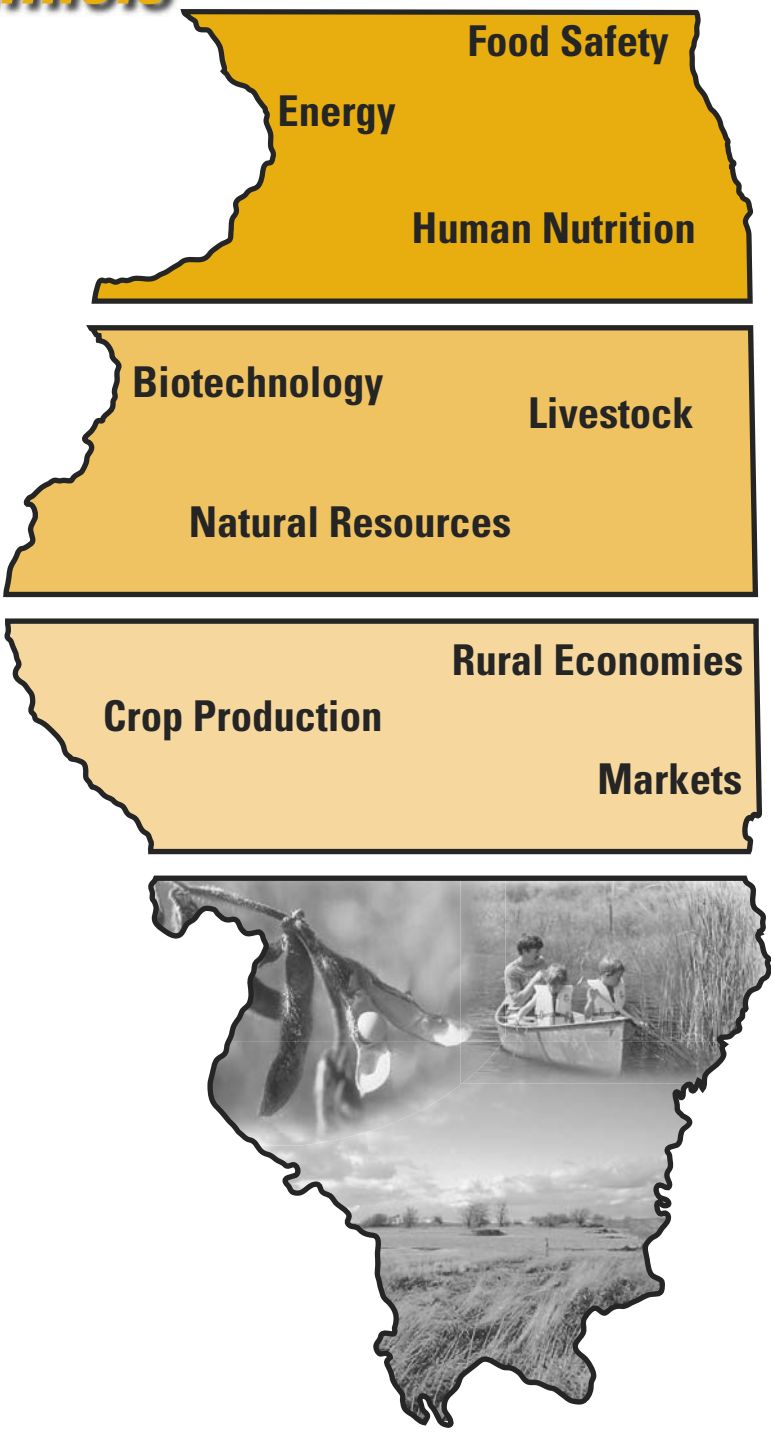
Research for Illinois



Illinois Council on Food and Agricultural Research

2006

Annual Report

A Partnership for Illinois Food and Agriculture

CFAR

OFFICE OF THE GOVERNOR
CHICAGO, ILLINOIS 60601

ROD R. BLAGOJEVICH
GOVERNOR

Dear Friends:

Illinois should be proud of its rich agricultural traditions. Our state's heritage and its future are directly linked to the strength of our agricultural, food, and energy-related enterprises. We extend our sincere gratitude to all C-FAR members for your significant contributions in guiding research that supports these vital segments of our state and its economy.

Like you, we know that research has enabled agricultural advancements that would not have otherwise been possible to achieve. Alternative energy development, increased protection of our natural resources, and the ability to better understand and prevent food-borne illnesses are just a few areas in which research has made a positive difference and can continue to have an impact.

With your continued commitment and leadership, Illinois agriculture will continue to benefit every citizen of our state. Thank you again for your efforts.

Sincerely,

Rod R. Blagojevich
Governor

Charles A. "Chuck" Hartke
Director, Illinois Department of Agriculture

C-FAR: A Statewide Partnership For Illinois

The Illinois Council on Food and Agricultural Research (C-FAR) is a statewide partnership organized to support relevant, high-quality research and related outreach programs for Illinois' food, agricultural, and related systems. C-FAR was founded in December 1993 as a nonprofit association to work strategically with the State of Illinois and Illinois' research community to ensure a viable food and agricultural research program and to provide stakeholder input into setting research priorities.

An Important Investment for Illinois and Its Economy

The State of Illinois appropriation for food and agricultural research via C-FAR and its stakeholder-based membership has created a new paradigm.

A Partnership: Food and agricultural leaders, government officials, researchers, and other dedicated individuals throughout Illinois are working together in an unprecedented manner to provide direction for targeted, high-quality research to support Illinois' number one industry. This partnership ensures maximum impact and accountability for state research investments via C-FAR.

Illinois' #1 Industry: Food and agricultural production and processing is Illinois' leading industry. Marketing of Illinois' agricultural commodities generates more than $9 billion annually. Nearly one million Illinois workers are employed in the food and agricultural system (Illinois Department of Agriculture).

High-impact Outcomes: C-FAR research has had an immense impact on the quality of life of Illinois citizens and the economy of the state since the first C-FAR appropriation in FY96. Research investments are guided by Illinois citizens to ensure that the most critical research needs of the state are met.

Bioenergy: Illinois is perfectly positioned to capitalize on the fastest growing energy sectors in the United States, which include the production of ethanol, butanol, and biodiesel, as well as the development of biomass for power generation.

Natural Resources: The proper management and protection of Illinois soils, air, and waters is crucial to the sustainability of the state's agricultural industry as well as to the health and welfare of all Illinois citizens.

State Funding Essential: National research funding is becoming even more limited. When it is available, it is often for research not of relevance to Illinois. State funding is critical to Illinois' research needs being met for its food and agricultural enterprises.

Millions Leveraged: C-FAR research investments are leveraged to attract additional dollars into Illinois' state economy. Researchers leverage C-FAR dollars to obtain roughly four times their C-FAR project funding in the form of additional funding. This has resulted in millions of additional dollars being directed to Illinois, further spurring the economy.

C-FAR research funding is provided by the State of Illinois. C-FAR gratefully acknowledges the State of Illinois for these financial investments, which are enabling advancements in Illinois' food and agricultural industries and contributing to the economic vitality of our state.

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Message from C-FAR

We are pleased to present this *2006 C-FAR Annual Report*. The report conveys our mission to support high-impact, stakeholder-driven food and agricultural research that results in beneficial outcomes for Illinois. An annual report should provide its members and other constituents with a full review of the organization's activities, accomplishments, and challenges of its past year. We trust you will find that this report does exactly that.

The front pages of the report provide a review of the vital mechanism which enables our state's unique, publicly-funded food and agricultural research program—our association. Without such an association, without its members and research partners, and without our alliance with the State of Illinois, there would be no meaningful collaborative research program in Illinois. This highly important set of partnerships allows a vibrant food and agricultural research program to be realized for the good of our state.

Food and agriculture—broadly defined—is our state's number one industry. Illinois citizens deserve nothing less than what we have forged through C-FAR—a deliberate and practical research program that is specifically aligned with the vast challenges and opportunities of this critical economic engine.

We remain absolutely committed to the high calling of our mission as we proudly stand with the State of Illinois in continuing to make a real and positive difference. The State of Illinois' investment, an unwavering commitment by the C-FAR membership, and a nationally and internationally recognized set of research partners, all individually, and collectively, have brought to fruition the progress documented in this annual report.

Sincerely,

Alan Puzey
Chairman of the Board

Kraig A. Wagenecht
Executive Administrator

Our Mission

The mission of the Illinois Council on Food and Agricultural Research (C-FAR) is to advance profitable, consumer-sensitive, environmentally sound food, agricultural, and related systems by securing funding for relevant research and outreach and fostering public participation in program guidance.

2006 Highlights

C-FAR Appropriation Increase

A $1 million increase in the C-FAR appropriation, from $3.5 million in FY06 to $4.5 million in FY07, is allowing for necessary new research initiatives to be started. C-FAR gratefully acknowledges the State of Illinois for this increased investment.

C-FAR members (left to right) Jack Norman, Kae Hankes, Linda Wikoff, and Jim Charlesworth engage in identifying Illinois' food and agricultural research priorities at an all-working group meeting in January.

Research Focus Areas Re-established

A highly significant initiative by the C-FAR membership during 2006 was the review and re-establishment of the organization's research focus areas (RFAs). About 100 C-FAR members convened at an all-working group meeting held on January 25 to identify high-priority research needs of Illinois' food and agricultural sectors. This work was continued at working group meetings held in conjunction with the February annual meeting and finalized at a meeting of the C-FAR research committee in March. The revised research focus areas will drive C-FAR's research portfolio from 2007 through 2010.

"We are extremely pleased with how our members responded to the call for reshaping our research focus areas," said Nels Kasey, C-FAR Research Chair. "The importance of communicating clear research priorities to our research community cannot be overstated. We know these priorities will result in research being conducted that specifically addresses the needs of our state."

Annual Meeting

C-FAR met for its annual meeting on February 28 in Springfield. The C-FAR membership re-elected Alan Puzey, Larry Fischer, and Steve Scates to serve on the seven-person board of directors. They join Fred Bradshaw, David Downs, Nels Kasey, and Karen Little. In addition, the membership approved the adoption of two proposed bylaw changes. These changes result in the semiannual meeting no longer being mandatory. Language was added, as a good business practice, to prohibit employees and their immediate family members from being eligible to serve on the Board of Directors.

Following the business portion of the meeting, C-FAR's five working groups met to finalize the examination and re-establishment of their research focus areas. Members then heard updates on the three C-FAR strategic research initiatives (SRIs) that began in fiscal year 2004.

C-FAR Vice Chairman David Downs (left) and past Chairman Terry Wolf at the 2006 Annual Meeting.

New Member Orientation Program

C-FAR members are able to learn more about C-FAR and how best to engage in the organization through a newly established new member orientation program. The program is available for new or other interested members, and it is expected to be held at the beginning of the C-FAR Annual Meeting and possibly at other meetings of the membership.

C-FAR Day at Southern Illinois University Carbondale

C-FAR held its sixth annual C-FAR Day on November 14 at Southern Illinois University Carbondale. C-FAR Day provides a highly unique opportunity for C-FAR members to visit with scientists and hear firsthand about their research activities. During this special event, attendees toured research facilities and learned about a broad range of C-FAR–funded research initiatives taking place at the university. SIUC faculty and research staff provided updates on ongoing research and recent achievements in areas including human nutrition, livestock production, alternative vegetable crops, and conservation tillage. C-FAR was pleased to have SIU President Glenn Poshard welcome C-FAR Day attendees to campus.

C-FAR Day 2006 attendees hear about C-FAR–funded research being conducted at the Southern Illinois University Carbondale

University Engagements

The Board of Directors continued their engagement with the partner universities by meeting with the presidents and other senior administrators of the University of Illinois/University of Illinois at Urbana-Champaign and Illinois State University.

Review of University Percentages

The process of reviewing the university C-FAR appropriation percentages was initiated. The review process, which is carried out every three years, will determine the research funding percentages for the four partner universities for the next three fiscal years (FY08 through FY10).

Water Quality SRI Matures

C-FAR's water quality strategic research initiative (SRI) matured as scheduled at the end of the fiscal year (June 30, 2006). Although funding of this important initiative has ended, additional research and outreach efforts associated with the SRI will continue through FY07.

Retention of Membership

The high retention of C-FAR members was realized again for 2006. Of 2005 members, 98% of Organizational members renewed (59 of 60), 95% of Affiliate members renewed (33 of 35), and 90% of Individual members renewed (120 of 133). In addition, new members joined across each membership category.

C-FAR Newsletter Distributed Electronically

C-FAR Connection newsletters are now provided to the vast majority of C-FAR members and constituents electronically. The newsletter is also available in hard copy to those indicating they prefer that format.

Who's Who

2006 Board of Directors and Staff

Board of Directors

Alan Puzey
CHAIRMAN OF THE BOARD, FAIRMOUNT

David Downs
VICE CHAIRMAN OF THE BOARD, ALLERTON

Fred Bradshaw
SECRETARY-TREASURER, GRIGGSVILLE

Larry Fischer
MEMBERSHIP CHAIR, QUINCY

Nels Kasey
RESEARCH CHAIR, PARIS

Karen Little
RESEARCH VICE CHAIR, PLEASANT PLAINS

Stephen Scates
DIRECTOR, SHAWNEETOWN

Staff

Kraig A. Wagenecht
EXECUTIVE ADMINISTRATOR

LeAnn M. Ormsby
COMMUNICATIONS DIRECTOR

Additional C-FAR Staff

Rhonda Hunter
ADMINISTRATIVE ASSISTANT

Gloria Buhrmester
SECRETARY

Arena Jackson
SECRETARY

2006 Working Group Leadership

Expanding Agricultural Markets

Jim Charlesworth
CHAIR, BLOOMINGTON

Heather Hampton+Knodle
VICE CHAIR, FILLMORE

Rural Economic Development

Kae Hankes
CHAIR, GALESBURG

Linda Wikoff
VICE CHAIR, ONEIDA

Agricultural Production Systems

Molly Ann Godar
CHAIR, ROCHESTER

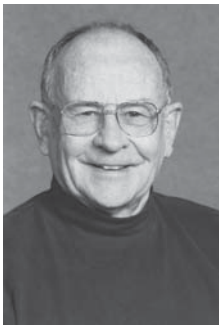
Anne Builta Crider
VICE CHAIR, ARROWSMITH

Human Nutrition and Food Safety

Jeanne Harland
CHAIR, LAFAYETTE

Jim Fraley
VICE CHAIR, COOKSVILLE

Natural Resources and Environment



Byford Wood
CHAIR, BREESE

Brian Frieden
VICE CHAIR, PETERSBURG

2006 Members

Organizational Members

C-FAR Organizational members are nonprofit Illinois organizations that represent varied food, agriculture, and agribusiness interests.

Association of Illinois Soil and Water Conservation Districts

Audubon Council of Illinois

Central Illinois Golf Course Superintendent's Association

Champaign County Farm Bureau

Dairy Management Inc.

DeKalb County Farm Bureau*

DuPage County Farm Bureau

GROWMARK

Horseradish Growers of Illinois

Illinois Agri-Women

Illinois Association of Drainage Districts

Illinois Association of Meat Processors

Illinois Beef Association, Checkoff Division

Illinois Beef Association, Dues Division

Illinois Corn Growers Association

Illinois Corn Marketing Board

Illinois Dietetic Association

Illinois Farm Bureau

Illinois Farm Business Farm Management Association

Illinois Farm Credit Services

Illinois Farmers Union

Illinois Fertilizer and Chemical Association

Illinois Forage and Grassland Council

Illinois Grape Growers and Vintners Association

Illinois Lamb & Wool Producers

Illinois Landscape Contractors Association

Illinois Milk Producers' Association

Illinois Nurserymen's Association

Illinois Pork Producers Association

Illinois Pork Producers Association, Checkoff Division

Illinois Restaurant Association

Illinois Seed Trade Association

Illinois Society of Professional Farm Managers & Rural Appraisers

Illinois Soil Testing Association

Illinois Soybean Program Operating Board

Illinois Specialty Growers Association

Illinois State Grange

Illinois State Horticultural Society

ISU Agriculture Alumni Association

Illinois State Veterinary Medical Association

Illinois Stewardship Alliance

Illinois Sustainable Agriculture Society

Illinois Turfgrass Foundation

Illinois Wheat Association

Institute of Food Technologists, Chicago Section

Kane County Farm Bureau

Kankakee County Farm Bureau

Knox County Farm Bureau

Land of Lincoln Soybean Association

Madison County Farm Bureau

Mason County Farm Bureau

Mercer County Farm Bureau

Midwest Association of Golf Course Superintendents

Midwest Dairy Association

Orr Agricultural Research Center

SIU College of Agricultural Sciences Alumni Society

The Chicago Farmers

UIUC College of Agricultural, Consumer and Environmental Sciences Alumni Association

UIUC College of Veterinary Medicine Alumni Association

Warren-Henderson Farm Bureau

*New member in 2006

Affiliate Members

C-FAR Affiliate members are largely university- and research-related entities and other organizations that similarly support the C-FAR mission.

Central Illinois Agricultural Research Farms

Environmentally Correct Concepts

Greene Farm Management Services

Illinois Crop Improvement Association

Illinois Department of Natural Resources

Illinois Finance Authority

Illinois Forestry Development Council

Illinois Institute for Rural Affairs*

Illinois State Geological Survey

ISU Department of Agriculture

Illinois State Water Survey

Lake Vermilion Water Quality Coalition

National Center for Food Safety and Technology

NIU College of Health and Human Sciences*

Sangamon County Soil and Water Conservation District

SIUC Center of Excellence for Soybean Research, Teaching, and Outreach

SIUC College of Agricultural Sciences

SIUC Department of Agribusiness Economics

SIUC Department of Animal Science, Food and Nutrition

SIUC Department of Forestry

SIUC Department of Plant, Soil and Agricultural Systems

The Nature Conservancy in Illinois

UIUC College of Agricultural, Consumer and Environmental Sciences

UIUC College of Veterinary Medicine

UIUC Department of Agricultural and Biological Engineering

UIUC Department of Agricultural and Consumer Economics

UIUC Department of Animal Sciences

UIUC Department of Crop Sciences

UIUC Department of Food Science and Human Nutrition

UIUC Department of Human and Community Development

UIUC Department of Natural Resources and Environmental Sciences

UIUC Department of Pathobiology

UIUC Department of Veterinary Biosciences

UIUC Department of Veterinary Clinical Medicine

WIU Allison Organic Farm*

WIU Department of Agriculture

*New member in 2006

Individual Members

In addition to the Organizational and Affiliate members and all of their representatives, there were 131 Individual members who also supported food, agricultural, and related research in Illinois via C-FAR in 2006.

Committees

Research Committee

The purpose and charge of this committee is to

- inquire into and prepare reports on current and planned research in Illinois on food and agriculture
- seek recommendations on research needs from (a) research professionals currently conducting such research at Illinois universities or elsewhere, (b) interested persons and groups, and (c) the public
- identify research beneficiaries
- prepare recommendations regarding research needs, processes, and impacts, and pursue their implementation as authorized
- foster public confidence in ongoing food and agricultural research by engaging public participation in planning and evaluating the process and impact of research activities

Committee Members

Nels Kasey, chair; Stephen Scates, vice chair; Susan Adams; Bill Becker; Constance Locher Bussard; Jim Charlesworth; Pat Dumoulin; Brian Frieden; Paul Gebhart; Molly Ann Godar; Kae Hankes; Jeanne Harland; Carl Hopphan; Richard Hull; John Huston; John Quandt; Wendell Shauman; Richard Showalter; William Whiteside; Linda Wikoff; and Byford Wood. *Ex-officio*: William Bailey; George Fahey, Jr.; Mary Ann Lila; Patrick O'Rourke; John Russin.

Rules and Procedures Committee

This committee, in consultation with the other committees, monitors C-FAR processes and develops proposals for improvements as needed.

Committee Members

Dennis Thompson, chair; Maralee Johnson; Dan Kelley; Neal Merchen; Bert Princen; and Ron Warfield.

Legislative Committee

The charge of this committee is to

- monitor all legislative activity, state and federal, that may have an impact on C-FAR or on its mission and objectives
- develop recommendations for Council or Board approval
- implement and execute plans

Committee Members

Karen Little, chair; Fred Bradshaw; Constance Locher Bussard; David Downs; David Erickson; Jack Erisman, Wally Furrow; Carl Hopphan; Carol Keiser; Alan Puzey; Stephen Scates; and William Whiteside. *Ex-officio*: Herman Bodewes.

Nominating Committee

The purpose and charge for this committee includes soliciting and receiving nominations for the board of directors from organizational members, and presenting a slate of candidates to be considered by the C-FAR membership at the annual meeting.

Committee Members

Terry Wolf, chair; Dean Adams; Allan Aves; Bill Campion; Richard Denhart; Charlie Grotevant; William McCartney; and Bob Swires.

RESEARCH PARTNERS

University of Illinois at Urbana-Champaign

Robert A. Easter, Dean

COLLEGE OF AGRICULTURAL, CONSUMER AND ENVIRONMENTAL SCIENCES

UNIVERSITY OF ILLINOIS AT URBANA-CHAMPAIGN

Mary Ann Lila, Interim Associate Dean for Research

COLLEGE OF AGRICULTURAL, CONSUMER AND ENVIRONMENTAL SCIENCES

UNIVERSITY OF ILLINOIS AT URBANA-CHAMPAIGN

George C. Fahey, Jr., Assistant Dean, Research Leadership–C-FAR

COLLEGE OF AGRICULTURAL, CONSUMER AND ENVIRONMENTAL SCIENCES

UNIVERSITY OF ILLINOIS AT URBANA-CHAMPAIGN

Southern Illinois University Carbondale

Gary L. Minish, Dean

COLLEGE OF AGRICULTURAL SCIENCES

SOUTHERN ILLINOIS UNIVERSITY CARBONDALE

John S. Russin, Associate Dean for Research and Personnel Administration

COLLEGE OF AGRICULTURAL SCIENCES

SOUTHERN ILLINOIS UNIVERSITY CARBONDALE

Illinois State University

Patrick D. O'Rourke, Chair

DEPARTMENT OF AGRICULTURE

ILLINOIS STATE UNIVERSITY

Western Illinois University

William C. Bailey, Chair

DEPARTMENT OF AGRICULTURE

WESTERN ILLINOIS UNIVERSITY

In addition to these primary research partners, C-FAR is pleased to work with a number of additional research related entities.

Research Programs

In 1995, the Food and Agriculture Research Act, the enabling legislation that provides the framework for C-FAR funding and research activity, became a state statute. In FY06, a $3.5 million* C-FAR appropriation was approved. The FY07 C-FAR appropriation was increased to $4.5 million.

Funds are allocated to three C-FAR research programs:

Strategic Research Initiatives

The Strategic Research Initiatives (SRIs) are team-based research efforts that provide a targeted, multidisciplinary, and multi-institutional approach for addressing major issues and concerns of Illinois' food and agricultural industry and consumers.

University Internal Programs

In accordance with the Food and Agriculture Research Act, the majority of research funds are allocated on a percentage basis to Illinois' four universities with food and agricultural research programs: the University of Illinois at Urbana-Champaign (Illinois Agricultural Experiment Station) (82%), Southern Illinois University at Carbondale (11%), Illinois State University (4%), and Western Illinois University (3%). Each university solicits requests for proposals (RFPs) as part of an internal competitive grants program to select innovative, high-quality research that addresses the needs of the Illinois food, agriculture, and related communities and consumers as defined by the C-FAR membership.

In 1999, the University of Illinois initiated its C-FAR Sentinel Program as part of the university's internal research program. The Sentinel Program's purpose is to take advantage of opportunities for performing creative, problem-solving research.

External Competitive Grants Program

C-FAR's External Competitive Grants Program is designed to encourage and support research efforts from nonprofit institutions, organizations, and agencies in Illinois. The program solicits RFPs from nonprofit research entities throughout the state. By legislation, a minimum of 15% of the C-FAR appropriation is allocated to support this program.

Working group participants review and select proposals submitted to this program for funding. Proposal review follows a two-step process. The first step is a request for, and review of, pre-proposals. C-FAR working group participants evaluate pre-proposals based on relevance to C-FAR research focus areas, potential outcomes and benefits to stakeholders, and dissemination plans. The second step involves inviting principal investigators of top-ranking pre-proposals to submit full proposals.

* The FY06 appropriation was assessed a 2% reserve, resulting in a $3.43 million appropriation.

Strategic Research Initiative Program

In 1998 the C-FAR membership established the Strategic Research Initiative (SRI) Program to implement a targeted, multidisciplinary, and multi-institutional team approach to addressing major concerns and opportunities for Illinois' food, agriculture, and related sectors and consumers. Currently, there are three ongoing initiatives that began in FY04. The following are highlights of FY06 progress reports submitted by the principal investigators of these initiatives.

Biomass Energy Crops for Power and Heat Generation in Illinois: Diversifying Cropping, Improving Energy Security, and Benefiting the Environment

Dr. Stephen Long, professor of crop sciences and plant biology at the University of Illinois at Urbana-Champaign, provides leadership for a multidisciplinary team of researchers working to provide Illinois with the foundation and technology leadership for the large-scale cultivation of biomass crops. In this five-year SRI, researchers are focusing on the use of Miscanthus (*Miscanthus x giganteus*), a perennial rhizomatous grass, as a potential renewable energy source for Illinois and as a profitable alternative crop for Illinois agricultural producers.

Principal Investigators

Stephen P. Long, Crop Sciences and Plant Biology

Yuanhui Zhang, Agricultural and Biological Engineering

Madhu Khanna, Agricultural and Consumer Economics

Michael S. Katterhenry, Animal Sciences

German A. Bollero, Jack M. Widholm, Crop Sciences

Anne Heinze Silvis, Human and Community Development

Mark B. David, Jack A. Juvik, Gregory F. McIsaac, Thomas B. Voigt, Michelle M. Wander, Natural Resources and Environmental Sciences

University of Illinois at Urbana-Champaign

Field Trials

The University of Illinois South Farms has six blocks, each containing one 0.5 acre plot each of Miscanthus, switchgrass, and corn/soybean rotation. Yield analysis continues in the 0.25 acre trials established at Dixon Springs, Urbana, and DeKalb. Averaged across the three sites, peak dry mass of Miscanthus compared to switchgrass was 21 verses 7 tons/acre in 2004 (a wet year) and 14 verses 3 tons/acre in 2005 (a dry year). Agronomic characteristics, including yield variability, establishment, and nitrogen response, are being evaluated at multiple sites.

Miscanthus Breeding and Improvement

Miscanthus x giganteus (the plant form used in the SRI) is a sterile hybrid. It has been grown in Denmark for over 40 years with no incidence of invasiveness into surrounding fields. Currently existing *Miscanthis x giganteus* germplasm is limited in its genetic diversity, and it is believed to originate from random hybridization between *M. sinensis* and *M. sacchariflorus*. It has not been subjected to selection for enhanced yield or adaptability to cultivation in the Midwest. To create new germplasm, researchers are conducting hybridizations between *M. sinensis* and *M. sacchariflorus*.

Researchers are evaluating tissue culture–regenerated plants transplanted to field plots for possible variations. Chromosome doubling of Miscanthus plants is also being investigated to determine whether it will increase plant growth as seen in similar studies using maize and sugar cane.

Development of Genetic Engineering Techniques

New tissue cultures using immature plumes from Miscanthus plants have been established. Regenerated plants have survived transplantation to field plots. Research to change the genetic makeup of plants has been initiated, but to date no confirmed transformants have been identified. A transformation system will provide a basis for introduction of traits such as resistance to disease, to pests, and to herbicides.

Soil Carbon and Gas Emissions

This project focuses on the short-term influence of biomass crop production on organic carbon contents of Illinois soils and the global warming potential of biomass-crop and row-crop production systems.

Biomass crop establishment has not reduced soil organic carbon. By year four, Miscanthus has achieved sequestration rates of 0.13 tons/acre/yr and switchgrass achieved rates of 0.09 tons/acre/yr. Increases in soil organic carbon under biomass crops were due to accumulation of particulate organic matter carbon in the top soil. Ammonium-nitrogen content decreased through season in the corn soil after N fertilization, whereas there was no clear change in the biomass crop soils. When global warming potential was estimated, the row-crop system had significantly higher values than Miscanthus or switchgrass. Miscanthus and switchgrass production systems have proven to be net absorbers of greenhouse gases.

Water Resource Implications

Researchers are evaluating water usage and nitrogen leaching in biomass crops contrasted against a conventional corn and soybean rotation. Collection devices were placed at a depth of 20 inches in corn/soybean and switchgrass plots. The nitrogen flux in the corn/soybean plots was higher than in the switchgrass plots, with most of the nitrogen leaching as nitrate. Results so far suggest that switchgrass would contribute almost no nitrate to drainage water, an important benefit for the water quality of Illinois lakes and rivers.

Propagation and Eradications of *Miscanthus X Giganteus*

Miscanthus rhizomes were evaluated for tolerance to cold storage. When stored for 0–4 months at 39°F, rhizome survival was high, ranging from 83% to 100%. In identifying optimal planting methods, 40g to 60g rhizomes planted at a depth of about 4 inches offered the best combination of high yield with less plant-to-plant variation. Four weed-control studies were conducted to evaluate the tolerance of Miscanthus plants to a variety of preemergence and postemergence corn herbicides. The studies showed no differences in phytotoxicity among treatments.

Harvesting and Preprocessing Technologies

Small ¾-acre plots of Miscanthus and switchgrass have been harvested using a self-propelled haybine with a sickle bar cutter head. A small square baler was used to bale the crops. In February, a 10-acre plot was harvested using a large square baler, which was more efficient. A rotary cutter/mower conditioner is being sought for testing. Miscanthus and switchgrass are being processed into pellets for possible use in biomass furnaces. Miscanthus has initially proven difficult to pellet. Pellets can be made from switchgrass very effectively.

Thermochemical Conversion of Biomass to Fuel

Miscanthus is being evaluated for the feasibility of converting it to an oil-based fuel. To date, a thermochemical process has been used to obtain oils from Miscanthus with a positive energy balance.

Economic Analysis

Yields and associated costs of producing Miscanthus and switchgrass were simulated for each county in Illinois. Revenues from using the biomass crops for electricity generation in existing power plants were also estimated to determine profitability and to determine profitability variation depending on location.

Simulations indicate Miscanthus profitability and opportunity costs vary across Illinois and depend heavily on transportation costs, harvesting costs, and yields. Switchgrass is not likely to be economically competitive with Miscanthus. Neither switchgrass nor Miscanthus is competitive with coal at current coal prices. Incentives from environmental, agricultural, or energy policy are needed to make Miscanthus competitive for use by power plants. One of these benefits is through soil carbon sequestration. Miscanthus has a much higher potential to sequester carbon in the soil as compared to other crops.

Social Acceptability of Energy Crops

Surveys were conducted in northern, central, and southern Illinois to determine producers' knowledge and attitudes toward the production of biomass energy crops. Results of the survey in northwestern Illinois indicate that producers have concerns about "containing" Miscanthus and characterize it as a possible invasive exotic species. Many are interested in the economic potential of the crop if it can be safely contained. Data from the central and southern regions of Illinois seem consistent with the data collected in northern Illinois. The next step is to add information from focus groups.

Illinois Livestock Integrated Focus Team (IL LIFT)

Dr. Michael Hutjens, professor of animal sciences at the University of Illinois at Urbana-Champaign, leads a multidisciplinary, multi-institutional research team to address the economic and social challenges facing Illinois' livestock industry. The four-year SRI focuses on livestock facility siting in Illlinois; using Illinois byproduct feeds in livestock feeding programs; pasture-based forage systems to sustain Illinois livestock producers; and animal identification for enhanced food quality and monitoring of livestock health.

Principal Investigators

Michael F. Hutjens, Animal Sciences

Larry L. Berger, Geoffrey E. Dahl, Animal Sciences

Ted L. Funk, Agricultural and Biological Engineering

Peter D. Goldsmith, Agricultural and Consumer Economics

University of Illinois at Urbana-Champaign

Justin W. Sexten, University of Illinois Extension

Livestock Facility Siting in Illinois

As Illinois livestock operations modernize and expand, they face requirements for manure handling, consumer acceptance, community reaction, and economic impact on their facilities. Researchers are investigating compliance by current livestock facilities, reasons for noncompliance, and ways to improve compliance and its impact on the community.

Researchers completed a site survey of swine concentrated animal feeding operations. Site visits to 36 farms indicated that nearly half have facility management challenges that, unless addressed, will likely have an adverse impact on their economic viability in the near future. Over the next year, research efforts will focus on the development of management tools to improve recordkeeping and planning, to improve feedlot runoff control for small- to medium-sized operations, and to improve producer access to environmental regulations and applications.

Using Illinois By-Product Feed in Livestock Feeding

New ethanol plants are being constructed and going into production, making byproduct feeds more abundant. Researchers developed an interactive website to inform Illinois livestock producers about the use of dried and wet distiller's grains in livestock diets. Information on distiller's grains and their utilization in livestock diets is available at http://ilift.traill.uiuc.edu/distillers. Information on ethanol plants in or within a 100 mile radius of Illinois is also provided.

Using Illinois Forages Based on Pasture-Based System

This project focuses on determining the economic value of integrating animal grazing systems into conventional short-term crop rotation. Forage testing indicates forage quality of managed grazing systems is sufficient to maintain a cow-calf enterprise. High-production enterprises such as lactating ewes and dairy cows or growing calves may require energy supplementation to support desired performance. While economic data analyses are ongoing, preliminary results suggest complete utilization of annual forages are required to compete with perennial forages. All field research can be monitored at www.livestocktrail.uiuc.edu/pasturenet.

Animal Identification for Enhanced Food Quality and Monitoring Livestock Health

Animal identification to improve animal health, provide traceability of livestock products, and enhance food quality is a national concern. Micrometer-scale electronic devices are being tested as a method for permanent animal identification and physiological monitoring, with an emphasis on body temperature tracking in real time. ID devices that also measure body temperature have been shown to track fever as an indicator of animal disease. Researchers examined 40 dairy cows, finding that the sampling frequency needs to be increased to reliably predict certain disease events. External factors such as heat stress were found to influence data measurement, and they should be included in any predictive model.

Water Quality with a Focus on Nutrient Standards

This initiative focuses on improving the research base to aid in the State of Illinois' development of nutrient standards for the surface waters of Illinois. Dr. George Czapar, a University of Illinois Extension educator, provides leadership for the SRI. The research team works closely with the Illinois Environmental Protection Agency, the Illinois Department of Agriculture, and the Metropolitan Water Reclamation District of Greater Chicago.

As the SRI nears completion, it has provided valuable insight on the development of nutrient standards. It has also raised additional questions and identified other factors that may have greater impacts on biotic integrity than nutrient concentration alone. Factors such as physical habitat, sediment, light availability, temperature, and hydrology are part of a complex relationship affecting biotic responses in rivers and streams.

Principal Investigators

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University of Illinois at Urbana-Champaign

Spatial and Temporal Relationships among Biotic Integrity of Illinois Streams, Dissolved Oxygen, and Nutrients

Nutrient enrichment in streams and rivers can increase productivity and the occurrence of nuisance algal blooms. Researchers are evaluating the model that increased nutrient loading (particularly phosphorus) to Illinois streams leads to increased chlorophyll a, which causes large daily fluctuations in dissolved oxygen and at the same time impairs biota. Researchers have conducted extensive state-wide sampling of approximately 140 sites to encompass the variability in stream and land use types that occur in Illinois during both late spring (high flow) and late summer (low flow) conditions.

At a state-wide scale, it does not appear that dissolved nutrients are strongly related to the abundance of chlorophyll a. Intensive work was also conducted at selected sites to gain a finer temporal resolution of nutrient-chlorophyll-oxygen relationships. Results show that light availability, temperature, and hydrology modify the cause-and-effect relationship implied in the above model. A recent focus has been to obtain dissolved oxygen measurements at as many sites as possible to expand on previous site-specific results. These dissolved oxygen concentrations have been related to chemical and biological conditions in each stream, as well as to physical habitat. Studies also have evaluated phosphorus forms and controls on concentrations in a range of streams. From these data, researchers hope to determine controls on phosphorus concentrations in Illinois waters, along with the resultant impact on chlorophyll a, dissolved oxygen, and biota, providing needed data for the development of nutrient criteria.

Effects of Phosphorus Mediated through Algal Biomass in Illinois Streams

To quantify the effect of phosphorus on algae, dissolved oxygen, and fish biodiversity in Illinois streams, researchers used an integrated research approach with data from controlled lab experiments, large scale natural experiments, and statistical modeling from long-term and contemporary observations. Results have provided scientific support for TMDL (total maximum daily loads) regulation of phosphorus in Illinois waters.

Data suggest that significant reductions in ambient Illinois phosphorus concentrations would be required to reduce algae growth in most Illinois streams. The plateau for algae growth occurs at levels at or below 75 ug/ml. Reduction of phosphorus to the EPA standard of 75 ug/ would not be likely to reduce algae growth and the abundant accumulation of nutrients in Illinois streams. Canopy cover strongly affected algae accrual across the full spectrum of nutrient concentrations. Restoration and maintenance of riparian canopy in wadeable streams would provide a buffer against nutrient effects in moderate-sized streams. Riparian shading also contributes habitat complexity to streams, a factor known to strongly affect animal diversity.

Headwater Stream Primary Production Dynamics—Nutrient Limitation and the Potential Role of Sediment Derived Nutrients

The goal of this project is to examine the relationships among nutrients, algal production, and dissolved oxygen in first- and second-order agricultural headwater streams of Central Illinois. To examine the link between nutrients and algal production, researchers have focused on six headwater streams of the Mackinaw River with similar geology, hydrology, and watershed size.

Previously, researchers determined that periphyton were nitrogen limited during late summer and early fall. Phosphorus was rarely limiting, even though dissolved reactive phosphorus levels were near detection during these times. These experiments, however, used artificial substrata to mimic hard substrata, but soft sediments dominate the bottoms of agriculture streams. Researchers are now testing the hypothesis that biomass and production of periphyton on soft sediments is higher than on hard sediments, and it may be rarely nutrient limited. Results suggest periphyton are rarely limited by nutrients or by light. The data indicate that these extensive algal blooms may be deriving nutrients from sediment-bound phosphorus, and the resulting algal blooms drive diurnal dissolved oxygen fluctuations. Periphyton on soft sediments are often overlooked by stream ecologists, but they may be the major contributor to oxygen minima, which can lead to decreased biodiversity.

The Impact of Sediments on the Potential Bioavailability of Phosphorus in Illinois Streams

Researchers are working to better understand the impact of suspended and bed sediments on the potential bioavailability of phosphorus in Illinois streams. The Spoon River watershed, a major tributary of the Illinois River, is the focus of this effort. Researchers carried out intensive low-flow and storm sampling of suspended and bed sediments to determine phosphorus forms and bioavailability.

Major findings to date are

- The severe drought conditions had major impacts on water quality. Low-flow water conditions resulted in unusually high concentrations of suspended algae, low concentrations of dissolved phosphorus, and persistently large diurnal swings in dissolved oxygen concentrations.
- Equilibrium phosphorus concentration values (that phosphorus concentration at which sediments are neither a source nor a sink of inorganic phosphorus) of sediments vary directly with mean overlying water column dissolved reactive phosphorus (DRP) concentrations over the relatively short term (weeks).
- Bioavailable phosphorus concentrations are generally equal to DRP concentrations during typical summer months, but were 2 to 5 times higher than draught condition DRP concentrations. Bioavailable phosphorus concentrations are also 2 to 5 times higher than DRP concentrations during storm events.

Sentinel Program

Introduced in 1999, the C-FAR Sentinel Program at the University of Illinois at Urbana-Champaign was initiated to take advantage of windows of opportunity to conduct research that address C-FAR priorities. Sentinel projects are multi-investigator and multi-departmental, with most crossing college boundaries and bringing together investigators from a variety of disciplines. In FY06, this program comprised seven creative, problem-solving research projects. Progress reports on these initiatives follow.

SoyFACE: Research and Discovery Program to Abate the Threats and Harness the Potential of Atmosphere Change to Benefit Illinois Agriculture

The SoyFACE project investigates the effects of rising atmospheric CO2 and surface ozone on soybeans and corn under fully open-air conditions. The facility is the largest of its type in the world, and it has provided new insights into the threat that these changes pose to Illinois' two major crops. Its uniqueness has leveraged the expertise of scientists from around the world, and it now indicates how crops must be adapted to cope with these ongoing changes. The project was made possible by C-FAR, and it has leveraged over $4 million additional dollars of support from the U.S. Department of Energy and U.S. Department of Agriculture, as well as important support from Archer Daniels Midland, BASF, Bayer, and Pioneer Hi-Bred.

A summary of research findings to date includes the following:

- In the open air, the positive response of soybeans to rising atmospheric CO_2 is less than expected and very much smaller than expected for corn.
- Damage caused by rising ozone in the open is more than expected based on previous chamber experiments.
- Elevated CO_2 delays senescence in soybeans and results in more insect damage, particularly from Japanese Beetles.
- Variant Western Corn Rootworm lay more eggs under soybeans at elevated CO_2.
- Micronutrients in the beans are lower in elevated CO_2.

The SoyFACE initiative has shown that a substantial breeding program will be necessary to adapt soybeans and corn to the changes that are developing as the atmosphere changes. Employing soybean chips, researchers have begun to identify key genes controlling the response of the crop to these two aspects of atmospheric change. Research findings were presented to a congressional briefing in Washington, D.C. in the summer of 2005.

Stephen P. Long, Crop Sciences and Plant Biology

Donald R. Ort, Crop Sciences and USDA-Agricultural Research Service

Evan H. DeLucia, Plant Biology

With contributions from investigators representing the UIUC departments of Animal Sciences, Atmospheric Sciences, Crop Sciences, Entomology, Food Sciences and Human Nutrition, Natural Resources and Environmental Sciences, and Plant Biology, as well as the Illinois State Water Survey, USDA-Agricultural Research Service, and other research institutions throughout the United States and Europe.

Illinois Genetic Marker Center

The Illinois Genetic Marker Center (IGMC) is being used by researchers in several departments on the University of Illinois campus. The center provides a valuable resource from which researchers can collect genetic data on biological samples. Genetic data can be collected inexpensively in the center, thus allowing more research to be completed on campus.

In the past year, the IGMC has been updating research technology for center users by creating cost-effective ways to carry out genotyping projects, primarily through the development of a universal marker system. This system enables users to cost effectively fluorescently label their DNA samples without the expense of buying individually labeled reagents. This method has been implemented by many center users, both in animal and plant species. The center has also been working on the development of new technology for SNP (single nucleotide polymorphisms) detection. With this new technology the center will provide another valuable service to researchers.

The center continues to teach both undergraduate as well as graduate students along with postdocs how to use the technology available in the center to aid in their individual projects. For many students this hands-on knowledge and experience promotes their general understanding of DNA fragment analysis.

Brian W. Diers, Torbert R. Rocheford, Crop Sciences

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John M. Epifanio, David P. Philipp, David H. Wahl, Illinois Natural History Survey

Lucienne T. Burrus, Manager

Development of a Soybean Cyst Nematode Genetic Infrastructure

Soybean cyst nematode (SCN) is the most economically important pathogen of soybean in the United States. SCN-induced disease is a chronic problem for soybean growers because, once a field is infested, SCN cannot be eradicated with currently available technologies. For this reason, there is a need for new sustainable and environmentally sound approaches to manage SCN. The goal in this project is to use SCN genomic sequence data to understand the molecular genetic basis of important traits of these microscopic worms that will be used as targets and tools for innovative tactics to reduce SCN's impact on soybean yield.

Prior to the initiation of this project, researchers devised a way of conducting controlled mating of inbred SCN biotypes. This technique opened the door for classical genetic analysis on SCN. To develop SCN as a genetic system, molecular markers are needed. Therefore, most of the effort for the first year of this project has been spent identifying DNA sequence differences between the SCN biotypes. Researchers compared 300 million base pairs of DNA sequence from one parental biotype (virulent) to 60 million base pairs of DNA sequence from another biotype (nonvirulent). Over 20,000 sequence differences in genomic sequences were identified.

Efforts are underway to generate a physical map of the SCN genome. Researchers expect to reach their goal of 500+ confirmed homozygous SNPs (single nucleotide polymorphisms) by the end of the grant period. SNPs (pronounced "snips") are DNA sequence variations that occur when a single nucleotide when the genome sequence is altered. Researchers plan to use these SNPs to construct a SCN genetic map and link markers to a SCN virulence gene(s).

Kris N. Lambert, Terry L. Niblack, Matthew E. Hudson, Leslie L. Domier, Crop Sciences

Multidisciplinary Research and Discovery Program to Convert Renewable Plant/Crop Biomass into Renewable Fuels and Chemicals

Researchers are working in collaboration with the National Renewable Energy Laboratory on screening maize cell-wall mutants in order to quantify cell-wall constituents such as cellulose and lignin in preparation of use of these materials for fermentation.

Genomics is being used for the development of enzymes with improved functionality for hydrolysis of plant cell-wall material. Researchers are identifying candidate genes that are differentially expressed in response to different samples of plant substrates. The expressed genes will be used to specifically produce recombinant enzymes for comparison with the commercial enzyme preparations. The hypothesis is that because these enzymes are selected on the basis of the specific substrate, they will be more effective at releasing sugars for further fermentations. Thus, researchers will generate a series of enzymes and enzyme combinations, selected on the basis of their increased expression in response to substrate. These enzymes and enzyme combinations will be tested for commercial enzyme preparations and compared to these data sets. The end result will be an optimal mixture for breaking complex carbohydrates into their monosaccharide components.

Researchers are working on the development of using yeast strains as potential hosts for production of butanol. Preliminary data suggest that the yeast strains are resistant to 1.6% butanol. In addition, several solvent-producing clostridia have been screened for their ability to use mixed sugars streams. Preliminary data is promising, and it bodes well for using these microbes to produce solvents from biomass such as trees, grasses, and agricultural residues.

Hans P. Blaschek, Thaddeus C. Ezeji, Food Science and Human Nutrition

Bryan A. White, Animal Sciences

Martin O. Bohn, Crop Sciences

Huimin Zhao, Chemical and Biomolecular Engineering

The Sentinel Crop Gene Identification Project

The goals of the Sentinel Crop Gene Identification Project are to develop, test, and implement new approaches to determine the biological functions for crop-specific genes (CSGs) from corn and soybean CSGs. These approaches integrate the use of bioinformatics, molecular biology, and genetics to add functional information to genomes and evaluate the potential of CSGs in crop improvement.

Researchers have refined a comprehensive list of thousands of soybean ESTs (expressed sequence tags) representing protein-coding genes in soybeans. They then determine the match of these sequences to those of proteins from any other organisms. Those that do not match any other plant, animal, or microbial sequence are likely to have arisen relatively recently during evolution or domestication of the crop, and they may have important functions for the agronomic performance of soybeans. Similar approaches are ongoing for maize, which also has a large EST collection. Information from national efforts to sequence the complete genomes of maize and soybean is being utilized to update data sets as it becomes available. In order to gain information on expression, researchers generate and analyze microarray data from both soybeans and maize.

Underpinning these efforts are developments of bioinformatics approaches toward defining the minimal set of soybean- or maize-specific genes. In order to develop novel bioinformatics criteria needed to delineate a quantitative basis for identifying gene complements unique to crop plants such as soybean and corn, researchers compared predicted proteins encoded in whole-genome sequences of 185–260 organisms. Advanced statistical models of structural pattern recognition were used to better understand the evolution of proteins. This allows for the categorization of proteins according to structure and their use in biological systems.

Lila O. Vodkin, Gustavo Caetano-Anolles, Matthew Hudson, Stephen P. Moose, Crop Sciences

Initiative for Low-input Apple Production in Illinois

The apple industry in Illinois generates about $30 million, with a tremendous capacity for increased growth and profitability. Apple growers currently use fungicides, bactericides, and insecticides to control several important diseases and insects. The overall goal of this project is to develop a low-input production system for the Illinois apple industry that minimizes pesticide use coupled with economic and marketing strategies for increasing profit and diversifying income.

To establish new blocks of apple trees for disease, insect, and cultural-management research experiments, five disease-resistant apple cultivars, developed from the Illinois apple breeding program, along with a standard control, have been propagated onto a dwarfing apple rootstock. Approximately 600 trees from all six apple varieties have been successfully propagated.

Researchers are evaluating a low-insecticide spray schedule on insect populations. Reduced-risk insecticides and insecticides certified for use in organic production systems were evaluated. On Red Delicious apples, the reduced-risk insecticides acetamiprid, novaluron, and rynaxypyr provided greater than 95% control of codling moth infestation, and a combination of the organically certified insecticides pyrethrin and spinosad resulted in greater than 90% control of this pest. These results are directly transferable to production systems, using disease-resistant cultivars, and to efforts to reduce the use and risks of organophosphate insecticides in fruit crops. In a one-acre block of transition organic apples comprising disease-resistant cultivars, a management program that used kaolin clay, pyrethrin, and spinosad significantly reduced overall insect damage at harvest in comparison with damage in the untreated portion of the same transition organic block.

In observations of the differential susceptibility of disease-resistant cultivars to insect damage, the disease-resistant cultivar GoldRush remained undamaged by Japanese beetles, whereas the disease-resistant cultivars Liberty and Enterprise and the susceptible cultivar Golden Delicious were moderately to severely defoliated. Further analyses of differences in cultivar response to insects are underway.

Trials were conducted to evaluate performance of a weather-based disease warning system for control of summer diseases. The disease prediction system saved from 2 to 4 sprays on a two-week spray schedule. There were no significant differences in disease severity between trees in the disease prediction system and those receiving conventional fungicide applications. None of the apple diseases were observed in Belleville, Malta, and Urbana. But, at Dixon Springs, apple diseases were present on all trees receiving either conventional spray-application of fungicides or sprayed according to the weather-based disease warning system.

Researchers are introducing scab resistance genes into traditional apple cultivars. Researchers have introduced scab resistance genes into a species of bacteria, *Agrobacterium tumefaciens*, which is now being used in the genetic transformation of Fuji apple leaves. Proliferating shoot cultures of Fuji, Gala, Honey Crisp, and Golden Delicious are being grown in tissue culture so researchers can propagate enough shoot cultures of these apple cultivars for genetic transformation experiments.

A survey instrument has been prepared to determine and evaluate consumer preferences regarding apple production practices.

Schuyler S. Korban, Mosbah M. Kushad, Natural Resources and Environmental Sciences

Richard A. Weinzierl, Mohammad Babadoost, Crop Sciences

Michael A. Mazzocco, Agricultural and Consumer Economics

Internal and External Programs Research Projects

The following section includes summaries of final reports submitted by the principal investigators of University Internal Program projects and External Competitive Grants Program projects that were completed in 2006. Please visit the C-FAR website at **www.ilcfar.org/research/index.html** for more detailed information about these projects.

Crops

ACES Genotyping Center

The primary goal of the ACES Genotyping Center is to provide a cost-effective facility for genotyping organisms with genetic markers. Genotyping is done to genetically describe organisms, and the results from these efforts can be used to map genes, select individuals, or genetically describe populations. Although this genotyping analysis can be very useful in research, the high costs of these analyses have limited their application in research. The Center was established to provide a way for researchers to genotype plants or animals with microsatellite genetic markers at a low cost. A secondary goal was to create a laboratory in which students and postdoctoral researchers could obtain hands-on experience in the use of DNA sequencers and other high-throughput genotyping equipment and gain knowledge in DNA genotyping analysis.

The Center has been used by researchers studying a wide range of topics from fish ecology to swine breeding, however, a major focus of research has been plant breeding. This plant-breeding research is centered on increasing the profitability of producers through increasing yield potential, enhancing pest resistance, and improving seed composition of the major crops of Illinois agriculture. The center's facilities have helped researchers map, select, and potentially clone important genes controlling these traits. Since the inception of the center, over 40 researchers across many disciplines have benefited from the services provided by the facility.

UIUC Sentinel Program

Brian W. Diers, Frederic L. Kolb, Randall L. Nelson, Torbert R. Rocheford, Crop Sciences

John A. Juvik, Natural Resources and Environmental Sciences

University of Illinois at Urbana-Champaign

Developing an Agricultural Remote Sensing Program at the University of Illinois

The ability to record and process crop field images from satellites, planes, and ground-based vehicles has provided tremendous opportunities to advance precision agriculture. The commercial use of agricultural remote sensing to improve farm management is closer to becoming a reality. This project focused on the applications of remote sensing in agricultural settings. Emphasis is placed on applied research and engaging U.S. agribusinesses to facilitate the commercialization of new advanced remote sensing technologies.

Officially opened and dedicated in April 2001, the Illinois Laboratory for Agricultural Remote Sensing (ILARS) located at the University of Illinois at Urbana-Champaign has been a unique infrastructure. It has brought together research experts from the University of Illinois College of Agricultural, Consumer and Environmental Sciences; National Aeronautics and Space Administration (NASA) Commercial Remote Sensing Program; Institute for Technology Development–Spectral Visions; National Center for Supercomputing Applications (NCSA); and the U.S. Department of Agriculture to develop "real world" applications of remote sensing.

It is believed that remote sensing technology can help precision farming reach its full potential. This technology will allow farmers to save herbicide with an intelligent, site-specific application system, identify soil types and problem areas in their fields, and accurately predict in-field yield variability. ILARS has been fusing cutting-edge technologies to develop new product ideas and application prototypes. Research projects include hyperspectral image sensing, the use of dynamic models to monitor agricultural runoff, and the development of data mining and neural network technology to process high resolution spatial and spectral remotely sensed data.

UIUC Sentinel Program

Lei Tian, Agricultural and Biological Engineering

Donald G. Bullock, Crop Sciences

James D. Westervelt, formerly of Agricultural and Consumer Economics

University of Illinois at Urbana-Champaign

Plant Disease Molecular Diagnostic Initiative

Plant pathogens cause billions of dollars worth of damage to crop production every year in Illinois. Currently plant diseases are managed using chemical pesticides, resistant plant varieties, and crop rotation strategies. No matter what control strategy is employed, an assessment of control effectiveness is essential to determine what pathogen types are in the field and whether these pathogen populations are increasing or decreasing over time. Pathogen detection needs to be performed in breeding programs, in research labs, and through extension services. Recommendations to producers depend directly on the accuracy and speed of pathogen detection.

In this project, equipment was purchased to aid in the rapid detection of plant pathogens. Researchers purchased a Zeiss microscope that speeds the counting of soybean cyst nematodes (SCN), a microplate spectrophotometer that can perform high-throughput immunological and DNA quantification assays, and two ABI sequence detection systems that can quickly quantitate pathogen DNA. This equipment has been used extensively for the detection of a wide range of plant pathogens, and the diagnostic assays devised have made a significant impact on the speed and accuracy of plant pathogen detection.

This initiative has had a wide impact, showing benefits to farmers, plant breeders, and researchers studying plant pathogens. The SCN diagnostic tests developed are helpful in breeding for resistance, in monitoring nematode levels in the field, and in studying and monitoring the buildup of destructive and virulent stains of SCN. The ability to detect low levels of fungal pathogens has been shown to be important for monitoring the invasion and spread of emerging pathogens, i.e. the use of quantitative real-time polymerase chain reaction (QPCR) assays have been essential for tracking the movement of soybean rust and for the accurate diagnosis of this potentially destructive plant pathogen. For both SCN and soybean sudden death syndrome diseases, the use of QPCR has been useful for measuring pathogen levels in the plants, which is critical in breeding for plant disease resistance.

UIUC Sentinel Program

Kris N. Lambert, Terry L. Niblack, Crop Sciences

Dean K. Malvick, formerly of Crop Sciences

University of Illinois at Urbana-Champaign

Weidong Chen, formerly of Illinois Natural History Survey

Crop Rotation Collapses as a Pest Management Tool for Western Corn Rootworms

Due to the loss of crop rotation as a pest management approach for western corn rootworms, Illinois producers have experienced an additional annual loss of $100 million in crop damage and management costs. Western corn rootworm rotation resistance is fundamentally a problem of movement: Egg-laying females now disperse from cornfields to deposit their eggs in soybeans and other crops rotated with corn. Despite the rotation of corn and soybeans, by the end of the 2002 growing season, over 4.5 million acres of corn produced across 30 counties of Illinois were susceptible to western corn rootworm larval injury. In 2007, rotated cornfields in the northern two-thirds of Illinois will be susceptible to economic losses caused by the variant western corn rootworm.

As a result of this initiative, researchers more fully understand the behavioral response of the variant western corn rootworm that has allowed it to overcome the pest management benefits of crop rotation. Due to the rigid rotation of corn and soybeans across central Illinois, and the trend toward earlier planting of corn, a variant of the western corn rootworm has been selected in which female beetles have expanded their egg-laying range to include many other crops including soybeans, wheat, alfalfa, oats, and wheat double-cropped with soybeans. This finding meant that switching to another rotational scheme for Illinois producers was not an effective management option. Consequently, unless corn producers scout their fields and use economic thresholds, they will need to consider the use of a soil insecticide or transgenic (Bt) corn rootworm hybrid on rotated or continuous corn acres throughout the northern two-thirds of Illinois.

Researchers are continuing efforts to unravel any potential genetic explanations that may clarify the behavioral adaptation by western corn rootworms. The Expressed Sequence Tag database portion of the project is complete, as well as the microarray hybridization assays. Sequencing of the cDNA library has also been completed. A total of 20,736 reactions have resulted in 16,797 sequences. Following trimming and filtering, 16,172 sequences were further analyzed. It is estimated that 7,000 unique sequences will result from this project. Microarray hybridization assays were conducted to determine whether the collection method induced a stress/alarm response in the beetles. Thus far, researchers have not detected gene expression differences in the brains of these two strains of beetles that might help explain the adaptation of east-central Illinois corn rootworm beetles to crop rotation.

This research initiative has assisted the U.S. EPA and industry to more efficiently develop resistance management plans designed to prevent or delay evolution of resistance by corn rootworm to transgenic insecticidal corn. These genomic studies generated information about western corn rootworm genetics and gene expression that provided a 'critical mass' of research and researcher interest contributing to the formation of the *Diabrotica* Genetics Consortium, a Non-Funded Cooperative Agreement (NFCA), administered by Thomas W. Sappington, USDA-ARS, of Iowa State University. Members of this group (including Sentinel grant principal investigators) are providing leadership in the study of western corn rootworm dispersal, ecology, and population genetics in the USA and in Europe. Members of this group are continuing the investigation of western corn rootworm dispersal, ecology, and population genetics in the United States and Europe. Additional collaborative relationships have been developed with the University of Nebraska and the Institut National de la Recherche Agronomique in France to address western corn rootworm insecticide resistance and population genetics.

UIUC Sentinel Program

Michael E. Gray, Crop Sciences

Mark R. Band, Lei Liu, Jose R. Pardinas, Keck Center for Comparative and Functional Genomics

Scott A. Isard, Geography

Harris A. Lewin, Institute for Genomic Biology

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Susan T. Ratcliffe, Crop Sciences

Hugh M. Robertson, Entomology

University of Illinois at Urbana-Champaign

Eli Levine, Joseph Spencer, Illinois Natural History Survey

Paul D. Mitchell, Agricultural Economics

Texas A&M University

Ethanol Policy in the Presence of Other Economic Distortions: Is a Win-Win Policy Change Possible?

This research was undertaken to bridge the gaps in the existing literature by estimating the net benefits to society of ethanol use, incorporating economic and environmental effects. More specifically, the objectives of this research are to estimate the economic costs of varied policies designed to promote ethanol, estimate the environmental effects of an expanded national ethanol program, and search for combinations of fuel and agricultural commodity policies that might lead to win-win situations relative to the effects of current policy.

Using Mathematica computer software, researchers developed a partial equilibrium theoretical model of motor fuels markets. The model was used to simulate the impacts of different tax policies and different externality costs on economic equilibria, and on the welfare of stakeholders and interest groups. The two principal policy instruments employed in the model were per-gallon ethanol and gasoline taxes. The model also simulates the environmental impacts of ethanol policy.

This research produced a number of key results. The simulations predicted that a "socially optimal" policy would raise taxes on motor fuels significantly. Current federal, state, and local taxes on gasoline average about 47.5 cents per gallon. Ethanol blenders receive a very large federal tax credit, and researchers estimated that on average the ethanol production sector (including corn farmers, ethanol producers, and blenders) receives a subsidy of 3.5 cents per gallon.

The model suggests that far higher taxes, 104 cents per gallon of ethanol and 87 cents per gallon of gasoline, would be socially optimal. This result comes about because the externality costs of burning motor fuel are high, because of pollution and congestion that result. Researchers estimate that implementing the socially optimal policy would raise national income ("surplus") by $1.99 billion, or by approximately $300 per family.

This research is of value to policy makers and to the general public. The study indicates that current motor fuel taxes do not appropriately take account of the pollution and congestion costs of burning motor fuel to drive automobiles. The policies researchers propose, however, would not benefit everyone. Consumers would end up facing higher prices for motor fuel, and producers would receive lower prices. But these losses would be compensated by welfare gains due to a better environment.

UIUC Internal Program

David S. Bullock, Amy W. Ando, Madhu Khanna, Agricultural and Consumer Economics

University of Illinois at Urbana-Champaign

Effect of Milling Parameters on Fiber and its Removal from the DDGS

Dry-grind ethanol production in the United States is increasing at an exponential pace. The conventional dry-grind ethanol process produces a modest-valued coproduct called distiller dried grains with solubles (DDGS). DDGS is sold as a foodstuff, mainly for ruminant animals' diets, due to its high fiber content. The purpose of this study was to investigate removal of fiber from DDGS to obtain the following potential benefits: (1) creation of a coproduct that can be used for recovery of high-valued nutraceutical compounds or other industrial products; and (2) increased protein and fat concentrations and reduced fiber content in the resulting DDGS, which may allow greater inclusion of DDGS in nonruminant diets.

A process called the "elusieve process" was developed to separate fiber from DDGS in dry-grind corn processing, resulting in enhanced DDGS with lower fiber, higher fat, and higher protein contents. The process involves two separation methods, sieving and elutriation (air flow). DDGS samples were sieved into five sieve categories. The two smallest sieve categories comprised greater than 40% of the original DDGS weight and had lower fiber and higher protein and fat contents. An apparatus was designed to elutriate fiber from DDGS samples. Elutriation of the larger three sieve categories resulted in higher protein and fat contents and lower fiber contents in fractions that were recovered at the bottom of the elutriation column. This process was effective in separating fiber from DDGS. For a dry-grind plant processing corn at a rate of 1,020 metric tons/day (40,000 bu/day), capital investment was estimated to be $0.9 million, and the payback period was 1.4 to 2.2 years. Enhanced DDGS had higher phytosterol content than elusieve fiber. Elusieve fiber was suitable for production of corn fiber gum and ethanol. The elusieve process was also effective in separating fiber from distillers dried grains (DDG). A patent application has been filed for the elusieve process.

External Competitive Grants Program

Vijay Singh, Kent D. Rausch, Agricultural and Biological Engineering

University of Illinois at Urbana-Champaign

Robert A. Moreau, Crop Conversion Science and Engineering Research Unit

USDA-Agricultural Research Service

Ronald L. Belyea, Animal Sciences

University of Missouri

Expanding Market for Activated Carbon from Corn-to-Ethanol By-Products

Corn fiber, a byproduct of ethanol production, is typically sold as part of the product called distillers dried grain, which is used for animal feed. This material could potentially be an attractive bio-based feedstock for producing activated carbon (AC). AC is produced industrially from several precursors including wood, peat, lignite, bituminous coal, and coconut shells. It is commonly used in water-treatment and air-purification processes. A conservative forecast indicates that the U.S. demand for activated carbon will expand 4.3 percent annually to 475 million pounds in 2008, valued at $315 million. Other estimates indicate much higher demand, because in 2005 the U.S. Environmental Protection Agency (EPA) proposed a Clean Air Mercury Rule (CAMR) for the reduction of mercury emissions from coal-fired plants. The CAMR will reduce utility emissions of mercury from 48 tons a year to 15 tons, a reduction of nearly 70 percent by 2018. Activated carbon injection (ACI) is projected to be the most commonly used technique for the removal of mercury from the flue gas.

In an earlier study, a process was developed for producing an activated carbon with optimized properties for removing mercury emissions from coal combustion flue gases. The current study was conducted to develop an expanded market for AC made from corn fiber for various pollution control systems, particularly for removal of volatile organic compounds from air steams and organic compounds from water streams.

Results indicate that corn fiber is a suitable bio-based feedstock for producing AC. In addition, CFAC can be used as an effective adsorbent in various air- and water-pollution control processes and could compete with commercially available ACs, as long as its adsorption surface area can be made equivalent to commercially available ACs. Although a high surface area activated carbon is desirable for some environmental applications, there are many applications, such as removal of mercury from coal combustion flue gases, where a lower surface area AC is adequate. A low-cost CFAC can potentially compete with commercial ACs in this type of application. An economic analysis revealed that that the selling price of CFAC could be substantially lower than the price of many commercial carbons.

Additional experiments were performed to evaluate the heating value of the flammable off-gases generated during the on-site manufacturing of CFAC, which could provide a source of energy to fire boilers for the production of steam in an ethanol plant. The heating value of the off-gases was about 7900 Btu/lb (dry basis), which is comparable to the heating values of lignite and subbituminous coals.

External Competitive Grants Program

Massoud Rostam-Abadi, Illinois State Geological Survey

Yongqi Lu, Mark J. Rood, Charles J. Werth, Civil and Environmental Engineering

University of Illinois at Urbana-Champaign

Soybean Aphid Challenge

In 2000, Illinois and much of the Midwest were invaded by the soybean aphid. The goal of this project was to develop a comprehensive strategy that combines chemical, cultural, and biological tactics for effective control of the soybean aphid.

Researchers sampled 14 soybean fields in each of two townships in Kendall and Champaign counties on four sampling dates during the summers of 2001–2003. Generally, there was little synchrony of population dynamics across the fields in either township during the middle of the summers. There was significant field-to-field variability in mean number of aphids per plant. For Kendall Township in all years, drilled soybean fields always had the highest mean density at the second and third sampling dates, but fields with wide rows had the highest mean density at the fourth date. However, row spacing had no significant influence on the mean density in most of the other analyses of variance. No relationship was found between aphid density and distance from the field edge over the 50m transects used in sampling. Results suggest that aphids should be counted on 50 plants per field to obtain a reliable estimate of the population. Additional data were used to develop models to forecast population growth of the soybean aphid during a season.

In 2001, suction traps were set up in various locations across Illinois to monitor movement of the soybean aphid. The traps have provided an interesting look at the movement and relative abundance of the aphid.

The summer counts reflect the surrounding field populations as might be expected. What was not expected was that the traps would catch the fall migrants that are moving from soybeans to the winter host, buckthorn. Years with high fall flight numbers have been followed by years of higher field populations, and years with low fall flight numbers have been followed by years with low populations. At present there are 40 traps located in 10 Midwestern states, providing a look at regional movement and potential over-wintering areas.

Although the trap network was started primarily to monitor the soybean aphid, many other species of agriculturally important aphids are identified and counted as well. The suction trap data are widely circulated to those interested in aphid vectors of viruses to specialty crops, cereals, and legumes, as well as the species that may affect the same set of crops by direct feeding.

UIUC Sentinel Program

David W. Onstad, Natural Resources and Environmental Sciences

Glen L. Hartman, Kevin L. Steffey, Crop Sciences

University of Illinois at Urbana-Champaign

David J. Voegtlin, Illinois Natural History Survey

Strategies for Management of Vegetable Diseases in Organic and Traditional Farms

Phytophthora blight, caused by *Phytophthora capsici*, has been identified as one of the most serious threats to production cucurbit crops (cucumbers, gourds, melons, pumpkins, squashes, watermelons) and peppers in Illinois. The disease can cause up to 100% crop losses. Integrated strategies are needed to minimize crop losses to this pathogen. In this project, researchers sought to evaluate the effectiveness of red-light treatment, seed-treatment, calcium application, and fungicide spray for control of Phytophthora blight and other diseases.

Pumpkin, watermelon, pepper, and tomato varieties were included in the studies. In the greenhouse, only 21% to 36% of red-light treated seedlings became infected, whereas 78% to 100% of the seedlings of control plants died from infection with *P. capsici*. Red-light treatment of seedlings during nights for four weeks was the most effective. Although it delayed infection, red-light treatment alone did not provide consistent season-long protection of the plants against *P. capsici* in the field. Through screenings, four bell peppers cultivars were found resistant against *P. capsici*.

Seed treatment with mefenoxam prevented *P. capsici* infection in pumpkin and watermelon plants until five weeks after sowing seeds. Calcium application alone did not provide consistent season-long protection. Seed-treatment plus spray application of fungicides in cucurbits, and red-light treatment plus spray applications of fungicides in pepper were more effective in controlling Phytophthora blight in the fields. Four fungicides (dimethomorph, famoxadone-cymoxanil, cyazofamid, copper sulfate) were determined to be effective and are used in the disease management strategies.

Illinois produces approximately 33,000 acres of cucurbit crops, eggplants, peppers, and tomatoes. More than 90% of processing pumpkins produced in the United States are grown and processed in Illinois. Implementing methods developed in this research (seed treatment and fungicide applications), reduces crop losses to less than 10%. Seed-treatment developed in this study is now widely used by cucurbit growers. Effective management of Phytophthora blight resulted in increasing acreage of processing pumpkins from about 6,000 acres in 1998 to more than 10,000 acres in 2005. Also, due to introduction of Phytophthora-resistant bell pepper cultivars, bell pepper production in Illinois has increased in the past years.

External Competitive Grants Program

Mohammad Babadoost, S. Z. Islam, Crop Sciences

University of Illinois at Urbana-Champaign

The Effect of Using Disease-Free Planting Stock on Horseradish Yield and Quality

Illinois horseradish contributes an estimated $2.5 million to the state's annual farm income. This amounts to an estimated $2,000 per acre. However, in recent years, Illinois production has declined from 80% of the nation's horseradish to approximately 50–60% as a result of increased disease pressure and its associated decrease in yield. This disease is caused by a complex of microorganisms, but the primary causal agents are Verticillium spp.

fungi. In addition, Turnip mosaic virus may play a secondary role by weakening plants and making them more susceptible to Verticillium infection. Illinois may soon lose its predominance in the horseradish market to growers in Wisconsin, California, Canada, Europe, China, and Japan.

Researchers have shown that Turnip mosaic virus and Verticillium spp. fungi can be removed from horseradish plants by meristem tip culture in vitro. Ultimately, economically important cultivars were introduced to plant tissue culture and freed of these two pathogens. In the field, the resulting pathogen-free horseradish plants were more vigorous and productive than plants propagated in the traditional manner. In terms of average root yields, clean planting material was the highest yielding over all fields. In all cases and all fields, the dirty roots were the least productive. In many cases, clean roots produced 2–3 times the yield of the dirty counterparts. Researchers have investigated Turnip mosaic virus and Verticillium reinfection rates for field-planted, pathogen-free horseradish to estimate how many seasons growers can save set roots before having to replant from tissue-culture generated growing material. Results indicate that to ensure the harvest will be more than 90% marketable, growers may have to replant from tissue-cultured plants every year in fields with high disease pressure. If growers are willing to accept a slightly lower threshold (~85% marketable), this may be extended to every other year. This is still in marked contrast to the 90–100% loss many growers are currently experiencing in some fields.

External Competitive Grants Program

Robert M. Skirvin, Margaret A. Norton, Natural Resources and Environmental Sciences

University of Illinois at Urbana-Champaign

Examination of Most Influential Factors on Crop Insurance Purchase Decisions of Northern Illinois Farmers

The goal of this project is to determine what factors are most influential relative to farmers' crop insurance purchasing decisions in northern Illinois. Research results indicate that survey respondents most frequently made their 2005 crop insurance purchase decisions independently, without being influenced by another party. Those who reported being influenced by an outside party most frequently identified crop insurance agents as being part of their decision-making process. Price was selected as the most important factor affecting purchased decisions, followed by the compatibility of insurance coverage with grain marketing plans, and the probability of receiving a claim payment. Farmers with larger operations tended to select group products more frequently than their counterparts with smaller farming operations.

This information will help make all parties involved with crop insurance delivery more effective in helping farmers select the appropriate coverage. Knowing the importance of price will help legislators and government agency officials make informed decisions about subsidy levels and increased participation levels. Similarly, crop insurance agents will benefit by knowing the perceived importance of the compatibility of crop insurance coverage with grain marketing plans when helping farmers select their coverage. Crop insurance companies will benefit from knowing which products and specific features producers select across various segments of farm operation and farm operator demographics. Farmers will gain perspective from the decision-making criteria utilized by their peers, and they will make more informed purchase decisions, better utilizing their crop insurance dollars to accomplish specific objectives.

ISU Internal Program

Aslihan D. Spaulding, Matt Ginder, Agriculture

Illinois State University

Development of High Lauric Acid Cuphea Varieties

Cuphea seed oil contains large amounts of fatty acids, such as lauric and capric acid, which provide soaps and detergents with their cleaning power. Currently, the U.S. soap industry gets half of these fatty acids from the petroleum industry and the other 50% from imported coconut and palm kernel oils. In 2002, the United States imported 1,325 million pounds of coconut and palm kernel oil valued at $526 million. The only potential candidate that has been identified for temperate crop production in the United States is Cuphea. An estimated 8 million acres of production would be needed to meet 50% of the lauric acid market demand.

The specific objective of this project was to develop high lauric acid seed oil cuphea varieties through interspecific hybridization techniques. Variety development and production guidelines for Cuphea have been developed for the Midwest region. The availability of improved varieties will be critical to the success of Cuphea as a new crop for Illinois.

External Competitive Grants Program

Winthrop B. Phippen, Agriculture

Western Illinois University

Creating Niche Market Opportunities in Animal Feeding for Small Farmers with Soybeans

The goal of this project was to identify and refine soybean processing methods that add value to soybean products as feed for swine and poultry. The knowledge gained as a result of conducting this research is meant to be applied in small-scale processing facilities owned and operated by small- to medium-sized soybean farmers with the intention of increasing profitability of soybean production.

Key results of this research project include the following:

- Processing of soybeans introduced compositional variability that impacted the nutritive value of the resultant SBMs.
- Optimal processing conditions were dependent on the composition and characteristics of the variety of soybean used.
- Composition of soybeans and SBMs varied depending on the country of origin and where they were processed.
- Amino acids in SBMs produced in Argentina and Brazil were less digestible than those in SBMs from the United States, India, and China.
- When gums, soapstock, and weeds/trash were added back to the meal at the time of processing, an 11 percentage unit decrease in amino acid digestibility by swine and a 10 percentage unit decrease by poultry occurred.
- SBMs produced at bed depths in the desolventizer/toaster higher than the current industry standard result in improvements in amino acid digestibility without over-processing the meal.
- Increasing the length of time that SBs spend in the extractor led to an increase in bioavailable phosphorus, but a decrease in bioavailable lysine, potentially negating the positive effect on phosphorus.
- Using extruder/expeller processing technology, optimal processing temperature should be >135 C, and temperatures as high as 160 C do not result in overprocessing of the meal.
- The negative nutritional effects of soybean oligosaccharides noted for poultry cannot be demonstrated with swine. The stimulation of the gut microbiota associated with good health in the colon of pigs was noted.
- It was determined that value-added SBM increased swine profitability by 5–10% and allowed low-density poultry production systems to be profitable, even when production ceased during the winter months.
- The development of a website showcasing the study results was completed.
- Farmer/producer groups interested in possible niche market opportunities for SBM resulting from biodiesel production were identified and contacted with information about the project, its goals, and how the research could be adapted for their benefit.

UIUC Sentinel Program

Neal R. Merchen, George C. Fahey, Jr., James H. Baltz, Michael F. Hutjens, Carl M. Parsons, Animal Sciences

Randall E. Westgren, Agricultural and Consumer Economics

Steven T. Sonka, Marilyn L. Nash, National Soybean Research Laboratory

University of Illinois at Urbana-Champaign

Rodney L. Frazier, Frazier, Barnes & Associates

Manipulation of Photoperiod to Enhance the Sustainability of Illinois Dairy Farms

Management of photoperiod (the duration of light a cow is exposed to each day) in dairy cattle is a profitable tool for producers in many economic situations. Properly implemented, photoperiod technology leads to immediate milk production responses, requires little capital investment, and has a quick asset turnover. This project emphasizes a combination of outreach education and applied research to demonstrate, optimize, and develop novel photoperiod management techniques, and thereby to facilitate widespread awareness and adoption of the techniques on dairy farms in Illinois.

Stakeholder interest in this area of research was estimated from results of a national survey in *Hoard's Dairyman*. In response to the question: "Do you use supplemental (photoperiod) lighting to extend daylength for your milking herd?" 32.4% of respondents answered "yes" vs. 67.6% "no." The survey went out to a total of 3000 producers, and it had an overall response rate of 43.6%. The survey results indicate that dairy producers are using the technology and suggest that new findings in this area are of interest.

The first field study testing the viability of photoperiod management in Illinois ran for two years on commercial farms. This study involved pairs of farms of similar production and management levels; within each pair, one farm installed lighting and is applying long day treatment to the lactating herd, and the other herd serves as a control of no treatment. Milk production, herd health, and implementation costs were followed for six months. Researchers are summarizing the results. A second study was conducted examining the impact of photoperiod manipulation to speed heifer growth and eventual entry into the milking herd.

Information on photoperiod management is available at www.traill.uiuc.edu/photoperiod. The site includes data summaries, installation instructions, and worksheets for estimating installation costs and economic benefits.

UIUC Sentinel Program

Geoffrey E. Dahl, Michael F. Hutjens, Animal Sciences

Richard L. Wallace, Veterinary Clinical Medicine

Gary D. Schnitkey, Agricultural and Consumer Economics

University of Illinois at Urbana-Champaign

David B. Fischer, University of Illinois Extension

How Much Domperidone is Needed to Treat Cows Suffering from Fescue Toxicosis?

Most tall fescue pastures are infected with an endophytic fungus that produces ergot alkaloids. When consumed by livestock, these alkaloids physiologically act like dopamine, causing animals to have lowered weight-gain performance, lowered reproductive rates, increased vasoconstriction, and increased body temperatures. Lowered performance costs the beef cattle industry $800 million dollars annually in the US. In a previous project, the dopamine antagonist domperidone was successfully used to block the actions of the ergot alkaloids. The drug was administered as a daily subcutaneous injection to avoid potential degradation in the rumen. In this study, researchers evaluated four oral dosages and a slow-release intramuscular injection of domperidone. Either of these methods would be more practical for livestock producers to administer as compared to daily injections.

The objective of this study was to develop a practical method of domperidone delivery to improve the symptoms of fescue toxicosis in beef heifers. The slow-release injection gave greater circulating levels of domperidone than the oral dosages. The long-term injection improved all hormone (progesterone and prolactin) and performance parameters (body weight gain, body condition score, body temperature) tested compared to non-treated controls. Results of this study indicate that a slow-release injection of domperidone is a practical and effective method of domperidone delivery for relieving the symptoms of fescue toxicosis.

SIUC Internal Program

Karen L. Jones, Sheryl S. King, Gary A. Apgar, Animal Science, Food and Nutrition

Southern Illinois University Carbondale

Dee L. Cross, Equi-Tox, Inc.

Patrick J. Burns, Burns Biosolutions, Lexington, KY

Transgenic Swine Program

The pre-weaning period constitutes a critical phase in pork production because this period represents the time of greatest animal morbidity and mortality. Two current management practices, namely larger litters and earlier weaning, have imposed a further need to optimize sow milk production. Despite the clear benefit to be gained by improving lactation, little progress has been made in this area through conventional technologies.

The overall goal of this project was threefold: first, to provide the infrastructure support required to maintain existing lines of transgenic swine and to support the research outcomes necessary to obtain regulatory approval of these animals for human consumption by the Food and Drug Administration (FDA); second, to support the development of accurate and precise analytical methods necessary to characterize the lines; third, to provide funds needed to develop new lines of transgenic swine with improved productivity and health.

The novel approach taken in this research has been to focus on transgenes directed towards the mammary gland and intestinal mucosa. The advantages to this approach are that both milk production and intestinal nutrient delivery have been identified as constraints on optimal piglet growth. Thus, researchers can use the mammary gland and gastrointestinal tract to drive piglet production. Further, as neither mammary tissue or intestinal mucosa is normally consumed by humans, this approach will reduce a number of potential regulatory hurdles associated with safety approval by the FDA of the resulting lines of transgenic animals for human consumption.

Results from this work have provided a wealth of new scientific information regarding the mechanisms of lactation and intestinal function. Beyond the obvious benefit to the knowledge base, these results have also provided funds that have been leveraged to provide an additional $2.4 million dollars for discovery research. The economic impact to the producers of this work has been conservatively estimated at between $45 million and $450 million dollars per of year additional revenue and/or production cost savings. This research has been instrumental in showing the potential uses of biotechnology in swine production.

UIUC Sentinel Program

Matthew B. Wheeler, Walter L. Hurley, Animal Sciences

Sharon M. Donovan, Food Science and Human Nutrition

University of Illinois at Urbana-Champaign

Illinois Center for Soy Foods

The Illinois Center for Soy Foods (ICSF) has been dedicated to promoting consumption of soy foods, thereby seeking to provide financial benefits to growers and processors in the state, technological innovations to large- and small-scale processors globally, as well as health benefits to consumers. In the United States and the rest of the developed world, major hurdles to widespread consumption of soy foods have been the negative consumer perceptions of soy and the limited numbers of highly acceptable soy food products in the marketplace. In North America, the health benefits of soy are quite well-known, and they are major drivers of the expansion of soy foods markets.

New markets for soy foods are critical, and school food service is an important focus. Programs in school districts throughout the United States emphasize the need for lower calorie and fat choices in school lunch programs, coupled with increased exercise. Educational opportunities exist for showing how soy can be incorporated into school lunches. Results from the pilot project "ISoy: A Better School Lunch" indicated that addition of soy products, either by substitution or enhancement of meat-based entrees, lowered fat, cholesterol, and calories in typical lunch offerings. Learning modules for elementary school students, teachers and food service personnel are under development.

Five cookbooks in the *Soy in the American Kitchen* series have been completed. A sixth cookbook with scaled up recipes for use by food service operators at educational institutions, restaurant chains, hospitals, prisons, etc., is near completion. Information and recipe booklets dealing with meat and soy combinations, soy for vegetarians, and home processing of soy have also been prepared. A Soy Foods Starter Kit was developed to familiarize consumers with a variety of soy products commercially.

Educational and outreach efforts have been a high priority for the ICSF. Short courses related to soy flavor, product development, and nutritional benefits of soy are part of the continuing effort to reach both U.S. and foreign markets. ICSF has conducted workshops for private voluntary organizations and government agencies. ICSF personnel spoke at schools, community organizations, and national and international food science and dietetics meetings about the health benefits of soy and the ease of using it. Outreach programs were held for international audiences in Botswana, Cote d' Ivoire, Haiti, Honduras, Kenya, Mozambique, Senegal, Tajikistan, Thailand, Uganda, and Vietnam on how to add soy to local diets. Outreach programs for Afghanistan and India are under development.

UIUC Sentinel Program

Keith R. Cadwallader, Barbara P. Klein, Food Science and Human Nutrition

University of Illinois at Urbana-Champaign

Note: This project received a no-cost extension until June 30, 2008. An updated final report will be provided.

Does Protein Source Enhance Weight Loss in a Low-Carbohydrate Diet?

Obesity is a major health problem affecting 21.9% of Illinoisans in 2003, a dramatic increase from 12.7% in 1991. Annual health care costs attributed to obesity are approaching $3.4 billion in Illinois. Currently many popular books indicate that diets high in carbohydrates and low in fat are the cause of the obesity problem. As a result, low-carbohydrate diets that are high in protein and fat are very popular for weight loss. Short-term studies have shown

that some people eating a low-carbohydrate, high-protein/fat diet eat fewer calories and lose more weight, compared to those eating a high-carbohydrate, moderate-protein diet. The way in which these diets work is still unknown, but it appears to be more related to the protein intake rather than the fat intake. Recently, researchers have found that dietary protein from some sources works better than dietary protein from other sources to help prevent weight gain in genetically obese rats.

This research examined the effectiveness of different proteins for presenting weight gain in rats fed low- and moderate-carbohydrate diets. Additionally the mechanism for protein's effects on food intake was sought by measuring hormones that are known to be involved in food intake control. Understanding the mechanism of weight loss on these diets is important to making recommendations to people who need to lose weight or want to avoid lifelong weight gain.

Fasted rats were given solution of whey, soy or egg protein, or saline and then offered a low-carbohydrate, high-fat diet (LC) or a high-carbohydrate, lower-fat diet (HC). Short-term food intake, weight gain, and circulating hormones were determined. Results indicate that the effectiveness of protein to reduce food intake appears to be dependant on total diet composition. Low-carbohydrate diets reduced food intake regardless of protein source, whereas high carbohydrate intake was suppressed by whey and soy protein, but not by egg. Dietary protein may influence food intake by multiple hormones.

SIUC Internal Program

Allan Higginbotham, Animal Science, Food and Nutrition

Southern Illinois University Carbondale

Evaluating the Beneficial Health Effects of Conjugated Linoleic Acid

Mounting evidence indicates that synthetic or highly purified conjugated linoleic acids (CLA) may exhibit novel antidiabetic, antiobesity, renal protective, and immunosuppressive effects similar to those of cutting-edge pharmacological drugs. CLAs can be found in ruminant meat and milk and altered via dietary manipulations. In this study, researchers aimed to test the effects of dietary CLAs in rat models of obesity, diabetes, renal disease, and organ rejection.

Human and animal studies using either CLA or diacylglycerol (DAG) oil have shown positive physiological effects, including improvement of abdominal fat, plasma triglycerides, glucose levels, and increased insulin sensitivity. Data provides evidence that a novel composition containing CLA-DAG oil may offer potential as a therapeutic agent in reducing some of the symptoms associated with human metabolic syndrome.

External Competitive Grants Program

William J. Banz, Allan Higginbotham, Animal Science, Food and Nutrition

Southern Illinois University Carbondale

M. Javed Iqbal, Institute for Sustainable and Renewable Resources, Institute for Advanced Learning and Research, Horticulture

Virginia Polytechnic Institute and State University

Susie W. Rockway, Clinical Nutrition

Rush University Medical Center

Pork: A Potential Healthful Dietary Replacement for Fish in the American Diet

The purpose of this research project is to enhance the nutritional value and quality of Illinois pork by boosting its level of omega-3 fatty acids. Omega-3 fatty acids in fatty tissues increased tenfold in pigs fed linseed oil at 3% (diet dry matter) when compared to pigs fed a control diet. The production of omega-3 enriched pork offers the Illinois hog industry a method for improving the consumers' perception of pork products. Additionally, the production of omega-3 enriched pork will broaden the Illinois hog market by increasing its competitiveness in the U.S. healthy food market.

SIUC Internal Program

Amer A. AbuGhazaleh, Gary Apgar, Animal Science, Food and Nutrition

Southern Illinois University Carbondale

How Healthy is Pasture-Fed Beef?

Beef cattle located in the southeastern United States, including southern Illinois, commonly graze endophyte-infected (EI) fescue grass pastures. The endophyte produces toxins that, when consumed, alter physiology by lowering average daily gains, reducing fertility rates, increasing vasoconstriction, and elevating body temperatures. Others have detected the endotoxins in subcutaneous fat from cattle fed EI forage using an ELISA assay. The purpose of this preliminary study is to develop protocols for the detection of endotoxins in hamburger (ground muscle and fat mixture) from EI fed cattle using the ELISA assay

or by mass spectrometry, and to determine whether human consumption of hamburger from EI fed cattle warrants further study.

The ELISA detection system was unsuccessful in detecting endotoxin metabolites in mixtures of fat and muscle. This may have been due to the relatively lean hamburger used in this study. Studies are currently underway to develop a protocol for endotoxin detection using mass spectrometry. The mass spectrometry analysis should garner greater sensitivity than the ELISA. Meanwhile, 16 students were fed one meal of either hamburger derived from EI fed cattle or a control hamburger. Their blood pressure, pulse, and body temperatures were taken three times (before and after consumption, and after exercise). No changes were observed in pulse or body temperature between treatment groups. Systolic blood pressures were different between treatments. A lowering of systolic blood pressures was observed after exercise in the EI hamburger group. These results, while preliminary, suggest that continued research should be conducted to determine the physiological consequences of consuming products from livestock fed endophytic fescue.

SIUC Internal Program

Karen L. Jones, Animal Science, Food and Nutrition

Southern Illinois University Carbondale

Consumer Attitudes Towards Issues of Food Safety Concern

The objectives of this study were to survey consumer attitudes regarding the safety of the food supply in general, relate general food safety concern levels with specific issues, and examine consumers' food safety funding priorities.

Half the consumers surveyed in this study considered the food they eat to be very safe. With regard to the "chemical issues" category, consumers were most concerned with pesticide residues, hormones in poultry and meat, and preservatives. In the "health issues" category, consumers were most concerned with fat and cholesterol content, but were also concerned with calorie and carbohydrate content. In the "microbiological issues" category, consumers were most concerned about restaurant sanitation and meat being thoroughly cooked, followed by microbiological contamination and mad cow disease in beef. In the "regulatory issues" category, consumers were very concerned about the inspection of imported foods and restaurant sanitation.

Consumers who considered the food they eat to be of moderate or much concern, gave moderate or moderately high priority to funding mandatory labeling of foods containing genetically modified components, and moderate priority to funding more human health studies to understand the risks of hormones in food animals. With respect to funding, the highest priority was given to inspecting imported foods in a manner similar to that used for domestically produced food. If the FDA has determined they are safe, between 70% and 80% of consumers believe that irradiated food, those containing GMOs, and products derived from animals treated with either antibiotics or hormones are safe to eat. However, 18% to 28% have reduced their consumption of foods they believe to be irradiated, to contain GMOs, or to be derived from animals treated with antibiotics or hormones.

External Competitive Grants Program

Mary Susan Brewer, Food Science and Human Nutrition

University of Illinois at Urbana-Champaign

Agricultural Policy

Illinois Agricultural Policy Center

The purpose of this initiative was to provide analyses and information that can be used by stakeholders, policy makers, and researchers to evaluate the economic impacts—particularly impacts in Illinois—of current or proposed state and federal legislation and regulations. To that end, the project focused on modeling and studying farm bill and trade issues, as well as developing communication channels for policy research. The communication efforts stemmed mostly from the development of the *Illinois Rural Policy Digest*, which serves as a forum for policy research at the University of Illinois at Urbana-Champaign Department of Agricultural and Consumer Economics.

The modeling addressed two areas of inquiry: First, techniques were developed to measure (a) the value of crop insurance programs relative to farm bill provisions and (b) the value of the current farm bill in terms of expected payments over long-term, equilibrium conditions relative to past programs. Second, the modeling addressed the production and trade patterns of United States and South America soybeans, which can now be estimated under different comparative-advantage conditions to assess and predict the effects of policy changes.

UIUC Sentinel Program

Robert J. Hauser, Agricultural and Consumer Economics

University of Illinois at Urbana-Champaign

Identification of the Sources of Nitrate in the Upper Illinois River

The mass of nitrate caused by humans within the Illinois River Basin is among the greatest of the large tributaries discharging into the Mississippi River and, as such, is a contributor to the environmental problems in the Gulf of Mexico. The purpose of this investigation was to identify the sources of nitrate in the Illinois River, using water chemistry, stable isotopes, and nitrate isotopes. A secondary goal was to examine seasonal variability of nitrate concentrations and sources, and the role denitrification plays in reducing nitrate within the Illinois River Basin.

Researchers sampled the Illinois River and selected tributaries at 14 locations from Lake Michigan to the Mississippi River over a two-year period, and end members, including precipitation, tile drain water, and treated waste water (TWW) from municipal plants in the Greater Metropolitan Area of Chicago. The discharge of TWW in the tributaries of the Chicago area resulted in elevated concentrations of nitrate, ammonium, organic nitrogen, sodium, potassium, boron, chloride, fluoride, phosphate, and dissolved organic carbon.

Researchers found that there were two dominant sources of nitrate in the Illinois River Basin: synthetic fertilizer and TWW. Nitrate, ammonium, and organic nitrogen concentrations were elevated in the headwaters of the Illinois River in the Chicago area and decreased downriver. Nitrate isotopes revealed that during high flow periods in the spring, the dominant source of nitrate was synthetic fertilizer; during low flow periods in the summer and fall, the dominant source of nitrate was TWW. One sampling event during the very dry summer of 2005 revealed that Illinois River water received nitrate only from TWW; little or no nitrate originating from synthetic fertilizer was observed in the river at that time. Based on this data, researchers are calculating the proportions of nitrogen coming from TWW and synthetic fertilizer.

A significant amount of denitrification was found to take place in shallow groundwater from non-tiled croplands and apparently within the hyporheic zone along a segment of the Illinois River. Both of these environments are currently the subject of additional research. Ancillary results of this investigation included the identification of the sources of sodium and chloride in the Illinois River. Researchers found that the source of these ions is dominated by road deicing agents in winter and spring, and by TWW in the summer and fall.

This research identifies two sources of nitrate in the Illinois River and confirms that denitrification is reducing the nitrate concentrations within the groundwater and within the river itself. This information is beneficial to the waste water treatment plants and the farmers because it shows that the farmers are not totally responsible for the nitrate and that denitrification is actively reducing the nitrate concentrations before and after entering the river. The information benefits the wastewater treatment plants by leading to a more accurate estimate of the proportion of nitrogen they are adding to the river and, ultimately, to the Mississippi River. Finally, the results of this investigation benefit the people of Illinois by providing regulators more information about the inputs and losses of nitrogen to the Illinois River Basin.

External Competitive Grants Program

Samuel V. Panno, Keith C. Hackley, Hue-Hwa Hwang, Illinois State Geological Survey

Walton R. Kelly, Illinois State Water Survey

Projects Receiving Extensions

Researchers for the following projects were granted no-cost extensions to complete their research. Requests for no-cost extensions are granted when unforeseen circumstances arise. Although the due dates for these projects have been extended, no additional funds were allocated. These projects will be reported on after their new maturity dates in 2007.

Building Illinois Meat Supply Chains: Analyzing Processors and Meat Managers

FY05 External Competitive Grants Program

Darlene S. Knipe

University of Illinois Extension

Degradation of Phytate and Lectins in Soybean Meal by Processing

FY04 ISU Internal Program

Kerry W. Tudor, Agriculture

Illinois State University

Determining the Market Potential of Organic Food Production in Illinois

FY03 External Competitive Grants Program

Martha S. Bazik-Rittmueller

University of Illinois Extension

Development and Evaluation of a Value-Added Feedstuff Using Distiller's Grains

FY06 External Competitive Grants Program

Paul M. Walker, Agriculture

Illinois State University

Evaluating Short-Season Field Peas as an Economically Viable and Nutritionally Appropriate Diet for Nursery Pigs

FY06 ISU Internal Program

Bryon R. Wiegand, Agriculture

Illinois State University

Evaluation of a Swine Manure Management System to Control Odor and Reduce Non-Point Source Pollution

FY06 ISU Internal Program

Paul M. Walker, Agriculture

Illinois State University

Expanding the Demand for Illinois Corn: High Speed Rail Loading Facilities Impact on Corn Prices

FY06 ISU Internal Program

Rick C. Whitacre, Agriculture

Illinois State University

From Research to Marketable Wheat By-Product Composites: Phase II

FY03 External Competitive Grants Program

Vivak M. Malhotra, Physics

Southern Illinois University Carbondale

New Product Development and Supply Chain Management of the US Confectionery Manufacturers

FY06 ISU Internal Program

Aslihan D. Spaulding, Agriculture

Illinois State University

Testing and On-Farm Application of Odor Reduction Technologies for Swine Facilities

FY05 External Competitive Grants Program

Michael Ellis, Animal Sciences

University of Illinois at Urbana-Champaign

Utilizing Processed Swine Manure as a Soil Amendment for Crop Production

FY06 ISU Internal Program

Kenneth D. Smiciklas, Agriculture

Illinois State University

Fiscal Year 2007: Internal Competitive Grants Programs

The Internal Competitive Grant Programs at the University of Illinois at Urbana-Champaign (UIUC), Southern Illinois University Carbondale (SIUC), Illinois State University (ISU), and Western Illinois University (WIU) funded the following new initiatives in FY07.

Projects	Principal Investigator
Expanding Agricultural Markets	
Engineering Yeast Strains to Enhance Bioethanol Production Efficiency	Ahmad M. Fakhoury, SIUC
Evaluating Short-Season Field Peas Processed with Two Milling Types to Improve Growth and Performance in Nursery and Grower Pigs	Bryon R. Wiegand, ISU
Expanding the Demand for Illinois Corn: The Impact of New and Expanded Ethanol Facilities on Corn Prices	Rick C. Whitacre, ISU
Fractionation of Thin Stillage from Dry-Grind Processes to Determine Water Recycling Rates and Heat Transfer Properties	Kent D. Rausch, UIUC
Optimizing Food and Fuel Production	Larry L. Berger, UIUC
Pork: A Potential Omega-3 Food Source in the American Diet	Amer A. AbuGhazaleh, SIUC
Synthesizing Biodiesel from Agricultural Waste Using Biocatalyst and Ethanol	Robert L. Rhykerd, ISU
Thermo-Chemical Conversion (TCC) of Biomass for Renewable Bioenergy	Yuanhui Zhang, UIUC
Rural Economic Development	
Development of Enterprise Profit Models for the Illinois Livestock Industry	Michael F. Hutjens, UIUC
Increasing Landowner Income through Recreational Leases	Phillip R. Eberle, SIUC
YouthWorks: Youth Leading Rural Communities' Economic Revitalization	Laurie F. Kramer, UIUC
Agricultural Production Systems	
A Novel Method for Disease Control in Livestock: Distillers Dried Grains with Solubles and Other Fibrous Feeds	James E. Pettigrew, UIUC
Consumer Attitudes and Expectations Toward Farm Animal Welfare	Aaron S. Moore, ISU
Development and Evaluation of High Efficiency Flexible Intelligent Farming Tools: Phase I—Autonomous Weed Control	Tony E. Grift, UIUC

Agricultural Production Systems (*continued*)

Effect of Variability in Gestation Stall Micro-Environment on Sow Well-Being, Physiology, and Productivity	Robert V. Knox, UIUC
Impact of Fermented Soybeans on Phosphorous Absorption in Weaned Pigs	Kerry W. Tudor, ISU
Integrated Genomic Biology in Beef Cattle	Dan B. Faulkner, UIUC
Pioneering Bionanosensing Systems for Use as a Decision Support Tool for Soybean Disease Management	Linda S. Kull, UIUC
Soybean Health: Rust Gene Discovery Initiative	Schuyler S. Korban, UIUC
Sweet and Hot Pepper Production Using Vermicompost and Compost	Gary R. Bachman, ISU
The Physiological Impact of Co-mingling Pigs	Mark D. Hoge, WIU
Toward Reducing Soybean Yield Losses Caused by Ozone	Brian W. Diers, UIUC

Human Nutrition and Food Safety

Adipotoxicity Biomarker Discovery Using a Canine Diet–Induced Obesity Model	Kelly S. Swanson, UIUC
Characterizing the Protective Effects of Soy Oil on Risk Markers for Cardiovascular Diseases	Kolapo M. Ajuwon, SIUC
College Students' Perceptions, Concerns and Knowledge of Obesity, Body Image, and Health	Aslihan D. Spaulding, ISU
Defining Protein Needs and Carbohydrate Tolerance for Adult Health	Donald K. Layman, UIUC
Folate Produced in the Large Intestine by Probiotics Can Mediate Colorectal Cancer Development via Epigenetic Mechanisms	Michael J. Miller, UIUC
Tomatoes and Broccoli for the Reduction of Prostate Cancer in Illinois African-American Men	John W. Erdman, UIUC

Natural Resources and Environment

A Watershed-Scale Assessment of the Water Quality Impacts of Riparian Buffers in Southern Illinois	Jon E. Schoonover, SIUC
Characterizing Corn for Grazing at Various Stages of Physiological Maturity	Kenneth O. Nimrick, WIU
Economic Impact of Alternative Organic Weed Control Techniques	Gerald T. Vigue, WIU
Evaluation of Land Application Systems for Swine Manure to Reduce Nonpoint Source (NPS) Pollution	Paul M. Walker, ISU
Utilizing Processed Swine Manure as a Soil Amendment for Crop Production	Kenneth D. Smiciklas, ISU

Fiscal Year 2007: External Competitive Grants Program

The External Competitive Grants Program funded the following initiatives in FY07.

Projects	Principal Investigator
Characterizing Virus-Nematode Complexes that Limit Vineyard Sustainability	Bradley H. Taylor, SIUC
Engineering-Economic System Models for Rural Ethanol Production Facilities	Luis F. Rodríguez, UIUC
Enhanced DDGS from the Elusieve Process: Foodstuff for Nonruminants	Vijay Singh, UIUC
High-Quality Protein Diets Decrease Insulin Resistance and Breast Cancer	Donald K. Layman, UIUC
On-Farm Evaluation of Alternatives to Antibiotics in Pig Production	James E. Pettigrew, UIUC
Thermochemical Conversion Process to Produce Oil from Various Types of Livestock Manure	Yuanhui Zhang, UIUC

Fiscal Year 2007: Strategic Research Initiatives

The Strategic Research Initiative Program includes the following initiatives in FY07.

Projects	Principal Investigator
Biomass Energy Crops for Power and Heat Generation in Illinois: Diversifying Cropping, Improving Energy Security, and Benefiting the Environment	
Agronomic Trials	Stephen P. Long, UIUC
Water Resource Implications	Mark B. David, UIUC
Miscanthus Breeding and Improvement	John A. Juvik, UIUC
Economic Analyses	Madhu Khanna, UIUC
Social Acceptability	Anne Heinz Silvis, UIUC
Propagating and Eradicating *Miscanthus x giganteus*	Thomas B. Voigt, UIUC
Carbon Sequestration and Greenhouse Gas Accounting	Michelle M. Wander, UIUC
Bioconversion	Yuanhui Zhang, UIUC
Illinois Livestock Integrated Focus Team (IL LIFT)	
Technology Development	Michael F. Hutjens, UIUC
Livestock Facility Siting in Illinois	Ted L. Funk, UIUC
Animal Identification for Enhanced Food Quality and Monitoring Livestock Health	Geoffrey L. Dahl, UIUC
Pasture-Based Forage Systems to Sustain Illinois Livestock Producers	Justin W. Sexten, University of Illinois Extension

Financials

A complete financial accounting of C-FAR–appropriated funds is compiled and reported to the State of Illinois annually. This reporting is organized in detail by C-FAR's research and related support programs. The following pages detail all FY06 expenditures and FY07 allocations. A summary precedes the individual expenditure and allocation reports.

Summary of FY06 Expenditures and FY07 Obligated Funds

External Competitive Grants Program		**$1,222,511**
Research Expenditures	447,879	
Research Obligations	771,484	
Scientific Reviewers	1,389	
Scientific Reviewers Obligations	1,759	
University Internal Programs and Other Programs/Accounts		**$3,342,795**
Research Expenditures	1,962,668	
Research Obligations	1,380,127	
Strategic Research Initiatives Program		**$1,570,658**
Research Expenditures	862,547	
Research Obligations	708,111	
Illinois Department of Agriculture Fee		**$17,150**
1% Member Expense Account		**$28,810**
Total FY06 Expenditures and Obligated Funds for FY07		**$6,181,924**[a]
Research Expenditures	3,273,094	
Research Obligations	2,859,722	
External Scientific Reviewers	1,389	
External Scientific Reviewers Obligations	1,759	
IDOA Fee & 1% Member Expense	45,960	

[a] *FY06 research expenditures and obligations are higher than the FY06 appropriation as a portion of funds from the previous fiscal year(s) were obligated for investment in the subsequent year(s).*

Summary of FY07 Allocations

External Competitive Grants Program	**$670,365**[b]
(15% of the total appropriation, after IDOA fee and 1% Member Expense Account)	
University Internal Programs and Other Programs/Accounts	**$3,437,525**
Strategic Research Initiative Program	**$330,100**
Illinois Department of Agriculture Fee	**$22,500**
($50,000, or ½ of 1% of the total appropriation, whichever is less)	
1% Member Expense Account	**$45,000**
(1% of the total appropriation)	
Total FY07 Allocations	**$4,505,490**[b]

[b] *An additional $5,490 was allocated to the FY07 External Program due to distributing unexpended funds from the FY06 1% Member Expense Account. Therefore, the total FY07 External Program funding level is $670,365, and the total FY07 C-FAR allocation is $4,505,490.*

Please see additional notes on individual summary reports.

FY06 Expenditure Summary: External Competitive Grants Program

(July 1, 2005 – June 30, 2006)

Actual Fiscal Year Expenditures						
C-FAR RESEARCH FOCUS AREAS	**EXPENDITURE AREAS**	**UIUC**	**SIUC**	**ISU**	**WIU**	**TOTALS**
Expanding Agricultural Markets	Equipment	617	0	0	0	**617**
	Materials/Supplies	3,335	403	0	0	**3,738**
	Personnel	52,613	7,402	0	0	**60,015**
	Services/Contracts	23,862	18,369	0	0	**42,231**
	Transportation	4,377	0	0	0	**4,377**
Rural Economic Development	Equipment	0	0	0	0	**0**
	Materials/Supplies	2,334	0	0	485	**2,819**
	Personnel	21,538	0	0	0	**21,538**
	Services/Contracts	5,612	0	0	313	**5,925**
	Transportation	7,308	0	0	0	**7,308**
Agricultural Production Systems	Equipment	5,313	0	0	0	**5,313**
	Materials/Supplies	34,390	0	0	0	**34,390**
	Personnel	99,596	0	0	0	**99,596**
	Services/Contracts	4,945	0	0	0	**4,945**
	Transportation	9,389	0	0	0	**9,389**
Human Nutrition and Food Safety	Equipment	0	0	0	0	**0**
	Materials/Supplies	5,272	1,818	0	0	**7,090**
	Personnel	10,270	19,840	0	0	**30,110**
	Services/Contracts	845	3.193	0	0	**4,038**
	Transportation	80	585	0	0	**665**
Natural Resources and Environment	Equipment	0	0	2,769	0	**2,769**
	Materials/Supplies	134	0	9,292	0	**9,426**
	Personnel	2,818	0	44,066	0	**46,884**
	Services/Contracts	16,220	0	16,784	0	**33,004**
	Transportation	3,111	0	806	0	**3,917**
Subtotals		313,979	51,610	73,717	798	**440,104**
Indirect Cost		N/A	2,771	4,925	79	**7,775**
Scientific Reviewers		N/A	N/A	N/A	N/A	**1,389**
Unexpended/Obligated Funds for FY07 Research		293,026	450,543	27,442	473	**771,484**
Total FY06 Expenditures and Obligated Funds for FY07		**607,005**	**504,924**	**106,084**	**1,350**	**1,220,752**

FY06 Expenditure Summary: Strategic Research Initiative Program

(July 1, 2005 – June 30, 2006)

Actual Fiscal Year Expenditures							
STRATEGIC RESEARCH INITIATIVES[1]	**EXPENDITURE AREAS**	**UIUC**	**SIUC**	**ISU**	**WIU**	**OTHER ENTITIES[2]**	**TOTALS**
Information Systems and Technology	Equipment	0	0	0	0	0	**0**
	Materials/Supplies	1	0	0	0	0	**1**
	Personnel	0	0	0	0	0	**0**
	Services/Contracts	75	0	0	0	0	**75**
	Transportation	0	0	0	0	0	**0**
	Coordination	(467)	N/A	N/A	N/A	N/A	**(467)**
Rural Community Development	Equipment	5,871	0	0	0	0	**5,871**
	Materials/Supplies	632	0	0	0	0	**632**
	Personnel	1,500	0	0	0	0	**1,500**
	Services/Contracts	6,483	0	0	0	0	**6,483**
	Transportation	2,179	0	0	0	0	**2,179**
	Coordination	N/A	N/A	N/A	N/A	N/A	**0**
Swine Odor and Waste Management	Equipment	2,833	0	0	0	0	**2,833**
	Materials/Supplies	2,817	0	0	0	0	**2,817**
	Personnel	28,911	0	0	0	0	**28,911**
	Services/Contracts	1,522	0	0	0	0	**1,522**
	Transportation	3,020	0	0	0	0	**3,020**
	Coordination	31,833	N/A	N/A	N/A	N/A	**31,833**
Food Safety	Equipment	0	0	0	0	0	**0**
	Materials/Supplies	0	0	0	0	0	**0**
	Personnel	0	0	0	0	0	**0**
	Services/Contracts	0	0	0	0	0	**0**
	Transportation	0	0	0	0	0	**0**
	Coordination	N/A	0	N/A	N/A	N/A	**0**
Water Quality	Equipment	0	0	0	0	0	**0**
	Materials/Supplies	5	0	0	0	0	**0**
	Personnel	6,259	0	0	0	0	**6,259**
	Services/Contracts	0	0	0	0	0	**0**
	Transportation	0	0	0	0	0	**0**
	Coordination	0	N/A	N/A	N/A	N/A	**0**

Biomass Energy Crops for Power and Heat Generation in Illinois	Equipment	0	0	0	0	0	**0**
	Materials/Supplies	8,316	0	0	0	0	**8,316**
	Personnel	184,249	0	0	0	0	**184,249**
	Services/Contracts	18,020	0	0	0	0	**18,020**
	Transportation	8,085	0	0	0	0	**8,085**
	Coordination	N/A	N/A	N/A	N/A	N/A	**0**
Illinois Livestock Integrated Focus Teams	Equipment	4,739	0	0	0	0	**4,739**
	Materials/Supplies	4,133	0	0	0	0	**4,133**
	Personnel	58,803	0	0	0	0	**58,803**
	Services/Contracts	12,586	0	0	0	0	**12,586**
	Transportation	3,569	0	0	0	0	**3,569**
	Coordination	N/A	N/A	N/A	N/A	N/A	**0**
Water Quality with a Focus on Nutrient Standards	Equipment	7,100	2,137	7,326	0	0	**16,563**
	Materials/Supplies	31,456	1,741	9,007	0	0	**42,204**
	Personnel	225,617	18,347	35,880	0	4,116	**283,960**
	Services/Contracts	28,788	485	1,116	0	0	**30,389**
	Transportation	18,025	9,280	3,615	0	0	**30,920**
	Coordination	58,958	N/A	N/A	N/A	N/A	**58,958**
Subtotals		765,918	31,990	56,944	0	4,116	**858,968**
Indirect Cost		N/A	3,167	0	0	412	**3,579**
Unexpended/Obligated Funds for FY07 Research		596,243	20,257	87,188	0	4,423	**708,111**
Total FY06 Expenditures and Obligated Funds for FY07		**1,362,161**	**55,414**	**144,132**	**0**	**8,951**	**1,570,658**

(1) The first five SRIs listed above did not receive additional funds after FY04. Amounts shown represent expenditures of funds carried over from previous fiscal years to complete work. The last three SRIs listed above were initiated in FY04.

(2) Other entity is Indiana University.

FY06 Expenditure Summary: University Internal Programs and Other Programs/Accounts

(July 1, 2005 – June 30, 2006)

Actual Fiscal Year Expenditures							
C-FAR RESEARCH FOCUS AREAS AND PROGRAMS	**EXPENDITURE AREAS**	**UIUC**	**SIUC**	**ISU**	**WIU**	**FOOD AND AGRICULTURE RESEARCH ACT**	**TOTALS**
Expanding Agricultural Markets	Equipment	7,300	0	0	0	N/A	**7,300**
	Materials/Supplies	15,653	3,166	201	0	N/A	**19,020**
	Personnel	223,705	1,331	1,414	0	N/A	**226,450**
	Services/Contracts	1,563	35	2,867	0	N/A	**4,465**
	Transportation	9,112	0	998	0	N/A	**10,110**
Rural Economic Development	Equipment	0	2,954	0	0	N/A	**2,954**
	Materials/Supplies	1,715	129	0	0	N/A	**1,844**
	Personnel	113,499	4,480	6,927	54,622	N/A	**179,528**
	Services/Contracts	4,164	1,111	0	0	N/A	**5,275**
	Transportation	1,290	1,326	445	0	N/A	**3,061**
Agricultural Production Systems	Equipment	3,043	0	0	0	N/A	**3,043**
	Materials/Supplies	31,083	6,651	0	0	N/A	**37,734**
	Personnel	482,893	21,168	11,136	0	N/A	**515,197**
	Services/Contracts	12,321	16,789	0	0	N/A	**29,110**
	Transportation	4,804	1,194	0	0	N/A	**5,998**
Human Nutrition and Food Safety	Equipment	0	0	0	0	N/A	**0**
	Materials/Supplies	12,123	4,402	0	0	N/A	**16,525**
	Personnel	230,092	12,702	0	0	N/A	**242,794**
	Services/Contracts	5,547	2,001	0	0	N/A	**7,548**
	Transportation	9,671	539	0	0	N/A	**10,210**
Natural Resources and Environment	Equipment	0	0	0	0	N/A	**0**
	Materials/Supplies	(64)	743	710	0	N/A	**1,389**
	Personnel	33,553	28,657	5,347	0	N/A	**67,557**
	Services/Contracts	53	1,890	1,642	2,850	N/A	**6,435**
	Transportation	(73)	111	0	0	N/A	**38**
Subtotals		1,203,047	111,379	31,687	57,472	N/A	**1,403,585**
Indirect Cost		N/A	N/A	3,247	67	N/A	**3,314**
Research Support		100,311	164,315	98	0	N/A	**264,724**
C-FAR Administrative Office		238,657	32,015	11,642	8,731	N/A	**291,045**
Achievement Award	(included above)	0	0	0	0	N/A	**0**
1% Member Expense		N/A	N/A	N/A	N/A	28,810	**28,810**
IDOA Fee		N/A	N/A	N/A	N/A	17,150	**17,150**
Unexpended/Obligated Funds for FY07 Research		1,325,937	11,926	32,997	9,267	N/A	**1,380,127**
Total FY06 Expenditures and FY07 Obligated Funds		**2,867,952**	**319,635**	**79,671**	**75,537**	**45,960**	**3,388,755**

FY07 Allocations Summary Report

(July 1, 2006 – June 30, 2007)

C-FAR RESEARCH FOCUS AREAS AND PROGRAMS	INTERNAL GRANTS PROGRAM					EXTERNAL COMPETITIVE GRANTS PROGRAM[1]	STRATEGIC RESEARCH INITIATIVE PROGRAM	FOOD AND AGRICULTURE RESEARCH ACT	TOTAL ALLOCATIONS
	UIUC (82%)	SIUC (11%)	ISU (4%)	WIU (3%)	TOTAL INTERNAL UNIVERSITY ALLOCATIONS				
Expanding Agricultural Markets	437,399	20,000	45,589	15,000	517,988	103,536	N/A	N/A	**621,524**
Rural Economic Development	338,001	19,810	0	56,000	413,811	251,437	*Biomass Energy* 262,342	N/A	**927,590**
Agricultural Production Systems	1,279,424	35,000	32,814	0	1,347,238	110,248	*Livestock Focus* 67,758	N/A	**1,525,244**
Human Nutrition and Food Safety	437,603	20,000	10,825	0	468,428	61,360	N/A	N/A	**529,788**
Natural Resources and Environment	56,848	105,000	26,095	23,530	211,473	143,784	N/A	N/A	**355,257**
Scientific Reviewers[2]	N/A	N/A	N/A	N/A	N/A	0	0	N/A	**0**
Research Support	34,547	146,801	0	0	181,348	N/A	N/A	N/A	**181,348**
Research Discretionary	0	0	4,714	0	4,714	N/A	N/A	N/A	**4,714**
Indirect Costs	N/A	N/A	6,003	0	6,003	N/A	N/A	N/A	**6,003**
C-FAR Administrative Office[3]	234,948	31,517	11,461	8,596	286,522	N/A	N/A	N/A	**286,522**
Achievement Award[4]	0	0	0	0	0	N/A	N/A	N/A	**0**
1% Member Expense	N/A	N/A	N/A	N/A	N/A	N/A	N/A	45,000	**45,000**
IDOA Fee	N/A	N/A	N/A	N/A	N/A	N/A	N/A	22,500	**22,500**
Totals	**2,818,770**	**378,128**	**137,501**	**103,126**	**3,437,525**	**670,365 (1)**	**330,100**	**67,500**	**4,505,490[1]**

[1] $5,490 of unexpended funds from the FY06 1% Member Expense Account was allocated to the FY07 External Competitive Grants Program (included in figures above).

[2] $1,759 of unexpended funds from the FY06 Scientific Reviewer account will be utilized for FY07. Therefore, no allocation from FY07 funds is necessary.

[3] The FY07 C-FAR administrative office budget is $302,006. This budget is met with $286,522 from the FY07 appropriation and $15,484 of unexpended FY06 funds from this account.

[4] The Achievement Award will not be given in FY07 so that these funds can be directed to ongoing research.

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