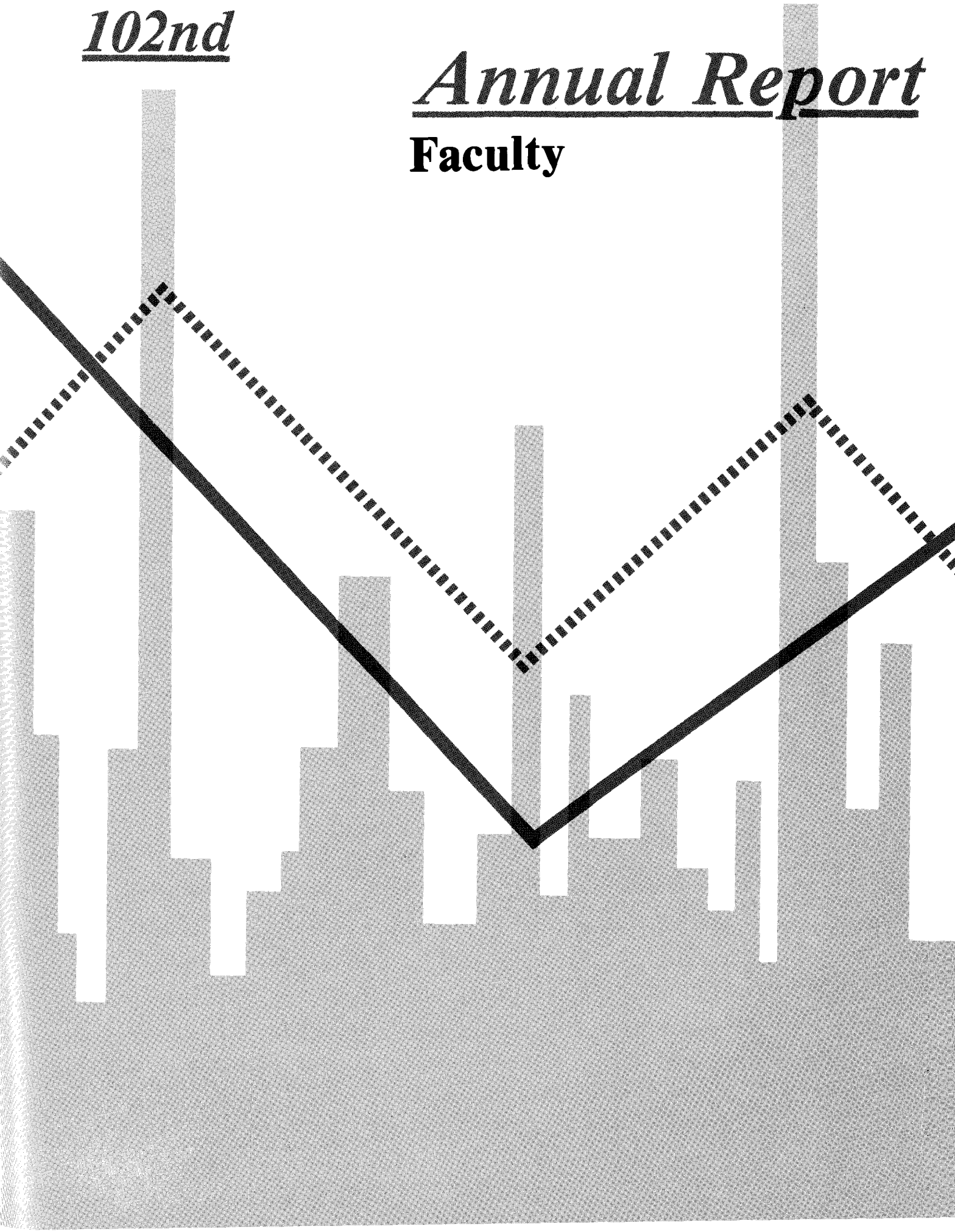
Organizational Chart

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



102nd Annual Report

Faculty



Agricultural Research Division
Faculty

	Rank	Rsch	Ext	Tch	Other	Area of Responsibility
Agricultural Communications						
Gary Vacin	Professor	0.19	0.53	0.19	0.09	Head
Richard L. Fleming	Professor	0.25	0.57	0.18		Marketing
James W. King	Associate Professor	0.20	0.80			Special Projects
Daniel B. Lutz	Professor	0.10	0.80	0.10		News
Terrence Meisenbach	Assistant Professor	0.22	0.78			Publications
Charlotte Murphy	Assistant Instructor	0.10	0.90			News
David E. Parrish	Assistant Instructor	0.20	0.60		0.20	News
James K. Randall	Professor	0.10	0.90			Radio
Edward F. Vitzthum	Associate Professor	0.25	0.75			Environmental Programs
Myra Wilhite	Associate Professor	0.10	0.80	0.10		Visual Aids/Educational Media
Agricultural Economics						
Michael S. Turner	Professor	0.35	0.65			Interim Head
J. David Aiken	Associate Professor	0.55	0.35	0.10		Water Policy
Azzeddine Azzam	Assistant Professor	0.70		0.30		Quantitative Methods
Dale G. Anderson	Professor	0.60		0.40		Marketing
Maurice E. Baker	Professor	0.70		0.30		Resource Economics
Allen L. Frederick	Professor	0.30	0.70			Public Policy Economics
Paul H. Gessaman	Professor	0.10	0.90			Agricultural Finance
Glenn A. Helmers	Professor	0.60		0.40		Farm Mgmt. & Production
Bruce B. Johnson	Professor	0.47		0.53		Resource Economics
H. Douglas Jose	Professor	0.20	0.80			Farm Management
James G. Kendrick	Professor	0.20		0.80		Marketing & Agr. Policy
Dean A. Linsenmeyer	Professor			1.00		Marketing
Lynn H. Lutgen	Associate Professor	0.30	0.70			Marketing
William L. Miller	Professor	0.85		0.15		Policy
George H. Pfeiffer	Associate Professor	0.25		0.75		Farm and Ranch Management
Raymond J. Supalla	Professor	0.75		0.25		Resource Economics
John F. Yanagida	Associate Professor	0.70		0.30		Quantitative Methods
Agricultural Education						
Allen G. Blezek	Professor	0.15	0.10	0.70		Head and Leadership
Leverne A. Barrett	Associate Professor	0.25		0.75		Teacher Effectiveness
Roy D. Dillon	Professor	0.30		0.70		Curriculum, Advanced Studies & Development
Richard M. Foster	Professor	0.40		0.60		Advanced Studies and Development
Osmund S. Gilbertson	Professor	0.10	0.20	0.70		Advanced Studies and Development
James T. Horner	Professor	0.15	0.25	0.60		Leadership, Advanced Studies & Development

[1/] Ended research appointment during 1987-88

[2/] Began research appointment during 1987-88

(continued)

Faculty

	Rank	Rsch	Ext	Tch	Other	Area of Responsibility
Agricultural Engineering						
James R. Gilley	Professor	0.60	0.18	0.22		Interim Head & Irrig. Eng.
Ramaswamy C. Anantheswaran	Assistant Professor	0.20			0.80	Food Engineering
Leonard Bashford	Professor	0.65		0.35		Power and Machinery
Gerald R. Bodman	Associate Professor	0.25	0.75			Livestock Environment
Y. R. Chen	Associate Professor				USDA	Modeling Animal Physiology Processes
James A. DeShazer	Professor	0.75		0.25		Livestock Environment
Elbert C. Dickey	Associate Professor	0.25	0.75			Soil & Water Conservation
Conrad B. Gilbertson	Associate Professor				USDA	Livestock Waste Management
John E. Gilley	Assistant Professor				USDA	Soil & Water Conservation
Robert D. Grisso	Assistant Professor	0.25	0.75			Power and Machinery
G. L. Hahn	Professor				USDA	Animal Calorimetry
Milford A. Hanna	Professor	0.57		0.23	0.20	Food Engineering
A. G. Haskimoto	Professor				USDA	Modeling Animal Physiology Processes
Louis I. Leviticus	Professor	0.83		0.17		Tractor Testing
Derrel L. Martin	Assistant Professor	0.80		0.20		Irrigation Engineering
George E. Meyer	Associate Professor	0.75		0.25		Biological Engineering
Jack A. Nienaber	Associate Professor				USDA	Animal Calorimetry
Richard Pierce	Assistant Professor	0.20	0.80			Crop Processing
Dennis D. Schulte	Professor	0.67		0.33		Structures, Processing
William E. Splinter[1]	Professor	0.50	0.30	0.20		Head
LaVerne Stetson	Professor				USDA	Electrical Safety
Thomas L. Thompson	Professor	0.70		0.30		Product Processing and System
Kenneth Von Bargen	Professor	0.55		0.45		Systems Engineering
Darrell Watts[2]	Professor	0.17	0.28	0.55		Water Quality/Irrigation
Howard D. Wittmuss	Associate Professor	0.53		0.47		Soil & Water Conservation
Agronomy						
Darrell W. Nelson	Professor	0.40	0.30	0.30		Head
Bruce E. Anderson	Assistant Professor	0.40	0.60			Forage Management
David J. Andrews	Professor	0.25			0.75	Millet and Sorghum Breeding
Roger J. Assmus[1]	Assistant Instructor	0.23		0.77		Soil Chemistry/Fertility
P. Stephen Baenziger	Associate Professor	0.75		0.25		Small Grains Breeding and Genetics
Ralph B. Clark	Professor				USDA	Sorghum Physiology
Max Clegg	Associate Professor	0.85		0.15		Crop Physiology
William A. Compton	Professor	0.70		0.30		Corn Breeding
Stephen M. Dofing[2]	Assistant Professor	1.00				Popcorn Breeding
John W. Doran	Associate Professor				USDA	Soil Biochemistry
August F. Dreier[1]	Professor	0.74	0.26			Crop Variety Evaluation
Jerry D. Eastin	Professor	0.85		0.15		Crop Physiology
James R. Ellis	Associate Professor				USDA	Soil Microbiology
Charles A. Francis	Professor	0.25	0.75			Crop Production

	Rank	Rsch	Ext	Tch	Other	Area of Responsibility
(Agronomy...)						
Byron C. Gabrielsen[1]	Assistant Professor				USDA	Forage Physiology
Charles O. Gardner	Professor	0.80		0.20		Statistics, Genetics
Herman J. Gorz	Professor				USDA	Forage Genetics
George L. Graef[2]	Assistant Professor	0.85		0.15		Soybean Breeding
Robert Graybosch	Assistant Professor				USDA	Wheat Genetics
Francis A. Haskins[1]	Professor	0.90		0.10		Forage Genetics
Michael D. Jawson	Assistant Professor	0.75		0.25		Soil Microbiology
Blaine Johnson	Assistant Professor				USDA	Sorghum Genetics
Alice J. Jones	Assistant Professor	0.50	0.50			Soil Conservation
Lowell Klepper	Associate Professor	1.00				Crop Physiology
Delno Knudsen[1]	Professor	0.50	0.50			Soil Testing
David T. Lewis	Professor	0.40		0.60		Soil Genesis and Classification
Jerry Maranville	Professor	0.85		0.15		Sorghum Physiology
Alexander Martin	Professor	0.33	0.67			Weed Science
Stephen C. Mason	Assistant Professor	0.40		0.60		Crop Production
Robert A. Masters	Assistant Professor				USDA	Range Weed Control
Paul J. Mattern	Professor	1.00				Cereal Quality
Dennis McCallister	Assistant Professor	0.40		0.60		Soil Chemistry
Lloyd N. Mielke	Associate Professor				USDA	Soil Physics
Richard Mills	Professor	1.00				Foundation Seed Production
M. Rosalind Morris	Professor	0.80		0.20		Cytogenetics
David A. Mortensen	Assistant Professor	0.75		0.25		Weed Science
Lowell E. Moser	Professor	0.18		0.82		Forage Physiology, Teaching Coordinator
Lenis A. Nelson[2]	Professor	0.50	0.50			Crop Variety Evaluation/New Crops
John Norman	Professor	0.80		0.20		Water Resources and Crop Modeling
Edwin J. Penas	Associate Professor	0.25	0.75			Soil Fertility
C. James Peterson	Assistant Professor				USDA	Wheat Genetics
James F. Power	Professor				USDA	Soil Fertility
William L. Powers[2]	Professor	0.80		0.20		Soil Physics
Donald H. Sander	Professor	0.50	0.50			Soil Fertility, Extension Coordinator
James S. Schepers	Associate Professor				USDA	Soil Chemistry
Patrick J. Shea	Associate Professor	0.80		0.20		Herbicide Dissipation
Joseph H. Skopp	Associate Professor	0.50		0.50		Soil Physics
Robert C. Sorensen	Professor	0.25		0.75		Soil Fertility
James E. Specht	Professor	0.80		0.20		Soybean Physiology and Breeding
Paul E. Staswick	Assistant Professor	0.75		0.25		Molecular Genetics
Robert N. Stougaard[2]	Assistant Professor	0.25	0.75			Weed Science
James Stubbendieck	Professor	0.50		0.50		Range Ecology and Management
Charles Y. Sullivan	Professor				USDA	Crop Physiology

(continued)

Faculty

	Rank	Rsch	Ext	Tch	Other	Area of Responsibilty
(Agronomy...)						
Dale Swartzendruber	Professor	0.90		0.10		Soil Physics
Mary Thomas-Compton	Assistant Professor	1.00				Popcorn Breeding
Gary E. Varvel	Associate Professor				USDA	Soil Management
Kenneth P. Vogel	Associate Professor				USDA	Grass Breeding
Steven S. Waller	Professor	0.55		0.45		Range Management and Improvement
Elizabeth Walter-Shea	Assistant Professor	1.00				Water Resources and Crop Modeling
Daniel T. Walters	Assistant Professor	0.50		0.50		Soil Management
Wallace W. Wilhelm	Associate Professor				USDA	Crop Physiology
Wayne C. Youngquist[2]	Assistant Professor	0.75		0.25		Corn Breeding
Animal Science						
Elton D. Aberle	Professor	0.35	0.34	0.31		Head
William T. Ahlschwede	Associate Professor	0.30	0.70			Swine Production
Mary M. Beck	Associate Professor	0.70		0.30		Poultry Physiology
Gary L. Bennett	Assistant Professor				USDA	Breeding
Dennis R. Brink	Associate Professor	0.30		0.70		Ruminant Nutrition
Robert A. Britton	Professor	0.70		0.30		Ruminant Biochemistry
Chris R. Calkins	Associate Professor	0.70		0.30		Meats
Ronald K. Christenson	Associate Professor				USDA	Physiology
Edgar T. Clemens[2]	Professor	0.50		0.50		Gastroenteric Physiology
John D. Crouse	Associate Professor				USDA	Meats
Larry V. Cundiff	Professor				USDA	Breeding
Gordon E. Dickerson[1]	Professor				USDA	Animal Breeding and Genetics
Joan H. Eisemann	Assistant Professor				USDA	Nutrition
Calvin L. Ferrell	Assistant Professor				USDA	Nutrition
J. Joe Ford	Associate Professor				USDA	Physiology
Earl W. Gleaves	Professor	0.25	0.75			Poultry Production
Keith E. Gregory	Professor				USDA	Breeding
H. Edward Grotjan, Jr.[2]	Associate Professor	0.60		0.40		Physiology
Thomas G. Jenkins	Assistant Professor				USDA	Breeding
Rodger K. Johnson	Professor	0.60		0.40		Swine Breeding
Steven J. Jones	Assistant Professor	0.50		0.50		Meats
Jeffrey F. Keown	Associate Professor	0.30	0.70			Dairy Management
James E. Kinder	Professor	0.60		0.40		Beef Physiology
Roger J. Kittok	Associate Professor	0.85		0.15		Reproductive Physiology
Terry J. Klopfenstein	Professor	0.70		0.30		Ruminant Nutrition
Robert M. Koch	Professor	1.00				Research Geneticist
Larry L. Larson	Associate Professor	0.50		0.50		Dairy Physiology
Austin J. Lewis	Professor	0.70		0.30		Swine Nutrition
Kreg A. Leymaster	Assistant Professor				USDA	Breeding
Michael D. MacNeil	Assistant Professor				USDA	Breeding
Roger W. Mandigo	Professor	0.60		0.40		Meats
Harry J. Mersmann[2]	Professor				USDA	Meats

	Rank	Rsch	Ext	Tch	Other	Area of Responsibility
(Animal Science...)						
Merlyn K. Nielsen	Professor	0.60		0.40		Beef Breeding
Robert R. Oltjen	Professor				USDA	Nutrition
Foster G. Owen	Professor	0.40	0.45	0.15		Dairy Nutrition
Ernest R. Peo, Jr.	Professor	0.55		0.45		Swine Nutrition
Wilson G. Pond	Professor				USDA	Nutrition
Bruce D. Schanbacher	Associate Professor				USDA	Physiology
Rick A. Stock	Assistant Professor	0.50	0.50			Feedlot Nutrition
Thomas W. Sullivan	Professor	0.65		0.35		Poultry Nutrition
John K. Ward	Professor	0.50		0.50		Beef Nutrition
Thomas H. Wise	Assistant Professor				USDA	Physiology
Jong-Tseng Yen	Associate Professor				USDA	Nutrition
Lawrence D. Young	Assistant Professor				USDA	Breeding
Dwane R. Zimmerman	Professor	0.50		0.50		Swine Physiology
Biochemistry						
Herman W. Knoche	Professor	0.80		0.20		Head, Lipid Biochemistry
Raymond Chollet	Professor	0.90		0.10		Photosynthesis
Richard Dam	Associate Professor	0.84		0.16		Nutritional Biochemistry
Robert M. Hill	Associate Professor	0.80		0.20		Protein Biochemistry
Robert V. Klucas	Professor	0.90		0.10		Nitrogen Fixation
Ricky J. Krueger	Assistant Professor	0.85		0.15		Molecular Endocrinology
John P. Markwell	Assistant Professor	0.90		0.10		Plant Biochemistry
Robert J. Ogden	Assistant Professor	1.00				Alfalfa Processing
Robert J. Spreitzer	Assistant Professor	0.85		0.15		Plant Molecular Genetics
Fred W. Wagner	Professor	0.90		0.10		Enzymes
Biometrics and Information Systems Center						
Walter W. Stroup	Associate Professor	0.35		0.65		Interim Head
James G. Emal	Associate Professor	0.25	0.75			Microcomputer Specialist
Robert F. Mumm	Professor	0.67		0.33		Statistical Consultant
Anne Parkhurst	Professor	0.70		0.30		Statistical Consultant
Ronald L. Roeber	Assistant Professor	0.25	0.75			Microcomputer Specialist
Kent Eskridge[2]	Assistant Professor	0.35		0.65		Statistical Consultant
Center for Agricultural Meteorology and Climatology						
Blaine Blad	Professor	0.80	0.10	0.10		Director
Kenneth Hubbard	Associate Professor	0.25	0.25		0.50	Ag. Climatology & Conservation and Survey
Shashi Verma	Professor	0.77		0.23		Agricultural Meteorology
Albert Weiss	Associate Professor	1.00				Agricultural Meteorology
Donald Wilhite	Associate Professor	0.50	0.15	0.35		Agricultural Climatology
Consumer Science and Education						
Gwendolyn Newkirk	Professor	0.17	0.12	0.71		Chair
E. Raedene Combs	Associate Professor	0.50		0.50		Housing
Elizabeth Davis[2]	Assistant Professor	0.25		0.75		Family Economics

(continued)

Faculty

	Rank	Rsch	Ext	Tch	Other	Area of Responsibility
Entomology						
Roger E. Gold[1]	Professor	0.59	0.26	0.15		Head, Urban Entomology
Mary Ellen Dix	Associate Professor				USDA	Shelterbelt Insects
Thomas O. Holtzer	Associate Professor	0.80		0.20		Crop Insects and Spidermites
Tony Joern	Associate Professor				1.00	Insect Ecology
J. Ackland Jones	Associate Professor	0.40		0.60		Shelterbelt Insects
George R. Manglitz	Professor				USDA	Forage Insect Investigations
Z B Mayo	Professor	0.80		0.20		Cytogenetics of Greenbugs, Interim Head
Lance J. Meinke	Assistant Professor	0.80		0.20		Soil Insects
Judith E. Pasek[2]	Assistant Professor				USDA	Shelterbelt Insects
James J. Petersen	Professor				USDA	Livestock Entomology
Kenneth P. Pruess	Professor	0.80		0.20		Aquatic Insects
Brett C. Ratcliffe	Associate Professor				1.00	Insect Curator
Gustave D. Thomas	Professor				USDA	Livestock Entomology
Environmental Programs						
Roger E. Gold[2]	Professor	0.18	0.07	0.05	0.70	Environmental Programs & Water Center
Shripat T. Kamble	Associate Professor	0.25	0.75			Environmental Programs
Edward F. Vitzthum[2]	Associate Professor	0.25	0.75			Environmental Programs
Food Science and Technology						
Steve L. Taylor[2]	Professor	0.26	0.34	0.40		Head and Food Toxicology
R. C. Anantheswaran	Assistant Professor	0.80			0.20	Food Engineering
Glenn W. Froning	Professor	0.40	0.34	0.26		Poultry Products
Lloyd B. Bullerman	Professor	0.60	0.10	0.30		Food Microbiology
Susan B. Cuppett	Assistant Professor	0.60		0.40		Food Lipids
Robert W. Hutkins[2]	Assistant Professor	0.65		0.35		Food Biotechnology
Michael B. Liewen	Assistant Professor	0.30	0.70			Food Microbiology
R. Burt Maxcy	Professor	0.30		0.20		Food Microbiology
John Rupnow	Associate Professor	0.55		0.45		Food Biochemistry
Khem M. Shahani	Professor	0.45		0.05		Food Chemistry
Randy L. Wehling	Assistant Professor	0.50		0.50		Food Processing
Michael G. Zeece	Assistant Professor	0.75		0.25		Food Protein Chemistry
Forestry, Fisheries and Wildlife						
Gary L. Hergenrader	Professor	0.17	0.16	0.17	0.50	Head
James R. Brandle	Associate Professor	0.90		0.10		Forestry
Ronald M. Case	Professor	0.40		0.60		Wildlife
Stephen G. Ernst	Assistant Professor	0.75		0.25		Forestry
Mark O. Harrell	Associate Professor	0.15			0.85	Nebraska Forest Service
Ronnie J. Johnson	Associate Professor	0.31	0.43		0.26	Wildlife
Michael R. Kuhns	Assistant Professor	0.25	0.75			Forestry
Edward J. Peters	Associate Professor	0.40		0.60		Fisheries
Julie A. Savidge[2]	Assistant Professor	0.40		0.60		Wildlife
David F. VanHaverbeke	Professor				USDA	Forestry

	Rank	Rsch	Ext	Tch	Other	Area of Responsibility
Horticulture						
Paul E. Read	Professor	0.43	0.33	0.24		Head and Plant Tissue Culture
Dermot P. Coyne	Professor	0.96		0.04		Vegetable Breeding
Jay B. Fitzgerald	Associate Professor	0.21	0.34	0.45		Ornamentals
William A. Gustafson	Associate Professor	0.25		0.75		Fruit and Nut Crops
Edward J. Kinbacher	Professor	0.50		0.50		Turf Physiology
Ralph E. Neild	Professor	0.39	0.56	0.05		Horticulture
Ellen T. Paparozzi	Associate Professor	0.50		0.50		Ornamentals
Terrance P. Riordan	Associate Professor	0.89		0.11		Turf Breeding
Sotero S. Salac	Associate Professor	0.81		0.19		Ornamentals
Robert C. Shearman	Associate Professor	0.59	0.25	0.16		Turf
Roger D. Uhlinger	Professor	0.60		0.40		Post Harvest Vegetables
Human Development and the Family						
William N. Meredith	Assistant Professor	0.25	0.10	0.65		Chairman
John D. DeFrain	Associate Professor	0.50		0.50		Rural Family Crisis
Violet Kalyan-Masih	Professor	0.59		0.41		Cognitive Development (Piaget)
Patricia Knaub	Associate Professor	0.27		0.73		Dual Career Families - Remarriage
Lois D. Schwab	Professor	0.25	0.15	0.35		Rehabilitation of Handicapped Women
John C. Woodward	Professor	0.48		0.52		Loneliness and Solitude
Human Nutrition and Food Service Management						
Lois O. Schwab	Professor	0.15	0.05	0.05		Interim Chair
Nancy M. Betts	Associate Professor	0.35		0.65		Nutrition
Anna M. Brenner	Associate Professor	0.25		0.75		Food Service Management
Audrey L. Hay	Assistant Professor	0.30		0.70		Food Service Management
Constance Kies	Professor	0.70		0.30		Nutrition
Phyllis Staats	Assistant Professor	0.32		0.68		Foods
Northeast Research and Extension Center						
Donald B. Hudman	Professor	0.23	0.69		0.08	Director
Michael C. Brumm	Associate Professor	0.50	0.50			Animal Science
William L. Kranz	Assistant Professor	0.25	0.75			Ag. Engineering
Terry L. Mader	Associate Professor	0.50	0.50			Animal Science
Russell S. Moomaw	Professor	0.49	0.51			Agronomy
Timothy A. Powell[2]	Assistant Professor	0.40	0.60			Farm Management
Charles Shapiro	Assistant Professor	0.50	0.50			Agronomy
David P. Shelton	Associate Professor	0.50	0.50			Ag. Engineering
John F. Witkowski	Professor	0.50	0.50			Entomology
Panhandle Research and Extension Center						
Robert D. Fritschen	Professor	0.42	050		0.08	Director and Animal Science
Burton A. Weichenthal	Professor	0.50	0.50			Associate Director and Animal Science
Frank N. Anderson	Associate Professor	0.50	0.50			Agronomy

(continued)

Faculty

	Rank	Rsch	Ext	Tch	Other	Area of Responsibility
(Panhandle Research and Extension Center)						
Dale M. Groteleuschen	Assistant Professor	0.50	0.50			Diagnostic Veterinary Science
Arthur F. Hagen[1]	Associate Professor	0.25	0.75			Entomology
Gary L. Hein[2]	Assistant Professor	0.25	0.75			Entomology
Eric D. Kerr	Professor	0.50	0.50			Plant Pathology
Duane A. Martin[2]	Assistant Professor	0.50	0.50			Agronomy
Lenis Nelson[1]	Professor	0.75	0.25			Agronomy
David S. Nuland	Assistant Professor	0.25	0.75			Horticulture
Robert O'Keefe	Professor	0.80	0.20			Horticulture
Patrick E. Reece	Assistant Professor	0.50	0.50			Agronomy
James G. Robb	Assistant Professor	0.50	0.50			Agricultural Economics
Ivan G. Rush	Professor	0.25	0.75			Animal Science
John A. Smith	Assistant Professor	0.50	0.50			Agricultural Engineering
Robert G. Wilson	Professor	0.50	0.50			Agronomy
C. Dean Yonts	Assistant Professor	0.50	0.50			Agricultural Engineering
Plant Pathology						
Anne K. Vidaver	Professor	0.75	0.15	0.10		Head
Michael G. Boosalis	Professor	0.66	0.19	0.15		Root Diseases and Mycorrhizae
Martin B. Dickman[2]	Assistant Professor	0.85		0.15		Genetics of Host/Parasite Interactions
Roy C. French[2]	Assistant Professor				USDA	Viruses and Nucleic Acids
Stan G. Jensen	Associate Professor				USDA	Corn and Sorghum Diseases
Leslie C. Lane	Associate Professor	0.85		0.15		Virus Diseases
Willem G. Langenberg	Professor				USDA	Virus Diseases
James Partridge	Associate Professor	0.80		0.20		Corn and Sorghum Stalk Rot
Glenn W. Peterson	Professor				USDA	Tree Diseases
Thomas O. Powers	Assistant Professor	0.85		0.15		Nematology
James R. Steadman	Associate Professor	0.90		0.10		Epidemiology of Vegetable Diseases
James L. Van Etten	Professor	0.90		0.10		Microbial Physiology
John E. Watkins	Associate Professor	0.25	0.75			Small Grains, Turf and Alfalfa
South Central Research and Extension Center						
Charles L. Stonecipher	Professor	0.14	0.78		0.08	Director
Benjamin L. Doupnik, Jr.	Professor	0.50	0.50			Plant Pathology
Dean E. Eisenhauer	Associate Professor	0.49	0.51			Agricultural Engineering
Roger Elmore	Assistant Professor	0.50	0.50			Agronomy
Richard Ferguson	Assistant Professor	0.50	0.50			Agronomy
Donald G. Levis	Associate Professor	0.25	0.75			Animal Science
Leroy Peters	Professor	0.50	0.50			Entomology
Fred W. Roeth	Professor	0.50	0.50			Agronomy
Roger Selley	Associate Professor	0.25	0.75			Agricultural Economics
Southeast Research and Extension Center						
Loyd L. Young	Professor	0.05	0.87		0.08	Director

	Rank	Rsch	Ext	Tch	Other	Area of Responsibility
Textiles, Clothing and Design						
Joan Laughlin	Professor	0.37	0.11	0.52		Chair, Textiles
Patricia Cox Crews	Assistant Professor	0.25		0.75		Textile Conservation and Science
Rita C. Kean	Assistant Professor	0.25		0.75		Textiles and Apparel Merchandising/Marketing
Veterinary Science						
John A. Schmitz	Professor	0.65	0.15	0.20		Head
Gary A. Anderson	Assistant Professor	0.90		0.10		Research Pathology
Edgar Clemens[1]	Associate Professor	0.50		0.50		Physiology
Paula J. F. Cray	Assistant Instructor	1.00				Research Pathology
Alan R. Doster	Associate Professor	0.93		0.07		Diagnostic Pathology
Gerald E. Duhamel	Assistant Professor	0.95		0.05		Diagnostic/Research Pathology
E. Denis Erickson	Professor	0.90		0.10		Diagnostic Bacteriology
Donald L. Ferguson[1]	Professor	0.86		0.14		Parasitology
Merwin L. Frey[1]	Professor	0.69		0.06		Research Virology
Alex Hogg	Professor	0.07	0.88	0.05		Swine Diseases
Clayton L. Kelling	Associate Professor	0.94		0.06		Research Virology
Rodney A. Moxley	Assistant Professor	0.93		0.07		Diagnostic/Research Pathology
Fernando Osorio	Assistant Professor	1.00				Diagnostic/Research Virology
Marvin B. Rhodes	Professor	1.00				Immunochemistry
Duane N. Rice	Associate Professor	0.07	0.87	0.06		Dairy and Beef Cattle Diseases
Daniel L. Rock	Associate Professor	0.85		0.15		Research Virology
Douglas G. Rogers[2]	Assistant Professor	0.90		0.10		Diagnostic/Research Pathology
Norman Schneider	Associate Professor	1.00				Diagnostic/Research Toxicology
S. Srikumaran	Assistant Professor	0.85		0.15		Immunology
R. Gene White	Professor	0.07	0.13	0.05	0.75	Feedlot Management Diseases and Director, Institutional Animal Care Program
Timothy J. Zamb[2]	Associate Professor	0.90		0.10		Molecular Biology
West Central Research and Extension Center						
Lavon J. Sumption	Professor	0.46	0.47		0.07	Director
John B. Campbell	Professor	0.50	0.50			Entomology (Livestock Insects)
Donald C. Clanton	Professor	1.00				Animal Science (Beef)
Richard Clark	Associate Professor	0.25	0.75			Agricultural Economics
David M. Danielson	Professor	1.00				Animal Science (Swine)
Gene H. Deutscher	Associate Professor	0.28	0.72			Animal Science (Beef)
Gary W. Hergert	Associate Professor	0.40	0.60			Agronomy (Soil Science)
Jerre Johnson	Professor	1.00				Veterinary Science
Norman L. Klocke	Associate Professor	0.50	0.50			Agricultural Engineering
Dale T. Lindgren	Associate Professor	0.50	0.50			Horticulture
James T. Nichols	Professor	0.50	0.50			Agronomy (Range Management)
Paul T. Nordquist	Associate Professor	1.00				Agronomy (Sorghum Breeding)
Gail A. Wicks	Professor	0.50	0.50			Agronomy (Weed Science)

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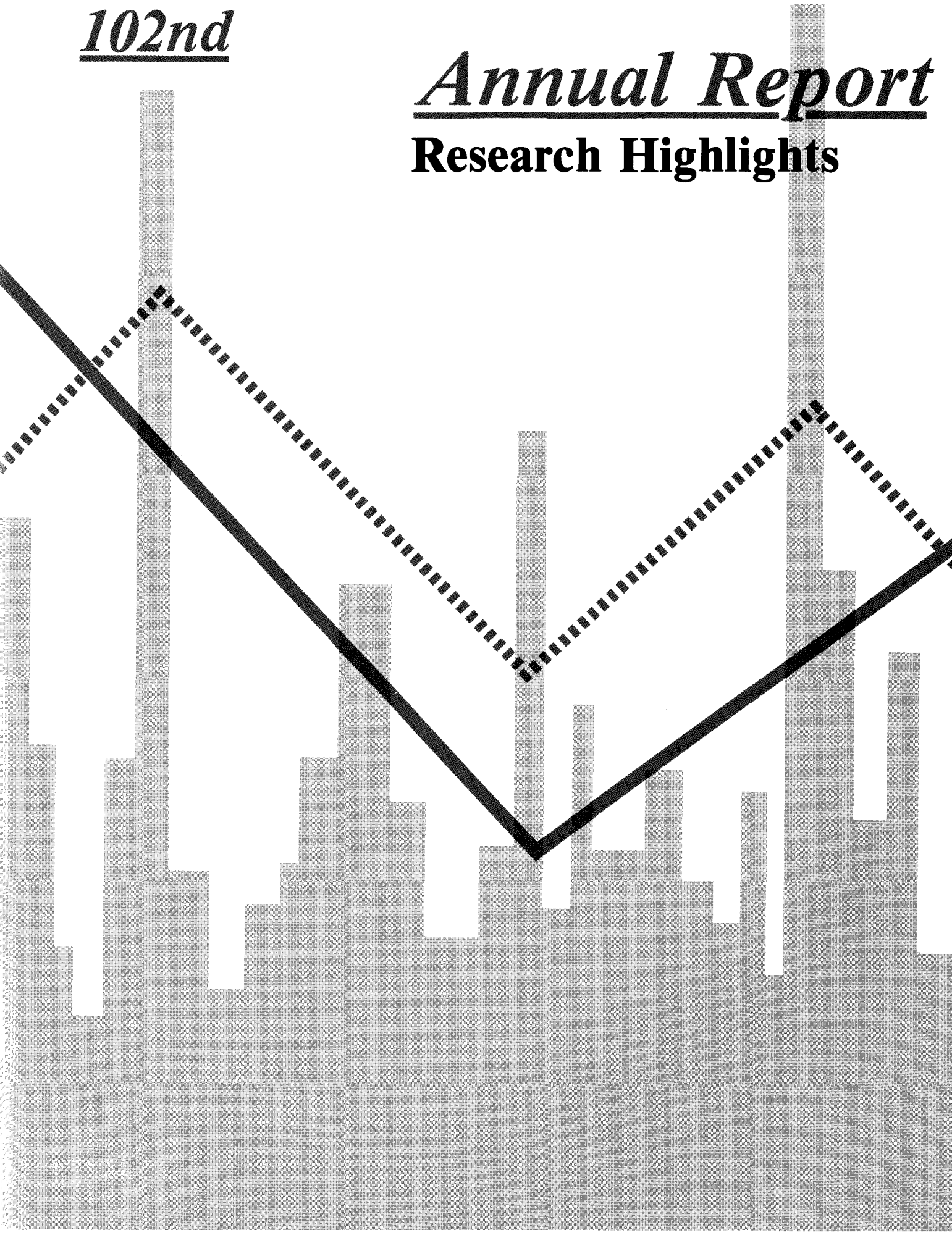
Annual Report

Research Highlights



Research Highlights

Agricultural Economics

Diversification

Diversification of agricultural crop farming by the addition of cattle feeding contributed to a reduction in income and security risk. However, low cash liquidity levels have an overriding negative impact upon income and security risk for both cash and diversified cash - cattle feeding operations. These results suggest benefits to greater diversification in crop and livestock farming operations in comparison to continuous cropping.

Cow Herd Management

The results of a cow herd management study revealed that open cows should be culled and replaced with replacement heifers. It also recommends longer breeding seasons for enhanced profitability, providing labor availability at calving time is not a constraining resource. Management practices which increase fertility and reproductive productivity contribute to higher profits. High replacement rates are also associated with increased profitability, providing feed supplies are adequate. With limited feed supplies, the reverse is expected.

Economics of School District Size

Research results show definite economies of size within 53 school districts in Eastern Nebraska. The economies of size are greatest when average daily attendance approaches 1,100. Most of the economies are achieved when average daily attendance reaches 400. Some slight diseconomies were also found at average daily attendance levels of 2,000, which was the largest size school involved in the study. In addition to daily attendance, the value of the physical plant per student, student density, and an educational quality index also helped to explain size economies in education in Nebraska.

Reinvestment Strategies

Reinvestment strategies based on a simulation of farm operations lead to the following conclusions and recommendations:

(1) Farmers with lower initial debt were better able to reinvest at higher levels.
(2) Farmers that participated in the "government program" marketing programs were able to reinvest at higher levels than farms that practiced the "sell at harvest" marketing strategies.
(3) Farms that practiced the "sell at harvest" marketing strategies experienced a higher frequency of cash short-falls than those who participated in "government program" marketing strategies.
(4) Irrigated farms were able to reinvest at higher levels than dryland farms.

Economic decision theory using common selection rules was used to evaluate optimal crop varieties for farmers. Based on producer behavior, characteristics of production functions, and risk two methods of variety selection would produce radically different genotype orderings. The results of the research suggest that economic decision theory, which reflects producer preferences, may in certain situations, lead to selection of very different varieties as compared to standard selection methods typically employed by plant breeders.

Agricultural Education

Agricultural Education

The purpose of the Leadership Education Action Development (LEAD) program is to provide promising adult men and women an opportunity to participate in a two-year education program designed to enhance the long-term future of farming/ranching and agribusiness by developing future leaders. It purports to enhance participants' knowledge of national and international economics and social changes; awareness of organizational decision-making processes and the role of political institutions; sensitivity to the needs of society; and preparation to deal with issues impacting agriculture.

An independent evaluation of the extent to which the program's purposes and objectives were being achieved concludes with the following:

1. LEAD increased participants' commitment to persist in an agricultural occupation.
2. LEAD Alumni were more active in a greater variety of organizations, particularly ag-related organizations. Further, they were more likely to be officers in those organizations and to devote more time participating in organizational activities. LEAD Alumni were significantly more likely to be asked to speak to larger groups, both in terms of size and variety, than were those who had not been through?
3. Attitudes of participants were significantly different than either new program enrollees or non-accepted applicants on the following factors:
   -Alumni have a more cosmopolitan understanding of economics.
   -Alumni were much less parochial in their attitude toward the formulation and effect of

policy.
-In addition to much greater involvement, alumni were significantly more likely to be supportive of farm organizations.
-While not statistically significant, there was a clear trend for LEAD alumni to be more understanding of the legislature's sensitivity toward agricultural needs.
-Alumni were broader in their view than others outside of agriculture and were as likely to be honest as those involved in agriculture.
-Although not statistically significant, there was a convincing trend that alumni feel those involved in agriculture were reasonably well informed on foreign policy.

4. LEAD Alumni overwhelmingly endorse the program.

Agricultural College Students

The psychological type profile of students majoring in the College of Agriculture is significantly different from the "typical" college student. College of Agriculture students are more introverted, less extraverted; more sensing, less intuitive; more thinking, less feeling; more perceptive, less judging than the typical college student. This translates into a student more interested in a practical application of knowledge than theory.

Agricultural Leadership

A statewide study of agricultural leadership from 4-H and FFA youth to adult leaders revealed differences in psychological type from youth to adults. The youth leaders were significantly more intuitive and feeling than were adult leaders who were more sensing and judging. Combining all the leadership groups studied (4-H/FFA, Young Farmers, LEAD, Vo-Ag teachers, Extension Agents, and Commodity group leaders) the psychological type profile is similar to a "main street business" leader - more sensing, less intuitive; more judging, less perceptive. Agricultural leadership may be characterized as hard working, traditional, loyal to their organization, somewhat resistant to change and skeptical of the future.

Classroom Environment

Preliminary data indicates that a teacher's personality type has a profound effect on the climate they create in the classroom, some negative and some positive. Teachers who were feeling and perceptive created more positive environments than did thinking-judging teachers.

Adult Agricultural Education in Secondary Schools

Attitudes of 171 superintendents, principals and vocational agriculture instructors in 57 Nebraska schools were somewhat to very positive for inclusion of adult education in existing vocational agriculture programs. Groups most likely to accept adult agriculturist as a secondary school clientele group were teachers, followed by principals and superintendents. Teachers were more likely to have higher agreement with statements about benefits and public support for adult education, while administrators were more likely to safeguard traditional school funding and structure. Existence of adult education in the current program positively impacted attitudes regarding adult education in agriculture for all respondent groups.

Agricultural Engineering

Extrusion-Cooking of Starch

Many breakfast cereals, expanded and puffed cereals, and pet foods which constitute a multi-billion dollar business in the continental U.S. alone are prepared using extrusion-cooking technology. Crispness or crunchiness is indicative of product quality and is controlled by the degree of expansion, which is in turn controlled by factors such as extrusion processing variables, quality of the raw material, and macromolecular and chemical changes that take place during and after extrusion cooking.

Systematic studies have covered the entire spectrum of corn starch extrusion cooking. Variables producing maximum expansion volume (16.1) of normal corn starch have been determined. Among corn starches, differing in apparent amylose contents from 0 to 70%, the 50% amylose starch (Amylomaize V) was found to expand the most. The expansion properties of 0, 25 and 70% amylose starches were enhanced when sodium chloride was mixed to starch at a rate of 1 g/100 g starch prior to extrusion processing. An overall maximum expansion of 17 was then achieved.

A fundamental change that took place during extrusion cooking of starches was the degradation of starch molecules into small pieces. This decreased paste viscosity and enhanced expansion of the starch product. Macromolecular degradation of starches was a function of extrusion process variables, type of starch, and addition of sodium chloride. In general, amylopectin, the branched fraction of the starch, underwent more severe degradation than amylose, the linear or unbranched fraction. Upon prolonged storage, cooked degraded starch molecules reassociate by the process of retrogradation which reduces the expanded volume and thus the crispness of the product.

Overall, this research has added to the understanding of the starch molecule and the extrusion-cooking process. The results, along with those of further in-depth studies on starch, will be useful in the development of grain varieties for specialty applications.

Thermal Conductivity of Soils

Performance of ground-coupled heat pump systems

for farm, home and industrial use greatly depends on the thermal properties of the soil in which the heat transfer coil is buried. Agricultural engineers with the help of soil scientists in the Agricultural Research Division of UNL are investigating the thermal properties of soils in Nebraska. They also are developing improved methods for backfilling and consolidating the soils which surround the coil.

The study involves field and laboratory trials as well as mathematical modelling so that a wide range of soil, soil moisture, soil density and soil admixtures can be assessed. Previously undefined effects of soil shrinkage away from the heat exchanger surface will be of particular value for design of improved ground-coupled heat pump systems. Included among applications of this rapidly emerging technology are heating and cooling systems for homes, swine farrowing and nursery operations, greenhouses, and commercial and industrial buildings in small communities and rural areas.

Development of Management Models

Recently developed Expert Systems (ES) technologies provide a new set of tools that can be used to develop advanced management models for agriculture. An expert system is a computer program that mimics an expert in helping solve specific problems or select among alternatives. Knowledge from experts is represented in the form of IF-THEN rules. Subjective decisions, such as "when to plant" or "which herbicide to apply", represent the types of problem to which these new methods can be applied. The field of artificial intelligence, of which expert systems is a subset, is currently under rapid development. New development shells allow the integration of the rule-based knowledge representation with virtually all types of software. Optional interfaces are available to connect hardware devices to the expert system, for automated data collection and control.

Agricultural Engineering has been involved with the development of advanced expert system methods integrating these new capabilities with other models and data collection hardware. A commercially available voice recognition unit has been interfaced to a meat grading expert system. Quality measurements are made on a carcass and orally reported via a microphone into the expert system.

A year-round beef forage expert system is under development to balance the forage resources available from Nebraska pastures with the nutrition requirement of herds of beef cattle. The expert system integrates the knowledge base rules with forage and animal data stored in various databases and simulates the bi-weekly forage production with the herd nutritional demands. The forage data base represents the bi-weekly production and quality of a wide range of forage species under varying Nebraska growing conditions. The animal data consists of database management routines to generate and maintain the animal inventories of several herds of beef cattle. The simulation model inventories the bi-weekly forage production and quality and compares it with the livestock intake and nutritional needs. The simulation model determines the recommended grazing rates under several grazing management strategies. When needed, protein supplementation is recommended. This model is being developed as a multi-disciplinary effort of agronomists, animal scientists and agricultural engineers.

Irrigation Management

Agricultural engineers have developed new methods of scheduling and managing irrigation to address changes that are occurring in agriculture. The method is specifically applicable to locations where the available irrigation water supply is limited to an amount less than required to produce the maximum crop yield on the total area that could be irrigated. The method utilizes computer models to estimate crop yield from specific irrigation strategies. Several techniques were used to select the best ("optimal") allocation of water. Decisions provided by the analysis include:

a) area to plant and type of crop to plant on irrigated and dryland areas,
b) distribution of water supply within a season,
c) allocation of water over a 5 year period, and
d) evaluation of risk associated with various management strategies.

Results from the new method will be summarized in tables for select areas. User friendly computer packages will also be developed to assist irrigation management. The results of the project will assist irrigation managers in adapting to the forced reduction of water use for irrigation. Irrigators have little experience in deficit irrigation and it appears to be an uncertain and risky practice. The research will also be useful to agencies responsible for managing water resources. It should help regulators evaluate and develop policies that are effective and economical. These results will also increase the value of the irrigation water used and maximize the benefits of the use of natural resources.

Agronomy

Reducing Weed Control Costs

In recent years, Nebraska grain producers have been confronted with drastic reductions in profit margins. Growers have been forced to look carefully at ways in which their farm operations can be managed in order to increase production efficiency and net profitability. Weed control costs comprise between 7

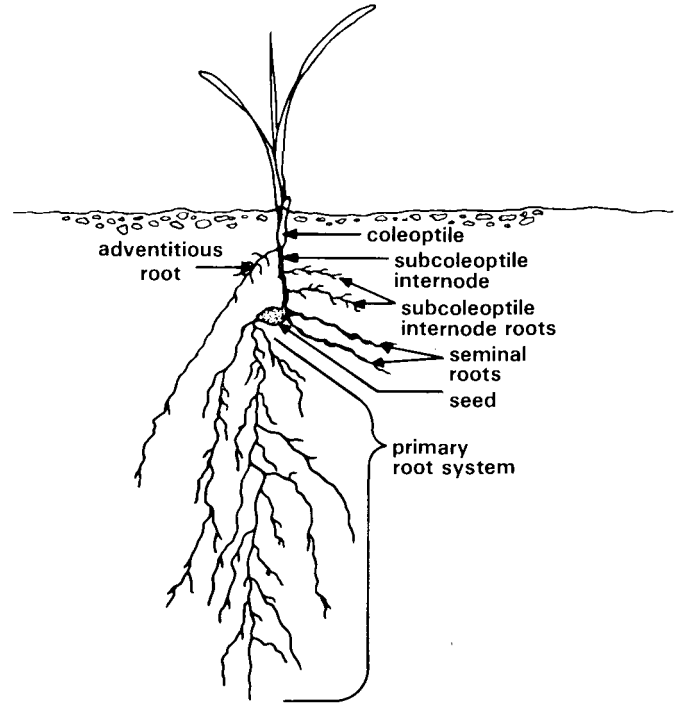
to 20% of the variable costs of grain crop production and, as such, represent an area in which cost-cutting measures could result in significant reductions in cost per unit of production.

The recent development of selective postemergence herbicides allows the grower flexibility which can translate into significant reductions in production costs. The grower can treat only those fields where weed populations will cause a significant yield loss. One of the keys to economical use of postemergence herbicides is knowing when it is cost effective to apply them. The weed population at which the cost of control is equal to the yield lost if no control measure is used is termed the "economic threshold" and is the foundation upon which sound weed control decisions are made. Significant reduction in the amount of herbicide applied could be realized if a decision-aid was available to help the grower with cost-benefit decisions on the many weed control treatments available.

Field studies are being conducted in Nebraska to determine the impact of weeds on crop yield. These weed competition results coupled with an existing data base on postemergence herbicide efficacy, herbicide costs, application expenses, potential weed-free yield, and an estimate of crop selling price will be used as inputs for a weed control decision aid. In order to consider all of this information in some practical time frame, it is necessary to speed the weed control recommendation process up with a personal computer. A management tool that helps Nebraska producers determine when a herbicide treatment is economically profitable will also reduce herbicide expense and the environmental impact of herbicide use.

Grass Seedling Morphology

Establishing perennial forage grasses is difficult, especially warm-season prairie grasses. Poor stands can result due to numerous environmental interactions with the seed or the young seedling. The three phases of seedling development are: 1) germination 2) emergence 3) establishment. Problems exist at each step. Germination may be limited by seed dormancy and lack of moisture. Emergence may be reduced because of too deep planting or crust formation. Establishment is reached when the seedling is capable of surviving with its own leaf area and the seedling is able to survive periods of adverse environmental conditions. The seedling root system lasts only a few weeks, so a grass seedling is not assured permanence until the adventitious (permanent) roots form at the seedling crown. A new grass stand is vulnerable to drying until adventitious roots are developed. Several days of moist soil around the seedling crown area are necessary for root formation. Warm-season grasses elevate their seedling crown to the soil surface by elongating the internode below the crown. This places the source of adventi roots at the soil surface where drying often delays or prevents adventitious root formation. Cool-season grasses elongate the node below the seedling crown little, if at all. This leaves the seedling crown near the seeding depth where environmental conditions are more conducive to adventitious root formation. Warm-season grasses should be seeded shallowly so the energy in the seed is not wasted elongating the internode below the crown. Cool-season grasses might be seeded a little deeper, in dry conditions since the seedling crown stays near the seeding depth.



Morphology of grass seedlings influences seeding success.

Predicting Fertilizer Needs for Winter Wheat

Fertilizer costs often exceed $20 per acre for winter wheat. Fertilizer may increase wheat yield far in excess of investment. However, much fertilizer is also applied in Nebraska when none is needed or a lower rate would maximize yield. Such applications result in reduced profits for producers. While accurately predicting fertilizer needs with soil testing has been an on-going research project for over 40 years, the task is difficult because of the many crop, soil, and weather factors that influence yield response to fertilizer. Recent research on wheat in southwest and central Nebraska has provided a data base from which phos-

phorus fertilizer needs can be predicted in terms of soil test level, soil pH, method of application, and yield level. The most economical rate, depending on prices of wheat and fertilizer, can then be predicted. This will be the first time growers anywhere have been provided such a comprehensive fertilizer prediction function. The data base for determining the most optimum rate of P, as influenced by method of application, will especially help producers to greater profits. Previous recommendations call for twice the rate of P when broadcast and incorporated compared to P applied with the seed. New recommendations based on profitability, suggest that a higher phosphorus rate be used with seed application than with broadcast application. However, profitability of the seed application will nearly double that of broadcast applications. This research will help wheat farmers in Nebraska become more competitive with other wheat growers in the U.S. as well as around the world because they can use their soil resources more effectively.

Animal Science

Swine Nutrition Research

Soybean meal is the most widely used protein supplement in swine feeds in the United States and perhaps throughout the world. Soybean protein is excellent in quality and contains abundant quantities of the essential amino acids (building blocks of protein) to balance those deficient in cereal grains. Soybean meal is produced from soybeans being crushed for extraction for their oil content. The crushing process involves heat which destroys antigrowth factors present in raw soybeans. Unfortunately, current soybean processing methods do not remove all of the antigrowth factors; thus, the soybean meal being fed today yields only 80% of its potential value for swine. Research being conducted in the Animal Science Department is directed towards improving processing to increase the nutritional value of soybean meal for swine. Our research has shown that when crushed, hexane extracted raw soybeans were further extracted with a 50:50 mixture of ethyl alcohol, the digestible protein in the resultant soybean meal was increased 60% for underheated soybeans, and 3% with properly toasted or even overheated soybeans, clearly indicating that the ethyl alcohol treatment made the protein and/or amino acids in soybean meal more available to the pig. This finding opens up another avenue for the use of ethanol being produced from Nebraska corn. Besides its use to extend gasoline supplies and reduce environmental pollution, the ethanol can also be used by soybean processors to increase the nutritional value of soybean meal.

Early Puberty in Swine

Early puberty is necessary to optimize reproductive efficiency of the breeding herd. Gilts that are bred at second or a later estrous period produce more live pigs at first parity than gilts bred at first estrus. Additionally, replacement gilts that cycle early are ready and able to fulfill the demands for replacement gilts in a batch farrowing program with minimal feed, labor, and facility costs. Swine research at the University of Nebraska Agricultural Research and Development Center at Mead, Nebraska, has focused on the identification of factors in the rearing environment of gilts that stimulate or inhibit pubertal development. Rearing gilts in total confinement delays puberty compared to rearing gilts in dry lots maintained outside. Extensive evaluation of decreased light exposure, i.e., day length and light intensity, as a possible cause of delayed puberty showed that quantity of light provided during development had little impact on age at puberty. More recently, the effect of pit gases (ammonia being one of the primary gases released in confinement when excretory products decompose) on pubertal development was evaluated. Gilts reared in poorly ventilated rooms in which ammonia levels were allowed to reach approximately 20 ppm attained puberty 8 days later than gilts reared in well ventilated rooms which contained approximately 10 ppm ammonia. Boar exposure is the most powerful natural stimulus identified thus far to trigger puberty whether gilts are reared in confinement or outside. Fifteen minutes of once-daily boar exposure is equally effective as 30 minutes to stimulate early puberty and for accurate detection of estrus in gilts maintained in confinement. Regular exposure of developing gilts to more mature estrous gilts is also stimulatory to pubertal development.

Energy Metabolism and Nutrient Restriction

Compensatory growth is a phenomenon exhibited in all mammals and can be defined as a period of accelerated growth following a period of slow or zero growth. Therefore, compensatory growth occurs in animals that have undergone some degree of nutrient restriction. In the beef cattle industry, compensatory growth usually occurs after a slow growing period associated with wintering calves. The biochemical mechanisms responsible for compensatory growth are not established, but may involve changes in maintenance energy requirements. The visceral organs (primarily gut and liver) account for about 40% of the maintenance energy requirement of animals even though these tissues account for only 8 to 10% of body weight. This research demonstrated that limiting nutrient intake modifies visceral organ size and energy metabolism. Sheep were either fed a high energy diet

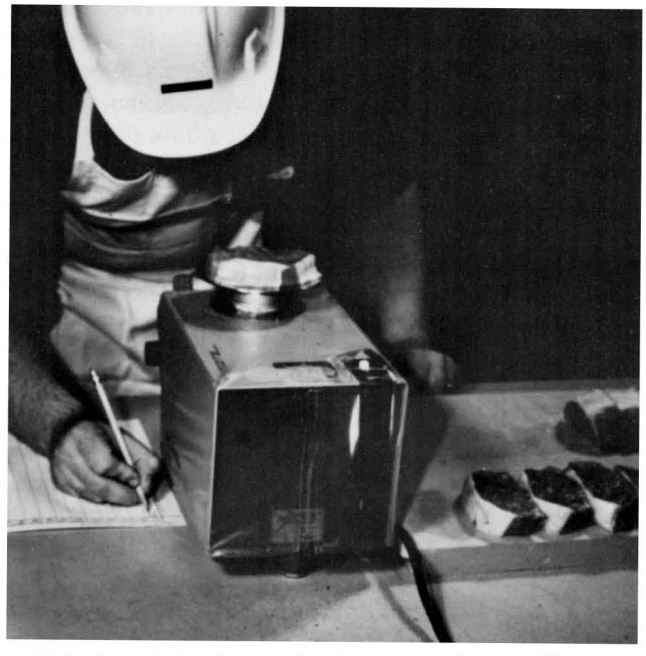
ad libitum or feed intake was limited to maintain their body weight. The amount of feed required to maintain body weight of lambs fed to maintain weight decreased suggesting a reduced maintenance requirement. Even humans show a similar response which is why it is easier to lose weight early when dieting. Liver and gut also became smaller in the maintenance group either in total weight or expressed as a percentage of body weight. In addition, the cells of the liver became smaller and actually had less metabolic machinery in them and required less energy to function. The next phase of these studies is to measure how the metabolically active organs in the maintenance group respond to excess nutrients. Does the fact that they have less metabolic machinery in their metabolically active organs allow the animals to partition more of the energy to growth of muscle when they are allowed to eat ad libitum?

Modeling of Reproductive Management

Average calf crop percentage in Nebraska is estimated to be approximately 80%. The 20% loss in calf crop can be traced to a wide array of environmental and genetic factors. Management practices which will improve number and weight of calves weaned are well documented. However, little consideration has been given to the economic efficiency of these practices. In the Nebraska Integrated Reproductive Management project, computer models were developed to evaluate the economic efficiency of (1) duration and timing of breeding seasons and (2) culling policies for non-pregnant females. Economic efficiency was higher for spring calving than fall calving due to lower feed costs. With high first service conception rate (70 or 80%), there was little difference in net income for breeding seasons of 45, 70 and 120 days. When first service conception rate was lower (50 or 60%), net income was highest for the 120 day breeding season. Breeding heifers 3 weeks ahead of the cows generated higher net income, especially when conception rate at first service was low. Culling of non-pregnant females was considered for a spring-calving herd where calves were sold at weaning. Net income was higher when non-pregnant females were culled compared to when they were retained. Net income decreased as number of non-pregnant cows retained increased. Current emphasis of the project is to evaluate artificial insemination and estrous synchronization as reproductive management strategies. Strategies to minimize economic losses and enhance rate of recovery from suppressed productivity due to environmental stress will also be studied. The accuracy of the models will also be improved by incorporating effects of nutrition on the length of postpartum anestrus and effects of birth date of calves on their probability of surviving to weaning.

Muscle Proteolysis and Meat Tenderness

Meat tenderness is enhanced through the action of naturally occurring enzymes within muscle, which specifically degrade certain proteins. This explains why meat becomes tender upon cooler aging. The impact of production of leaner meat animals is to decrease meat tenderness as animals become leaner. Thus, our ability to optimize action of the enzymes that improve tenderness will become increasingly important. Two enzyme systems in muscle function to improve tenderness. Each system is optimally active at specific conditions within post-mortem muscle. The calcium-dependent protease (CDP) system requires calcium and is active during conditions found early after slaughter. The lysosomal enzyme system is active under conditions found within muscle after rigor mortis is complete. Research in the Animal Science Department shows that CDP activity accounts for about one-half of the variation in tenderness found one day after slaughter. About one-third of the change in tenderness that occurs during 14 days of cooler aging is explained by lysosomal enzyme activity. Research to find appropriate ways to optimize activity of each enzyme system is currently being conducted. By understanding the mechanism by which meat becomes tender, opportunities are created to improve palatability and increase the potential for production of lean, consumer-acceptable meat.



Methods are being developed to improve tenderness of lean, consumer acceptable meat.

Biochemistry

Sucrose Esters

Sucrose fatty acid esters (sucrose esters) have be-

come important additives for food, cosmetics, and pharmaceuticals. The FDA has approved their use as emulsifiers and stabilizers for baked goods, baking mixes, dairy product analogs, and frozen dairy desserts. They are used to improve texture in bakery products and to provide a protective coating for fresh fruits such as apples, bananas, pears, and pineapples. Sucrose esters are safe and are derived from natural food products - ordinary table sugar (sucrose) and beef tallow (fatty acids).

One or more fatty acid molecule(s) is/are linked to sucrose by a chemical reaction to make an ester, but there are eight different sites in the sucrose molecule where a fatty acid can attach. If only one fatty acid is attached, the compound is called a monester, while a diester has two, a triester has three, and a polyester has four to eight fatty acid molecules attached to one sucrose molecule. The number of fatty acid molecules per sucrose molecule affects the emulsification properties of the ester and which type of ester performs best depends on the food to which it is to be added. Currently, the industrial process for producing sucrose esters yields an uncontrolled mixture of mono-, di-, tri-, and polyesters. To obtain fractions rich in monoester, diester, triester, or polyester, expensive separation processes must be employed.

In a project sponsored by the Nebraska Department of Economic Development, reaction conditions have been developed that control the number of fatty acids linked to a sucrose molecule. Thus, for example, a monoester can be produced in a high yield without the expensive separation step. The new process should reduce production costs for the various esters significantly. Currently, two patents are pending concerning this research on sucrose esters.

Photosynthesis

In photosynthesis, plants take up carbon dioxide from the air and, with the energy of sunlight, convert the carbon dioxide to compounds that the plant can use for growth and grain production. Actually, photosynthesis consists of two major processes. The part that involves uptake of carbon dioxide and its conversion to compounds is called carbon fixation, while the absorption and utilization of light energy is referred to, collectively, as the "light reactions." During daylight, the light reactions and carbon fixation acts together in concert. However, in darkness, the light reactions cannot occur, but carbon fixation could theoretically proceed if a suitable form of chemical energy were available.

Research in the Department of Biochemistry has revealed mechanisms by which warm-season plants, such as corn and sorghum, shut off the carbon fixation process when darkness occurs and turn it on when there is light. Presumably, these regulatory mechanisms are important in maintaining a proper energy balance within the plant regardless of the presence or absence of light. An understanding of the control mechanisms involved in photosynthesis should suggest ways that the photosynthetic efficiency of plants might be improved. Such an improvement would in turn increase the production efficiency of crops.

Biometrics

Improved Statistical Methods

A continuing concern to agricultural researchers is the cost of experiments. Unwarranted cost cutting severely 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 have not been 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 that utilize information from experimental designs more comprehensively than "traditional" procedures. These mixed model methods facilitate the use of highly efficient designs that researchers tended to avoid because of their complexity. Using these techniques can result in up to 50% reduction in the cost of an experiment with no loss in the quality of information.

Microcomputer Technology Assists Interdisciplinary Research

A group of scientists from Agronomy, Ag Engineering, and Ag Economics at the West Central Research and Extension Center in North Platte are investigating a cropping systems approach to reducing ground water depletion and degradation by agricultural chemicals. Using Lotus 123 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 its collection. Soil moisture levels calculated weekly from 1000 neutron probe readings 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. Microcomputer technology has provided the scientist the opportunity to analyze and interpret data during

instead of after the growing season.

Center for Agricultural Meteorology and Climatology

Climatological Processes Studied by Satellites

Researchers from the University of Nebraska-Lincoln were among a select group of scientists involved in the First ISLSCP Field Experiment on the Konza prairie, near Manhattan, Kansas, during 1987. The objective of the research is to obtain an understanding of the processes controlling energy/mass exchange at the surface and how these are manifested in satellite radiometric data. The project on the Konza prairie centers on developing, improving, and validating methods to infer small-scale surface climatological processes from satellite observations. Experiments were conducted during four intensive field campaigns to document different periods of vegetative growth on the prairie: (1) green-up (May 26-June 6); (2) peak greenness (June 25-July 11); (3) dry-down (August 5-21); and (4) senescence (October 5-16). One group of UNL scientists made measurements of surface fluxes of heat, water, and carbon dioxide. Another group took radiometric and biophysical data measurements. The results obtained from this study will give a better understanding of processes occurring at the earth's surface. This should lead to the development of better models for forecasting weather and should provide information needed to help understand the impacts of various processes which have been implicated as having the potential to change the climate.

Instruments to measure radiation from prairie vegetation are used to duplicate data collected by satellites.

Climatology for the Decision Maker

New climate tools are being developed to help identify such climatic events such as drought. These tools incorporate data gathered in near-real time by telephone and satellite communication. Near-real time monitoring of the climate aids in the early detection of drought and in achieving more effective response to drought. The weather monitoring system now extends into 7 states and employs 60 automated weather stations. Wide-spread use of data from the system in irrigation scheduling has been achieved.

A prototype "on the farm" weather data gathering system has been developed to examine the potential of using weather data in a progressive scientific approach to agricultural production. The system provides data every 15 minutes to farm headquarters. Data are factored into decisions related to planting, tillage, chemical application, irrigation, and harvest.

Weather data to aid the decision maker are collected throughout the year by automatic equipment.

Consumer Science and Education

Independent Living for the Elderly

The increasing proportion of elderly residents and decreasing resources in smaller communities has the potential of creating serious problems for the state, communities, and residents unless appropriate planning and actions occur. Nebraska has a larger proportion than the national average of its elderly residents in nursing homes. It is estimated that 20 to 40% of those in nursing homes are inappropriately housed. An alternative strongly supported both by the elderly population and by those looking for less costly living alternatives for the elderly is the concept of indepen-

dent living. Elderly individuals are able to remain in their own homes rather than moving to a nursing home. However, to make independent living a viable alternative, a support system for services must be developed to provide for the gradually increasing needs of the elderly as they remain in their homes. Also, their housing may need to be modified to accommodate changes in health, mobility, and sensing abilities.

A study is currently underway to investigate the interaction between housing and service needs of the elderly and housing and service provisions within the community. Based on the findings, recommendations will be made that contribute to the well-being of elderly residents and the communities in which they live.

Changes in Family Financial Well-Being

A study is being conducted to determine how the economic situation of Nebraska Families changed between 1981 and 1986. The study utilizes data from the Nebraska Annual Social Indicators Survey which was assembled after contacting over 900 households every two years to ascertain changes.

Two measures of economic well-being are used: a) change in household income (adjusted for inflation) and b) change in an income/needs ratio based on household size and composition. The study compares changes in economic well-being between rural and urban households and between households with heads over 65 years and those with heads under that age.

Housing Design to Meet Future Needs

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. 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

Chiggers

Chiggers (*Eutrombicula alfredugessi*) are parasitic mites that infest many Nebraskans who work or vacation out-of-doors. Results of research indicate that chigger populations appear in early June, increase to a peak in July, and almost disappear by late September. One generation occurs per year, with the greatest numbers of these perennial pests associated with the intersection of tall grasses with either roadsides, mowed, or grazed areas. Results of field trials indicated that the best protection against chiggers is through the use of insect repellents containing high levels (50-100%) of DEET. Evaluation of Dursban, Deltic, Sevimol, and Ficam insecticides on infested grass plots failed to control the chiggers sufficiently to warrant their use. Preliminary indications are that close mowing of grass and weeds provided the best means of excluding chiggers from work and recreational areas.

European Corn Borer

The effects of the European corn borer on the internal functions of the corn plant are being investigated in greenhouse and field studies. Although this serious pest was first found in the United States over 75 years ago, the mechanisms through which it reduces yield are still poorly understood. Research has shown that moderate infestations of European corn borer larvae reduce photosynthesis of corn plants by 22% and the water conducting ability by 65%. The effects of European corn borer feeding in well-watered and drought-stressed corn also is being evaluated. These results may provide clues to improving non-chemical methods for reducing the effects of this pest. Alternatives may include timing of irrigation, changes in fertilization patterns, and corn breeding.

Corn Rootworm Management

Adult corn rootworm attractants, a feeding stimulant, and an insecticide have been successfully encapsulated in a corn based matrix to create slow-release granular formulations. Results of initial experiments indicate that corn rootworm beetles are attracted to the starch encapsulated formulations, and that beetles are killed when they feed on the granules. Additional field experiments are being conducted to increase knowledge of beetle behavior and to determine the effectiveness of various formulations under different field conditions. If this concept can be successfully applied to large scale corn production, an environmentally sound alternative method of rootworm control would be available to growers that would also

make use of a raw corn product.

Black Flies

Black fly adults, or buffalo gnats, are blood-feeding pests of humans, horses, livestock, and poultry. Species occur in Nebraska which look alike and only can be separated by differences in the chromosomes of larvae. Correct identification is essential to development and timing of any control measures. At least one of these look-alikes is the black fly which feeds in the ears of horses. Research in progress involves determining differences in DNA which may permit identification of the adults.

Environmental Programs

Production Practices and Water Quality

The effects of crop production practices on ground water quality is the principal focus of a major IANR research-demonstration project. Financed by a $1 million dollar grant over five years from the Burlington Northern Foundation, IANR scientists are examining the effects of various tillage, planting, irrigation, and chemical application practices. A substantial part of the project, now in its fourth year, is being conducted at the University's South Central Research and Extension Center. One of the chief focuses of the project is chemigation, or the application of agrichemicals through irrigation systems, particularly center pivot systems. One study simulates accidental chemical backflows. The purpose is to determine chemical movement in an aquifer and evaluate various cleanup methods. Other components of the project include evaluations of chemical injection and antipollution safety equipment and an extensive program of soil sample testing. While complete results of the research will not be available for some time, the study already is producing information on nitrogen use by a growing crop, nitrogen accumulation and movement in the soil, herbicide and insecticide dissipation and leaching, pest control, and water use efficiency.

Food Science and Technology

Mushroom Compost from Paunch Manure Wastes

During 1987, a portion of the work directed at studying the feasibility of mushroom production in Nebraska involved a study of the use of paunch manure wastes from cattle slaughter for production of compost for mushroom culture. During late summer and early fall of 1987, a small batch (i.e., 2000 lbs) of mushroom compost was produced using waste products as ingredients. Some of this compost was taken to the laboratory and inoculated with mushroom spawn. The compost supported the growth of the mushroom mycelia, and the mycelia ultimately fruited and produced mushrooms. If a mushroom growing industry becomes established in Nebraska, compost production from paunch manure could be a major source of compost as well as a means of utilizing the paunch wastes.

Two-Dimensional Electrophoresis to Determine Wheat Quality

It has been well established that baking quality of wheat is directly related to its protein content. However, there is enormous variability in quality even among wheats of similar protein content. Thus, the composition of individual proteins within a variety must play a role. An analytical method, called two-dimensional electrophoresis was developed to identify individual wheat proteins so that differences between varieties can be closely examined. The procedure is sensitive and requires only small amounts of sample. It may even be possible to perform this test on a single seed. Our goal with this technique is to identify proteins most important to baking quality. Successful completion of that task would be of benefit to the breeder in identifying key proteins to select for and by providing an analytical tool to screen wheats for baking quality. Wheats which have been successfully tailored or identified to specific food applications should have a substantial competitive edge in foreign markets.

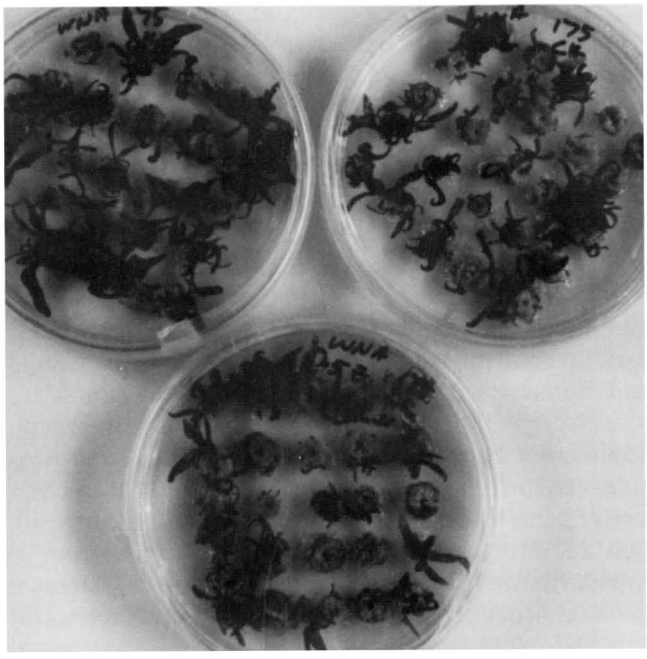
Forestry, Fisheries, and Wildlife

Eastern Cottonwood

Eastern cottonwood is the state tree of Nebraska, and also the most dominant tree species in terms of sawtimber volume in the state. Eastern cottonwood and some interspecific hybrids in the genus *Populus* are also the species of choice for short rotation, intensive culture biomass plantations for energy production. However, relatively little is known about the basic genetics and physiology of eastern cottonwood. Field studies aid in the selection of those genotypes which produce the most biomass. Genotype rankings vary depending on where the plantation is located in the state. Those traits which make one genotype more drought tolerant than another are also being investigated.

In the laboratory, research is focused on developing a gene transfer system for eastern cottonwood. A gene transfer system will allow genes isolated from other organisms (e.g., herbicide, disease, and insect resistance) to be transferred to selected eastern cottonwood genotypes. For the gene transfer system, it is necessary to grow the eastern cottonwood tissues in sterile culture in the laboratory to produce plantlets. Such a system has been developed, and the gene trans-

fer studies are now underway. This laboratory work also will provide a means for understanding the genetic control of traits especially important in woody plants, e.g., induction of dormancy and secondary growth.



Tissue culture of eastern cottonwood is one step in the development of a gene transfer system.

Eastern Redcedar and Rocky Mountain Juniper

Eastern redcedar and Rocky Mountain juniper are the most-planted species in the Great Plains region, primarily for windbreaks and shelterbelts. However, little is known regarding the genetics and physiology of either species. The two species are believed to hybridize extensively, making it even more difficult to determine the characteristics influencing adaptability of each species. However, laboratory studies have indicated the two species may not be hybridizing as extensively as once believed. In analyzing the chloroplast DNA from individuals of both species originating from Montana to Texas, a 1,000 base pair deletion has been observed in the chloroplast DNA of Rocky Mountain juniper relative to eastern redcedar. Also, Rocky Mountain juniper requires two years for the cones to mature, while the cones of eastern redcedar mature in one growing season. If the two species are hybridizing as extensively as is reported in the literature based on morphological and biochemical traits, such a species-specific distinction in the chloroplast DNA would not be expected. This research will aid in determining which traits make Rocky Mounatin juniper and eastern redcedar more drought hardy and selection of genotypes which better tolerate the harsh environmental conditions found in central and western Nebraska.

Instream Flow And Fish

Water is a precious commodity in Nebraska. Statutes dating from 1895 designate that water can be used for beneficial purposes (domestic, agricultural, and manufacturing). In 1984, LB1106 was passed by the legislature which recognizes instream flow (fish and wildlife) as a beneficial use of water.

Studies are under way to determine how much water a fish needs. Channel catfish and flathead catfish prefer water over two feet deep with slow moving current and cover from logs or fallen trees. On the other hand, many minnow species seem to prefer shallow water, less than one foot deep, with currents of about one to two feet per second. However, different minnow species use different habitats. Sand shiners and silvery minnows use shallow waters around sand bars. Several species of chubs use deeper, swifter water in channels between sand bars. This is important to birds like the least tern that swoop down and catch fish in shallow water feeding primarily on sand shiners and silvery minnows.

This information in the form of habitat suitability index curves will be used in simulation models of river systems to allow water resource managers to predict how much water is needed for recreation and fish and wildlife uses of Nebraska rivers. Water needs can then be quantified to allow all beneficial uses of water to be considered when management decisions are made.

Locating a radio-tagged channel catfish in the Platte River using a hand-held antenna and receiver.

Horticulture

Breeding Dry Beans for Multiple Disease Resistance

Common bacterial blight, rust and white mold di-

seases are serious problems affecting dry bean production and seed quality in Nebraska. Bean common mosaic virus (BCMV) diseases affects susceptible varieties in Idaho where seed is produced for Nebraska farmers. Common blight interacts with both white mold and rust dictating the use of separate disease nurseries. The reactions to common blight and white mold are quantitatively inherited and narrow sense heritabilities are low. Rust (hypersensitive and small pustule disease reactions) and BCMV reactions are simply inherited. No genetic associations between reactions to the four pathogens were found. Selection for resistance to rust and BCMV is done on a single plant basis in early segregating generations while advanced lines are evaluated in separate replicated field tests for common blight, white mold and in non-disease yield tests. Pedigree, non-structured recurrent selection and back-cross methods have been used to combine multiple disease resistances in Great Northern and Pinto lines. Superior lines possessing multiple disease resistance will be released in 1989-1990.

Breeding for disease resistance (left) in Great Northern Beans improves quality and yield as compared to a standard variety (right).

Imbibition of Seed of Dry Beans

Seed hardness of dry beans is an undesirable trait affecting imbibition and cooking times of dry beans. An experiment was conducted to evaluate seed hardness of dry bean cultivars/lines from different planting dates in western Nebraska and stored under high and low controlled temperature and relative humidity (RH) conditions. Nine Great Northern and Pinto dry bean varieties/lines were planted at six dates, seven days apart at Scottsbluff, Nebraska and harvested at physiological maturity. Seed samples of each entry from each planting date were stored in incubators at 16 °C and 45 °C combined with 22-24% and 98-100% RH, respectively, for 21 days. Seed weight after storage, seed weight after soaking for 8 hrs. and number of imbibed seeds were measured to evaluate imbibition and seed hardness. Seeds stored at 98-100% RH showed a linear increase in weight after storage and weight after soaking with later planting dates. The number of imbibed seeds of beans stored at 16 °C and 22% RH showed a linear decrease with later PDs. Seeds of white beans, particularly GN-Emerson, stored at 16 °C and 22% RH had greater weight after soaking and more imbibed seeds than the pinto cultivars. RH had a greater effect than temperature on increasing (high RH) or decreasing (low RH) seed weight after storage, seed weight after soaking and number of imbibed seeds. Storage conditions, varieties/lines and planting dates affected imbibition, and therefore hardness of bean seeds.

Somaclonal Variant Studies in Horticultural Crops

In vitro selection of stress-resistant plants is an objective of research in somaclonal variation. 'Bonnie Best' tomato plants regenerated from cotyledon- or hypocotyl-derived callus exhibited marked differences in leaf morphology and fruit size and type. Some variants had a leaf form that resembled typical potato leaves and other variants produced "cherry-type" fruits, i.e., small fruits born in clusters. Formation of such distinctly different types is encouraging, suggesting that stress-resistant plants could result if cultures are exposed to a stress agent such as a disease organism. Research is underway to improve regeneration rate from woody species such as *Castanea* in order to facilitate application of this approach in development of stress-resistant woody plants, i.e. blight resistance in chestnut.

Using Sulfur to Reduce Nitrogen Applications

The balance between fertilizer applications of sulfur and nitrogen has been explored for agronomic crops, but not for horticultural crops. In preliminary hydroponic studies using poinsettias, the amount of nitrogen needed was half the recommended rate when sulfur was supplied at half or full rates. Quality of vegetative and flowering plants was not affected. When sulfur was eliminated or available in low supply in the hydroponic treatments, poor quality and delayed flowering occurred. Reducing the quantities of applied nitrogen by using small amounts of sulfur shows promise towards reducing grower costs as well as groundwater contamination.

New Drought Tolerant Turfgrass Cultivar

An intensive four-year project on buffalograss (*Buchloe dactyloids*) has led to the planned release of a new turf-type cultivar by the fall of 1988. Buffalo-

grass is a warm-season species which requires little water, fertilizer, or mowing. Although it is used as turf in some situations, its poor turf quality has limited its general acceptance. The initial phases of this long-term breeding and development project have allowed the selection of genotypes with improved color, density, rate of cover, and a lower growth habit than the standard cultivar. The first buffalograss cultivar to be released NE84-315 is a female genotype selected in Fillmore, Nebraska. Initially it will be available for vegetative propagation as a prerooted plug. A prerooted plug is a container-grown cube of sod. This makes vegetative establishment of an area quite competitive with seed establishment. This genotype is also being used as a female parent in synthetic plantings for development of a seeded turf-type buffalograss. Use of this turf-type buffalograss cultivar should reduce the amount of water and fertilizer used to maintain a satisfactory turf by 50% when compared to Kentucky bluegrass.

Turfgrass Water Use

Water conservation is an important issue facing many turfgrass managers and homeowners. Selecting turfgrasses with reduced evapotranspiration (ET) rates is one potential means of enhancing water conservation. Cultivars of creeping bentgrass, perennial ryegrass, tall fescue and Kentucky bluegrass were evaluated for ET under field conditions. Cultivars were found to vary by a mean of 39% in their ET values. Creeping bentgrass cultivars had the least variation, with 30%, and Kentucky bluegrass cultivars had the greatest variations, with 64%. ET was positively correlated to cultivar vertical elongation rate and negatively correlated to cultivar greenness and shoot density. Cultivars with dense, low growth habits had lower water use rates than those with more vertical or upright growth. A reduced ET rate was associated with canopy resistance. These criteria have practical implications. Turfgrass managers and homeowners wishing to conserve water should select turfgrass species and cultivars with dense, low growth habits and slow vertical elongation rates. Water can be conserved in existing turfs by increasing mowing frequency. Increased mowing frequency eliminates vertical elongation, produces high stand density, and increases the canopy resistance associated with lower water use rates. In addition, the criteria of reduced vertical elongation rate and increased verdure production and shoot density can be used by turfgrass breeders to select and develop water conserving turfgrass species and cultivars.

Human Development and the Family

Single-Parent Families

Strengths and stresses of 738 single-parent families in 45 states were studied. The researchers found that a strong single-parent family is not a contradiction in terms. In fact, the researchers believe that there are millions of healthy single-parent families in the U.S. today. Problems faced by these families, however, are not insignificant. They include financial difficulties, feelings of loneliness and alienation, and difficulties in dealing with ex-spouses in regard to post-divorce parenting.

Stress and Wives' Off-farm Employment

Of the 323 Nebraska farm couples in this sample, 38% represented families in which the wife was employed off the farm. Supplementing farm income was the most common reason given for her off-farm employment (67%), though 18% reported their enjoyment of working was the most important reason. Thirty-seven percent of the women were in professional occupations, 31 percent in clerical or sales, 22 percent as laborers, and 10 percent self-employed. About half of the women reported they were employed 40 hours or more a week and were employed the year round.

Stress was a frequently reported experience among farm wives: 45 percent of employed wives and 34 percent of wives not externally employed reported experiencing stress "often" or "most of the time". The cause of their stress was reported as depressed farm economy (39%), threat of bankruptcy (28%), and multiple role demands (28%). Most of the wives reported they only rarely or occasionally shared their stress with their husbands, and 65% felt they received little help from their family in coping with their stressful life circumstances. The women coped with stress by praying (35%), talking with others (24%), and recreation (15% including hobbies, reading, watching TV).

Despite the high levels of stress, farm couples reported high satisfaction with their lifestyle. Although those wives employed off the farm were significantly higher in their reported experience with stress than those not employed off the farm, neither employment status nor number of hours employed were directly related to wives' perceptions of marital and life satisfaction. Rather, it was those husbands and wives in the high stress category, regardless of employment status, who reported significantly lower lifestyle satisfaction and marital adjustment. Also, it would seem that stress is most often modified by sharing the stressful experience with the spouse and receiving help in dealing with stress from the family. Interestingly, a husband's perception of stress did not seem to be affected by his wife's employment. It would appear that wives absorb most of the stress associated with their off-farm employment.

Marital Happiness

This study investigated specific, repetitive, small daily acts that strengthen marriage and events that disturb a stable relationship. Fifty-seven individuals married for 30-51 years were given an in-depth interview of 20 direct and open-ended questions. The smallest acts of smiling, touching, looking, hugging, thanking, etc., had a cumulative effect in: 1) maintaining and continuing a love relationship; 2) enhancing physical comfort and well-being; 3) encouraging individual growth and enjoying shared togetherness; 4) keeping special rituals and memories; 5) accepting children and in-laws as extra bonuses; and 6) removing negative occurances through open communication, humor, forgiveness, and courtesy. The ebb and flow of positive and negative helps maintain an open equilibrated system through self-regulatory compensatory activity of the couple.

Loneliness, Coping Strategies, and Cognitive Styles

Relationship between loneliness, coping strategies, and cognitive styles of 52 gifted students from rural Nebraska were studied. These students felt most lonely when rejected, alienated, or isolated. Coping strategies most frequently used were individual pursuits, social contacts, and cognitive reframing.

Disabled Individuals' Perceptions of Family

Family care and concern for individuals with disabilities is increasing. Governmental actions and public policy have decreased the hospital and institutional care and increased the family care. A group of 124 physically disabled individuals related their perceptions of the strengths of their family and the coping behaviors which they find most helpful in dealing with their disability. They indicated that the family showed a love and concern for them and helped them cope with their limitations. Often, they were not included in as many family activities, but nevertheless, the family of origin and marriage were both supportive. The family will continue to be the major source of support for these individuals.

Clinical Skills Required for Transitional Living

Individuals with mental illness are being released from settings to community health centers and other services. Generally, these individuals have been under the direct care of psychiatrists and psychologists. Clinicians and administrators (121) in 87 agencies and institutions across a four-state region were asked what educational background should be given individuals hired for positions in transitional living for the mentally ill. Two distinct sets of skills were identified. At the bachelor's level, assessment, service planning, and independent living were the desired clinical skills. At the master's level, program development, adminstration, management, and clinical supervision were the desired skills. The educational offering in the College of Home Economics have been adapted to meet these requirements.

Loneliness and Rural Families

Rural Nebraska adults living on farms and ranches were found to be the loneliest among all the adult groups studied. Loneliness and crisis are closely related. Many Nebraska farmers were experiencing extreme crisis because of the depressed farm economy.

Research has shown that the way to reduce loneliness is to interact with other people. Rural dwellers did not list activities that involved this type of interaction. Rather, they listed housecleaning, yard work, gardening, reading, and watching T.V. as ways they coped with loneliness.

Human Nutrition and Food Service Management

Nutrition Education

Older adults are particularly vulnerable to diseases related to nutritional status. They also tend to be more susceptible to nutrition misinformation. Sixty rural and urban adults, 60 years of age and older, were found to have misconceptions about health foods and supplements. The average amount of money spent on supplements was $52.00 per month with four individuals spending from $100 to $480 per month. Urban older adults most frequently purchased multi-vitamin supplements followed by calcium supplements. Rural participants most frequently purchased calcium followed by vitamin C supplements. While one-third of the respondents reported that they would be unlikely to take calcium supplements, in a later question, 86.7% stated that they would take supplements to prevent a health problem.

Cooking Turkey

Consumption of turkey has increased due to the interest in reducing saturated fats in the diet. When the whole turkey is prepared, the quantity of leftovers is a concern. As a means of encouraging increased consumption, many new forms of turkey, including processed luncheon products and raw parts, are available to the consumer. Acceptable cooking times and oven temperatures for roasting turkey breast and thigh parts have been investigated. Whole turkeys were wrapped in foil and cooked to a temperature of 180 degrees F in the thigh muscle. During this cooking it was found that the breast only reached 176 degrees F. Turkey thighs, with bone in, cooked to 180 degrees F and boned turkey breast cooked to 176 degrees F were tested by a sensory panel. Three different oven temperatures were used in cooking the turkey parts.

The thighs were found to be more juicy and tender when cooked in a 375 degrees oven to 180 degrees F in the muscle. The sensory panel found no preference in the breast meats cooked at the three oven temperatures.

Purchasing Practices of Food Service Directors

A survey of 235 rural Nebraska schools was conducted to identify current purchasing practices and opinions about cooperative purchasing. General information obtained about each school included number of meals served, use of a cycle menu, available equipment, storage capacity for food and present purchasing practices. Completed questionnaires were returned by 83% of the schools.

Food items were purchased by bid in 31 percent of the schools, while 68 percent of the schools purchased equipment by bid. The food service directors indicated satisfaction with present practices, and 35 percent considered indicated that a cooperative purchasing program would be cost effective. Only 17 percent indicated that such a program would be time effective.

Cost Control in Hospital and Nursing Home Food Service

Successful management of a food service operation includes serving a quality product and controlling food and labor costs. Implementation of prospective payment programs for medicare patients and private insurers has changed the approaches to food service management.

Opposite trends were found between hospitals and nursing homes in the areas of census, length of stay, and staffing changes. Hospitals reported a decrease in patient census and length of stay with a subsequent decrease in food and labor costs. Nursing homes reported an increase in food and labor budgets as resident census and length of stay increased. Hospital dietitians were thus, also interested in catering activities, limiting menu selections, and providing outpatient nutrition services.

Weight Control

Obesity is prevalent in American society. However, not only is the prevalence alarming, but a majority of people are unsuccessful at maintaining weight loss. Permanent weight loss and maintenance is successful only when the overweight person makes lifestyle changes in diet, eating behaviors, and exercise.

A multidisciplinary weight management program was developed for college students at the University of Nebraska Student Health Center. Nutrition lectures, aerobic exercises, individualized meal plans, behavior modification tools, and individual/group counseling were utilized over a ten-week period. During this interval there were significant mean decreases in daily calories, the consumption of margarine, candy and regular soft drinks. The percentage of protein of the total calories increased significantly.

Improving Hospital Food Service

The performance of hospital dietary personnel in preparing the correct diet order for each patient directly affects the quality of patient care provided. Errors in diet tray assembly influence patient satisfaction, hinder educational and medical therapies, and affect food costs. A pre-training audit of 255 diet trays was used as a control and the basis for the development and implementation of a five-session training program. A significant reduction in the error rate for all meals occurred as a result of the instruction.

Metabolic Nutrition

The hypocholesterolemic (cholesterol-lowering) effect of soy protein was found to be attributable to its high cysteine to methionine ratio. If methionine is used as a supplement to soy protein in an attempt to improve its protein quality, this assumed positive characteristic (blood serum lipid lowering) of soy protein is lost.

The feeding phase of a human study designed to evaluate the effects of tannins from tea on utilization of nutrients was completed and biological samples (urine, feces, blood) were sent to cooperating investigators in Oregon, Wyoming, Indiana (Purdue), New Mexico, Colorado, Washington, Hawaii, and California (Davis). Among other findings, tea consumption was found to have a hypercholesterolemic (increasing cholesterol) effect but was found to have an apparent lowering effect on absorption of lead, selenium and iron. Omega-3 fish oil and beta-carotene supplements were fed to human subjects in order to determine effects on blood serum lipid patterns.

Northeast Research and Extension Center

Crops Research

Research spanning 15 years continues to develop weed control programs for various conservation tillage systems. A new phase of this research is investigating various grasses and legumes which could be underseeded in soybeans as cover crops and subsequently regulated the next year in no-till corn. Initial research has identified potential cover crops and ways to more effectively establish them in growing soybeans. The effect of a living mulch on soil erosion will be studied with the rainfall simulator. Enhanced weed control and improved soil fertility are other potential benefits of the program. Potential adverse effects of a living mulch on no-till corn are also being studied. These include competition for soil moisture, which may de-

crease dryland corn yield by 10 to 15%. 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 produced. Oilseed rape, buckwheat, millet, 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.

Scientists examine corn roots to determine if development is adequate.

Swine Production

Three experimental trials using three- to four-week-old weaned pigs were conducted to evaluate the influence of a modified reduced nocturnal air temperature management regimen combined with hovers on animal performance and nursery building energy utilization. Overall average daily gain was reduced 5.7 percent with no difference in feed intake or mortality. Utility energy inputs and utility cost savings of nearly 26 percent were obtained by reducing daytime room air temperatures approximately 2 C° and beginning one week after weaning further reducing nighttime temperatures by as much as an additional 5.8 C°. These savings amounted to $0.50 per weaned pig placed on test. Reducing nocturnal air temperatures in a swine nursery offers the potential to reduce energy costs. However, when combined with hovers to further reduce energy inputs, pig performance may decrease sightly, even though air temperatures in the pig zone are maintained at what were previously thought to be adequate temperatures.

In cooperative research with scientists at the University of Missouri, the effects of feed and water restriction at the auction market and varying protein levels in the receiving diet were investigated. Upon arrival at a southern Missouri auction market, commingled pigs were given access to feed and water or no feed and water. Although pigs given feed and water lost less weight in the marketing and transport process, they were lighter at slaughter due to a reduction in overall feed intake. While there was a linear reduction in performance post-arrival, with decreasing protein in the receiving diet, there was no overall effect on performance.

Cattle Production

A series of studies evaluating corn silage, alfalfa silage and alfalfa hay in dry rolled, dry whole, ground high moisture and whole high moisture corn finishing feedlot diets demonstrated that corn silage was the preferred roughage source. Alfalfa tended to have a negative effect on feed utilization and/or intake during the early part of the feeding period, however, this was partially overcome by the end of the feeding period. Also, alfalfa silage was found to be an excellent roughage source in some diet treatments, suggesting that moisture in the roughage is most likely an important factor in utilization of high grain diets.

A summary of 12 trials conducted over three years showed that performance of cattle exposed to moderate cold stress during the winter was not improved by providing wind protection. Wind protection impaired cattle performance during the summer but aided in improving cattle performance during more severe winter feeding conditions. Cattle fed in unprotected areas in the winter had equal or greater fat thicknesses, marbling scores and quality grades compared to cattle fed in areas protected from the prevailing winds, suggesting that the animals priority for fat deposition is a mechanism for insulating the body when cattle are exposed to cold stress.

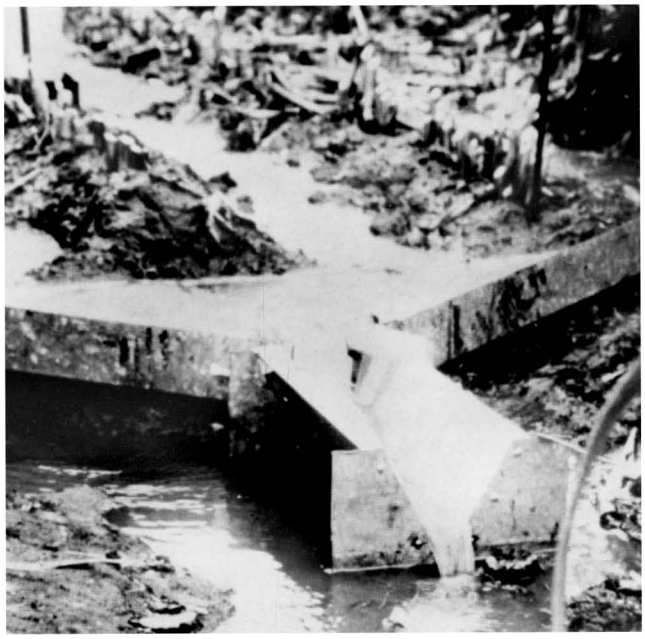
Soil Fertility

Research has been initiated to determine optimum soil sampling strategies in reduced tillage fields, residual value of phosphorus bands, and the effects of phosphorus placement in soybean production. Northeast Nebraska has many acres of soil that are calcareous and high in pH. It has been thought that phosphorus additions applied in the fall or from previous years would become unavailable for future crops. Research has shown that enough phosphorus can be applied for two or three years at one time without affecting crop production. This will save trips across the field and permit producers to move expenses from one tax year to another for accounting purposes.

Tillage Research

Runoff of water applied by center pivot irrigation

systems can be reduced by utilizing tillage practices which provide soil surface storage. The most effective practices alter the soil surface creating small reservoirs or basins. For instance, researchers found that on 10 percent field slope the use of implanted reservoirs at layby time reduced runoff by nearly 65 percent compared to a single disking when subjected to 4.5 inches of simulated rainfall. Similar reductions were recorded under field slopes of 1 percent. The ability to temporarily store water on the soil surface has an even greater effect on soil erosion reservoirs compared to a single disking. By storing the water which would normally move downslope, surface storage decreases the velocity of the water movement allowing the soil to settle into the storage areas created by the tillage practices.



Reduced run-off is measured from sprinkler irrigation following basin tillage while soil moisture storage is increased.

Panhandle Research and Extension Center

Benefits from Improved Proso Millet

Proso millet, a drought hardy crop, has been grown for many years in western Nebraska. Older varieties had lower yields, were prone to lodge, and were less profitable to grow. 'Rise' is the latest proso millet release from the University of Nebraska millet breeding program in western Nebraska, and it has about 10 percent better yield than any previous variety. In addition, it resists lodging and responds to better management. At current prices, the 10 percent yield increase would equal about $24.00 for every acre on which certified millet seed is grown. Its lodging resistance makes it much easier to harvest than the older varieties. Rise has also been used extensively as a parent in the breeding program for improved varieties beyond Rise.

Conservation Tillage

Five years of research at the University of Nebraska Panhandle Research and Extension Center have shown that sugarbeets and dry beans can be grown successfully in a rotation with corn using reduced tillage practices. Management of residue throughout the season is the key to success because of the extreme differences in the amount of residue produced by the different crops. Yield levels for all three crops were found to be similar for the plow, rotary strip till and minimum till systems. This work has resulted in the adoption of conservation tillage practices in an area traditionally using the plow as the primary pre-plant tillage implement.

Plant Pathology

Virus Diagnosis and Identification

A major concern of plant virology is identifying virus diseases. Since different viruses often give similar symptoms, identification requires more sophisticated physical or serological techniques. Techniques involving ultracentrifugation for purifying virus and gel electrophoresis for identifying its components have been developed. Techniques have been recently developed to separate viruses which are difficult to distinguish by even these more sophisticated techniques. These techniques involve breaking the protein of the virus into characteristic fragments by chemical or enzymatic treatment and then separating these fragments by gel electrophoresis.

New Form of Disease Resistance

Bean rust is a fungal disease causing damage to dry bean crops in the high plains and throughout the world. The main control is by repeated fungicide applications with continuing attempts to breed for specific resistance. Because of its extreme adaptive variability, this fungus is difficult to manage by specific resistance, and chemicals can be expensive. Plant pathologists and plant breeders have found that leaf hairs at high density can confer rust resistance that is not race specific. This unique disease resistance was found in beans grown in the Dominican Republic. It is easy to transfer genetically and can be incorporated into new rust resistant United States cultivars. The mechanism(s) of resistance is being studied.

Fungal Molecular Genetics

Plant pathologists are using recombinant DNA technology in order to determine the molecular basis of fungal-plant interaction. For example, anthracnose is one of the most serious diseases of alfalfa in the

United States. The breeding and development of resistant cultivars has been the primary control mechanism, since fungicides are not economically feasible. Initially, these cultivars are resistant to the fungus, however, new fungal races have appeared which are extremely virulent, causing considerable economic loss.

DNA transfer systems have been developed for these fungi. Thus the isolation and analysis of genes involved in pathogenicity can be identified. Similarly genes involved which successfully trigger the resistance response of the plant can also be obtained. Knowledge of how plants defend themselves on a molecular level will lead to the development of new concepts in controlling plant diseases.

South Central Research and Extension Center

Soybean Seed Treatment Studies

The effects of seed treatments on stand, seed weight, and yield of soybeans have been evaluated for three years. Disease pressure was present from pre- and post-emergence damping-off; but, not from Phytophthora root rot. Four different seed lots of poorer quality (70-82% germination) and two of higher (89%) were grown. Although some of the seed treatments did significantly increase the stands of the poorer seed lots, none of the seed treatments significantly increased the seed weights or yields of any of the seed lots over the untreated controls. Based on the above research results, the routine treatment of soybean seed is not recommended in Nebraska at this time. The exception to this recommendation would be to use a systemic seed treatment if there is a history of Phytophthora root rot problems and/or if a low-quality seed lot (less than 70% germination) is going to be planted.

Evaluating Sexual Behavior in Boars

At least 35,000 boars, or 20% of those used for breeding by commercial pork producers in the United States do not perform adequately sexually. This translates into a $50 million a year problem for the pork industry.

Swine research at the South Central Research and Extension Center, in cooperation with the U.S. Meat Animal Research Center, has been evaluating hormonal and management effects on sexual behavior in male pigs. This research is unique to the U.S. and has led to the development of an accurate method which can be used by the swine industry for identifying boars that have inadequate sexual behavior. The developed method systematically identifies non-performing boars as soon as they are sexually mature at about 7 to 9 months of age. Therefore, pork producers can avoid wasting money on keeping boars that will not satisfactorily perform and save the costs of maintaining females that do not get pregnant.

Phosphorus Fertilizer Placement for Grain Sorghum

Preliminary results of a three-year study evaluating phosphorus placement methods for grain sorghum on low P soils (less than 12 ppm P) have shown that band application is more efficient than broadcast application. Placement methods evaluated include broadcast, surface-band, starter, and sub-surface band. The surface treatments (broadcast and surface-band) were incorporated after application. Preliminary results indicate that surface-banding, along with incorporation, may be an efficient method to apply phosphorus fertilizer, along with starter and sub-surface band methods.

Research on phosphorus fertilizer placement for grain sorghum will lead to more efficient production.

Textiles, Clothing and Design

Home Dye Setting Treatments

Research was conducted on salt treatments to prevent bleeding and color loss when laundering new clothing. Seven treatments were evaluated and included soaking in salt water, salt and vinegar, Epsom salts, and copper sulfate. Results showed that none of the "dye setting" treatments reduced bleeding or fading in brightly colored cotton fabrics. Some treatments actually increased bleeding, fading and/or caused significant color changes. Therefore, home treatments for setting dyes appear to be a waste of the consumer's time, energy, and money.

A colorimeter is used to evaluate color change of clothing.

Cleaning Pesticide Contaminated Clothing - Oily Soils

The problem of 'invisible soil' or pesticide residues remaining in protective work clothing worn during mixing, handling, and application has been examined. Laundering recommendations have been published for minimizing direct and indirect exposure to workers and family members through appropriate laundering procedures. With few exceptions, laboratory laundering has been used to duplicate the home laundering procedures, and the fabrics studied have been unused or "new" fabrics.

Fabric that is used by pesticide handlers, mixers, and applicators may be soiled by body oils and by oily soils associated with equipment operation. This study was undertaken to determine whether the oily soils (synthetic sebum and vegetable oil) applied onto fabric specimens and then laundered prior to contamination contributed to pesticide absorption and retention. Research indicated that it is important that applicator clothing, especially of all cotton fiber content, be kept as clean as possible relative to oily soils such as body oils, machinery oils, or oily food stuffs. Residuals of oily soils in fabrics complicate residue removal. These findings point to the importance of daily laundering of protective apparel for pesticide application. Although these recommendations have been made in the past from concern for re-doning apparel contamination with pesticides, the results of this study illustrate the importance of removing all previous soil, particularly oily soil, from apparel fabrics prior to exposure to pesticide to minimize residue accumulation.

Cleaning Pesticide Contaminated Clothing - Fabric Softener

Fabric softener may accumulate on fabrics, because subsequent washing does not remove the lipophile already adsorbed by the textile item. "Softener build-up," refers to this phenomenon, such that as softness increases, absorbency decreases. Repeated use of high concentrations of fabric softener may render a fabric moisture repellent and affect chlorpyrifos absorption at initial contamination; however a trend was observed for increased after-laundering pesticide residue when fabric softener had been used in the laundering prior to contamination. Given the potential for fabric softener "build-up," this work was done to evaluate the use of fabric softener in laundering pesticide contaminated clothing.

At initial contamination, there was no consistent effect of previous washing with or without fabric softener on pesticide absorption. However, it was noted that as pre-laundering increased, there was a decrease in methyl parathion absorption. It was theorized that detergent residue or fabric softener was affecting subsequent absorption of pesticide. Fabric softener, whether not used, used once, or used repeatedly with and without removal cycles, had no impact on residue remaining after laundering.

Recovering pesticides from contaminated clothes is one step in determining the efficiency of laundering.

Cleaning Pesticide Contaminated Clothing -Detergents

Previous recommendations for laundering clothing contaminated with pesticides have included using as hot a wash temperature as practical and using heavy duty detergents. Recommendations also have been made for renewable, user-applied soil-repellent (SR) finish, yet work to date has not determined the contribution of detergent type (liquid, powder, etc.) and

concentration (package directions, more or less than the recommended amount) with the SR finish on residue remaining after laundering.

Research showed that one-half the amount of detergent recommended on the package was inadequate for effective residue removal. As the concentration of detergent in the wash water increased, the amount of residue removed increased; however, doubling the package recommendations for detergent was less successful than one and one-half times the recommended amount. Based on these findings, we recommend the use of the renewable, user-applied soil-repellent finish for clothing worn during pesticide application and laundering the applicator clothing with maximum water level and a measure and a half of detergent.

Redeposition of Pesticide in Laundering

Fabrics commonly used for work clothing, cotton and/or polyester, will continue to be used for clothing of pesticide applicators. Pesticide spills on the fabric may wet the area of original spill and remain in that position or may migrate to adjacent areas.

Soiling occurs not only when the textile is used; the textile may become soiled during laundering. Wet soiling during laundering involves transfer of soil from the textile via the washing solution to another fabric, or generalized redeposition by removal from the site of soiling, into the washing medium and thus to all areas of the fabric. Furthermore, during the laundering process, pesticide residue in the fabric from contamination can be re-solubilized and dispersed throughout the fabric by the washing medium. This work studied the spread or movement of pesticide through a large specimen fabric from the original site of contamination, and the contribution of laundering to that spread.

The greatest amount of after-laundering pesticide soil was located at the site of soiling, but there was generalized soiling throughout the fabric. Less pesticide soil removal was noted at the original site for durable press and soil repellent finishes. During laundering, the water/detergent acted as a solvent moving the soil from the fabrics; but also aided in generalized redeposition of the pesticide soil throughout the fabric. Based on these findings, recommendations are made to vigorously treat the site of soiling before and during laundering. Redeposited pesticide residue in minute amounts is difficult to remove from most fabrics.

Veterinary Science

Diagnosis of Bovine Herpesvirus-1

The infection with bovine herpesvirus-1 (BHV-1) causative agent of infectious bovine rhinotracheitis (IBR) or red nose, is one of the leading causes of respiratory disease which has been estimated to cost over $200 million per year to the U.S. livestock industry. In order to prevent and treat such a costly disease, a rapid and accurate diagnosis of BHV-1 infections was developed using a single blood sample collected at the time the animal appears sick. The test is based on the detection of the earliest type of virus-specific antibody, IgM, which appears transiently in the blood of the animal soon after infection. The test uses a rapid colorimetric reaction and involves the use of highly specific monoclonal antibodies. This test can be used effectively to detect acute respiratory and reproductive infections caused by BHV-1. The assay is a highly valuable diagnostic tool because blood is often the only specimen available to the practitioner.

Pseudorabies Not Carried in Water

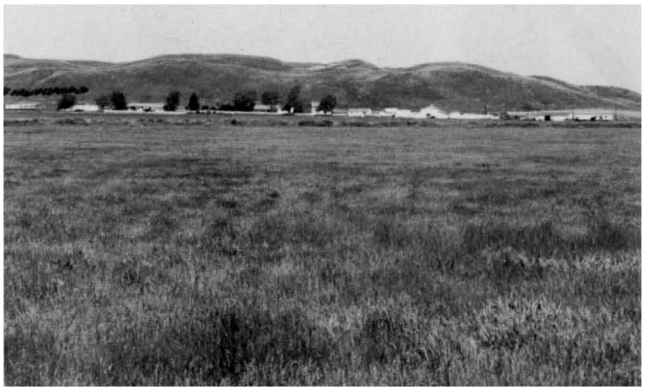
Pseudorabies or "Aujeszky's Disease" is a disease of swine and other mammals. Humans are not affected by the causative agent which is a herpesvirus. Swine are the principal host, and the disease is of great economic concern to swine producers. Young pigs under 2 weeks-of-age are most severely affected and usually die if infected with the virus. Older swine are more resistant and may not exhibit visible signs of sickness, but may harbor virus and serve as carriers of disease. The disease is usually carried from herd to herd by inapparently-infected swine; however, disease outbreaks have occurred in herds that have had no introductions of swine from outside sources. In these cases, owners are left searching for sources of disease introduction other than by carrier swine. Wildlife and pet animals are susceptible to infection with virus and have been incriminated as vectors of disease, but their role in disease transmission has been shown to be minor since the disease is rapidly fatal in these animals thus limiting the distance the virus is carried.

Surface water run-off has been implicated as a transmission source since pseudorabies virus (PRV) is shed in nasal secretions of infected swine. A research project was developed to determine if PRV virus is carried in run-off water. A specialized filtration system (tangential flow molecular filtration apparatus) was used to concentrate PRV in water to increase chances of recovery of the virus in the laboratory. The procedure was then used to sample run-off water from ten hog farms that were quarantined because of PRV infection. Pseudorabies virus was not detected in the water samples from any of the farms; indicating run-off water from farms with pigs infected with PRV is not a major source of virus to infect herds located downstream. The likelihood of natural transmission of PRV to swine via run-off water appears remote.

West Central Research and Extension Center

Fertilization of Subirrigated Meadows

Fertilization of a subirrigated meadow over a four-year period at the Gudmundsen Sandhills Laboratory near Whitman increased average hay yields by as much as 76 percent. Positive yield response resulted from fertilization with nitrogen, phosphorus, and sulfur applied alone and in combination. The highest yields were obtained from 120 lb. of nitrogen, 40 lb. of phosphate, and 20 lb. of sulfur per acre. This combination resulted in 3315 lb. of additional forage. Increasing nitrogen resulted in higher yields, but also caused a decrease in nitrogen efficiency (yield increase/unit of nitrogen applied). Percentage protein and digestibility of the forage were reduced by nitrogen fertilizer but not by phosphorus or sulfur. The magnitude of these forage quality responses were small. Any consideration of these negative effects on forage quality must be evaluated in conjunction with the positive yield responses. The economic feasibility of using commercial fertilizer to increase hay yields from subirrigated meadows should be evaluated on an individual ranch basis. Production costs and the need for additional hay to balance forage resources are factors that need to be considered. Follow-up studies on these same plot areas are being conducted on the fate of residual nitrogen. In addition, legumes are being evaluated as a means of improving hay yield and quality while circumventing the need for nitrogen fertilizer.



Research on subirrigated meadows at the Gudmundsen Sandhills Laboratory is determining the influence of fertilizers on forage yield and quality.

Ground Whole Soybean Diets

Recognition of the presence of growth inhibitors found in unprocessed whole soybeans prompted researchers to investigate their use, in an unprocessed but ground form, in swine gestation and lactation diets where the primary contribution of supplementation is for reproduction rather than growth. The studies showed that unprocessed ground whole soybeans compared favorably with soybean meal as the protein supplement. In addition to providing supplemental protein, ground whole soybeans provide added energy resulting in increased animal performance. Other advantages of including ground whole soybeans include: less dust because of the higher fat content, savings in transportation costs, savings in processing costs, and the possibility of using market discounted soybeans due to the presence of unacceptable inert materials. These studies have also influenced the acceleration of research involving the use of roasted and extruded soybeans.

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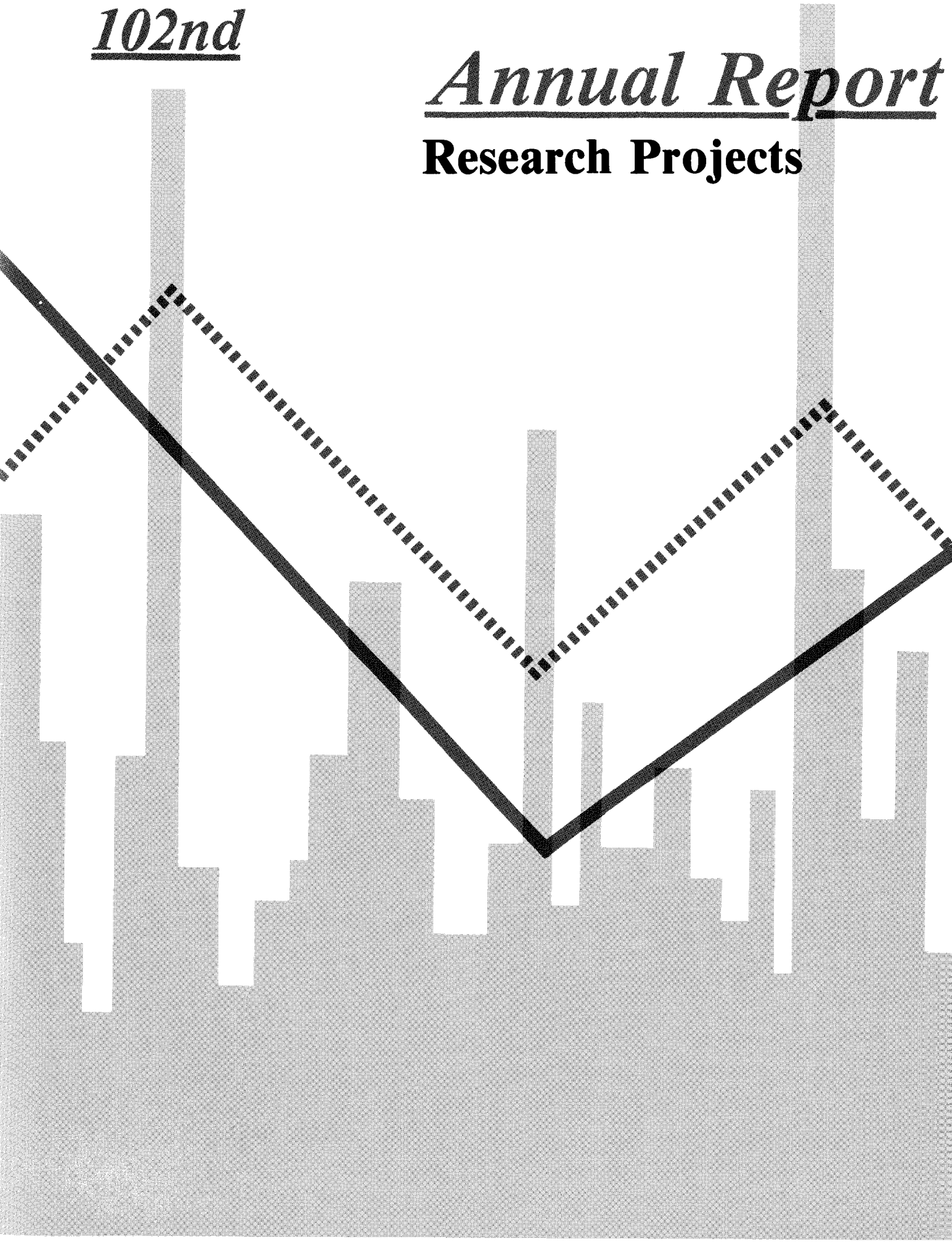
Annual Report

Research Projects



Research Projects

Research projects are listed by departments. An asterisk (*) indicates that the project was discontinued in fiscal 1987-1988.

Administration

01-001 General administration of federal fund research (D. H. Vanderholm)

01-004 Regional research coordination, North Central Region (D. H. Vanderholm)

Agricultural Communications

18-001 Dissemination of research information (G. L. Vacin)

Agricultural Economics

10-071 Effect of changes in transportation on performance of the U. S. Agricultural Transportation System (D. G. Anderson)

10-077 Reporting and analyzing farm real estate values and market developments in Nebraska (B. B. Johnson)

*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)

10-091 An economic analysis of risk management strategies for agricultural production firms (G. A. Helmers, H. D. Jose)

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 crops-livestock sectors (J. F. Yanagida)

10-099 Economic analysis of the potential for production and marketing of grain sorghum in the Phillipines (D. G. Anderson)

10-100 International trade and the macroeconomics of agriculture (E. Pagoulatos)

10-101 Determinants of farm size and structure in north central areas of the U.S. (G. A. Helmers, M. E. Baker, B. B. Johnson)

10-102 Domestic and international marketing strategies for western beef (J. F. Yanagida)

10-103 Price spreads and market structure in the beef marketing industry: theory and measurement (A. M. Azzam)

10-104 Empirical evaluation of integrating fundamental and technical market analysis (L. H. Lutgen, J. G. Kendrick)

10-105 Economic consequences of alternative food and agricultural policies (W. L. Miller)

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 soil and water conservation (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)

11-067 Integrated irrigation water and nitrogen management to sustain ground water quality and quantity (J. R. Gilley, D. L. Martin)

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)

11-079 Agricultural tractor testing board: policies and procedures (K. VonBargen, R. D. Grisso, J. R. Gilley)

Agricultural Research and Development Center

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

Research Projects

Agronomy

12-001 Corn breeding and genetics (W. A. Compton)

12-002 Improvement and evaluation of oats and barley (P. S. Baenziger)

12-011 Properties of Nebraska soils as related to soil genesis, classification, survey and land use (D. T. Lewis)

12-034 Cytogenetic studies on wheat and its relatives (M. R. Morris)

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 (P. S. Baenziger, C. J. Peterson, P. J. Mattern)

12-072 Introduction, multiplication, evaluation, preservation, cataloguing and utilization of plant germplasm (D. Andrews, K. P. Vogel)

12-076 Evaluation of grain crop variety performance in Nebraska (A. F. Dreier, R. S. Moomaw, R. W. Elmore, L. A. Nelson)

12-077 Systems for controlling weeds with emphasis on velvetleaf, shattercane and leafy spurge (A. R. Martin)

12-078 Nutrient management in conservation tillage to sustain productivity and preserve environmental quality (D. H. Sander, K. D. Frank)

12-080 Chemical aspects of phosphorus movement and availability to plants in sandy soils (R. C. Sorensen)

12-089 Integrating crop culture, chemicals, and life cycles to control persistent weeds (B. A. Swisher, R. G. Wilson)

12-091 Novel genetic approaches for soybean cultivar improvement (J. E. Specht)

*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)

12-109 Improving nitrogen-use efficiency in conservation production systems (J. F. Power, L. N. Mielke, W. W. Wilhelm)

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

12-114 Genetics, biochemistry, and breeding of forage sorghum and sundangrass (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)

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

12-126 Potassium 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)

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

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

*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. Power)

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

12-141 Mineral element uptake, use, efficiency, and tolerance in sorghum and millet (R. B. Clark, J. W. Maranville, D. Andrews, M. D. Clegg)

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)

12-145 Physical/chemical basis for microbial activity and nutrient cycling with conservation management (J. W. Doran, J. F. Power, L. N. Mielke, W. W. Wilhelm, J. M. Skopp)

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)

12-153 Resource efficient cropping systems for Nebraska (C. A. Francis)

12-154 Agronomy and cropping systems (M. D. Clegg, S. C. Mason)

12-155 Perennial forage grass breeding for Nebraska (K. P. Vogel)

12-156 Integrated weed control in grasslands of the central plains (R. A. Masters)

12-157 Physical, chemical, and biological interactions between mycorrhiza, soil and plants (J. R. Ellis, M. D. Jawson, L. N. Mielke, P. J. Shea)

12-158 Crop rotations and manure versus conventional fertilizers and chemical practices (C. A. Francis, M. D. Jawson, A. R. Martin, S. C. Mason, D. W. Nelson, J. F. Power, W. W. Sahs, P. J. Shea, D. T. Walters)

12-159 Evaluation, management and utilization of maize germplasm and breeding systems (C. O. Gardner, M. A. Thomas-Compton, W. A. Compton)

12-160 Increasing the efficiency of fertilizer nitrogen and phosphorus for grain crops (D. H. Sander)

12-161 Impacts of soil management practices on nutrient cycling in the agricultural ecosystem (D. T. Walters)

12-162 Ecological and agronomical manipulation of Nebraska rangeland vegetation (J. Stubbendieck)

12-164 Structure and expression of soybean leaf storage protein genes (P. E. Staswick)

12-165 Quantitative inheritance, selection theory and methods, and germplasm enhancement in grain sorghum (B. L. Johnson)

12-166 Sorghum genotype responses to mineral element stresses (R. B. Clark)

12-167 Physical factors controlling microbial aspects of movement and transformation of solutes in soil (J. M. Skopp, J. W. Doran, M. D. Jawson)

12-168 Analysis of genetic recombination in maize populations using molecular markers (W. A. Compton, M. A. Compton, M. R. Morris, C. O. Gardner)

12-169 Analysis of genetic recombination in maize populations using molecular markers (W. A. Compton, M. A. Thomas-Compton, M. R. Morris, C. O. Gardner, D. W. Galbraith, P. Staswick, M. Walton)

12-170 Alternative fertility sources in crop rotations (C. A. Francis, A. R. Martin, D. T. Walters, W. W. Sahs, P. J. Shea, J. F. Power, S. C. Mason, D. W. Nelson, M. D. Jawson, G. A. Helmers, T. W. Sullivan)

12-171 Selecting wheat and other cereal grains with improved market quality (P. J. Mattern, P. S. Baenziger, C. J. Peterson)

12-172 Studies on the physiological basis for improving efficiency of nitrogen metabolism in corn, sorghum and pearl millet (J. W. Maranville)

12-173 Evaluating plant nutrient needs and product quality (D. Knudsen)

12-174 Market quality of hard wheat for domestic and international foods (P. J. Mattern)

12-175 Improving the forage quality of grasses for Nebraska and the central great plains (B. C. Gabrielsen)

12-176 Development of an economic threshold decision aid for weed control in soybeans (D. A. Mortensen, G. A. Wicks)

12-177 Genetic determinants of baking quality in wheat (R. A. Graybosch)

12-201 Maintenance, increase and distribution of elite germ plasm (R. N. Mills)

Animal Science

13-022 Mineral requirements of swine (E. R. Peo, Jr., A. J. Lewis)

13-029 Genetic improvement of efficiency in the production of quality pork (R. K. Johnson, D. R. Zimmerman, R. J. Kittok)

13-036 Improving dairy herd management practices (L. L. Larson, F. G. Owen)

13-045 Improvement of beef cattle through breeding methods (M. K. Nielsen)

*13-050 Factors affecting texture of fresh and processed meat products (C. R. Calkins, R. W. Mandigo)

13-052 The requirements for and utilization of protein and amino acids by swine (A. J. Lewis, E. R. Peo, Jr.)

13-055 A systems approach to the evaluation of environmental constraints affecting poultry production (M. M. Beck, J. A. DeShazer)

13-056 Nutrient sources, levels and interrelationships in layers and turkeys (T. W. Sullivan)

13-058 Physiological mechanisms and reproductive management of the postpartum interval and puberty in the bovine female (J. E. Kinder, R. J. Kittok)

*13-063 Reproductive endocrinology of the bovine in the nutritionally induced state of anestrus (J. E. Kinder, R. J. Kittok, E. T. Clemens)

13-064 Pork carcass evaluation (W. T. Ahlschwede, R. K. Johnson, R. W. Mandigo)

*13-065 Factors affecting acidosis in ruminants (R. A. Britton, D. R. Brink, T. J. Klopfenstein, R. A. Stock)

13-066 Dynamics of forage production and utilization by beef cattle (T. J. Klopfenstein, J. Stubbendieck, K. VonBargen, T. L. Thompson, G. A. Helmers)

*13-067 Redirecting the nutrient flow in cows for maximum milk production (F. G. Owen, L. L. Larson)

13-068 Well-being and productivity of poultry under various environmental and management conditions (E. W. Gleaves)

13-070 Control of gonadotropin secretion in boars (R. J. Kittok, R. K. Johnson, J. E. Kinder)

13-071 Evaluating the utilization of grain diets fed to finishing cattle (R. A. Stock, R. A. Britton, T. J. Klopfenstein, T. L. Mader)

13-072 Forage utilization and ammoniation of crop residues for beef cows (J. K. Ward)

13-073 Improving utilization of ensiled forage by sheep (D. R. Brink)

13-074 Physiological and nutritional aspects of the postpartum interval to conception in dairy cattle (L. L. Larson, F. G. Owen)

13-075 Factors affecting rumen production and effects of acidosis on nutrient metabolism and absorption (R. A. Britton)

*13-076 Regulation of energy metabolism in the brain of the domestic fowl (M. M. Beck)

13-077 Selection effectiveness for reproduction and energy utilization in mice (M. K. Nielsen)

13-078 Estimation of breeding values of reproductive and other performance traits in swine (R. K. Johnson)

13-079 Evaluation of management practices and traits that influence reproductive efficiency in beef cattle (J. E. Kinder, M. K. Nielsen)

13-080 Factors regulating protein turnover and growth in skeletal muscle (S. J. Jones, C. R. Calkins, R. A. Britton, J. E. Kinder, M. G. Zeece)

13-081 Effect of energy source and feed additives on energy utilization by swine (E. R. Peo, Jr., A. J. Lewis)

13-082 Optimum use of rangeland, pasture and crop residues in beef production system (T. J. Klopfenstein)

13-083 Improving dairy cattle genetically (J. F. Keown)

13-084 Meat manufacturing, restructuring and processing (R. W. Mandigo, C. R. Calkins)

13-085 Hormonal regulation of pituitary gonadotropin secretion in the bovine female (J. E. Kinder, B. D. Schanbacher)

13-086 Economical forage based beef storage (T. J. Klopfenstein, R. A. Stock, R. A. Britton)

13-087 Influence of nutrition upon the reproductive endocrine system of the bovine (J. E. Kinder, R. J. Kittok)

13-088 Physiological and management apsects of expression of estrus and ovulation rate in swine (D. R. Zimmerman, R. K. Johnson, R. J. Kittok, M. M. Beck, J. A. DeShazer)

13-089 Metabolism in chick brains: cellular apsects (M. M. Beck)

13-090 Muscle proteolysis and meat tenderness (C. R. Calkins, S. J. Jones)

Biochemistry

15-022 Regulation of photosynthetic processes (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 Regulation of photosynthetic processes (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 nitrogeneous constituents of selected plants (R. M. Hill)

15-047 Characterization of the ACTH receptor: polypeptide structure and life cycle (R. J. Krueger)

15-048 Molecular control of photosynthetic energy production (J. P. Markwell)

Biometrics and Information Systems Center

23-001 Applications of statistics to research in agriculture (W. W. Stroup, R. F. Mumm, A. M. Parkhurst)

23-002 Statistical computing methodology for research planning and analysis (W. W. Stroup)

Center for Agricultural Meteorology and Climatology

27-002 Chemistry of atmospheric deposition - effects on agriculture, forestry, surface waters and materials (S. B. Verma)

27-003 Exchange of carbon dioxide and other atmospheric traces gases in vegetated ecosystems (S. B. Verma, N. J. Rosenberg)

27-004 Spectral radiation techniques to estimate productivity and water stress in vegetation (B. L. Blad)

27-005 A climate data base and model for estimating crop yields (K. G. Hubbard)

27-006 Environmental and genotypic control of assimilate allocation in crops (N. J. Rosenberg, M. D. Clegg, J. D. Eastin, J. W. Maranville, G. E. Meyer, J. M. Norman, S. B. Verma, F. W. Wagner)

Consumer Science and Education

92-011 Relationship of perceptions of solar and earth sheltered systems to behavior of housing intermediaries (E. R. Combs)

*92-012 Residential mobility of rural populations and relocation of the rural elderly (J. A. Memken)

92-013 Economic, social, psychological and health consequences of the housing decisions of rural families (E. R. Combs, J. A. Memken)

92-014 Changes in the economic well-being of Nebraska families, 1981-1986 (E. P. Davis)

Entomology

17-030 Pest management strategies for leafhoppers, spittlebugs, and aphids on alfalfa (G. R. Manglitz)

*17-032 Biology and integrated control of the greenbug and other arthropods on grain sorghum (S. D. Kindler)

17-033 Ecology and control of stable flies and horse flies around confined livestock (J. J. Petersen, G. D. Thomas, C. B. Gilbertson)

17-034 Insects affecting tree and shrub plantings in Nebraska (J. A. Jones)

17-039 Factors affecting the population ecology of a rangeland grasshopper, Phoetaliotes nebrascensis (Thomas) (A. Joern)

*17-040 Aquatic invertebrates as indicators of water quality in Nebraska streams (K. P. Pruess)

17-041 Improvement of legume and grass insect control (G. R. Manglitz)

17-042 Cytogenetic factors associated with the development of aphid biotypes (Z B Mayo)

17-043 Ecology and management of soil insects in corn and soybean (L. J. Meinke)

17-044 European corn borer tunneling, stalk rot, water stress, and corn plant physiology (T. O. Holtzer, J. F. Witkowski, J. M. Norman, D. S. Wysong)

17-045 Black fly damage thresholds, biology and control (K. P. Pruess)

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)

16-040 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 Factors regulating protein synthesis, degradation, and growth in skeletal muscle (M. G. Zeece, S. Jones)

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. Cuppett)

16-048 Development of new processes and technologies for the processing of poultry products (G. W. Froning)

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)

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)

26-006 Interactions of wildlife and agricultural systems in Nebraska (R. M. Case, R. M. Timm, J. R. Brandle)

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)

26-009 Strategies and procedures for advanced generation breeding of N.C. forest species (S. G. Ernst, D. F. VanHaverbeke)

26-010 Effects of water stress on growth and survival of certain deciduous tree species in Nebraska (M. R. Kuhns)

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, J. R. Steadman)

20-044 Breeding Kentucky bluegrass, tall fescue and native 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)

20-048 Influence of nitrogen and sulfur on growth and development of ornamental plants (E. T. Paparozzi)

Human Development and the Family

*93-016 Stress, coping and adaptation in the middle years of the family life cycle (J. D. DeFrain)

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)

91-025 Modification of human diets designed to affect lipid metabolism (C. V. Kies)

91-026 Communication strategies to improve nutritional practices of adolescents (N. M. Betts)

91-027 Nutrition problems of the elderly in southeast Nebraska and methods of changing food behavior (N. M. Betts)

91-028 Changes in dietary intake produced by social environment (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)

42-006 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)

44-012 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 Species and bionomics of leafhoppers in the Nebraska panhandle (A. F. Hagen)

*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)

44-028 Reduction of corn losses caused by nematodes in the North Central Region (E. D. Kerr, D. S. Wysong)

44-029 Machinery requirements and water management of conservation tillage for irrigated row crops in the Nebraska Panhandle (J. A. Smith, C. D. Yonts)

44-030 The effect of microclimate on plant pests in a semi-arid environment (A. Weiss)

44-031 Transplanting sugarbeets 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)

44-036 Control of *Heterodera schachtii* and *Cercospora beticola* on sugar beet in the Nebraska panhandle (E. D. Kerr)

44-037 Development of dryland cropping systems for western Nebraska (D. A. Martin)

44-038 Cultural and nutrient investigations for crops in western Nebraska (F. N. Anderson)

44-039 Marketing alfalfa in the western region: structural analyses strategies and issues (J. Robb, J. Yanagida)

44-040 Influence of grazing frequency and date on Nebraska Sandhills vegetation (P. E. Reece, J. T. Nichols)

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. Riffle)

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, E. M. Ball)

21-015 Epidemiology of diseases of dry edible beans 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)

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

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)

21-038 Use of recombinant DNA technology to study population genetics of soybean cyst nematode (T. O. Powers)

21-039 Reduction of corn losses caused by nematodes in the NC region (T. O. Powers)

21-040 DNA replication and gene expression of chlorella viruses (J. L. VanEtten)

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)

46-011 Construction of Center for Advanced Studies in Food Animal Health at Clay Center (D. H. Vanderholm, J. A. Benson, B. Carpenter, H. A. Schrader, R. G. White)

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. Elmore)

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)

48-013 Information and producer decisions in central Nebraska agriculture (R. Selley)

48-014 Biology, control and cost of shattercane and velvetleaf in south central Nebraska (F. W. Roeth)

48-015 Genetic resistance and benomyl for control of phomopsis seed decay in soybeans (R. W. Elmore, D. Doupnik, Jr.)

Textiles, Clothing and Design

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

94-013 The study of clothing as a contributor to the self-esteem of individuals with special needs (R. Kean, A. Newton)

94-014 Textile fiber systems for performance, performance, protection and comfort (J. M. Laughlin)

94-015 Reducing pesticide exposure of applicators through improved clothing design and care (J. M. Laughlin)

94-016 Functional topical finishes for enhancing color stability and strength retention in textiles (P. C. Crews)

Veterinary Science

14-001 Diagnostic surveillance of livestock and poultry health problems in Nebraska (E. D. Erickson, A. R. Doster, R. A. Moxley, N. R. Schneider, F. A. Osorio, D. Rock, A. Hogg)

14-009 Prevention and control of enteric diseases of swine (R. Moxley, J. A. Schmitz, S. Srikumaran, F. A. Osorio)

14-014 Bovine respiratory disease (M. B. Rhodes, G. A. Anderson, F. A. Osorio, S. Srikumaran, D. Rock)

14-018 Integrated methods of parasite control for (D. L. Ferguson)

*14-025 Bovine respiratory syncytial virus: pathogenesis and immune response (M. L. Frey, G. A. Anderson)

14-028 Bovine viral diarrhea virus and reproduction in cattle (C. L. Kelling, A. R. Doster, M. B. Rhodes, G. Duhamel)

14-030 Perinatal immune responses during infectious diseases in the bovine (G. A. Anderson)

14-032 Monoclonal antibodies for characterization of bovine respiratory syncytial virus infections (G. A. Anderson)

14-033 Nutritional impact on colonic structure and function (E. T. Clemens)

*14-035 Detection of viruses in bovine semen by nucleic acid hybridization (F. A. Osorio)

14-036 Immunity to infectious bovine rhinotracheitis (S. Srikumaran)

14-038 Lymphokine regulation of antibody production in bovine respiratory infections (S. Srikumaran)

14-039 Nebraska SPF swine laboratory (J. A. Schmitz, G. A. Anderson, A. Hogg, T. E. Socha)

14-040 Occurrence of mycotoxins in feed and foods and their effects on animal and human health (N. R. Schneider)

14-042 Molecular characterization of bovine herpesvirus type 1 (BHV -1) latency-related genes (D. L. Rock)

14-043 Development of rapid diagnostic techniques for virus diseases of livestock (F. A. Osorio)

14-044 Bovine respiratory syncytial virus subunit vaccine, immunity, and rapid diagnosis (G. A. Anderson, T. J. Zamb)

14-045 Molecular characterization of pseudorabies (PRV) latency-related genes (D. L. Rock, F. A. Osorio)

14-046 Molecular analysis of latent infection with bovine herpesvirus type 1 (D. L. Rock)

14-047 Molecular analysis of latent herpesvirus infections (D. L. Rock)

14-048 The immunobiology of enteric diseases of swine and cattle (G. E. Duhamel)

West Central Research and Extension Center

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)

43-035 Evaluation of management practices to improve reproductive efficiency of beef cattle (G. H. Deutscher, D. C. Clanton, J. E. Kinder)

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)

43-045 Profitability and income variability of cropping and range cattle production systems (R. T. Clark)

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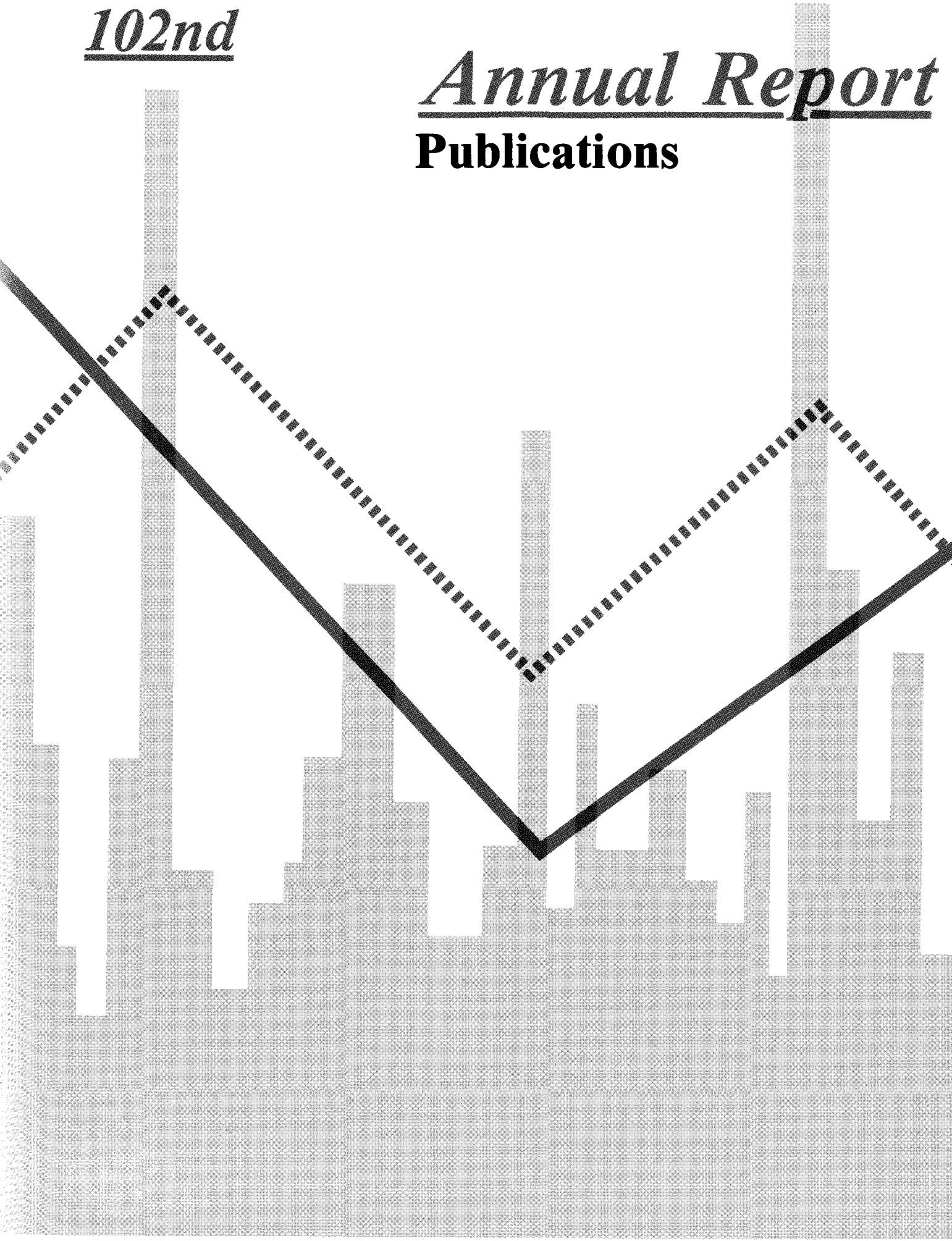
Publications



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Forsythe, Ken
Economies of size in public schools, a case study in Eastern Nebraska. (Bruce Johnson, Advisor)

Morrill, John M.
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Voboril, Mark J.
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Vansteelant, B.
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Wieman, G.A.
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Schmitt, Cathy
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Wozniak, Chris A.
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South Central Research and Extension Center

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West Central Research and Extension Center

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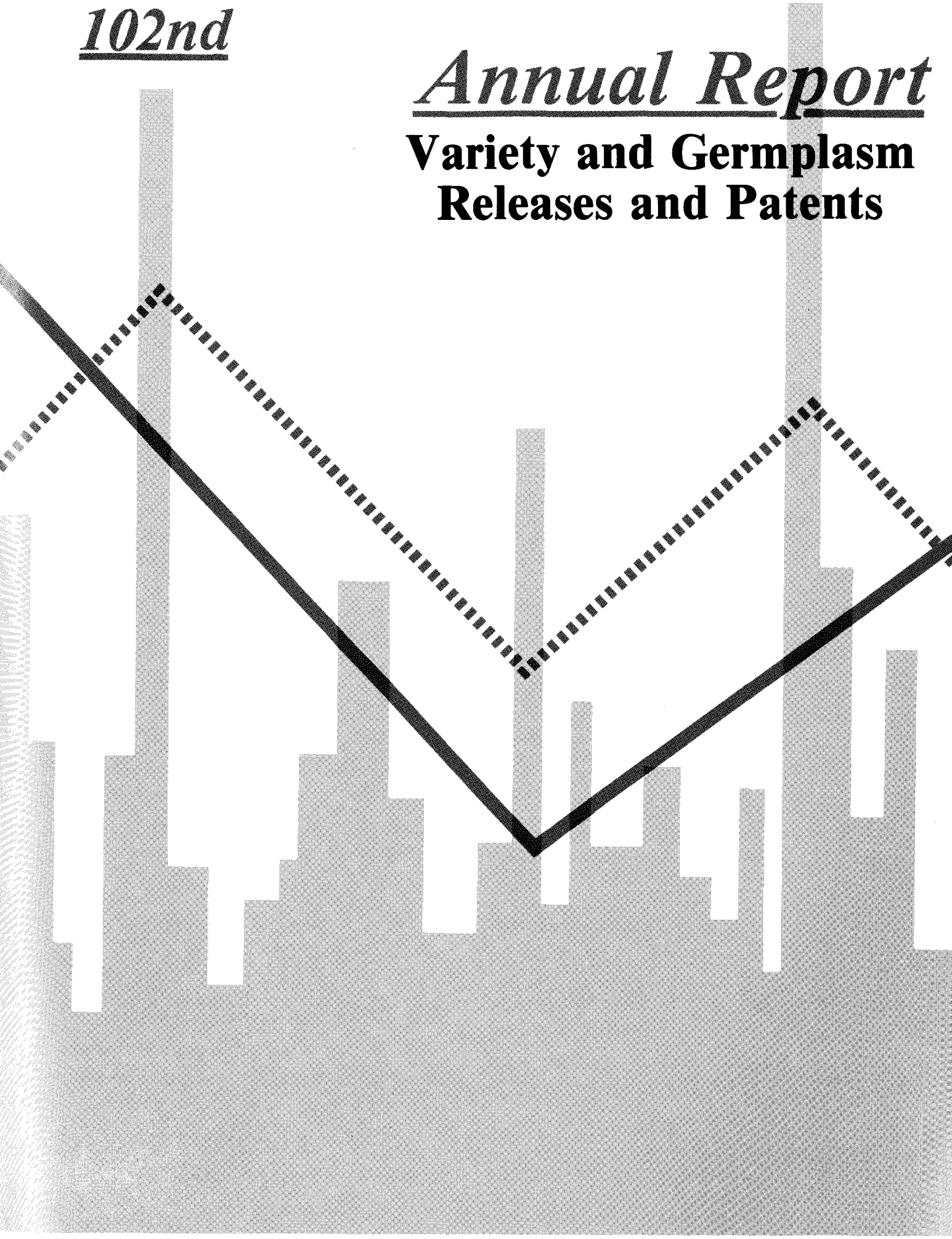
Variety and Germplasm Releases and Patents



Variety and Germplasm Releases and Patents

Department of Agronomy

Crop: Hard Red Winter Wheat

Variety Name: Arapahoe

Scientists: P. S. Baenziger, J. W. Schmidt, C. J. Peterson (ARS/USDA), V. A. Johnson (ARS/USDA), P. J. Mattern, A. F. Dreier, R. W. Elmore, P. T. Nordquist, L. A. Nelson, D. V. McVey (ARS/USDA) and J. H. Hatchett (ARS/USDA).

Released by: Nebraska, South Dakota, Northern Plains Area, Agricultural Research Service, USDA.

Characteristics: When compared to Brule and Redland, Arapahoe is approximately one day earlier, is 1% higher in kernel protein concentration, is slightly more winter hardy, has a slightly longer coleoptile, and is one pound heavier in bushel weight. Arapahoe is similar to Brule and Redland in flowering date, 1000 kernel weight, and plant height. Arapahoe has moderately strong straw as but not as strong straw as Brule or Redland. Arapahoe is moderately resistant to the currently prevalent races of leaf rust and stem rust, and is believed to be moderately tolerant to Cephalosporium stripe.

Crop: Prairie Sandreed (*Calamovilfa longifolia*)

Variety name: 'Pronghorn'

Scientist: K. P. Vogel (ARS/USDA)

Characteristics: Pronghorn has significantly superior rust tolerance. Its level of rust infestation is typically about one-fourth to half that of Goshen. Although its primary advantage in comparison to Goshen is its improved rust resistance, it also produces stands and forage yields equivalent or superior to those of Goshen.

Crop: Grain Sorghum

Germplasm release: Sorghum R Line N91

Scientists: Jerry D. Eastin, Eugene Boilesen, P. K. Verma, Merle Witt and Robert Wilson

Released by: Nebraska, Kansas

Characteristics: The line possesses better than average stress resistance, has a very strong stalk, and has excellent combining ability. Hybrids are medium to tall with medium seed size and are medium to full maturity.

Crop: Grain Sorghum

Germplasm release: Sorghum R Line *N92*

Scientists: Jerry D. Eastin, Eugene Boilesen, P. K. Verma, Merle Witt and Robert Wilson

Released by: Nebraska, Kansas

Characteristics: It is stress tolerant and medium in maturity. Hybrids are medium to short with good stalk strength. Yields are medium to good and have a high seed number with small seeds.

Crop: Grain Sorghum

Germplasm release: Sorghum germplasm R line *N93*

Scientists: Jerry D. Eastin, Eugene Boilesen, Merle Witt and Robert Wilson

Released by: Nebraska, Kansas

Characteristics: The line has moderate stress tolerance and is medium in maturity. Hybrids bloomed 2 to 3 days earlier than TX432 hybrids and yields were comparable in limited tests.

Crop: Grain Sorghum

Germplasm release: Sorghum germplasm A/B pair *N94*

Scientists: Jerry D. Eastin, Eugene Boilesen, David Andrews, Merle Witt and Robert Wilson

Characteristics: The line is stress resistant and yields 50 to 100% more than CK60 when stress levels are sufficient to reduce CK60 yields to about 2000 kg/ha in the western Kansas climate. It also yields substantially more under good conditions. This full season line is both drought resistant and water responsive under mid U.S. Great Plains conditions.

Crop: Grain Sorghum

Germplasm release: Sorghum germplasm A/B pair *N95*

Scientists: Jerry D. Eastin, Eugene Boilesen, David Andrews, Merle Witt and Robert Wilson

Released by: Nebraska, Kansas

Characteristics: The line is stress resistant and yields 50 to 100% more than CK60 when stress levels are sufficient to reduce CK60 yields to about 2000 kg/ha in the western Kansas climate. It also yields substantially more under good conditions. This full season line is both drought resistant and water responsive under mid U.S. Great Plains conditions.

Crop: Grain Sorghum

Germplasm release: Sorghum germplasm A/B pair *N96*

Scientists: Jerry D. Eastin, Eugene Boilesen, David Andrews, Merle Witt and Robert Wilson

Released by: Nebraska, Kansas

Characteristics: The line is stress resistant and yields 50 to 100% more than CK60 when stress levels are sufficient to reduce CK60 yields to about 2000 Kg/ha in the western Kansas climate. It also yields substantially more under good conditions. This full season line is both drought resistant and water responsive under mid U.S. Great Plains conditions.

Crop: Yellow Dent Corn

Germplasm release: Inbred line N195

Scientist: W. A. Compton

Released by: Nebraska

Characteristics: It is tall with upright leaves. It tends to turn nearly white under extremely hot, dry conditions and is therefore not expected to grow well in hybrid combinations under hot, droughty conditions. It has been very productive in crosses with lines related to Mo17 when grown under good growing conditions. It stands well with little root or stalk lodging.

Crop: Yellow Dent Corn

Germplasm release: Inbred line N197

Scientists: W. A. Compton and Paul Nordquist

Released by: Nebraska

Characteristics: It flowers about 5 days earlier than M017 but does not dry quite as rapidly. It has done quite well in combinations with early Stiff Stalk Synthetic lines such as N190 and N192. It is a close sister line to N198.

Crop: Yellow Dent Corn

Germplasm release: Inbred line N198

Scientists: W. A. Compton and Paul Nordquist

Released by: Nebraska

Characteristics: It flowers about 5 days earlier than M017 but does not dry quite as rapidly. It has done quite well in combinations with early Stiff Stalk Synthetic lines such as N190 and N192. It has an extremely long ear for an inbred line as does its cross with its sister line N197.

Crop: Yellow Dent Corn

Germplasm release: Population NBS(6)

Scientist: W. A. Compton

Released by: Nebraska

Characteristics: The selection criterion was yield x upright plants x plants without dropped ears. Thus, yield and standability have been increased. The base population for this study was the Nebraska "B" synthetic developed by Dr. J. H. Lonnquist in 1946. It has undergone several cycles of improvement for general combining ability in addition to the 6 cycles of S1 *per se* selection. The "B" population flowers at about the same time as N28 and should be regarded as a full-season variety in southeast Nebraska.

Crop: Yellow Dent Corn

Germplasm release: Population NSS(6)

Scientist: W. A. Compton

Released by: Nebraska

Characteristics: The selection criterion was yield x upright plants x plants without dropped ears. Thus, yield and standability have been increased. The base population for this study was the Nebraska version of the Stiff Stalk Synthetic orginally synthesized by Dr. G. F. Sprague. It has undergone several cycles of improvement for general combining ability in addition to the 6 cycles of S1 per se selection. The population flowers at about the same time as N152 and should be regarded as mid- to full-season variety in southeast Nebraska.

Crop: Yellow Dent Corn

Germplasm release: Population NB(S)RF(6)

Scientist: W. A. Compton

Released by: Nebraska

Characteristics: The selection criterion was yield x upright plants x plants without dropped ears. Thus, yield and standability of the variety cross has been increased. NB(S)RF(6) has been selected from the B synthetic developed by Dr. J. H. Lonnquist in 1946. It has undergone several cycles of selection for general combining ability in addition to the 6 cycles of reciprocal full sib selection. The population is a full-season variety in southeast Nebraska.

Crop: Yellow Dent Corn

Germplasm release: Population NS(B)RF(6)

Scientist: W. A. Compton

Released by: Nebraska

Characteristics: The selection criterion was yield x upright plants x plants without dropped ears. Thus, yield and standability of the variety cross has been increased. NS(B)RF(6) has been selected from Stiff Stalf synthesized by Dr. G. F. Sprague. It has undergone several cycles of selection for general combining ability in addition to the 6 cycles of reciprocal full sib selection. The population is a full-season variety in southeast Nebraska.

Department of Horticulture

Patent Title: Potting Media

Patent Number: 06/680,148

Scientist: Sotero S. Salac

Description: Ground alfalfa forage (high N) and wheat straw (high C) were mixed in various proportions and substituted for peat moss in potting media with and without soil. Appropriate mixtures of the two plant materials benefitted the growth of test plants by releasing nutrients, particularly N, during biological decomposition.

Department of Plant Pathology

Crop: Dry Bean

Germplasm release: BELNEB-rust resistant-1 and -2

Scientists: J. R. Stavely, J. R. Steadman, D. P. Coyne, and D. T. Lindgren

Released by: Nebraska, Maryland and ARS/USDA

Characteristics: These are rust, common and halo blight and common mosaic resistant, high-yielding, type 3 (CIAT classification) viney Great Northern (GN) dry bean breeding lines. Both lines have medium large, white GN type seed. They are the first GN dry beans developed specifically for resistance to all 33 available races of the bean rust pathogen, *Uromyces appendiculatus* (= *U. phaseoli).*

West Central Research and Extension Center

Crop: *Penstemon grandiflorus*

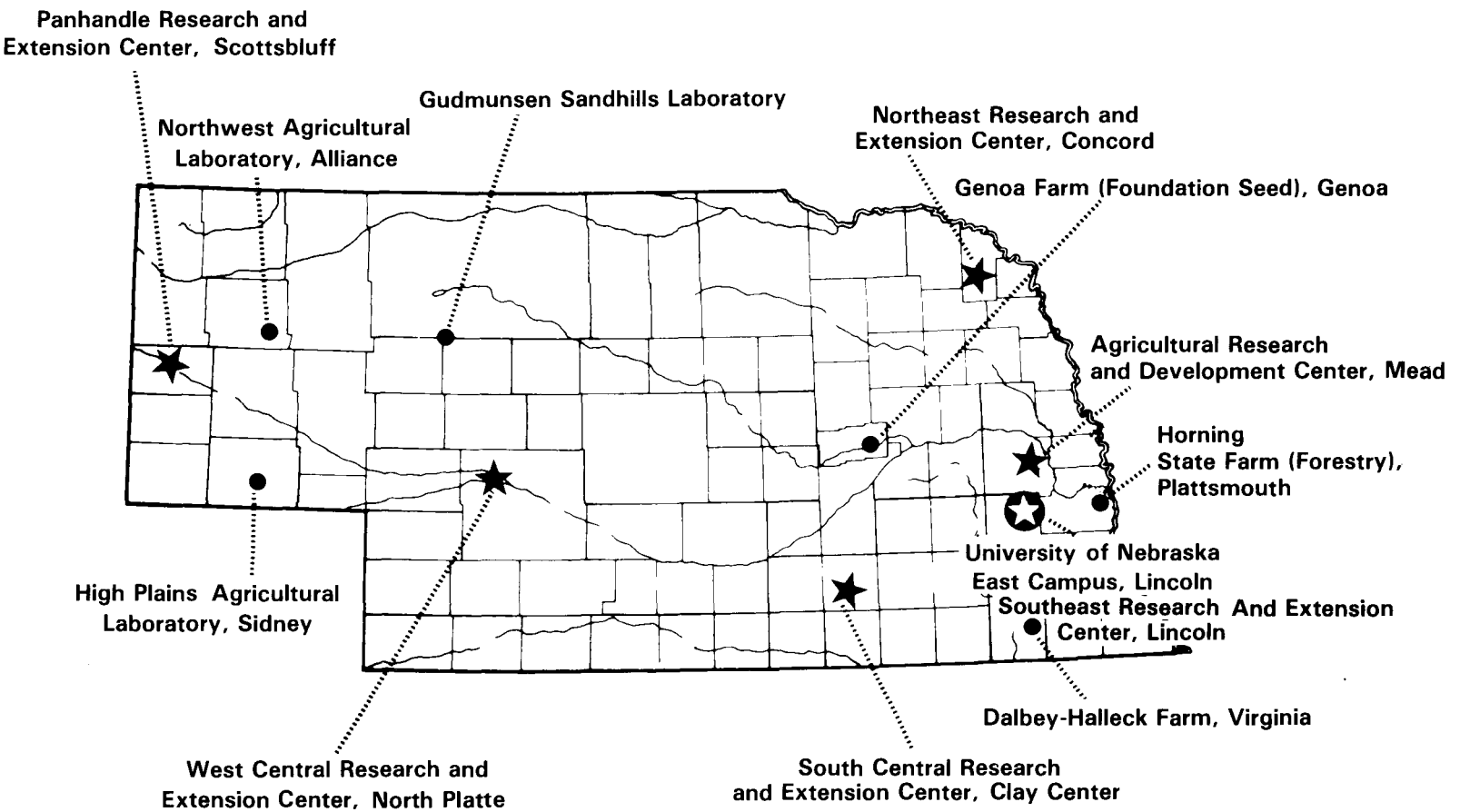
Variety name: Prairie Snow

Scientist: Dale T. Lindgren

Released by: Nebraska

Characteristics: Prairie Snow is a white-flowered selection of *P. grandiflorus*. Approximately 99% of native *P. grandiflorus* are pink or lavendar, making the white-flowered more unique. This is seed propagated bulk population variety with an average plant height of 70 cm (range of 54 to 84 cm), an average of 6.8 stalks per plant (range of 2 to 13) and an average of 50 flowers per stalk (range of 35 to 110). It is considered a short-lived perennial.

AGRICULTURAL RESEARCH SITES



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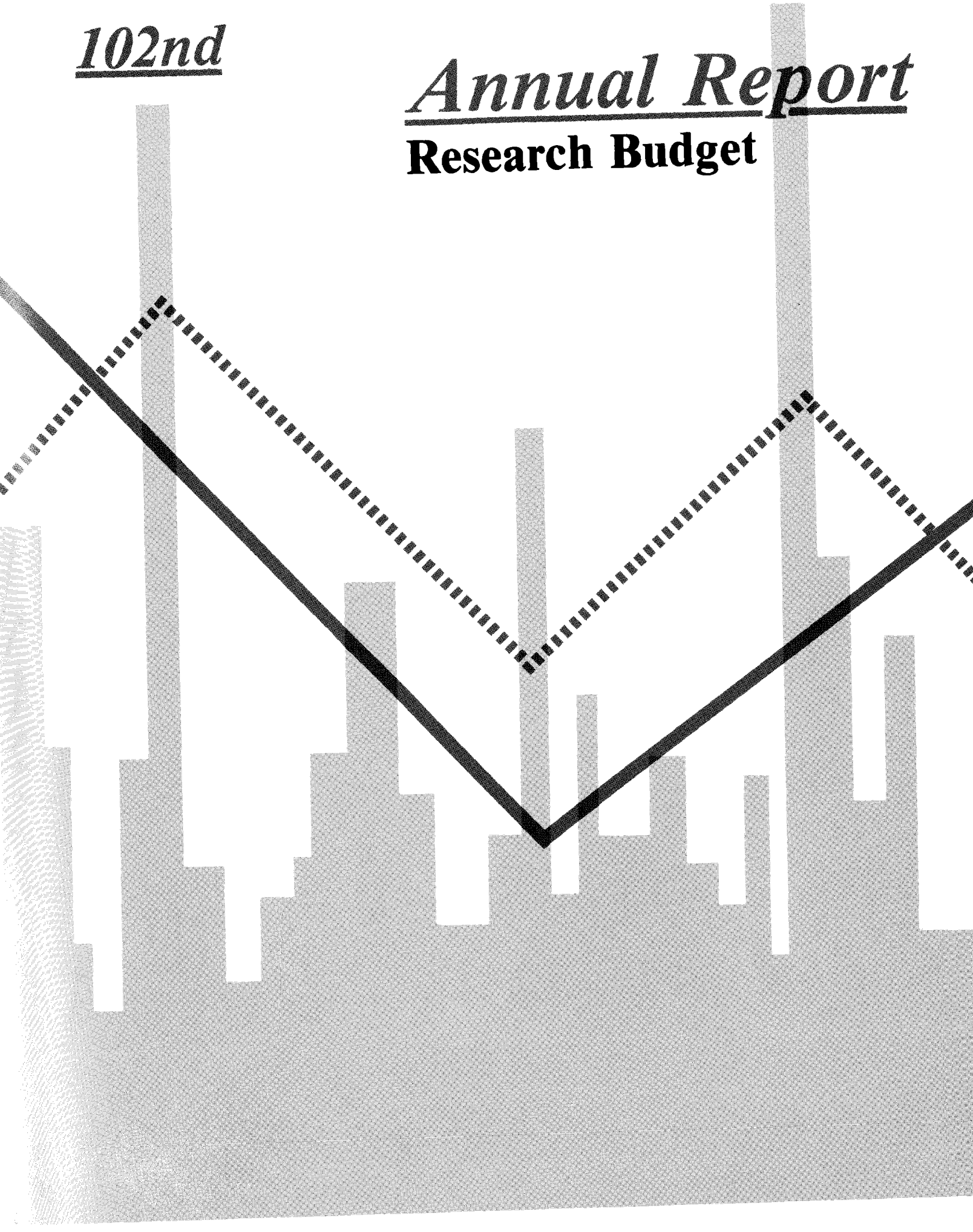
Annual Report

Research Budget



REPORT OF RESEARCH EXPENDITURES
THE UNIVERSITY OF NEBRASKA
AGRICULTURAL RESEARCH DIVISION
July 1, 1987 through June 30, 1988

FEDERAL FORMULA FUNDS:	
Hatch Formula	$1,980,369
Regional Research	762,438
McIntire-Stennis	95,117
Animal Health	178,523
Total Federal Formula Funds	$3,016,447
STATE APPROPRIATED FUNDS	$14,542,389
CONTRACTS AND GRANTS:	
USDA Coop Agreements	$2,238,941
USDA Special & Competitive	380,157
Federal Grants - NSF, NIH, HEW, AID	2,715,143[1]
Industry Grants	2,774,862
Total Grants and Contracts	$8,109,103
Sub-Total	$25,667,939
PRODUCT SALES	$5,118,619
TOTAL EXPENDITURES	$30,786,558

[1]Beginning with 1987-88, $1,328,480 was added to show actual Agricultural Research Division expenditures reflecting transfers from International Programs.