Department of Agronomy and Plant Genetics

Self Assessment Study

USDA CSREES Review
November 17-22, 2008

UNIVERSITY OF MINNESOTA

College of Food, Agricultural and Natural Resource Sciences

SOLUTION ▸ *DRIVEN* SCIENCE™

Department of Agronomy and Plant Genetics
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Executive Summary

The Department of Agronomy and Plant Genetics has a long and productive history of making significant contributions to agriculture in Minnesota and the world. In 1869, the Minnesota legislature reorganized the University of Minnesota providing for a College of Agriculture and Mechanic Arts to conform with the Morrill Act. By 1882, agronomic research was being conducted on University owned land in St. Paul and the Agricultural Experiment Station and College of Agriculture were established. In 1909, the University of Minnesota Extension was established by the legislature. In 1928, the Division of Agriculture and Farm Management was divided into the Division of Farm Management and Agricultural Economics and the Division of Agronomy and Plant Genetics which later became the Department of Agronomy and Plant Genetics. H.K. Hayes served as the first Department Head from 1928 to 1952.

The Department of Agronomy and Plant Genetics continues its strong tradition of excellence to this day. In the last half of the 20th century, the Department was exceptionally strong with discipline-based research and education programs in plant breeding and genetics, weed science, and plant physiology. Some notable discoveries by the Department include the following. Soybean was introduced into Minnesota in the early 20th century as a green manure or annual hay crop. In 1946, under the leadership of Jean Lambert, a highly successful soybean breeding program was initiated which transformed the crop into a high-quality oil crop. Strong plant breeding programs existed in all the major commodity and forage crops during this same period and significant contributions to agriculture were made through the public releases of improved varieties. Plant genetic research has always been a strong and integral part of the Department. In the mid 1960's, the Department began an emphasis on cell and tissue culture research and molecular genetics. One of the landmark discoveries was the regeneration of corn from cells grown in tissue culture in 1975 by Ed Green and Ron Phillips. After World War II, with the advent of chemical weed control methods, weed science became an integral part of the agronomic research conducted by the Department. Many significant discoveries were made by the weed science faculty including the value of herbicide mixtures to increase the spectrum of weed control as well as basic research on mechanisms of uptake, translocation, and fate of herbicides in the environment.

Changes since 1992 CSREES review: The Department, College and University have undergone significant changes since 1992. During this period of time, we have had three different Department Heads: Kent Crookston (1990-1998), Burle Gengenbach (1998-2004) and Nancy Ehlke (2005-present). Over the same period of time, the College has had five Deans: Richard Jones (1991-1995), Michael Martin (1995-1998), Phillip Larson (Interim, 1998-1999), Charles Muscoplat (1999-2006), and Allen Levine (2007-present); and the University of Minnesota had three Presidents: Nils Hasselmo (1988-1997), Mark Yudof (1997-2002), and Robert Bruininks (2002-present), each with their own footprint. The College of Agriculture has also undergone significant changes being renamed the College of Agricultural, Food, and Environmental Sciences to broaden the mission. This was followed by a merger in 2006 with the College of Natural Resources to form the new College of Food, Agricultural, and Natural Resource Sciences (CFANS).

Since our last review, significant changes have occurred in our educational programs. The University of Minnesota switched from the quarter system to the semester system in 1999 resulting in a review of our curriculum. The two graduate programs, Agronomy and Plant Breeding, that were primarily associated with the Department merged with the Horticulture graduate program in 1999 to form the new Applied Plant Sciences graduate program. Graduate student numbers in the Department appear to have stabilized at approximately 30 students, but this is a significant decline since 1992 due to changing demographics and financial issues. The undergraduate program underwent significant changes due to changes in the majors at the College level. In 2004, the new Applied Plant Science undergraduate major was initiated to fill the need of students when the Crops, Soils, and Pest Management and the Science in Agriculture

majors were eliminated. Over the past five years, we have experienced a relatively steady number of undergraduate students averaging 62 between the Applied Plant Science and the Agricultural Industries and Marketing majors. While this is a significant reduction from our undergraduate student numbers at our last review, we are experiencing many of the same issues faced by other agronomy and crop science departments which have seen an average 32% reduction in undergraduate majors between 1984 and 2003.

Within the Department, there has been substantial faculty turnover since 1992. The Department has had 11 faculty retire, 6 faculty resign, and 17 new faculty hires. With a change in philosophy at the College level, 6 of the new hires since 1993 have been placed on Research and Outreach Centers often replacing faculty positions previously located in St. Paul. The faculty have seen a major shift from funding of research and graduate students through the Agricultural Experiment Station state special dollars to reliance on grants and contracts. The faculty have met this challenge and average about $3.5 million dollars in grant expenditures per year. The Department of Agronomy and Plant Genetics consistently ranks second in the college for grant expenditures after the Department of Plant Pathology. Many of the faculty are internationally and nationally recognized as leaders in their field. We currently have one faculty member who has the distinction of being a member of the National Academy of Sciences, a Regents Professor, and a McKnight Presidential Chair in Genomics (Phillips). The Department has two endowed professorships: Molecular Genetics Applied to Crop Improvement (Muehlbauer) and Corn Genetics and Breeding (Bernardo). Many faculty have held offices, received awards, and been named fellows in national professional societies, and served in editorial roles for many of our distinguished journals. Some of our distinguished faculty have been recruited into administrative positions at the University of Minnesota including Robert Jones, Senior Vice President for System Academic Administration; Beverly Durgan, Dean, University of Minnesota Extension and Director, Minnesota Agricultural Experiment Station; and Gregory Cuomo, Associate Dean for Extension, College of Food, Agricultural, and Natural Resource Sciences. Many of our faculty and adjunct faculty actively participate in leadership roles at the University of Minnesota. For example, Helene Murray is the Executive Director of the Minnesota Institute for Sustainable Agriculture; Don Wyse is the Co-Director of the Center for Integrated Natural Resources and Agricultural Management Research; Jeff Gunsolus is the Extension Program Leader for the Crops Program Area; and Kathy Draeger is Executive Director of the Regional Sustainable Development Partnerships.

Future opportunities: The Department is critically aware of the shifting nature of food and energy production coupled with landscape management that necessitates innovations in research programs, educational activities, and outreach. With those changes in mind, the Department of Agronomy and Plant Genetics is well-positioned to lead a renewed sense of the land grant mission toward leadership and the creation of scientific knowledge around preservation of natural resources, sustainable and efficient food and biomass production, and landscape management, vitality and prosperity of rural communities, and alleviation of poverty and hunger. During the winter of 2006 – 2007, faculty undertook a strategic planning process to articulate a new mission and priorities, to identify new goals and benchmarks, to prioritize new faculty hires, and to suggest human and fiscal resources required to fulfill these aims.

Since our last review, our areas of research, education and outreach have shifted from traditional discipline-based programs to a more holistic, interdisciplinary approach to solving the issues facing society of food, feed, fuel and environmental protection. Many faculty across numerous disciplines within the Department are actively engaged in research, education and outreach on multifunctional agriculture and are providing leadership across the University focusing on the joint production of agricultural products and ecological services. These faculty have expanded their activities to more broadly focus on key issues of strategic agricultural diversification and perennialization of cropping systems and agroecosystems. Faculty continue to focus on crop breeding, molecular genetics, and genomics for the development for food, feedstocks, pharmaceuticals and bioenergy generated from diversified cropping systems while simultaneously protecting water quality and conserving ecological

resources. There will be considerable breakthroughs in genomics and molecular genetics that will continue to compliment our strong plant breeding programs.

Challenges and opportunities continue to face the Department of Agronomy and Plant Genetics. The need for plant breeding, genetics, and agronomic research and expertise in the dynamic and diverse economy of Minnesota is as vital as ever to meet the issues related to agriculture and a growing world population. Our major strengths include biotechnology and physiology; crop production and ecology including cropping systems diversity, sustainable agriculture, and human and animal health; plant breeding and genetics including crop variety development and value-added traits; and weed science. We feel we are strongly positioned to take on the challenges facing agriculture now and in the future.

Acknowledgements

I want to acknowledge the participation by all of the Department of Agronomy and Plant Genetics for their efforts in putting together our CSREES Self Assessment Study document. I especially want to recognize the CSREES Review Committee for taking a leadership role in designing, drafting, and reviewing the document.

Jim Anderson	Graduate Education
Jeff Gunsolus	Extension Education
Nick Jordan	Multifunctional Agriculture
Gary Muehlbauer	Crop Improvement
Paul Porter	Multifunctional Agriculture
Kevin Smith	Undergraduate Education

I would also like to recognize the contributions of the Department office staff for their assistance with the CSREES Self Assessment Study and the logistics associated with the review. I especially want to acknowledge Jeanne Davy, Department of Agronomy and Plant Genetics Administrator for fact checking the document and Jean Swanson for proofreading and assembling the entire document.

Thank you to everyone in the Department of Agronomy and Plant Genetics that contributed to making our CSREES review a success.

Nancy Jo Ehlke
Professor and Head

Department of Agronomy and Plant Genetics
CSREES REVIEW AGENDA
November 17-21, 2008

Monday, November 17, 2008			
Time	**Subject**	**Participants**	**Location**
1:30 – 3:30 pm	Tour of facilities		Borlaug, Hayes, Cargill, Biodale, Containment facilities, Plant Growth facilities, Seed Storage, Crops Research, Crop Service, Field plots on campus
3:30 -5:00 pm	Welcome Reception	**Agronomy Faculty and Review Team**	
6:30 pm	Dinner	Review team with **Dr. Allen S. Levine** *Dean, CFANS* **Dr. F. Abel Ponce de León** *Associate Dean for Research and Graduate Programs, CFANS* **Dr. Nancy Ehlke** *Agronomy & Plant Genetics Department Head*	
Tuesday, November 18, 2008			
7:30 am	Breakfast	Review Team with **Dr. Allen S. Levine** *Dean, CFANS* **Dr. F. Abel Ponce de León** *Sr Associate Dean for Research and Graduate Programs, CFANS* **Dr. Greg Cuomo** *Associate Dean for Extension and Outreach, CFANS* **Dr. Jay Bell** *Associate Dean for Academic Programs and Faculty Affairs, CFANS*	**220 Coffey Hall**
9:30 – 10:30 am	Orientation	**Nancy Ehlke, Head and CSREES Review Committee**	**408 Hayes Hall**
11:00 – 12:00 pm	Stakeholders meeting	**Stakeholders**	**408 Hayes Hall**
12:00 – 1:30 pm	Lunch	**Undergraduate & Graduate Students (no faculty)**	**408 Hayes Hall**
1:30 – 2:00 pm	Presentation: *Graduate Education*	**Jim Anderson & graduate faculty**	
2:00 – 3:00 pm	Presentation: *Undergraduate Education*	**Kevin Smith & undergraduate faculty**	**408 Hayes Hall**
3:00 – 3:30 pm	Break		
3:30 – 5:00 pm	Open Discussion: *Educational Programs*	**Agronomy and Plant Genetics Faculty**	**408 Hayes Hall**

Wednesday, November 19, 2008			
8:30 – 10:00 am	Presentation: *Multifunctional Agriculture*	**Nick Jordan & Paul Porter**	**408 Hayes Hall**
10:00 – 10:30 am	Break		
10:30 – 12:00 pm	Open Discussion: *Multifunctional Agriculture*	**Agronomy and Plant Genetics Faculty**	**408 Hayes Hall**
12:00 – 1:30 pm	Lunch	**Office and Scientific Support Staff (no faculty)**	**408 Hayes Hall**
1:30 – 3:00 pm	Presentation: *Crop Improvement*	**Gary Muehlbauer**	**408 Hayes Hall**
3:00 – 3:30 pm	Break		
3:30 – 5:00 pm	Open Discussion: *Crop Improvement*	**Agronomy and Plant Genetics Faculty**	**408 Hayes Hall**
Thursday, November 20, 2008			
8:00 – 9:30 am	Presentation: *Extension*	**Jeff Gunsolus and Extension Faculty**	**408 Hayes Hall**
9:30 – 10:00 am	Break		
10:00 – 11:00 am	Open Discussion: *Extension*	**Agronomy and Plant Genetics Faculty**	**408 Hayes Hall**
11:00 – 12:00 am	Faculty Discussion	**Agronomy and Plant Genetics Faculty (without Head)**	**408 Hayes Hall**
12:00 – 1:30 pm	Lunch	**CFANS Dept. Heads**	**408 Hayes Hall**
1:30 -	Work Session		Hotel
Friday, November 21, 2008			
8:30 – 10:00 pm	Exit Interview	**Administration** ***Dr. E. Thomas Sullivan*** *Senior Vice President Academic Affairs and Provost* **Dr. Allen S. Levine** *Dean, CFANS* **Dr. F. Abel Ponce de León** *Associate Dean for Research and Graduate Programs, CFANS* **Dr. Jay Bell** *Associate Dean for Academic Programs and Faculty Affairs, CFANS* **Dr. Greg Cuomo** *Associate Dean for Extension and Outreach, CFANS*	**220 Coffey Hall**
10:30 – 12:00	Exit Interview	**Agronomy and Plant Genetics Faculty**	**408 Hayes Hall**

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Minnesota Agriculture

Minnesota is a diverse state consisting of three biomes: Laurentian Mixed Forest, Eastern Broadleaf Forest, and Prairie Parkland (Fig. 1). Laurentian Mixed Forest is the most highly forested area, comprised of conifer, conifer-hardwood, or hardwood vegetation. The Eastern Broadleaf Forest is the transitional area between the prairie and the true forest. The Prairie Parkland once was primarily tallgrass prairie (Mn/DNR Web site, 2005). It is unique to have three biomes within one non-mountainous state, but much of the original natural habitat is gone. Less than 1% of the prairie ecosystem, less than 4% of the original old growth forest, and 47% of wetlands in Minnesota remain. Minnesota spans 53.8 million acres with 27.4 million acres (51%) in farmland, with the most productive regions spanning the former tall prairie grasslands; 16.3 million acres (30%) in forests; and 3.1 million acres (6%) in lakes.

Figure 1. The three ecological biomes in Minnesota. http://www.dnr.state.mn.us/biomes/index.html

In the last 50 years, agriculture has changed from a large number of small family farms to a mix of small hobby farms and medium to large-size farms. In 2006, the number of farms in Minnesota continued to decline with 79,000 farms. Many farms are small; 39% are less than 100 acres and are located primarily in central and southeastern Minnesota; about 42% of the farms are between 100 to 500 acres; 11% are 500 to 1000 acres; and 8% are greater than 1,000 acres and are primarily located in the northwest and western regions. Although the average farm size in 2007 was 347 acres, the numbers of farms are increasing only in two categories: the hobby farms with 10 to 49 acres and the very large farms with over 2,000 acres.

Diverse crops contribute to economic stability in the state. Nationally, Minnesota ranks first in production of sugarbeet, sweet corn for processing, and green peas for processing; second in spring wheat, oat, canola and cultivated wild rice; third in soybean; fourth in corn for grain, sunflower, dry edible beans, and

flax; fifth in barley; sixth in potato; and seventh in hay. Nearly 20 million acres were sown to crops in 2006, with a production value of approximately $8.9 billion dollars. Corn and soybean comprised the largest acreage (74% combined). Corn was the most valuable crop at $4.4 billion followed by soybean at $2.5 billion.

Table 1. Acreage and production value of major agricultural crops in Minnesota in 2007

Commodity		Acres harvested	Average yield	Price per unit	Value of production
Corn grain		7,800,000	146.0 bu	$ 3.85/bu	$ 4,384,380,000
Soybeans		6,150,000	41.0 bu	$ 10.10/bu	$ 2,546,715,000
Wheat		1,710,000	47.0 bu	$ 7.35/bu	$ 589,145,000
Forages					
Dry Hay		1,880,000	2.5 tons	$ 111.00/ton	$ 507,978,000
Haylage		205,000	2.7 tons		
Corn Silage		500,000	13.5 tons		
Pasture*	Cropland	728,593	2.0 tons/acre	$111.00/ton	$161,747,646
	Woodland	1,332,924			
	Other	1,187,082			
Potatoes		47,000	444.0 cwt	$ 6.40/cwt	$ 132,352.000
Dry Beans		145,000	1,800 lbs	$ 25.80/cwt	$ 67,338,000
Sunflowers		127,000	1,508 lbs	$ 22.00/cwt	$ 41,933,000
Oats		180,000	60.0 bu	$ 2.25/bu	$ 24,300,000
Barley		110,000	56.0 bu	$ 3.85/bu	$ 23,716,000
Canola		31,000	1,360 lbs	$ 18.50/cwt	$ 7,507,000
Flax		4,000	22.0 bu	$ 12.70/bu	$ 1,118,000

Minnesota Agricultural Statistics – 2007 and 2002* (www.nass.usda.gov)

In Minnesota, organic production is a fast-growing segment in agriculture. In 2005, Minnesota had 433 certified operations on 129,064 acres. The state ranks fifth in the number of organic farms and fourth in the number of certified crop acres nationally. In 2006, the number of organic farms was estimated to be approximately 530, a 22% increase. The average size of these organic farming operations is similar to conventional farm size and averages 324 acres. Even with the dramatic increases in acreage, organic farms comprise less than 1% of the farms in Minnesota. Minnesota does have significant production of organic agronomic crops ranking first in the U.S. in acreage of corn grain (20,822 acres), soybean (26,581 acres) and rye (2,057) and in the top three for acreage of oats (6,271 acres), sunflowers (1,124 acres) and alfalfa hay, haylage and silage (21,945 acres). Field crops represent the majority of the organic crop

production occupying 93% of the certified organic land. Since organic farming virtually prohibits use of synthetic chemicals and relies on cultural and biological pest management, organic growers have unique agronomic production systems research and educational needs.

Agriculture is an economic cornerstone in Minnesota and the gross value of commodities and services annually exceeds $11 billion. Agriculture reaches beyond on-farm revenue and impacts all sectors of economic activity including manufacturing, transportation, wholesale and retail trade, services, construction, banking, insurance, and real estate. Among manufacturing industries in the state, the second largest is food, which accounts for 14% of the state's value-added income from manufacturing of meat products, grain and oilseed milling, and dairy products. The total impact of Minnesota's agriculture approaches $55 billion in economic activity and 367,000 jobs. These numbers reflect a strong agricultural industry, but rural areas in the upper Midwest are facing many changes and challenges. Rural populations continue to decline and in 2006 represented 27% of nearly 5.2 million residents in Minnesota. Most residents in rural areas are not involved in agriculture. About 12% of rural jobs are agriculture-related with 7% directly on farms and 5% in supplying, processing, and marketing farm goods. Of the 79,000 farms, most are small operations that contribute relatively little to the production of food and fiber while a relatively small number of increasingly large farms produce a large amount of agricultural output. Within these production systems growers are carving out niches, e.g., organic and specialty crops with added value for local, regional, national, and international markets. Producers continue to adopt practices to improve efficiency, yield, and quality of crops. More acres are being sown to transgenic crops, which often reduces pesticide applications. Producers are rotating crops and managing residues to reduce fertilizer applications and costs.

The need for plant breeding, genetics and agronomic research and expertise in the dynamic and diverse economy of Minnesota is as vital as ever to meet the issues related to agriculture and a growing world population. The University of Minnesota's Department of Agronomy and Plant Genetics discovers and shares information and genetic materials that increase the efficiency, reliability, and profitability of crop production and utilization in Minnesota and the world. We promote environmentally-sound practices that preserve the natural resource base upon which agriculture depends. The members of the Department of Agronomy and Plant Genetics at the University of Minnesota will continue to conduct research to address new issues as they arise, especially those issues that impact society, agriculture, environmental quality, and food security.

The Department's plant breeding and molecular genetics program is ranked among the top five of major land grant universities. Our primary graduate program, Applied Plant Sciences, attracts many high quality students. Significant research activities in cropping systems diversity, protecting environmental quality, and sustainable agriculture appeal to prospective graduate students. The new undergraduate major in Applied Plant Science prepares students to understand relationships within plant systems that impact food, fiber, energy, health, industry, and environment. The major emphasizes basic knowledge in biology, chemistry, math, plant biology, and genetics with specialization in one of three areas of emphasis: Agroecology, Plant Improvement, or Plant Utilization.

Diversifying agricultural systems through the development of comprehensive, collaborative research and outreach programs will support new crop production systems that provide ecosystem services, diversify the corn-soybean rotation, improve water quality and wildlife habitat, and have positive economic, environmental, and social impacts. These multifunctional agricultural systems will provide critically needed new and sustainable sources of energy and foods while protecting and improving our natural resources. There will be considerable breakthroughs in genomics and molecular genetics that will complement our strengths in plant breeding and genetics. These include a better understanding of gene function and genome organization. Innovative approaches will include crop modifications that could potentially enhance human and animal health, bioenergy and biocatalysis, and better ecosystem services.

University and Collegiate Organization:

The University of Minnesota was chartered in 1851 as a preparatory school, seven years prior to Minnesota achieving statehood. Financial problems forced the school to close during the Civil War, but with the help of Minneapolis entrepreneur John Sargent Pillsbury, it reopened in1867. Known as the father of the University, Pillsbury, who was a University regent, state senator, and governor, used his influence to establish the school as the official recipient of public support from the Morrill Land-Grant Act, designating it as Minnesota's land-grant university.

William Watts Folwell was inaugurated as the first president of the University in 1869. In 1873, two students received the first Bachelor of Arts degrees. In 1888, the first Ph.D. degree was awarded. Today the University of Minnesota is one of the largest in the United States offering more than 370 degree programs to over 50,000 students on the Twin Cities campus and over 65,000 students in the University of Minnesota system. The University of Minnesota system includes four other campuses located in Crookston, Duluth, Morris and Rochester, MN. The University of Minnesota awards over 8,500 undergraduate, 3,000 masters, 750 professional and 750 doctoral degrees per year.

The University of Minnesota is governed by a Board of Regents comprised of 12 members elected by the legislature. The President of the University of Minnesota and its chief operating officers lead the Twin Cities campus in and serve as system-wide administrators. The University of Minnesota is making enormous strides in the effort to transform itself into one of the top three public research universities in the world. Colleges, programs, and institutes have been launched to create new academic synergies that will lead the way to meet many of the challenges we will face in the 21st century. The results include three new colleges (College of Design, College of Education and Human Development, and College of Food, Agricultural and Natural Resource Sciences); several new programs to enhance the undergraduate and graduate educational experience, including a new Department of Writing Studies; and four major interdisciplinary institutes including the Institute on the Environment positioned to tackle the questions of tomorrow.

The University of Minnesota, founded in the belief that all people are enriched by understanding, is dedicated to the advancement of learning and the search for truth; to the sharing of this knowledge through education for a diverse community; and to the application of this knowledge to benefit the people of the state, the nation, and the world. The University's mission carried out on multiple campuses and throughout the state, is threefold:

1. **Research and Discovery**
   Generate and preserve knowledge, understanding, and creativity by conducting high-quality research, scholarship, and artistic activity that benefit students, scholars, and communities across the state, the nation, and the world.
2. **Teaching and Learning**
   Share that knowledge, understanding, and creativity by providing a broad range of educational programs in a strong and diverse community of learners and teachers, and prepare graduate, professional, and undergraduate students, as well as non-degree-seeking students interested in continuing education and lifelong learning, for active roles in a multiracial and multicultural world.
3. **Outreach and Public Service**
   Extend, apply, and exchange knowledge between the University and society by applying scholarly expertise to community problems, by helping organizations and individuals respond to their changing environments, and by making the knowledge and resources created and preserved at the University accessible to the citizens of the state, the nation, and the world.

In all of its activities, the University strives to sustain an open exchange of ideas in an environment that embodies the values of academic freedom, responsibility, integrity, and cooperation; that provides an atmosphere of mutual respect, free from racism, sexism, and other forms of prejudice and intolerance; that assists individuals, institutions, and communities in responding to a continuously changing world; that is conscious of and responsive to the needs of the many communities it is committed to serving; that creates and supports partnerships within the University, with other educational systems and institutions, and with communities to achieve common goals; and that inspires, sets high expectations for, and empowers individuals within its community.

The College of Food, Agricultural and Natural Resource Sciences (CFANS) was formed in 2006 by the merger of the former College of Agricultural, Food and Environmental Sciences with the College of Natural Resources. CFANS is comprised of six divisions, fourteen academic units, The Bell Museum of Natural History, The Minnesota Landscape Arboretum, and seven Research and Outreach Centers.

Division of Applied Economics

- Department of Applied Economics

Division of Bioresources and Bioenergy

- Department of Bioproducts and Biosystems Engineering (joint with the Institute of Technology)

Division of Environmental Science, Policy, and Management

- Department of Entomology
- Department of Fisheries, Wildlife, and Conservation Biology
- Department of Forest Resources
- Department of Soil, Water and Climate

Division of Food, Animal and Nutritional Sciences

- Department of Animal Science
- Department of Food Science and Nutrition

Division of Plant Science

- Department of Agronomy and Plant Genetics
- Department of Horticultural Science
- Department of Plant Biology (joint with the College of Biological Sciences)
- Department of Plant Pathology

Division of Translational Research and Engagement

- Cloquet Forestry Center, Cloquet, MN
- North Central Research and Outreach Center, Grand Rapids, MN
- Northwest Research and Outreach Center, Crookston, MN
- Southern Research and Outreach Center, Waseca, MN
- Southwest Research and Outreach Center, Lamberton, MN
- UMore Park, Rosemount, MN
- West Central Research and Outreach Center, Morris, MN

College Mission and Priorities

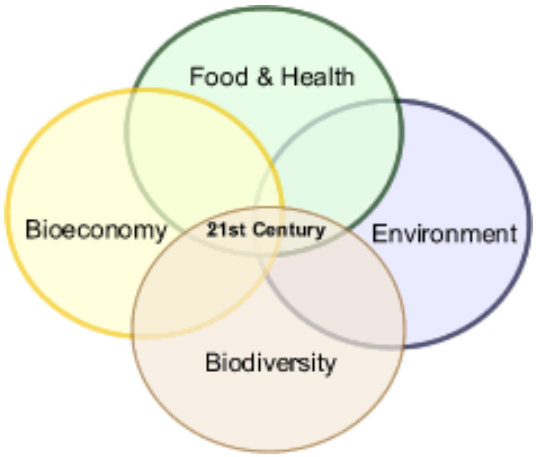
The College of Food, Agricultural, and Natural Resource Sciences (CFANS) provides extraordinary education, breakthrough research, and dynamic public engagement as we strive to be a world leader in advancing solution-driven science in food, agricultural and natural resources to improve the human condition.

The mission of CFANS is to promote interdisciplinary scholarship supporting food systems, agriculture, and natural resources. The College of Food, Agricultural and Natural Resource Sciences plays a lead role in keeping Minnesota competitive and connected as challenges and discoveries abound in genomics, plant and animal biology, the relationship of food to health, the inter-relatedness of ecosystems, renewable energy, the promise of biocatalysis and bioinformatics, and the economic, communication, and policy issues associated with these discoveries.

Strategic Alignment

As the College most closely connected with the University's historical roots as a land grant institution, our programs revitalize the University's core mission and support the University's "top three" goal through interdisciplinary and aligned research efforts and a systems approach to complex problems. Furthermore, our proximity to public agency offices provides a unique outreach role: providing solid scientific support for policy decisions.

Priority Themes



Strategic Goals

- Food and Health: Position the University to develop viable food and agricultural systems for the 21st Century.
- Bioeconomy: Position the University as the national center of excellence in research related to energy and products from renewable resources.
- Environment: Position the University to address fundamental issues related to global climate and environmental change.
- Biodiversity: Position the University to explore and utilize global biodiversity which is the foundation of our natural and human dominated landscapes.

University of Minnesota Extension

The University of Minnesota Extension implemented a major reorganization in January, 2004 to respond to changing economic and societal needs and to enhance efficiency. The reorganization of the University of Minnesota Extension from the old model of having Extension agents in every one of the 87 counties has resulted in the development of 18 comprehensive regional Extension Centers throughout the state. The mission of the University of Minnesota Extension is to deliver high quality, relevant, research-based educational programs and information to the citizens and communities of Minnesota primarily in the areas of community development and vitality; agriculture, food and the environment; natural resources; and youth development and family living.

Minnesota Agricultural Experiment Station

The Minnesota Agricultural Experiment Station funds research of University of Minnesota scientists on ways to improve Minnesota's agricultural and forest products, horticulture, human nutrition, family and community life, and environmental quality. It supports both basic and applied research with practical goals for improving the lives of Minnesotans. As it funds scientists who work in five different colleges and at Research and Outreach Centers across the state, it is an organization that supports cross-disciplinary problem solving, and responsiveness to emerging issues.

In any given year, Experiment Station funding supports approximately 400 research projects conducted by more than 300 faculty. Their projects employ more than 600 field research and laboratory assistants, technicians and postdoctoral research associates. The Department of Agronomy and Plant Genetics was allocated approximately $2.5 million in research funds during this fiscal year which accounts for approximately 12% of the research funding allocated to CFANS departments.

Research results are brought to Minnesotans through a partnership with University of Minnesota Extension. From soybeans to tourism, from Norway pines to new apple cultivars, from beef cattle to housing for families, the Minnesota Agricultural Experiment Station continues to seek, through its statewide research programs, a better life for all Minnesotans.

University Administration:

Robert Bruininks	President
Thomas Sullivan	Senior Provost for Faculty and Academic Affairs
Robert Jones	Senior Vice President for System Academic Administration
R. Timothy Mulcahy	Vice President for Research
Gail Dubrow	Dean of the Graduate School

St. Paul Campus Administration:

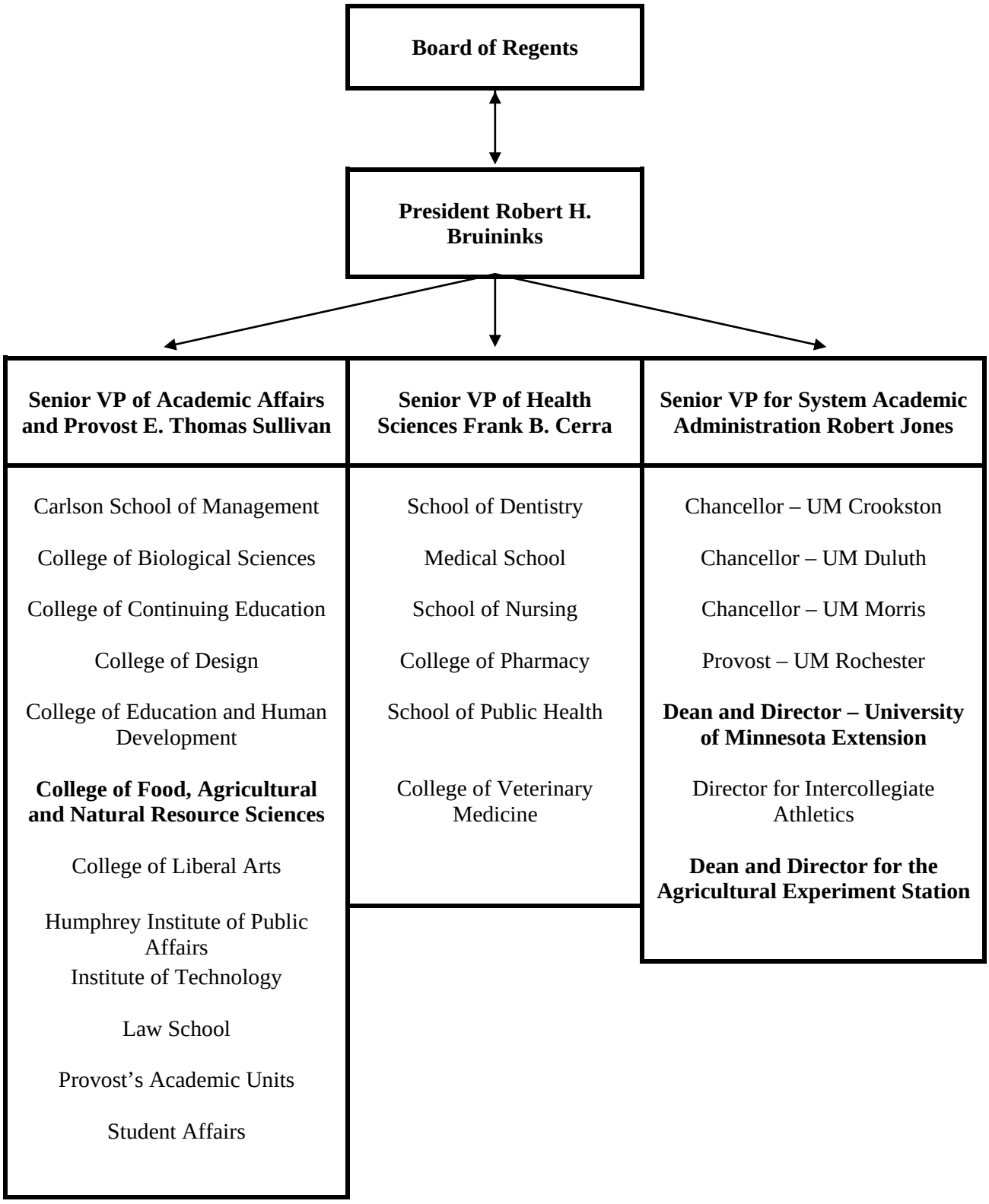
Beverly Durgan	Dean and Director, University of Minnesota Extension Director, Minnesota Agricultural Experiment Station
Allen Levine	Dean of the College of Food, Agricultural, and Natural Resource Sciences (CFANS)
Jay Bell	CFANS Associate Dean of Academic Programs and Faculty Affairs
F. Abel Ponce de León	CFANS Senior Associate Dean of Research and Graduate Programs

Greg Cuomo	CFANS Associate Dean of Extension
Robert Elde	Dean of the College of Biological Sciences
Trevor Ames	Dean of the College of Veterinary Medicine

Department and Outreach Center Heads:

Nancy Ehlke	Agronomy and Plant Genetics
James Linn	Animal Science
Brian Buhr	Applied Economics
Shri Ramaswamy	Bioproducts and Biosystems Engineering
Mark Ascerno	Entomology
Francesca Cuthbert	Fisheries, Wildlife and Conservation Biology
Gary Reineccius	Food Science and Nutrition
Alan Ek	Forest Resources
Thomas Michaels	Horticultural Science
Kathryn VandenBosch	Plant Biology
Carol Ishimaru	Plant Pathology
Ed Nater	Soil, Water and Climate
Ronald Severs	Cloquet Forestry Center
Dan Erkkila	North Central Research and Outreach Center
Larry Smith	Northwest Research and Outreach Center
Forrest Izuno	Southern Research and Outreach Center and UMore Park
Pauline Nickel	Southwest Research and Outreach Center
Forrest Izuno	UMore Park, Rosemount, MN
Jerry Wright (Interim)	West Central Research and Outreach Center

Organization of University of Minnesota



Overview of Department of Agronomy and Plant Genetics

Mission:

The mission of the Department of Agronomy and Plant Genetics is to discover and share knowledge and to develop plant genetic materials that increase the efficiency, reliability, and profitability of crop production and utilization within Minnesota and around the world.

We conduct these research and education activities in a local to global context to promote efficient crop production, rural and economic vitality, human wellness, environmentally sound practices, biodiversity, renewable energy, and alleviation of poverty and hunger.

Vision:

We envision a world where each individual and every family and community is deeply connected to the food system and the land. In this world the landscape is healthy, diversified and beautiful with clean water, air, and soil, where the food we eat and grow is a balance between local and global production. Strong economies are supported by these agricultural production systems that benefit local, rural communities. Whether growing backyard gardens, protecting environmentally fragile areas, ecologically conscious urban development, or producing food and biofuels, we will all make decisions from a perspective that cares for nature; respects those who produce our food; seeks sustainable innovation in biofuels and natural products; develops appropriate technology; and provides public support to sustain ecosystems, agriculture, and related land grant programs. In this world, the Department of Agronomy and Plant Genetics will serve as a role model, conducting unbiased research, providing future-oriented and transformative educations, developing new materials for the landscape, building respectful connections between vital urban and rural communities, and contributing to robust regional agricultural systems and economies.

Values:

In keeping with the land grant mission of contributing to and sustaining the common public good, the Department of Agronomy and Plant Genetics values:

- High quality, innovative, ethical and unbiased teaching, research and extension efforts in basic, applied and translational components.
- Proactive approaches that make a positive difference in Minnesota economies, ecologies, and communities and maintain relevance in agriculture, renewable energy, environmental sustainability, and health.
- Collaborative, team-oriented approaches to our work.
- Active support for personal and professional development for students, faculty, staff, and stakeholders.

Department of Agronomy and Plant Genetics Profile

Personnel: The Department has undergone changes in its faculty and staff since the 1992 CSREES review following a series of University-wide retrenchments, changes in administration, and changes in the direction of the Department. Downsizing of agricultural-related departments occurred across the entire college. The Department of Agronomy and Plant Genetics has stabilized and we are currently hoping to strengthen our faculty numbers and research programs in the near future. There are three faculty searches currently underway: a Computational Biology for Plant Breeding and Genetics position (75% research/25% teaching); a Biomass/Renewable Energy Cropping Systems position (60% extension, 40% research) located at the West Central Research and Outreach Center in Morris, MN; and an Organic and Conventional Cropping Systems position (60% extension, 40% research) located at the Southwest Research and Outreach Center in Lamberton, MN.

Faculty: Currently there are 25 faculty in the Department of Agronomy and Plant Genetics including three faculty located on Research and Outreach Centers (Haar, Johnson and Wiersma) and three faculty with 100% administrative appointments outside the Department (Cuomo, Durgan and Jones). In addition, there are six USDA-ARS adjunct faculty housed within the Department, two adjunct faculty associated with Centers/Partnerships housed within the Department and four USDA-ARS adjunct faculty located at the North Central Soil Conservation Laboratory located in Morris, MN.

Faculty Personnel Changes Since 1992 in the Department of Agronomy and Plant Genetics:

Year	Retirements	New Hires	Resignations
1993			Putnum, Daniel Alternative crops
1994		Gallo-Meagher, Maria Molecular genetics	
		Jordan, Nicholas Weed ecology	
		Johnson, Gregg* Weed science	
1995		Porter, Paul* Cropping systems	
		Wiersma, Jochum* Small grains extension	
1996		Cuomo, Greg* Forage management	Gallo-Meagher, Maria Molecular genetics
1997	Burnside, Orvin Weed science	Muehlbauer, Gary Molecular genetics	
	Smith, Larry Undergraduate education		

Year	Retirements	New Hires	Resignations
	Stucker, Robert Corn breeding		
1998	Crookston, Kent Department Head	Anderson, James Wheat breeding	
		Dyck, Elizabeth Undergraduate education	
		Naeve, Seth Soybean extension	
		Smith, Kevin Barley breeding	
1999			Martin, Neal Forage Extension
2000	Lueschen, William Weed Science	Bernardo, Rex Corn breeding	
	Oelke, Ervin Grain crop extension	Peterson, Paul Forage extension	
		Scott (Faulkner), Lori* Undergraduate education	
2001	Rasmusson, Donald Barley breeding		Dyck, Elizabeth* Undergraduate education
2002		Haar, Milton* Undergraduate education	
2005	Hardman, Leland Extension education		
2006	Gengenbach, Burle Department Head		Somers, David Molecular Genetics
2007	Hicks, Dale Corn Extension		Scott (Faulkner), Lori* Undergraduate education
2008	Simmons, Steve Undergraduate education	Stupar, Robert Molecular genetics	
		Coulter, Jeffery Corn extension	

* Tenured, Tenure-track, and Extension Faculty originally located on Research and Outreach Centers

Research Associates and Research Specialists: The Department of Agronomy and Plant Genetics has maintained a relatively stable number of Research Associates and Research Specialists. Since 1992, the department has averaged 20 Research Associates or Research Specialists (range: 8 – 28) and currently has only 8 Research Associates and Research Specialists.

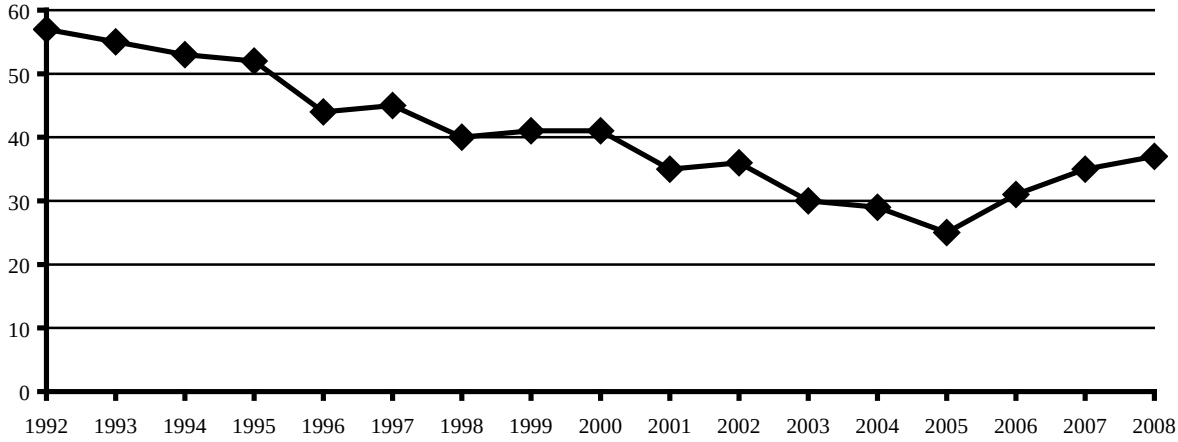
Technical Staff: The Department of Agronomy and Plant Genetics has a long history of strong technical support for our faculty with primary research appointments. Since 1992, the Department has averaged 52 support staff (range: 39 – 61). Since 2002, the number of technical staff has remained stable averaging 53, but the funding for these positions has become reliant on external funds due to major reductions in financial support from the state to the University of Minnesota. The Department is also fortunate to have long-term, highly competent technical support staff, over half of the support staff have been employees of the Department for over twenty years.

Office Staff: The Department of Agronomy and Plant Genetics has an excellent office staff comprised of a Department Administrator and three additional members. One staff member is primarily responsible for supporting the graduate and undergraduate programs affiliated with the department. The other two staff are primarily responsible for word processing of grants, documents, and correspondence for the 22 faculty located on campus. With large reductions in base funding to the Department within the last five years, it has been necessary to support at least one of our office staff with indirect cost recovery funds allocated back to the Department.

Within the past year, the financial management model has changed from being departmentally based to being consolidated into divisions. The Department of Agronomy and Plant Genetics is one of three departments in the Plant Science Division and shares accounting and budgeting activities with the Department of Plant Pathology and the Department of Horticultural Science. Financial staff continue to be housed in each department to assist faculty and staff.

Graduate Students: The Department of Agronomy and Plant Genetics has seen a significant reduction in graduate student numbers since 1992. In the early 1990's, the Department averaged 52 students per year. Most of these students were supported by departmentally-based research assistantships. With the large increases in tuition and health care costs coupled with major reductions in financial support from the state legislature, the Department of Agronomy and Plant Genetics has averaged only 31 graduate students per year almost exclusively supported by competitive fellowships, grants, gifts and contracts. Graduate research assistantships pay the student a stipend of $20,311, cover the cost of tuition and 95% of the cost of health insurance for a total cost to the faculty member of $37,101 per year. The major reasons for the reductions in graduate student numbers is twofold. First, the number of high quality students applying to our graduate programs has been significantly reduced. This is a common phenomena experienced by our peer institutions across the United States. Secondly and more importantly, reductions in state support for the University of Minnesota has translated into major reductions in funding to the Department and significant increases in the cost of graduate tuition and health insurance. Currently, there are extremely limited discretionary funds available to support graduate student Research Assistantships in the Department.

Figure 2. Graduate student numbers in the Department of Agronomy and Plant Genetics from 1992 -2008.



USDA-Agricultural Research Service (USDA-ARS)

The St. Paul, MN location comprises three Units of the USDA-ARS: Cereal Disease Laboratory (CDL), Plant Science Research (PSR), and Soil and Water Management Research (SWMR). The mission of the CDL is to reduce losses in wheat, oat, and barley to major diseases including leaf rust, stem rust, and Fusarium head blight. This mission is accomplished through research on the biology of pathogens that cause these diseases and on methods to enhance disease resistance in small grains. The mission of the PSR is to develop new knowledge that expands our understanding of the fundamental processes controlling increased production, improved quality, and enhanced use of alfalfa, oat, wheat, and soybean and to utilize this knowledge to develop germplasm and crop management schemes that lead to increased farm profitability and sustainability of the nation's resource base. The mission of the SWMR is to understand fundamental soil properties and processes affected by conservation tillage and develop process-oriented models of these properties and processes applicable to a broad spectrum of agricultural problems including groundwater quality. These understandings and models are applicable whenever soil is managed by tillage to prevent groundwater contamination.

Plant Science Research Unit: The PSR Unit is most closely aligned with the Department of Agronomy and Plant Genetics with six of the eight scientists physically housed in the Department. The Unit utilizes multidisciplinary strategies and team approaches to address national priorities in agricultural and environmental research. Implicit in this mission is collaborative research with University of Minnesota, state, and regional cooperators.

Research initiatives of the PSR are varied and include developing bioenergy, energy alternatives, and animal feed with optimal traits while offering environmental protection focused primarily on alfalfa. This research should help transition U.S. agriculture to the production of renewable energy and biobased products resulting in important environmental benefits such as reduced greenhouse gas emissions, increased carbon sequestration, and maintaining the long-term productivity of agriculturally-relevant natural resources such as soil and water. The unit also has a large number of research activities related to plant biological and molecular processes. This research is designed to produce tomorrow's advances in crop production, quality, and safety by conducting fundamental research on plants that forms the basis for greater crop productivity and efficiency, better product quality and safety, improved protection against pests and diseases, and sustainable practices that maintain environmental quality. The research is focused on investigating the genomics, germplasm evaluation, and genetic improvement of oats, soybean, alfalfa,

lupine and *Phaseolus* beans for nutritional quality and feed. Research is also investigating the functional genomics of symbiotic nitrogen fixation and root adaptation to phosphorus deficiency and the identification of genes involved in iron deficiency chlorosis and the regulation of oil content in soybean.

Cereal Disease Laboratory: The second most closely aligned USDA-ARS unit with the Department of Agronomy and Plant Genetics is the CDL. The CDL is located in a separate federal building on the St. Paul campus. The CDL's major areas of research include understanding the genetics, population biology, and host-parasite interactions of cereal rust fungi and their diseases and the pathogen population biology and genomics, and host resistance for Fusarium head blight of cereals. The CDL research objectives are to: (1) identify genes used by plants in defense against pathogens and determine their cellular and biochemical mechanisms of action; (2) elucidate molecular aspects of the expression of virulence in rust fungi; (3) identify and utilize rust resistance factors to protect small grain crops against existing and future pathogenic races in rust populations; (4) analyze population genetics of cereal rust fungi and devise strategies to enhance durability of resistance against diverse rust populations; (5) identify and characterize resistance in wheat and barley to Fusarium head blight and determine impacts of partial resistance on pathogen populations in crop residue; and (6) identify genetic factors for pathogenicity in Fusarium and explore ways to block their activity and minimize pathogen attack in small grains. With the emerging virulent stem rust race (Ug99) and vulnerability of wheat in the U.S. and worldwide, research is currently underway at the CDL to screen U.S. wheat in Kenya against stem rust races, characterizing sources of rust resistance, and mapping effective resistance genes. The CDL has excellent collaborations with our plant breeding programs.

Department of Agronomy and Plant Genetics Faculty

Name	Academic Rank	Ph.D. Institution	Year Awarded	Percent Appointment				Research Area
				Research	Teaching	Extension	Admin.	
Anderson, James	Professor	Cornell University	1992	80	20			Wheat Breeding and Genetics
Becker, Roger	Professor	Iowa State University	1982	25		75		Weed Control – Vegetables, Invasive species, Non-crop land
Bernardo, Rex	Professor	University of Illinois	1988	80	20			Endowed Chair in Corn Breeding and Genetics
Cardwell, Vernon	Professor	Iowa State University	1967		100			Undergraduate teaching
Coulter, Jeffery	Assistant Professor	University of Illinois	2008	40		60		Corn Cropping Systems
Cuomo, Gregory	Professor	University of Nebraska	1992				100	CFANS Associate Dean of Extension
Durgan, Beverly	Professor	North Dakota State University	1985	2*	3*	5*	100	Dean and Director – University of Minnesota Extension and Director – MAES
Ehlke, Nancy	Professor and Head	The Pennsylvania State University	1987	35*	15*		100	Grass and Legume Breeding, Genetics and Seed Production
Gunsolus, Jeffery	Professor	North Carolina State University	1986	25	5	45	25	Weed Control – Corn and Soybean; Area Program Leader
Haar, Milton	Assistant Professor	Iowa State University	1998	90	10			SWROC - Weed Ecology and Management

Johnson, Gregg	Associate Professor	University of Nebraska	1994	100				SROC - Biomass and Biofuels Production, Weed Control
Jones, Robert	Professor	University of Missouri	1978				100	Senior Vice President for System Administration
Jordan, Nicholas	Professor	Duke University	1986	80	20			Weed Ecology
Muehlbauer, Gary	Associate Professor	University of Minnesota	1994	100				Endowed Chair – Molecular Genetics of Wheat and Barley
Naeve, Seth	Associate Professor	Iowa State University	1998	25		75		Soybean Production and Management
Orf, James	Professor	University of Illinois	1979	80	20			Soybean Breeding and Genetics
Peterson, Paul	Associate Professor	University of Minnesota	1993	25		75		Forage Production and Management
Phillips, Ronald	Regents Professor	University of Minnesota	1966	90	10			Molecular and Cytological Research for Crop Improvement
Porter, Paul	Professor	University of Illinois	1986	75	25			Canola, Cropping Systems and Organic Agriculture
Sheaffer, Craig	Professor	University of Maryland	1977	75	25			Sustainable Cropping Systems
Smith, Kevin	Associate Professor	University of Wisconsin	1997	80	20			Barley Breeding and Genetics
Stupar, Robert	Assistant Professor	University of Wisconsin	2006	75	25			Biochemical Legume Genomics and Genetics

Stuthman, Deon	Professor	Purdue University	1967	90	10			Oat Breeding and Genetics
Wiersma, Jochum	Associate Professor	University of Minnesota	1995	15	15	70		NWROC – Small Grains Production and Management
Wyse, Donald	Professor	Michigan State University	1974	80	20			Perennial Weed Control and Sustainable Cropping Systems
USDA-ARS Adjunct Faculty Housed in the Department of Agronomy and Plant Genetics								
Garvin, David	Adjunct Assistant Professor	Cornell University	1992	100				Wheat Genetics and Genomics
Gronwald, John	Adjunct Professor	University of Illinois	1979	100				Alfalfa, Bioenergy Fuel Production
Jung, Hans	Adjunct Professor	University of Illinois	1982	100				Cell Wall Chemistry, Lignin and Biofuels Production
Lamb, JoAnn	Adjunct Associate Professor	University of Nebraska	1985	100				Alfalfa Breeding and Genetics
Rines, Howard	Adjunct Professor	Yale University	1968	100				Oat Genetics and Biotechnology
Vance, Carroll	Adjunct Professor	The Ohio State University	1971	100				Physiology and Molecular Biology of Legumes

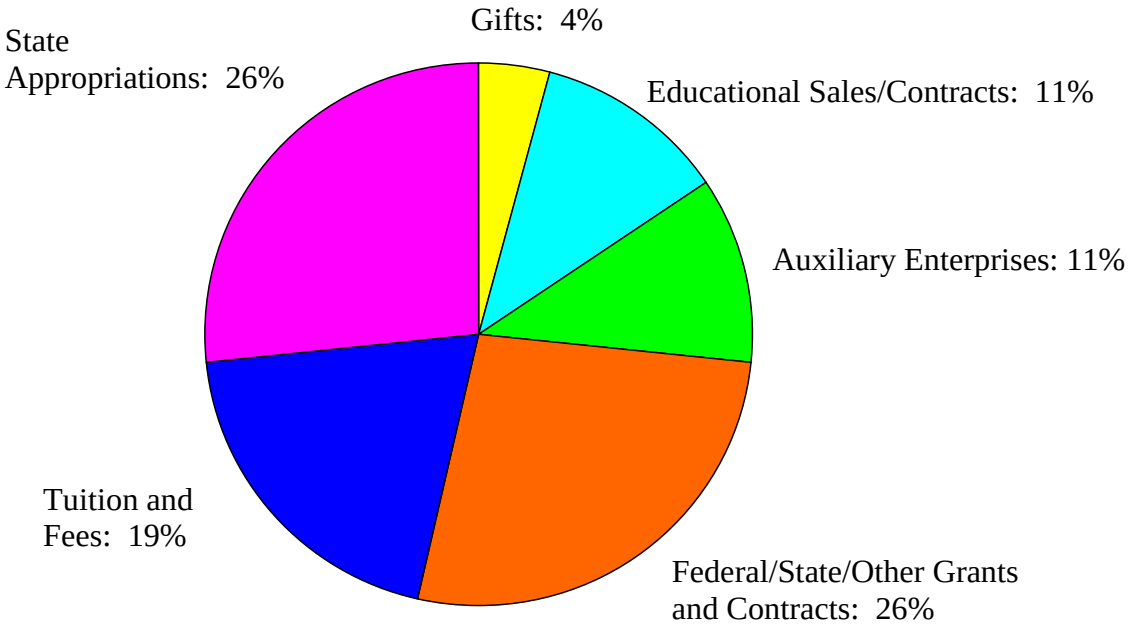
Adjunct and Affiliated Faculty Associated with the Department of Agronomy and Plant Genetics								
Brakke, Mary	Education Specialist	University of Florida	1989		100			Department of Agronomy and Plant Genetics
Draeger, Kathryn	Adjunct Assistant Professor	University of Minnesota					100	Statewide Director - Regional Sustainable Development Partnerships, University of Minnesota
Forcella, Frank	Adjunct Professor	University of Oklahoma	1979	100				USDA-ARS NCSCL*: Weed Ecology and modeling weed dynamics
Gesch, Russell	Adjunct Assistant Professor	Texas A&M University	1995	100				USDA-ARS NCSCL: new crops management strategies and environmental stresses.
Jaradat, Abdullah	Adjunct Professor	Washington State University	1983	100				USDA-ARS NCSCL: new crops genetics and physiology and environmental stress
Johnson, Jane	Adjunct Assistant Professor	University of Minnesota	1995	100				USDA-ARS NCSCL: Cropping systems, soil conservation, carbon cycling
Joo, Pilju Kim	Adjunct Professor	Cornell University	1970					Vice President: Agglobe Technologies – worldwide marketing /consulting service for agriculture. St. Paul, MN
Murray, Helene	Adjunct Assistant Professor	Oregon State University	1993				100	Executive Director: Minnesota Institute for Sustainable Agriculture, University of Minnesota
Porter, Rayme	Research Associate	Cornell University	1988	100				Wild Rice Breeder – North Central Research and Outreach Center, Grand Rapids, MN.
Somers, David	Adjunct Professor	Washington State University	1983					Monsanto Company, Agracetus campus – Site Director, Middleton, WI

* NCSCL: North Central Soil Conservation Laboratory is a USDA-ARS laboratory located in Morris, MN.

Financial Overview:

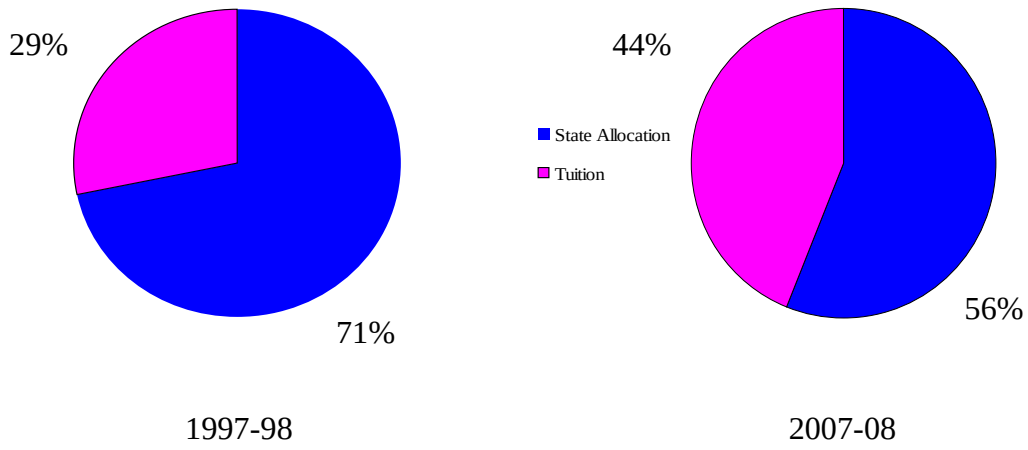
The University of Minnesota: The University of Minnesota has undergone radical changes in its funding base since the last CSREES review. The overall annual budget for the University of Minnesota is almost three billion dollars. The most significant funding change has been the decrease in state appropriations resulting in an increased reliance on tuition revenue to support the teaching, research and outreach activities of the University of Minnesota. The State of Minnesota spends about 9% of it's $15.8 billion budget on higher education with the University of Minnesota receiving slightly over half of the funding with the remainder going to support the Minnesota State Colleges and University system comprised of 32 institutions. During the past fiscal year, only one-quarter of the University's revenue came through the state appropriation and one-fifth from tuition and fees.

Figure 3. University of Minnesota Revenue Sources



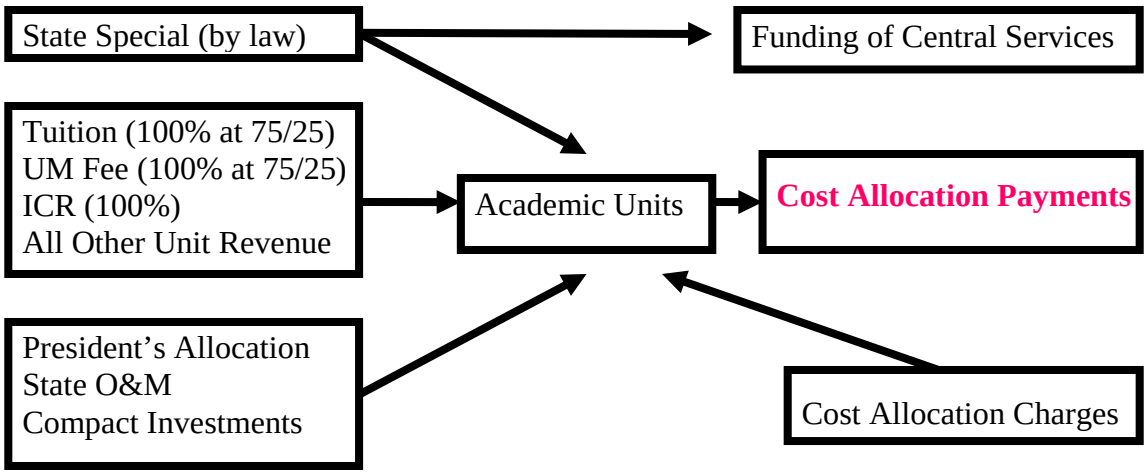
During FY 2007-08, the state appropriations and tuition revenue generated $1.2 billion. This funding represents about 45% of the total University budget and used primarily to support instructional costs including faculty compensation and student services. In CFANS, this funding accounts for 75% of the budget in comparison to other colleges such at the Institute of Technology where it is 78% of the budget and the College of Liberal Arts where is comprises 93% of the budget. There has been a dramatic shift from reliance on state appropriations to tuition revenue over the past ten years.

Figure 4. Changes to the state appropriations and tuition revenue mix from 1997-2008.



In July 2002, with the State of Minnesota facing a record $4.2 billion deficit, the University of Minnesota received a $185 million reduction in the state appropriations which resulted in the University's level of state financial support being equivalent to 1986 levels. Although a number of uiversities were faced with reductions in base funding due to economic crises in most states, the University of Minnesota sustained some of the highest reductions in funding of any public research institution in the U.S. This translated into a 15% reduction in the base budget for the Department of Agronomy and Plant Genetics. In July, 2006, the University of Minnesota changed budget models to an earned income/full cost model which resulted in a substantial unallotment of $355,000 from the Department in allocated dollars. This unallotment was used by the college to cover the cost pools associated with the new budget model and resulted in the Department being forced to layoff one technician, reduce the time to 80% of two of our educational support staff, fund one of the office staff on indirect cost recovery dollars, eliminate the few remaining Graduate Research Assistantships, and reduce the state appropriated support for technical staff on our research projects by 10 to 15%.

Figure 5. Earned Income/Full Cost Model



The cost pools are set by Central Administration to cover a wide number of activities that do not have earned income and require financial support. The cost pools are assessed at the College level and are determined as follows.

Attributed Cost	Basis for Attribution
Utilities	Actual usage
Custodial operations	Assignable space
Debts and leases	Actual cost
Libraries	Weighted student and faculty headcounts
Research Administration	3 year rolling average of sponsored expenditures
Information Technology	Headcount
Student Services	Student headcount
Central Administration	Expenditures
General Purpose Classrooms	Course registration

The College of Food, Agricultural, and Natural Resource Sciences: The College of Food, Agricultural, and Natural Resource Sciences financial profile based on FY 2006-07 expenditures shows a budget of $161,278,538. The College is comprised of 14 academic units (11 academic departments, Bell Museum, Minnesota Landscape Arboretum, and the Water Resource Center), 7 Research and Outreach Centers, and over 30 campus-based interdisciplinary centers. There are approximately 275 faculty, 795 staff, 1,800 undergraduate students and 760 graduate students. The sources of funding in the college are found in Figure 6 and Tables 1 and 2.

Figure 6. Sources and amounts of funding in CFANS.

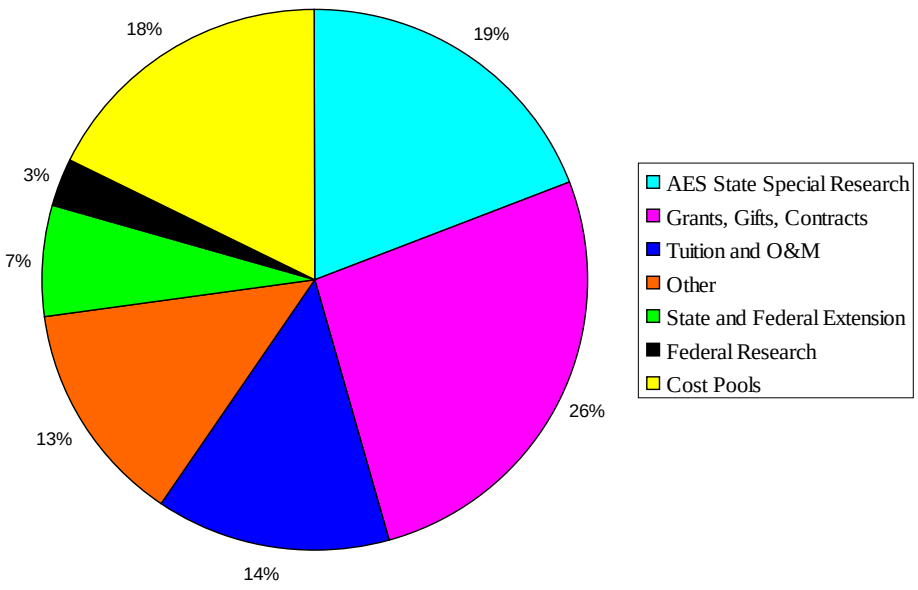


Table 2. Financial Profile of the College of Food, Agricultural, and Natural Resource Sciences

	College of Agriculture, Food, and Environmental Sciences						CFANS[1]			
Funding Source	FY 2002-03		FY 2003-04		FY 2004-05		FY 2005-06		FY 2006-07	
AES State Special	$30,682,658	32%	$26,933,502	28%	$27,056,532	26%	$30,838,908	23%	$30,809,872	19%
Grants, Gifts, Contracts	$26,088,167	27%	$27,491,449	29%	$30,020,444	29%	$40,000,712	30%	$42,708,286	26%
Tuition and O&M	$13,066,152	14%	$12,898,624	14%	$13,934,171	13%	$20,869,721	16%	$22,204,422	14%
Other Income	$12,695,596	13%	$12,539,596	13%	$16,242,856	16%	$19,819,896	15%	$21,610,548	13%
Extension	$5,660,913	6%	$6,009,599	6%	$7,772,353	7%	$9,513,701	7%	$21,610,548	7%
Federal Research	$4,230,184	4%	4,653,399	5%	$3,933,533	4%	$4,776,049	4%	$4,560,595	3%
Cost Pools							6,182,659	5%	$28,749,445	18%
IRS Assessment[2]	$3,829,990	4%	$4,717,783	5%	$4,966,523	5%				
Total	$96,253,659		$95,243,952		103,924,114		$132,001,646		$161,278,538	

[1]CFANS: The College of Agriculture, Food, and Environmental Sciences merged with the College of Natural Resources to produce the new College of Food, Agricultural, and Natural Resource Sciences effective July 1, 2006.

[2]IRS Assessment: Institutional revenue sharing assessment used to fund institutional common goods and academic priorities.

Table 3. CFANS 2007-2008 base allocations by funding source.

Unit	Faculty FTE's	CFANS Teaching/O&M	MN Agriculture Experiment Station Research Funds				Extension		Total
			State Special	Hatch	McIntire-Stennis	MRF[1]	State Special	Federal	
Agronomy and Plant Genetics	19.0	685,383	2,119,784	301,013	0	119,587	376,407	0	3,602,174
Animal Science	21.0	1,326,421	1,951,917	447,607	0	299,429	377,034	108,785	4,511,193
Applied Economics	33.0	1,702,478	1,653,835	558,226	0	61,782	719,311	122,743	4,818,375
Bioproducts and Biosystems Eng.	22.0	882,169	1,778,875	176,001	101,672	53,002	398,921	161,545	3,552,185
Entomology	17.5	591,886	1,348,179	110,623	0	76,561	344,274	16,374	2,487,897
Fisheries, Wildlife, Cons. Biology	13.6	840,525	807,662	87.350	16.458	0	97,639	20,119	1,869,713
Food Science and Nutrition	23.0	1,796,947	1,125,828	279,201	0	0	178,059	63,063	3,443,098
Forest Resources	15.7	763,235	1,268,603	74,723	274,099	0	163,329	55,347	2,598,336
Horticultural Science	19.2	840,928	1,963,390	343,185	0	0	278,599	103,591	3,529,693
Plant Pathology	15.0	649,288	1,448,384	151,328	0	0	97,557	0	2,346,557
Soil, Water and Climate	17.6	744,564	1,162,941	227,135	0	71,575	329,221	86,353	2,621,789
Department Totals	216.6	10,823,824	16,629,398	2,669,129	375,787	681,936	3,360,351	737,920	35,381,010
CFANS Administration and Student Services	4.0	32,166,543	7,148,947	552,782	104,596	0	1,217,637	0	41,190,505

Unit	Faculty FTE's	CFANS Teaching/O&M	MN Agriculture Experiment Station Research Funds				Extension		Total
			State Special	Hatch	McIntire-Stennis	MRF	State Special	Federal	
Research and Outreach Centers									
Cloquet	0.0	64,922	409,912	0	0	0	0	0	474,904
NCROC – Grand Rapids	2.9	0	1,481,469	0	0	0	27,993	0	1,509,462
NWROC – Crookston	6.3	0	1,762,177	0	0	0	111,624	0	1,873,801
SROC – Waseca	9.0	0	1,853,874	0	0	0	81,015	0	1,934,889
SWROC – Lamberton	2.0	0	667,686	0	0	0	0	0	667,686
ROC – Rosemount	1.0	0	410,691	0	0	0	0	0	410,691
WCROC – Morris	5.0	0	1,759,956	0	0	0	121,820	0	1,881,776
ROC Totals	26.2	64,922	8,345,765	0	0	0	342,452	0	8,753,209

[1]MRF: Multistate Research Funds

The campus-based tenure and tenure track FTE's by department and funding source for the college are in Table 3. Campus–based faculty in the Department of Agronomy and Plant Genetics primarily have two-way split appointments and generally carry a majority research appointment with a teaching component or a majority extension appointment with a research component. Salary data by CFANS department and for comparable departments at peer institutions in the North Central region is found in Tables 4 and 5. Faculty salaries in the Department of Agronomy and Plant Genetics are in the median range of our peer institutions and CFANS departments.

Table 4. 2007-2008 Campus-based tenure and tenure track faculty FTE's by department and funding source.

Unit	Teaching	MAES	Extension	Other	Total
Agronomy and Plant Genetics	4.2	9.6	3.0	2.2	19.0
Animal Science	7.0	9.8	4.2	0.0	21.0
Applied Economics	11.7	12.2	5.9	3.2	33.0
Bioproducts and Biosystems Eng.	6.4	12.6	2.9	0.2	22.0
Entomology	4.4	9.7	2.7	0.8	17.5
Fisheries, Wildlife, Cons. Biology	5.7	5.5	0.9	1.2	13.4
Food Science and Nutrition	10.3	8.1	2.2	1.4	22.0
Forest Resources	4.4	8.4	1.5	1.4	15.7
Horticultural Science	5.4	9.4	3.2	1.2	19.2
Plant Pathology	4.2	8.7	0.9	1.3	15.0
Soil, Water and Climate	5.3	8.3	3.0	1.0	17.6
Department Totals	69.0	103.2	30.3	15.0	217.5

Table 5. 2007-08 Tenured and tenure track faculty salaries from CFANS Departments excluding Heads, Administrators and Regents Professors.

Department	Professors			Associate Professors			Assistant Professors		
	#	Average	Range	#	Average	Range	#	Average	Range
Agronomy and Plant Genetics	13	113,444	84,602 – 165,000	4	89,905	75,568 – 110,000	4	72,465	62,825 – 79,444
Animal Science	15	104,555	87,251 – 132,991	4	83,662	75,534 – 89,534	1	70,085	70,085 – 70,085
Applied Economics	15	128,792	84,970 – 211,542	13	94,033	78,225 – 139,333	4	91,737	75,385 – 106,211
Bioproducts and Biosystems Engineering	13	110,833	92,604 – 146,970	7	96,725	75,202 – 111,588	3	77,246	76,267 – 78,938
Entomology	12	99,452	85,245 – 116,551	4	82,882	73,562 – 98,514	1	75,227	75,227 – 75,227
Fisheries, Wildlife, Conservation Biology	9	110,617	78,391 – 124,373	5	80,844	65,760 – 85,931	1	87,555	87,555 – 87,555
Food Science and Nutrition	11	117,442	83,405 – 180,902	6	88,178	76,122 – 94,910	6	77,251	69,802 – 83,299
Forest Resources	9	122,109	98,764 – 223,282	4	91,151	81,226 – 101,623	3	83,023	81,889 – 83,994
Horticultural Science	11	109,621	79,091 – 140,842	6	77,612	68,390 – 83,201	2	77,410	72,892 – 81,927
Plant Pathology	8	106,685	91,604 – 140,103	2	96,776	93,138 – 100,414	4	87,438	81,211 – 92,929
Soil, Water and Climate	14	108,488	80,535 – 162,446	1	87,173	87,173 – 87,173	3	86,499	80,393 – 100,120
Overall average salaries	130	112,106	78,391 – 223,282	56	88,743	65,760 – 139,333	32	81,189	62,825 – 106,211

Table 6. 2007-08 Tenured and tenure track faculty salaries from comparable departments in the North Central Region.[1]

Department	Professors			Associate Professors			Assistant Professors		
	#	Average	Range	#	Average	Range	#	Average	Range
University of Illinois	15	128,017	103,270 – 194,798	9	91,947	83,502 – 123,420	7	77,578	72,209 – 83,417
Purdue University	22	113,083	80,655 - 183,600	5	104,241	92,906 – 116,238	7	87,840	82,681 – 107,025
Iowa State University	31	118,339	83,989 – 224,974	10	87,530	68,954 – 111,222	5	75,316	60,013 – 83,540
Michigan State University	21	135,122	98,295 – 218,894	7	96,578	80,954 – 122,929	6	75,557	70,000 – 94,018
University of Minnesota	14	120,195	84,602 – 233,692	4	89,905	75,568 – 110,000	4	72,465	62,825 – 79,444
University of Missouri	15	118,646	77,128 – 174,709	14	72,744	54,350 -92,400	4	67,884	63,630 – 72,000
University of Nebraska	26	119,288	86,100 – 178,300	9	81,374	73,000 – 89,400	2	72,830	68,700 – 77,000
North Dakota State University	11	88,800	71,000 – 104,000	10	79,400	67,700 – 108,200	8	66,500	64,900 – 68,800
The Ohio State University	15	103,417	89,760 – 123,492	20	86,889	54,504 – 129,136	3	75,712	69,324 – 80,736
The Pennsylvania State University	11	136,489	87,552 – 185,427	9	82,052	67,788 – 96,306	5	79,534	75,165 – 83,904
South Dakota State University	18	79,518	68,035 – 98,497	4	71,280	57,592 – 84,968	11	61,479	45,615 – 72,698
Overall Average Salaries	199	115,270	68,035 – 233,692	101	84,810	54,350 – 123,420	62	73,032	45,615 – 107,025

[1]Salaries are based on 12 month appointments.

The Department of Agronomy and Plant Genetics: The Department of Agronomy and Plant Genetics has a long and committed history of providing financial support to faculty to accomplish our mission. Even with substantial budget reductions since our last CSREES review, the Department continues to be one of the best supported departments within the college. The faculty are strongly committed to having adequate resources to support our faculty, but this has been more difficult under the current financial climate and the lack of public support for higher education. With the substantial reductions in the state appropriated funds to the University of Minnesota and few increases in funding for the AES State Special, faculty have been active in pursuing grants, gifts and contracts. The base allocations of the campus-based departments show that only the Department of Animal Science has a higher allocation of resources per FTE than the Department of Agronomy and Plant Genetics. However, the reduction in base funding for the entire college has greatly increased our reliance on grants, gifts, and contracts to carry forward our landgrant mission.

Faculty in the Department of Agronomy and Plant Genetics are actively pursuing granting opportunities to support their research programs. With the decrease in state funding to the Department, it is necessary for faculty to obtain extramural funding to fund technical support and graduate students. Currently, tenured faculty with a greater than 50% research appointment receive approximately 65% of one technician's salary and less than $1000 in operating support (Table 7 and 8). With essentially no departmental funds remaining for Graduate Research Assistantships, this change in the level of funding over the past ten years has resulted in graduate students being entirely funded by grants, competitive fellowships, gifts and endowments. Tenure track faculty are provided higher levels of financial support to help insure their success than tenured faculty in the Department.

The Department of Agronomy and Plant Genetics is successful in obtaining extramural funding and averages over $3.5 million dollars in grant expenditures per year. Indirect cost recovery funds are split between the College and Department (Table 9 and 10). The Department relies on indirect cost recovery funds to support office staff and to have flexible funds for set up packages for new faculty hires, emergency or bridge funding for faculty, and unexpected expenses. The Department generates an average of $365,000 in indirect costs resulting in the effective indirect cost recovery rate of only 10% due to the high level of funding received by the Department from commodity groups, state agencies, and contracts which do not pay indirect costs and the lower negotiated indirect cost recovery rates of federal agricultural grant programs (Table 10). An emphasis on pursuing grants with higher indirect cost recovery rates continues to be a goal for faculty, however these opportunities are not available for all faculty based on their area of research. Success rates of getting grant awards are also affected by the increased competition nationally for grant funding coupled with reduced resources for agricultural research and higher education.

With the new financial model, limited educational funding through tuition revenue is returned to the Department based on student credit hours. The Department has been striving to increase student credit hours though new courses and increased enrollments (Table 11 and 12). In recent years, tuition revenue to the college has been used to support faculty salaries, student services, and the cost pools. The College does distribute a small percentage of the instructional tuition revenue to the Department based on student credit hours (currently $15,000 - $20,000). This educational funding is used primarily for Teaching Assistants for our larger enrollment courses with laboratories and to purchase educational supplies. In the future, this revenue may need to be used to help support the salaries of our education staff.

Table 7. The Department of Agronomy and Plant Genetics financial history from FY 2003-04 to FY 2009-10.

	2003		2004		2005		2006		2007		2008		2009	
	Funds	FTE	Funds	FTE	Funds	FTE	Funds	FTE	Funds	FTE	Funds	FTE	Funds	FTE
Faculty	1,847,467[1]	20	1,847,467	20	1,894,723	20	1,729,626	18	1,801,321	17	1,707,241	16	1,835,883	17
Technical Staff	612,238	17	484,589	15.8	497,466	14.8	512,574	14.8	406,575	11.8	421,689	11.8	473,037	13.3
Office Staff	223,225	5	223,225	5	221,126	5	208,280	5	177,491	4[2]	100,162	1.7[3]	92,858	1.5[4]
Education Staff	139,293	3	139,293	3	143,450	3	147,757	3	134,804	2.6[5]	140,795	2.6	145,382	2.6
Project Support	104,398		56,783		51,285		49,783		38,783		24,929		11,173	
RA Funds	243,441		123,441		125,684		125,684		33,746		34,668		35,661	
Operating Support	165,770		124,236		127,617		128,001		83,752		37,952		39,975	
Total	3,335,832		2,999,034		3,061,351		2,901,705		2,676,472		2,467,436		2,632,807	

[1]Fund totals do not include the fringe benefit costs which are approximately 33%.
[2]The reduction in office staff FTE is the result of moving one FTE staff member to indirect cost recovery funds.
[3]The reduction in office staff FTE is due to the restructuring of the financial staff into the Plant Science Division Finance Team under supervision of the CFANS financial staff and having 1.3 FTE office staff on indirect cost recovery funds.
[4]The reduction in office staff FTE is the result of having 1.5 FTE office staff on indirect cost recovery funds.
[5]The reduction in education staff is the result of reducing 2 staff to 80% appointments.

Table 8. Total expenditures by department from FY03 to FY08.

Department	2002-03	2003-04	2004-05	2005-06	2006-07	2007-08
Agronomy and Plant Genetics	$10,597,384	$10,181,683	$10,202,666	$9,905,188	$10,250,130	$9,513,933
Animal Science	$7,505,483	$6,795,074	$6,470,194	$6,500,737	$7,038,286	$6,927,314
Applied Economics	$7,791,329	$7,878,194	$7,890,366	$8,658,406	$9,489,039	$10,147,403
Bioproducts and Biosystems Eng.	$7,876,549	$6,483,193	$6,713,700	$7,651,766	$8,791,178	$10,261,199
Entomology	$5,821,920	$5,622,033	$6,088,879	$6,430,707	$6,487,370	$5,952,036
Fisheries, Wildlife, Cons. Biology	$4,231,531	$4,641,909	$4,660,194	$5,645,922	$5,998,854	$6,482,255
Food Science and Nutrition	$7,712,803	$6,819,839	$6,844,145	$7,612,091	$8,529,593	$8,604,700
Forest Resources	$6,897,044	$5,999,086	$5,745,033	$6,153,966	$6,201,960	$7,235,755
Horticultural Science	$6,479,513	$6,177,982	$6,053,493	$5,645,325	$5,836,736	$6,429,039
Plant Pathology	$5,293,423	$6,933,015	$10,690,406	$9,812,998	$8,946,745	$7,895,552
Soil, Water and Climate	$7,236,697	$7,246,868	$6,907,000	$6,846,192	$6,868,986	$6,259,030
Total	$77,443,676	$74,778,876	$78,266,077	$80,863,297	$84,438,876	$85,708,216

Table 9. Grant expenditures by department from FY03 to FY08.

Department	2002-03	2003-04	2004-05	2005-06	2006-07	2007-08
Agronomy and Plant Genetics	$3,640,189	$3,540,086	$3,562,078	$3,614,121	$3,551,175	$3,600,330
Animal Science	$940,096	$957,966	$736,214	$1,067,500	$1,256,627	$1,241,554
Applied Economics	$1,628,123	$1,853,808	$1,587,937	$1,689,582	$2,097,499	$2,665,919
Bioproducts and Biosystems Eng.	$2,270,787	$1,726,658	$2,008,981	$2,456,557	$2,982,837	$4,441,662
Entomology	$2,637,990	$2,579,560	$2,679,660	$2,771,327	$2,842,004	$2,514,343
Fisheries, Wildlife, Cons. Biology	$1,731,305	$2,032,357	$1,922,913	$2,725,488	$2,915,503	$3,476,655
Food Science and Nutrition	$1,785,366	$1,634,463	$1,547,158	$1,847,483	$2,097,509	$2,561,597
Forest Resources	$3,457,787	$3,044,726	$2,785,404	$2,982,506	$2,804,748	$3,060,310
Horticultural Science	$783,224	$817,320	$739,681	$630,742	$756,752	$1,303,363
Plant Pathology	$1,535,135	$3,506,048	$7,260,331	$6,156,895	$5,099,477	$4,319,545
Soil, Water and Climate	$2,343,958	$3,010,833	$2,772,303	$2,401,343	$2,713,786	$1,738,896
Total	$22,753,959	$24,703,827	$27,602,658	$28,343,542	$29,117,916	$30,924,174

Table 10. Indirect cost recovery by department from FY03 to FY08.

Department	2002-03	2003-04	2004-05	2005-06	2006-07	2007-08
Agronomy and Plant Genetics	$414,457	$404,898	$417,978	$421,023	$287,661	$246,235
Animal Science	$154,922	$168,126	$109,334	$172,136	$217,381	$246,522
Applied Economics	$175,058	$142,598	$116,783	$135,445	$138,152	$241,104
Bioproducts and Biosystems Eng.	$309,742	$206,272	$253,218	$326,058	$337,896	$436,884
Entomology	$507,750	$480,243	$548,685	$562,509	$570,288	$509,802
Fisheries, Wildlife, Cons. Biology	$168,265	$218,037	$205,233	$160,476	$251,633	$221,531
Food Science and Nutrition	$176,993	$157,888	$172,762	$224,417	$265,388	$425,979
Forest Resources	$520,432	$466,002	$324,204	$326,751	$316,078	$420,045
Horticultural Science	$90,259	$91,688	$74,907	$44,206	$87,514	$177,726
Plant Pathology	$240,742	$365,060	$436,748	$426,310	$332,211	$344,636
Soil, Water and Climate	$184,659	$271,548	$261,606	$270,719	$255,624	$213,921
Total	$2,943,278	$2,972,360	$2,921,457	$3,070,050	$3,059,826	$3,484,384

Table 11. Total student credit hours from FY03 to FY08.

Department	2002-03	2003-04	2004-05	2005-06	2006-07	2007-08
Agronomy and Plant Genetics	2,045	1,886	1,682	1,416	1,593	1,551
Animal Science	3,225	3,478	3,738	4,295	4,609	4,908
Applied Economics	5,362	5,019	5,638	5,609	5,369	5,559
Bioproducts and Biosystems Eng.	1,531	1,394	1,630	1,967	1,942	2,703
Entomology	1,153	1,044	1,013	830	849	586
Fisheries, Wildlife, Cons. Biology	2,578	3,267	3,628	2,845	3,273	3,426
Food Science and Nutrition	8,496	8,456	9,213	9,721	10,088	10,110
Forest Resources	5,174	4,858	4,455	5,368	5,415	5,661
Horticultural Science	2,940	3,018	3,092	3,032	2,788	2,908
Plant Pathology	851	994	1,271	1,036	931	980
Soil, Water and Climate	1,938	2,016	2,162	2,230	1,556	2,236
Total	35,293	35,430	37,522	38,349	38,413	40,628

Table 12. Instructional Tuition Revenue Generated by Department from FY04 to FY08.

Department	2003-04	2004-05	2005-06	2006-07	2007-08
Agronomy and Plant Genetics	$356,393	$341,244	$305,726	$359,472	$386,409
Animal Science	$552,835	$662,111	$801,328	$910,969	$1,006,317
Applied Economics	$919,049	$1,113,788	$1,238,253	$1,223,615	$1,304,530
Bioproducts and Biosystems Eng.	$260,084	$314,408	$381,152	$519,253	$638,410
Entomology	$211,385	$199,914	$185,485	$217,564	$163,848
Fisheries, Wildlife, Cons. Biology	$594,754	$720,371	$573,531	$838,802	$834,608
Food Science and Nutrition	$1,449,641	$1,718,379	$1,901,986	$2,114,548	$2,258,029
Forest Resources	$904,173	$882,554	$1,128,483	$1,093,979	$1,293,126
Horticultural Science	$481,193	$545,118	$566,252	$555,237	$608,494
Plant Pathology	$201,839	$278,648	$237,715	$230,299	$272,270
Soil, Water and Climate	$368,434	$420,265	$443,887	$425,710	$480,859
Total	$6,299,780	$7,196,800	$7,763,798	$8,489,448	$9,246,900

Instructional Tuition accounts for 75% of the tuition generated and is attributed to the course instructor(s) tenure home department.

Department Endowment Funds

The Department of Agronomy and Plant Genetics has established an excellent, world-renowned reputation in education and research. Alumni, friends, retired faculty, and industry partners of the department have been generous with their time, effort, and financial gifts to help build a substantial endowment to promote and sustain department activities worth approximately $9.3 million (July, 2008 market value). The Department of Agronomy and Plant Genetics has the highest level of endowment support of all of the departments in CFANS with approximately two thirds of the funds committed to the two Endowed Chairs (Table 13). The amount of available funds varies from year to year but over $400,000 is available annually to spend.

Endowment funds are privately contributed philanthropic gifts held in trust for specific purposes. The funds are managed by the University of Minnesota Foundation. The Foundation was founded in 1962 as an independent non-profit organization. The mission of the Foundation is to engage the resources of the private sector to build and sustain excellence at the University of Minnesota. The Foundation works with the Development Officers affiliated with CFANS to raise gifts on behalf of the University, College and Departments. The University of Minnesota determines the percentage of the investment income that can be spent with the remaining investment income being reinvested in the fund insure adequate growth and to compensate for inflation.

The Department of Agronomy and Plant Genetics is fortunate to have two endowed chairs. The first endowed chair was established in 1987 and is the Molecular Genetics Applied to Crop Improvement Chair. The goal of the chair was to utilize the new tools of molecular genetics to improve crop plants, The chair was generously funded by numerous commodity and industry partners including the Minnesota Crop Improvement Association, the Minnesota Wheat and Barley growers, the Minnesota Soybean Growers, Quaker Oats, and the Minnesota Wild Rice Growers. The Corn Genetics and Breeding chair was established in 1997 with funding from industry partners and the Minnesota Corn Growers and the Minnesota Corn Research and Promotion Council. The goal of the Chair is to provide outstanding leadership in cutting edge research and graduate education focused on breeding corn, the largest acreage crop in the state. Both chairs were established during a University-wide program where the University of Minnesota matched contributions dollar for dollar up to one million dollars.

The Department of Agronomy and Plant Genetics has approximately $800,000 in endowments designated for undergraduate scholarships, undergraduate educational program support, and professional development activities (Table 14). On a yearly basis, the department is able to give between $30,000 and $40,000 primarily in direct student scholarships. The majority of these scholarships are awarded to new, incoming students to assist with recruiting activities in either the Applied Plant Science or the Agricultural Industries and Marketing majors. Any remaining endowment funds available after making these initial awards are distributed to current undergraduate students based on academic performance and extra curricular activities.

The Department of Agronomy and Plant Genetics has a large number of endowments designated for Graduate Fellowships valued at approximately $1.2 million. Of these sixteen funds, few of the funds are large enough to completely fund a ½-time Research Associate with the exception of the Pioneer Hi-Bred Plant Breeding Fellowships demand fund which supports two graduate students per year through a Memorandum of Agreement. The other 15 endowments generate over $75,000 per year with most used to award Graduate Fellowships (which averaged $2,000) to students in the department to supplement their Research Assistantship salaries and reward excellence in academic and research performance. Approximately half of these gifts are matched by the 21st Century Graduate Fellowship Endowment which essentially doubles our investment return and provides a market value of over $1.7 million. The University of Minnesota recognizes that graduate students are an indispensable part of the intellectual

fabric of our research programs and the recruitment of high quality graduate students is a key piece in ensuring that the University remains among the world's top institutions in our fields. But competition for graduate students is intense, so to strengthen our ability to attract top students the 21st Century Fund matches gifts greater than $25,000 designated for graduate fellowships. The 21st Century Graduate Fellowship Endowment was made possible as a result of the licensing agreement with Glaxo Wellcome PLC, a pharmaceutical company. The endowment is created through royalties generated by worldwide sales of Ziagen, an AIDS drug that contains antiviral compounds created by researchers led by Professor Robert Vince in the College of Pharmacy.

Table 13. Funds administered by the University of Minnesota Foundation by CFANS department (demand, quasi-endowments, and endowments).

Department	Demand Funds	Quasi-Endowments	Endowments	Total
Agronomy and Plant Genetics	54,752	1,294,947	8,611,217	9,960,916
Animal Science	116,193	906,898	1,407,048	2,431,039
Applied Economics	26,876	5,380,232	511,563	5,918,671
Bioproducts and Biosystems Engineering	245,177	6,401,708	1,451,656	8,098,541
Entomology	39,108	372,858	230,589	642,555
Fisheries, Wildlife, and Conservation Biology	43,810	20,224	1,364,699	1,428,733
Food Science and Nutrition	35,320	2,502,835	7,277,854	9,816,009
Forest Resources	127,842	47,872	8,228,885	8,404,509
Horticultural Science	55,078	430,805	6,318,875	6,804,758
Plant Pathology	104,547	501,633	3,261,008	3,867,218
Soil, Water, and Climate	15,816	517,036	2,948,705	3,481,557
Totals	864,519	18,377,048	40,205,051	60,854,506

Table 14. Summary of departmental endowments administered by the University of Minnesota Foundation.

Account	Initiation Date	Fund Type	Purpose	Market Value
Undergraduate Scholarships and Activities:				
Harold K Wilson Scholarship	1998	Demand	Undergraduate scholarships	2,665
Oliver E. Strand Fund	1986	Endowment	Undergraduate scholarships	77,919
Cardwell Fund	1990	Endowment	Undergraduate Activities	120,311
Howard C. Abraham Scholarship	1990	Endowment	Undergraduate scholarships	95,237
Clifford & Marie Christenson Fund	1996	Endowment	Professional development, internships, awards, scholarships	19,662
Bert Enestvedt Fund	1998	Endowment	Support undergraduate education	47,927
Allen & Joan Wiese Scholarship	1999	Endowment	Undergraduate scholarships with priority to transfer students	43,152
Lawrence H.& Jacquelyn J. Smith Undergraduate Fund	1999	Endowment	To support undergraduate teaching, student experiences, and scholarships	43,144
Spandl Family Scholarship	2007	Demand	Undergraduate scholarships	2,501
Harley Otto Memorial Fund	2008	Endowment	Undergraduate scholarships	25,467
Edgar Hartwig Undergraduate Scholarship	1990	Endowment	Scholarship for the outstanding Junior	50,062
Laddie Elling Fund	2000	Quasi	Undergraduate academic and professional development	274,913
Graduate Fellowships:				
Gandrud Fellowship	1976	Endowment	Support research on weed control and management practices	131,555
Pioneer Hi-Bred Plant Breeding Fellowship	2007	Demand	Two annual graduate fellowships in plant breeding	70,000
Ron and Judy Phillips Plant Genetics Scholars Fund[1]	2006	Endowment	Graduate fellowships	48,639
Donald C. Rasmusson Fellowship[1]	2008	Endowment	Graduate fellowships	24,572
Donald C Rasmusson Graduate Education Fund	1996	Endowment	Graduate fellowships in plant breeding and genetics	50,905
Burnham/Chang Fund	1999	Endowment	Graduate student activities related to biodiversity and the environment	153,564

Burle & Lou Gengenbach Graduate Fund[1]	2000	Endowment	Graduate fellowships	38,765
Rahr Foundation Graduate Endowment Fund[1]	2001	Endowment	Graduate fellowships with preference given to studying barley research.	168,106
Northern MN Forage and Turf Seed Fellowship Fund[1]	2001	Endowment	Graduate Fellowship for conducting research on seed production	43,491
Project AgGRAD Fund[1]	2002	Endowment	Support students from needy nations who are working on agricultural issues.	272,875
Fick Graduate Fund[1]	2002	Endowment	Supplemental support for a graduate student studying plant breeding	57,464
The Jean E. and Mark T. Schroepfer Fellowship Fund[1]	2004	Endowment	Graduate fellowships	118,242
Gordon and Lynette Marten Fellowship[1]	2006	Endowment	Graduate fellowships with preference given to students studying forages	28,792
Jean W. Lambert Graduate Fellowship	1990	Quasi	Graduate fellowships	177,791
Hayes 21st Century Fellowship Fund[1]	2002	Endowment	To provide support for graduate students	35,597
Pioneer Plant Breeding Fund	1999	Demand	Graduate support for students in plant breeding	81,923
Norman and Cynthia Engelbrecht Fellowship Fund	2003	Endowment	Graduate student support	46,450
Endowed Chairs:				
Molecular Genetics Applied to Crop Improvement	1987	Endowment	To provide funding for the endowed chair in molecular genetics	3,957,910
Corn Genetics and Breeding	1997	Endowment	To provide funding for the endowed chair in corn breeding and genetics	2,377,188
Other Funds:				
Phillips Fund for Grad Student Travel	1986	Demand	Travel expenses for graduate students to attend scientific meetings.	13,321
Burnham School/Research By Pre-College Student	1986	Demand	To support high school students involved in scientific research	9,909
Syngenta Fund	1984	Quasi	To support programs that benefit faculty, staff and students	454,131
Roy Thompson Agronomy Fund	2007	Quasi	To support research in the department	13,654
Agronomy Service Fund	1986	Quasi	General department support	425,049
Total Endowments				9,960,916

[1]Fund earnings are matched by the 21st Century Graduate Fellowship Endowments.

Resources Available to the Department of Agronomy and Plant Genetics:

Laboratories, Offices and Classrooms on the St. Paul Campus: The Department is largely housed in two interconnected buildings on the Saint Paul Campus: Borlaug Hall and Hayes Hall. These buildings contain the faculty offices, staff offices, classrooms, high-quality laboratory space, technical support and two members of the Plant Science Division Finance Team. Technical staff for the research programs that are primarily field based have offices and laboratories in the Crops Research Building, Crop Services Building, Seed House and/or Weed Research Laboratory. Currently, no Department faculty members are housed in the Cargill Building for Microbial and Plant Genomics.

Hayes Hall is gradually being renovated to provide higher quality laboratory, office and meeting space. An effort has been made to replace the furniture, install carpeting, and paint the offices of faculty, staff and graduate students. Given our current faculty, staff, and students, the space needs of the department are being met. However, our laboratory space is being fully utilized and with future hires it may be necessary to house faculty in other buildings to meet their needs. Faculty, students and staff benefit greatly from many other resources located in or near this building complex. The following is a short review of some of the most important facilities.

Student Computer Facilities: In Stakman Hall, a computer room is available to students in the Departments of Plant Pathology and Agronomy and Plant Genetics. The facility contains four Dell model Optiplex 745, two Intel Core 2 Duo iMacs, and one PowerPC iMac G5 with a large selection of software. The computers are complemented by a large volume network laser printer, two scanners and access to two LCD projectors and a slide scanner.

In Hayes Hall, computers and a printer are available to students in a student lounge located in 304 Hayes Hall to access email, use the resources of the internet, and print files. However, most graduate students generally own a laptop computer. To facilitate their use, the graduate student offices are wired with Ethernet jacks and wireless access points are distributed throughout Borlaug and Hayes Halls.

Computational Biology and Bioinformatics Resources:

Biodale: Biodale is one-stop shopping for cutting-edge biological research support services. (www.cbs.umn.edu/biodale) Biodale is a consortium of University of Minnesota research service facilities that offer state-of-the-art instrumentation and user-friendly, walk-in service and training. Members of the business community, as well as the University community, are invited to use Biodale services and equipment. Each facility is staffed by specialized scientists and technicians. The following facilities are available:

> The Imaging Center: This center uses light and electron microscopy combined with digital imaging and analysis to visualize biological specimens.
>
> The Biotechnology Resource Center: This center provides capabilities to grow a wide range of microorganisms from shake-flask to 240L fermenter scale and to recover the cells and/or metabolites. A particular area of expertise is the expression and purification of recombinant proteins.
>
> The Center for Mass Spectrometry and Proteomics: This Center provides support, equipment, and expertise for analyzing complex protein mixtures. The affiliated Proteome Analysis Core Facility has special equipment for comparing and differentiating samples.

The BioMedical Genomics Center: This center provides a variety of genetic sequencing and analysis services for researchers.

The High Throughput Screening and Analysis Facility: This facility uses robots to screen large numbers of microbes, biological compounds, and chemical libraries to identify those with useful biological activity.

The Computational Biology Centers -- Center for Computational Biology and Bioinformatics is a structure designed to foster research in all aspects of biology and medicine. As such, it includes a major infrastructure component of high performance Unix workstations, associated servers and disk farms, networks and software. Support is provided for molecular biology, genomics, biostatistics, and computational chemistry, as well as an environment for developing educational tools.

Minnesota Supercomputing Institute: The Minnesota Supercomputing Institute provides user support, software, databases, and hardware resources for all aspects of high-performance computing. In the area of computational biology, this includes bioinformatics, genomics, structural biology, and proteomics. (www.msi.umn.edu)

Computational Genetics Laboratory is an initiative of the Supercomputing Institute, the Center for Microbial and Plant Genomics, and the Biomedical Genomics Center and is designed to meet the emerging computational needs in bioinformatics, computational genomics, and proteomics. This laboratory is located in the Cargill Microbial and Plant Genomics Building on the St. Paul campus. It provides researchers with access to hardware, software, and technical support related to computational biology. (www.msi.umn.edu/cgl/intro)

Cargill Building for Microbial and Plant Genomics: The Cargill Building is the first public research university building dedicated to microbial and plant genomics in the nation. Fifteen research groups from four colleges and three Institutes use the building. This building provides 64,000 square feet of research laboratories, meeting rooms, and offices. A few of the facilities that are available for use include Computational Genetics Laboratory, Conviron plant growth chambers, bioinformatics research area, microbial fermentation lab space, and a robotic high throughput center for screening new biological compounds, picking colonies, and replating libraries.

Mycotoxin Diagnostic Laboratory: This laboratory is located on the first floor of Stakman Hall and is one of three central DON (deoxynivalenol) diagnostic laboratories in the country supported by the United States Wheat and Barley Scab Initiative. The laboratory is equipped with two Shimadzu Gas Chromatograph-Mass Spectrometers, and provides mycotoxin analyses, especially DON, for Fusarium head blight (scab) research projects.

Educational and Student Resources:

SMART Learning Commons: The SMART Learning Commons offers free academic support in a variety of subjects and is located in Magrath Library on the St. Paul Campus. Peer Learning Consultants offer one-on-one assistance for help in gateway courses and skills such as mathematics, sciences, statistics, economics, writing, and library research. Additional courses may be supported, based on the backgrounds of our Peer Learning Consultant staff in any given semester. SMART is home to the Peer-Assisted Learning (PAL) program, which pairs experienced undergraduates (PAL Facilitators) with specific course sections to facilitate group learning experiences. The PAL program is a facilitated group review session for select academically-rigorous courses at the University of Minnesota. Each PAL session is guided by an experienced student working from the course syllabus and in collaboration with the course instructor. There is no charge for attendance at PAL sessions and the PAL program is supported by student fees.

Individual and group study spaces are available in SMART centers for self-directed study on a first come, first served basis. The SMART also hosts short introductory workshops in Excel, PowerPoint, academic services, skill development, and library resources. (website: http://smart.umn.edu/)

St. Paul Campus Career Center: The St. Paul Campus Career Center provides comprehensive career development assistance to undergraduate and graduate students through individual appointments, workshops, courses, as well as through online and print resources. Specifically, the Center focuses on helping students in four areas: 1) deciding major/career plans; 2) securing internships/experience; 3) effective job searching; and 4) graduate school selection and application. (http://www.stpaulcareers.umn.edu/)

Center for Teaching and Learning: The Center for Teaching and Learning seeks to be a partner in shaping and sustaining a University environment where teaching matters. The mission of the Center for Teaching and Learning is to enrich the professional growth of faculty, instructional staff, and teaching assistants through programs, services, and resources that promote significant learning experiences for students. The broad goals of the Center are to: deepen the pedagogical knowledge and teaching effectiveness of faculty, instructional staff, and TAs; establish and extend communities of teaching and learning among departments and colleges; advance University initiatives on teaching and learning; support, generate, and disseminate pedagogical research and expand instructional practices that address cultural diversity in the learning environment. Two of the programs that faculty in the Department have participated in are the Early Career Series where early career faculty can select from an array of professional development opportunities designed to support individual teaching goals and the Mid-Career Faculty Learning Community where mid-career faculty are uniquely positioned to explore innovations in teaching and learning within their respective disciplines and within the context of new initiatives at the University of Minnesota. Many of these programs have received financial support from the Archibald Bush Foundation. In addition to these programs for faculty, there are numerous online workshops and tutorials; individualized teaching consultations; customized teaching and learning workshops; and resources for non-native English speaking faculty and teaching assistants. (http://www1.umn.edu/ohr/teachlearn/index.html)

Digital Media Center: The Digital Media Center (DMC) is a unit of the Office of Information Technology on the Twin Cities campus of the University of Minnesota. The purpose of the DMC is to advance life-long learning opportunities for all members of the University community by promoting a scholarly approach to the design and implementation of technology rich learning environments and by providing evidence-based educational technology development opportunities and support to University of Minnesota faculty and staff members. The goal is to enhance student learning through the thoughtful application of educational technologies within a learner-centered paradigm. The DMC has consultants

that will help with many aspects of planning and designing classroom learning activities and materials, courses, and even entire curricula that make effective use of educational technologies and can assist in the evaluation and assessment of teaching and learning that make use of educational technologies. The DMC has design and development studios and computer classrooms to develop and teach with educational technology activities and materials and offers free or reduced-priced multimedia software to faculty and educational staff to assist in the development of educational technology activities and materials. Student staff members are available for hire to assist in the development of course web sites and course materials. The DMC also offers short courses about technology-enhanced learning (TEL), educational technologies such WebVista, and general multimedia development issues to assist faculty in the development of pedagogical and technical skills. (http://dmc.umn.edu/index.shtml)

Plant Growth Facilities:

Greenhouses: The St. Paul campus has approximately two acres of greenhouse facilities that support the University of Minnesota's tripartite mission of research and discovery, teaching and learning, and outreach and public service. The greenhouses, supporting head houses, teaching rooms, environmental chambers, high security containment facility for insects, and the maximum containment greenhouse are collectively referred to as the Plant Growth Facility (PGF). Though the PGF is available to the entire University of Minnesota community and collaborators, faculty in CFANS and the College of Biological Sciences are the primary users. The Minnesota Agricultural Experiment Station (MAES) serves as the administrative support unit for the PGF. A greenhouse user fee per square foot of bench space is charged. This fee is used for operating expenses, supplies and greenhouse equipment upgrades. In addition to the superb new greenhouses, fully equipped teaching laboratories also are located in the PGF building.

Insect Quarantine Facility (Biosafety Level 2): The Insect Quarantine Facility supports research and the release of imported natural enemies for biological control of exotic insect pests and noxious weeds. The Minnesota Agricultural Experiment Station/Minnesota Department of Agriculture (MDA) Containment Facility had been in the planning stage for over 10 years. This biosafety level 2 quarantine facility was built by CFANS and the MAES. The facility was opened in May 2003 and is jointly operated by CFANS and the MDA. It is licensed to the MDA by the United States Department of Agriculture Animal and Plant Health Inspection Service (APHIS) and is the only facility of its kind in the Midwest.

Maximum Containment (Biolevel-3) Greenhouse: The new $5.0 million addition was completed in Spring, 2008 and was approved by APHIS to conduct research on plant pathogens. The approval means that scientists will be allowed to use this facility to research pests that cause diseases such as Asian Soybean Rust, Ug99 stem rust in wheat and Sudden Oak Death Syndrome, all threats to Minnesota agricultural production but not present in the state. Such facilities are rare with only three universities in the United States having approval to conduct research on exotic plant pathogens in a combined laboratory and greenhouse containment facility. The MAES and MDA will jointly operate the facility. This facility is the final piece of a $24 million plant growth facilities project at the University of Minnesota that includes classrooms, 15,000 square feet of growing space in state-of-the-art greenhouses and the Insect Quarantine Facility.

Growth Chambers: The department owns 33 Conviron growth chambers purchased and installed in 1985. These are located in 121 Borlaug Hall and include a potting and work area. All units have a 3:1 ratio of fluorescent to incandescent lighting. Control capabilities include; daylength, operating temperature of 4 to 50^{o} C, humidity from ambient to 99% (no dehumidification), and three auxiliary outputs. There are 6 chambers that are 8 square feet, 19 chambers that are 15 square feet, and 8 chambers that are 36 square feet with three of these having an extended height. Users are billed monthly at the following rates based on interior chamber dimensions: $3.00/day for 36 ft^2, $1.50/day for 15 ft^2 and $0.75/day for 8 ft^2. Rates are set to match operating expenses for lamp purchase and repairs. A separate

building fund account is used for growth chamber support. Facilities Management handles all repair work and preventative maintenance and absorbs the cost of repairs on the 36 ft^2 chambers as they were designated as building equipment at the time of installation. Chambers are issued on a first-come-first-served basis depending on availability and departmental personnel are given top priority. The chambers are overseen by a laboratory-based research scientist with assistance from a departmental committee.

In the Crops Services Building there are 11 growth chambers available to all University of Minnesota researchers. These are fully programmable with temperature, light and humidity controls. Four of the chambers are 36 square feet and seven of the chambers have 15 square feet of plant growth area. A technician in the Department of Agronomy and Plant Genetics coordinates maintenance and space assignment for use of these growth chambers. Fees are also assessed for using these chambers and are higher than the departmental controlled growth chambers located in Borlaug Hall. The fees are used to cover maintenance and upkeep of the chambers.

Research and Outreach Centers and Research Sites:

CFANS Magnusson Research Farm, Roseau, Minnesota: The major focus of the Magnusson Research Farm is to address producer problems associated with the agricultural production systems in the northwestern part of the state and to deliver new technologies through variety development activities, the introduction of new crops, and the development of better management and cropping systems. The Magnusson Research Farm is comprised of forty acres of land located 3 miles from Roseau, MN of which over half is devoted to research plot area. Varietal trials of some the important agronomic species to the area (wheat, barley, oat, and soybean) are conducted with the data being available through the Varietal Trials Publication. The farm is managed by a technician in the Department of Agronomy and Plant Genetics associated with the seed production research project. The Magnusson Research Farm primarily has served the agricultural community by conducting research on grass and legume seed production, an agricultural production system that is unique to northern Minnesota. Seed production of forage and turf species is environmentally sensitive and therefore must be conducted in the specific production ecoregion.

Northwest Research and Outreach Center (NWROC), Crookston, Minnesota: The Northwest Research and Outreach Center at Crookston was the first branch outpost of the MAES and was established in 1905. The research and outreach programs of the NWROC focus on many agricultural commodities and enterprises including major crops like barley, dry edible bean, potato, sugarbeet, sunflower, wheat, and specialty crops such as canary grass, buckwheat, canola, flax, and mustard seed. The Center's laboratories and staff support more than 140 research projects. There are 1,500 acres of University land, plus 10 other research sites operated in cooperation with area growers. This facility supports the work of more than 50 researchers, and an educational program for University of Minnesota-Crookston students enrolled in agriculture and natural resources programs. The Center builds connections with area farmers and demonstrates small plot research on a field-scale basis. Major parts of NWROC research programs focus on wheat, barley, and soybean varietal development and on production management issues such as fertility, disease, insect, and weed control in sugarbeet, potato, soybean, and small grains. One Departmental faculty member, Jochum Wiersma, is located at the NWROC.

North Central Research and Outreach Center, Grand Rapids, Minnesota: The Center at Grand Rapids has research underway primarily focusing on crops, timber, and ornamentals. Thirteen acres near the NCROC are devoted to wild rice research and 200 acres five miles south of the NCROC have been developed for beef, forage, and alternative crops research. The NCROC has been a University resource since 1896. Northern sandy soils and abundant rainfall provide important research opportunities found nowhere else in the University's agricultural research system. With its short growing season and cold winters, NCROC is nearly perfect for studies of cold hardiness. Available water and flat terrain are well suited to wild rice research. Abundant forage and pastureland support the University's beef research herd.

Major agronomic research projects focus on the evaluation of grass and legume species and mixtures, pasture management, the utilization of industrial by-products, forage variety testing (red clover, alfalfa, birdsfoot trefoil, reed canary, orchardgrass, tall fescue, and timothy), the phytoremediation of industrially contaminated soil and the use of grass species for cellulosic ethanol.

Sand Plain Experiment Research Farm, Becker Minnesota: Opened in 1976, the Sand Plain Research Farm provides an important site for research on agronomic and horticultural crops under primarily irrigated conditions. It is conveniently located about 50 miles northwest of campus. About 45 acres of research plots are irrigated at the Sand Plain Research Farm, using water from four wells running through 28 miles of pipe and 1,600 rotating sprinklers. Dozens of experimental trials are under way including research on crop variety performance and breeding, water quality in relation to nutrient leaching and crop nitrogen use, nitrogen fixing ability of some crops, plant moisture response and drought tolerance, and adaptation and performance of plants for soil and water conservation.

St. Paul Campus Field Research Site: The department has access to approximately 50 acres of research field plots on the University of Minnesota, St. Paul campus. Plot requests and assignments are made during late winter. For the St. Paul field plots, the Facilities Management Office is contracted to do general field preparation. The St. Paul field plots are a short walk from the laboratories and offices and are a unique and invaluable resource. The on-campus research plots not only benefit researchers and students, but they also serve as an educational tool for the surrounding urban community. Recent developments by Central Administration to use six acres of plot land for intramural soccer fields has met with resistance by campus faculty and staff to no avail.

Southern Research and Outreach Center, Waseca, Minnesota: The Southern Research and Outreach Center (SROC) at Waseca is ideally located to represent the soil and climatic conditions of south-central and southeastern Minnesota. It has approximately 200 acres of land available for major agronomic, wetland, and water management research. The SROC has a long history of addressing the agricultural concerns of producer in Minnesota and was started as a demonstration and research farm in 1913. Research projects are selected on the basis of relevancy to farm enterprises in the area and the particular talents of the research staff. Located in the prime corn and soybean production area of the state, the SROC dedicates the majority of its field research effort to those two crops. Gregg Johnson is a Departmental faculty member located at the SROC. The primary mission of agronomy research at the SROC is to develop integrated crop and weed management strategies that focus on the economic and environmental sustainability of upper Midwest farmers. Proactive field research focuses on applied weed ecology and the spatial/temporal dynamics of weed populations. New tools such as global positioning systems and geographic information systems are an integral part of an information-based crop and weed research program. A major new area of research is the development of biomass cropping systems including the incorporation of woody plant species. Cooperative studies with faculty in the Departments of Agronomy and Plant Genetics, Entomology, Plant Pathology, and Soil, Water, and Climate are an integral part of the research focus.

Southwest Research and Outreach Center, Lamberton, Minnesota: The Southwest Research and Outreach Center (SWROC) at Lamberton originated in 1959 with 240 acres and has grown to 828 acres with the addition of the Elwell Agroecology farm. Milton Haar is a Departmental faculty member located at the SWROC. Research programs are directed toward providing more effective, efficient and environmentally safe methods of crop and soil management. Diversified agricultural production systems are being developed as potential economic and environmental strategies and include access to 120 acres of certified organic cropland. The Center leads an extensive program dedicated to exploring agriculture alternatives and the science of organic systems which are focused on sustaining and revitalizing Minnesota's rural communities. A unique program at the SWROC is its strong emphasis on K-12 education. Ag&U programming offers professional development opportunities for current and future

educators at the K-12 level, modeling innovative, proven, and effective K-12 instructional strategies for teaching concepts related to the food system. The cross-disciplinary approach connects professionals to science-based resources supportive to increasing agricultural literacy at the student level.

UMore Park, Rosemount, Minnesota: The University of Minnesota Outreach, Research and Education (UMORE) Park is a 7,700-acre site near Rosemount which is located approximately 25 miles southeast of the Twin Cities at the suburban-rural interface. It is the largest contiguous property in the United States that is owned by a land grant university. The vision to build a University-founded community at UMORE Park, a 25- to 30-year endeavor, was affirmed by the University's Board of Regents in November 2006. The vision, detailed in Creating the Vision: The Future of UMORE Park, is for a community that will be notably distinctive through the University's unique imprimatur of education and discovery that brings quality of life to individuals and their families. Hallmarks of the values contributed through the University academic mission include the integrated elements of education, health, energy, environment, transportation and interdisciplinary strengths.

UMore Park provides a land-based research site for approximately 45-50 faculty and their students and staff each year. Faculty conducting research at UMore Park are primarily from CFANS and the Colleges of Design and Veterinary Medicine. Approximately 600-900 acres are dedicated to support of research at UMore Park. Research programs are carried out each year by University of Minnesota faculty on soybean, potatoe, small grains, soil fertility, forages, vegetable production, plant pest management, carbon sequestration, turf grass, ornamental plants, turkeys, and beef cattle. UMore Park staff provide research support for faculty including such tasks as tillage, planting, treatment applications, harvesting, and livestock management.

West Central Research and Outreach Center, Morris, Minnesota: The West Central Research and Outreach Center possesses a rich and varied heritage. Its roots lie in a Native American High School, founded in 1890. In 1910, that school became the West Central School of Agriculture. In 1960, the agricultural high school split into two entities: the University of Minnesota - Morris, a four-year liberal arts college and the West Central Experiment Station, a center for agricultural research.

The core of this center involves animal husbandry, crop production, and horticulture. Crop production research focuses on emerging needs such as scab in small grains and white mold and iron chlorosis in soybeans as well as evaluating herbicides, production systems and variety development. Other studies include forage crops such as kura clover and birdsfoot trefoil, better management for the production of hay and forage, and grazing-based livestock systems. In 2004, the University of Minnesota commissioned the Renewable Energy Research and Demonstration Center (RERDC) at the WCROC. The RERDC hosts a variety of renewable energy projects with the dual purpose of generating greater knowledge about renewable energy production and educating the public about energy alternatives to fossil fuel sources. The RERDC is part of the University's Initiative for Renewable Energy and the Environment which is a collaborative effort across the University of Minnesota, and with private and public sector partners, to promote statewide economic development, sustainable, healthy, and diverse ecosystems, and national energy security through development of bio-based and other renewable resources and processes.

Centers, Partners and Institutes

Agricultural Utilization Research Institute: The Agricultural Utilization Research Institute (AURI) is a nonprofit corporation created to improve the economy of rural Minnesota through new uses and new markets for the state's abundant agricultural commodities. AURI was created and funded by the Minnesota legislature to foster long-term economic benefit through increased business and employment opportunities to rural Minnesota through the identification and expansion of existing markets for new or existing commodities, ingredients and products; the development of new uses or value improvements for Minnesota agricultural commodities; and the development of renewable energy opportunities from Minnesota agricultural commodities and coproducts. AURI assists Minnesota businesses along every product development step, from research to marketing and have helped in the development of hundreds of new ag-based products. AURI staff work one on one with businesses and agricultural groups and also link innovators with other agencies and organizations to provide a network of the best available resources. AURI has scientists and technicians on staff with a wide range of expertise including food product development, waste utilization, and microbiology. (website: http://www.auri.org/)

Center for Integrated Natural Resources and Agricultural Management: The Center for Integrated Natural Resources & Agricultural Management (CINRAM) is a partner-based organization that catalyzes the development and adoption of integrated land use systems. CINRAM links the expertise of the University of Minnesota with the experience and insights of people and organizations who work with, and have an understanding of, opportunities and issues across the landscape. CINRAM coordinates and implements research and extension projects related to agroforestry and other integrated land use systems with a focus on applied research. The center also links University educators, public agency staff, landowners, business people, and others interested in integrated land use; promotes and conducts educational and training activities throughout Minnesota; serves as a clearinghouse and referral center for agroforestry and integrated natural resources and agricultural management; and encourages use of the land to meet both present needs and to protect its long-term integrity. CINRAM encourages profitable technologies and practices that mesh diverse land uses--crop production and water quality maintenance, agroforestry and wildlife protection, livestock production, and soil enhancement. (website: http://www.cinram.umn.edu/)

Initiative for Renewable Energy and the Environment: The mission of the Initiative for Renewable Energy and the Environment (IREE) is to promote statewide economic development, sustainable, healthy, and diverse ecosystems, and national energy security through development of bio-based and other renewable resources and processes. The goals and objectives of IREE are 1) to provide leadership in research and development of environmentally sound production, distribution, and use of energy, chemicals and materials from renewable resources; 2) to create jobs by transferring technologies into practical outcomes for industry and communities; 3) to support the goal of moving toward an economy based on hydrogen and other renewables; and 4) to utilize bio-based and other renewable sources as a substitute for fossil fuel-based energy, chemicals and materials. The activities of IRRE are diverse and include the coordination and facilitation cutting-edge integrative research, demonstration projects and develop public policy based on scientific research on energy issues and renewable resource alternatives. In addition, IREE has been active in convening meetings and symposia and facilitating communication that fosters multidisciplinary research, technology transfer and outreach. This center has played an active role in identifying sources of funding to support these diverse activities and has anticipated and responded to new and emerging opportunities in numerous areas of energy. (website: http://www1.umn.edu/iree/)

Institute on the Environment: The Institute on the Environment (IonE) leads and facilitates research teams and ongoing initiatives that represent the University of Minnesota's remarkable breadth and depth of disciplines. Pollution and public health, the loss of biodiversity, the food vs. fuel dilemma—all in the context of a changing climate—encompass just a few of the complexities facing today's world. In

response, IonE has mobilized scholars from across the University of Minnesota. Top researchers from the natural and social sciences, design, engineering, law, health, policy and other disciplines have joined forces with each other and with community partners to identify and solve problems of both local and global significance. Surrounded by Minnesota's vast forests, plains, rivers and lakes, these transdisciplinary teams can directly address environmental impacts on America's heartland and beyond. This century calls for a nationwide effort on the order of a "race to the moon" for solutions. IonE is leading this effort by discovering solutions and delivering results to the state, the country and the world.

The Institute's research is organized around a set of overarching themes, themes that will change over time as solutions to existing problems are found and new challenges arise. The current themes are: Climate Change Adaptation and Mitigation, Renewable Energy and the Environment, Landscapes and Watersheds, and Human and Ecosystem Health. Each theme is examined from the twin perspectives of *sustainability* and *restoration*. The *sustainability* perspective addresses how human and ecological systems can be made sufficiently resilient and adaptive to weather future constraints and demands on their resources. The *restoration* perspective has both a retrospective and a prospective aspect: it looks back at damaged and degraded systems, and forward toward measures to re-create healthy ecological systems and human communities.

The first cohort of Institute fellows were selected and began work early in 2007. The Institute's founding fellows come from 15 departments and 8 colleges and include three Founding Fellows from CFANS: Susan Galatowitch, Horticultural Science, a landscape ecologist who focuses on the revegetation of natural communities; Anne Kapuscinski, Fisheries, Wildlife and Conservation Biology, who conducts policy analysis on cross-sectoral governance of biotechnology and is leading efforts to develop recommendations for US organic aquaculture; and David Mulla, Soil, Water and Climate, who conducts research in soil and water resource management involves many aspects of non-point source pollution. (website: http://environment.umn.edu/)

International Programs in Food, Agriculture, and Natural Resource Sciences:
International Programs was initially founded in 1954 to coordinate the international development activities of the University of Minnesota's Institute of Agriculture, Forestry and Home Economics. Since that time, International Programs has demonstrated its leadership capacity on a number of agricultural projects, coordinating the involvement of the St. Paul Campus' faculty and resources in countries around the globe. The program manages collaborative projects on behalf of the University of Minnesota with other American universities providing agricultural and natural resource technical assistance abroad. International Programs is a service unit within the college of Food, Agricultural and Natural Resource Sciences Dean's Office and has been renamed the International Programs in Food, Agricultural and Natural Resource Sciences (IPFANS). IPFANS is a nexus within the college connecting our collegiate community to the global community and integrating an international perspective into the land-grant mission of teaching, research and outreach. In conjunction with the priorities of the college, the office provides avenues for our faculty, staff and students to interact or have a first-hand experience with our peers and colleagues outside the USA.

IPFANS supports faculty and researchers in establishing international programs of collaboration and monitors new opportunities offering multidisciplinary projects for all the college departments. IPFANS provides leadership to offer options for international experiences for our students and works with MAST International (http://mast.cfans.umn.edu/) to offer an alternative international experience through non-campus, work experiences as a reciprocal cultural exchange program. International Programs serves as the liaison on behalf of the college with the USDA to connect the research and outreach expertise of our faculty to the needs for education and training requests of the USDA offices. IPFANS represents the college in the national effort by land grant universities to expand the role of research and training within USAID priorities for the development of countries around the world. IPFANS also works collaboratively

with faculty and the CFANS Curriculum Committee to assist in the development of materials for courses to internationalize the curriculum and to help prepare students for the multicultural work world they will be entering. (website: http://international.cfans.umn.edu/)

The University of Minnesota/IRRI Shuttle Internship Program: The University of Minnesota signed a Memorandum of Understanding with the International Rice Research Institute (IRRI) to have several graduate students in the Applied Plant Sciences Program spend 6 weeks to 3 months at IRRI. In the 2007-08 academic year, five students took advantage of the opportunity. The University of Minnesota/IRRI Shuttle Internship Program gives students the opportunity to visit IRRI, conduct research, and exposure to international agriculture. Graduate credit can be earned from the internship. The costs of the program are split with the IPFANS program providing logistical support and the purchase of the airline ticket and IRRI providing all in-country support. The students are required to provide oral reports and/or seminars at IRRI and the University of Minnesota. Students in the University of Minnesota/IRRI Shuttle Internship Program have participated in studies including testing for insect transmission tests using ELISA, mapping of disease resistance genes, testing for the involvement of candidate genes, designing PCR and RT-PCR primers and optimizing the amplification process, bioinformatics tests, flood tolerance, anaerobic germination, marker-assisted backcrossing, selection of mutants, and pyramiding of genes.

Microbial and Plant Genomics Institute: The mission of the Microbial and Plant Genomics Institute (MPGI) is to promote advances in microbial and plant genomics, genomics-enabled science, and molecular genetics for the benefit of society. The Institute supports research, educational and outreach activities that foster a multi-disciplinary interchange of ideas, and cutting-edge technologies and their applications. Activities of the Institute contribute to basic science and the translation of genomics for applications to the environment, agriculture, and human health.

Members of the Microbial and Plant Genomics Institute are faculty who are interested in the successful development and application of genomics and the resulting societal and environmental impact. The scientific aim of the Institute is to enhance the development of functional and translational genomics concomitantly with the expansion of bioinformatics capabilities and the development of specialized instrumentation. Within the University community, the Institute facilitates crosscutting communication among faculty engaged in diverse areas of genomics research. Building public awareness about genomics and its applications in a social and ethical context is one of MPGI's outreach functions. In addition, training outstanding students for the 21st century in this important biological field is a major goal. These are among the activities designed to bring the benefits from genomics to Minnesotans, the nation, and the world. (website: http://www.mpgi.umn.edu/)

Minnesota Institute for Sustainable Agriculture: The Minnesota Institute for Sustainable Agriculture (MISA) is a partnership between CFANS, University of Minnesota Extension, and the Sustainers' Coalition, a group of individuals and community-based, non-profit organizations. Membership in the Sustainers' Coalition currently includes: Institute for Agriculture & Trade Policy; Land Stewardship Project; Minnesota Food Association; The Minnesota Project; and the Sustainable Farming Association of Minnesota. MISA's purpose is to bring together the agricultural community and the University community in a cooperative effort to develop and promote sustainable agriculture in Minnesota and beyond. Sustainable agriculture encompasses a wide range of farming systems that seek to balance the long-term goals of economic profitability, environmental stewardship, and quality of life for the farmers and their communities. MISA is housed in the Department of Agronomy and Plant Genetics.

The guiding principles for MISA activities are based on the belief that agriculture is a system in which the land, the people and the production of food are interwoven. One aspect of the system cannot be changed without influencing all of it. MISA believes that all efforts to improve agriculture should take care to balance the long-term economic, ecological and social effects. It is MISA's intention to promote

sustainable agriculture through all of its various activities. Its goals and objectives include increasing the University's response to the needs of the sustainable agriculture community including access to faculty and research-based information. In addition, MISA fosters teamwork on sustainable agriculture by funding interdisciplinary research projects, supporting undergraduate and graduate academic programs, fostering partnerships and through a rotating chair in sustainable agriculture. MISA continues to work with rural communities in discovering and implementing the values of sustainability, promoting sustainable community development principles, and developing methods for defining the sustainability of agricultural systems and for assessing their impacts on rural communities. (website: http://www.misa.umn.edu/)

Regional Sustainable Development Partnerships: Formed in 1997 by the committed efforts of faculty in the Department of Agronomy and Plant Genetics, the U of M Regional Sustainable Development Partnerships are a citizen-driven partnership between communities and their land-grant university. The Regional Partnerships have five citizen led boards located throughout greater Minnesota that play a unique catalyzing role by linking local needs and innovation with University expertise and broad multi-sector/multi-agency partnerships. The Regional Partnerships identify and help implement solutions to complex community issues facing greater Minnesota, focusing on sustainable agriculture and local foods, natural resources, renewable energy, and sustainable tourism.

The Department of Agronomy and Plant Genetics and the CFANS have been a leading supporter and contributor to the work of the Regional Partnership. The Regional Partnership is housed in the Department of Agronomy and Plant Genetics which provides office space to the staff of the Clean Energy Resource Teams, the office of the Statewide Director, and the Research Fellow on Food, Sustainability and Wellness. In addition to providing resource support, faculty from the Department of Agronomy and Plant Genetics have served on Partnerships regional boards throughout greater Minnesota. Many faculty from numerous CFANS departments contribute to the research agenda of the Partnerships. (website: http://www.regionalpartnerships.umn.edu/)

Response to 1992 CSREES Review:

Due to the timeframe of our last review, many changes have occurred from the individual faculty level in the Department of Agronomy and Plant Genetics through higher administration at the College and the University of Minnesota. Below is a brief response to the recommendations and concerns of the 1992 Review Team. The entire Review Team report is in the Appendix.

General Concerns for the Department of Agronomy and Plant Genetics:

1. There is an urgent need to develop dialogue between the Department and Administration.
   Dialogue between the Department and the College Administration is greatly improved with the current college administration.

2. There is a need to establish and communicate the long term plans affecting availability of land on the Rosemount Research Farm.
   The University's long range plan for UMore Park (formerly Rosemount Research Farm) was done with little consultation of faculty stakeholders. The faculty have been assured of adequate land space for research at UMore Park, however the land being set aside for research is problematic due to the quality of the sites.
   The University of Minnesota Outreach, Research and Education (UMore) Park is a 7,700-acre site 25 miles southeast of the Twin Cities at the suburban-rural interface, near Rosemount, MN. The vision to build a University-founded community at UMore Park, a 25- to 30-year endeavor, was affirmed by the University's Board of Regents in November 2006. The vision is for a community that will be notably distinctive through the University's unique imprimatur of education and discovery that brings quality of life to individuals and their families.
   In May 2006 the Governor of Minnesota signed into law legislation whereby the state will acquire 2,822 of the southern-most acres of UMore Park in 25 years in conjunction with its support for the University's new Gopher football stadium on the Minneapolis campus. This parcel, now jointly managed by the University and the Minnesota Department of Natural Resources, was renamed Vermillion Highlands: A Research, Recreation and Wildlife Management Area in June, 2007,by action of the Board of Regents. The joint management team, which also includes representation from Dakota County, is focusing on long-term planning that maximizes partner strengths in research, education, trails and recreation, and wildlife management and hunting. Vermillion Highlands will be maintained as a natural area for public access in perpetuity.

3. There is a need for greater faculty participation in sabbatical and quarter study leaves.
   Since 1992, five faculty have participated in sabbatical and semester study leaves. However participation is still low and is often tied to spousal and/or family commitments.

4. Attention should be given to communication with commodity groups to assure mutual understanding of intended use of funds.
   Communication between commodity groups and the Department has been greatly enhanced. Commodity group funds are primarily awarded as grants resulting in greater accountability by the faculty for using the funding and fewer misunderstandings with funders. The Department is in the process of establishing a Stakeholders Advisory Committee.

5. The low number of women and ethnic minorities in the graduate program at this time should be addressed.
   Female graduate student numbers have been increased and average approximately 48% of our graduate student population. Recruitment of ethnic minorities of U.S. citizenship

continues to be problematic. The Applied Plant Sciences graduate program received it's first Diversity of Views and Experiences Fellowship in 2008 awarded to a Hispanic female. These fellowships are awarded to approximately 15 to 20 first-year students from under-represented groups of U.S. citizens or permanent residents across all of the graduate programs at the University of Minnesota.

6. The Branch Station Agronomists should be invited to become members of the Department.
   Since the 1992 review, tenure and tenure track faculty in the Department of Agronomy and Plant Genetics have been hired for positions located on the Research and Outreach Centers (Branch Stations). This has both positive and negative impacts for the outstate and campus-based faculty in the Department.

7. In this time of economic stress there is a need and "an obligation to use the Department's creativity to deal with budgets as well as the science".
   The Department has weathered numerous economic stresses since 1992 and we continue to try to deal creatively with these challenges. The major impacts of these budget retrenchments has been the loss of state funds to support our long term technical support and graduate student research assistantships resulting in increased reliance on grant funds to support our research and education mission.

Research

Crop Production and Ecology:

1. Give high priority to rebuilding the crop production and ecology component of the Department.
   Crop production faculty have been hired in tenure track positions at the Research and Outreach Centers. This has helped rebuild some of our crop production expertise but has limited their interaction with the undergraduate and graduate programs.

2. Provide technical support for corn and soybean management extension specialists to support research activities in cropping systems and management.
   Two new faculty have been hired in the corn and soybean management extension specialists positions since 1992. The Department has a commitment to financially supporting new faculty hires at least until they are tenured. The soybean and corn commodity groups have also financially supported these positions through both research and extension grants.

3. Give attention to re-evaluation of cultural practices research data in the context of today's integrated systems.
   This approach is common among our crop production and systems research, teaching and extension faculty.

4. Look for opportunities for multi-state cooperation to strengthen crop production and ecology data base.
   Many faculty participate in regional technical committees and work across interdisciplinary and state lines.

5. Continue aggressive efforts to attract outside funding for crop production and ecology research.
   The crop production and ecology faculty have successfully competed for grant funding from a diversity of sources including national programs, legislative commissions, and commodity groups. With the reduction in state resources, it has become imperative for faculty to seek outside funding.

Plant Breeding:

1. Every effort should be made to maintain level of support for this very important area.
   Long term support for public plant breeding programs is a national issue. The Department strives hard to maintain support for these projects but is faced with declining resources. New sources of support through grants, commodity groups, and industry partners are being actively pursued.

2. Consideration should be given to assigning part of the Vice-Enfield position to breeding for value-added or alternative crops.
   The Vice-Enfield quantitative genetics position was never refilled. The priority position for the Department is a Computational Biology for Plant Breeding and Genetics and is currently being advertised.

3. The plant breeding faculty should be encouraged to maintain this position expansion within their respective programs.
   The newer hires among the plant breeding faculty are highly successful in continuing the tradition of graduate education. The faculty continue to contribute significantly to the research and teaching program at both the graduate and undergraduate level.

4. Every effort should be made to maintain and strengthen the ties between plant breeding and molecular genetics.
   Strong collaborations exist between the plant breeding and the molecular genetics faculty. In addition, many of the newer plant breeding faculty have significant molecular genetics expertise which contributes to fostering these linkages between the faculty.

5. Plans should be developed for additional facilities that will be needed by new plant breeders hired when the senior faculty retire.
   Since 1992, new facilities have been added to the St. Paul campus. These include the new Plant Growth Facilities with over two acres of greenhouses, new environmental chambers, a Biolevel-2 facility and a maximum containment laboratory and greenhouse (Biolevel-3). Adequate updated seed storage facilities are still needed to meet the needs primarily of the plant breeding and molecular genetics faculty.

Plant Genetics and Physiology:

1. Accelerate development of plans for a containment facility for testing genetically altered plants.
   These facilities are available to test genetically altered plants.

2. Continue efforts to identify and adopt non-radioactive techniques in molecular biology.
   Non-radioactive techniques are now routinely used.

3. Fill the quantitative genetics position as soon as resources allow.
   The Vice-Enfield quantitative genetics position was never refilled. The priority position for the Department is a Computational Biology for Plant Breeding and Genetics and is currently being advertised.

4. Keep plant developmental biology as a high priority if the endowed chair does not provide the expertise.

   Plant developmental biology is a strength of faculty collaborators located in the Department of Plant Biology, College of Biological Sciences and CFANS.

5. The faculty should take advantage of sabbatical or quarterly leave opportunities.

   Faculty are encouraged to take sabbatical or semester leaves. Many do not take advantage of these opportunities due to family circumstances and two career households.

Weed Science:

1. The Weed Ecologist position should be given highest priority for refilling.

   This position was quickly refilled and is currently held by Dr. Nicolas Jordan.

2. Integrate programs of the three extension/research Weed Scientists with those of the branch station agronomist and the integrated weed management research on campus.

   The extension/research weed scientists in the department facilitate their research activities by conducting research on the ROC's in collaboration with other faculty and technical staff and Extension Educators. The branch station agronomists that were present in 1992 have retired and been replaced with tenure and tenure-track faculty that conduct independent research, outreach and extension programs.

3. Explore potential funding for research on aquatic weed biology and management.

   Aquatic weed biology and management did not continue to be a priority of the Department and/or the Weed Science faculty. Current research is being conducted in the Department of Fisheries, Wildlife and Conservation Biology on the use of native and naturalized insects for the biological control of Eurasian watermilfoil, the control of invasive aquatic organisms, and aquatic plant management strategies.

4. Consider temporary reallocation of existing resources for start up of expanded biological weed control research.

   The Department has an active research program in biological weed control using existing faculty resources, post-doctoral fellows, and graduate students primarily funded through grants.

5. Initiate dialogue with the administration and the Horticulture Department concerning the need for and the potential for funding to address weed research in horticultural crops.

   A dialogue was initiated with the Department of Horticultural Science which resulted in Dr. Roger Becker conducting weed control research in vegetable crops.

6. The weed science faculty is encouraged to utilize quarter and sabbatical leaves to renew and enrich their expertise in weed management systems.

   Faculty are encouraged to take sabbatical or semester leaves. Many do not take advantage of these opportunities due to family circumstances and two career households.

Extension:

1. Develop innovative funding approaches to support priority extension efforts.

   Extension has developed innovative approaches to funding programs including industry support and fee-based programming.

2. Maintain direct contact and communication links with clientele.
   Communication with clientele and the Department has been greatly enhanced.

3. Develop an applied research effort in grain crops management to support extension program.
   A faculty member was hired at the Northwest Research and Outreach Center to conduct a small grains extension and applied research program.

4. Integrate branch station agronomists into extension and applied research activities.
   The branch station agronomists that were present in 1992 have retired and been replaced with tenure and tenure-track faculty that conduct independent research and outreach activities.

5. Explore potential for multi-state cooperation especially with adjacent states.
   Multi-state cooperation among Extension specialists occurs routinely.

6. Consider participating in sabbatical and other professional development leaves plans.
   Faculty are encouraged to take sabbatical or semester leaves. Many do not take advantage of these opportunities due to family circumstances and two career households.

7. Develop and maintain strong linkage with non-extension colleagues.
   Extension faculty have strong linkages with non-extension faculty to enhance their research-based extension programming.

International Programs:

1. The review team recommends the Department look for opportunities to continue a modest level of involvement in international agriculture to maintain its global perspective for teaching and research.
   The faculty are committed to international agriculture and fostering relationships with international research institutions and faculty. Currently, the Department has established a relationship with IRRI for sending graduate students to the Philippines for research and educational activities. The US-AID project with Morocco is currently being revisited with the intent being to reestablish that important program. Undergraduate students are encouraged to participate in international experiences as part of their education. International students comprise approximately 30% of graduate students in the Department.

Facilities:

1. Administration-faculty communication concerning the long term availability of the Rosemount Facility.
   See Item #1 under General Concerns for the Department.

2. Initiate planning process for development of appropriate containment facility of testing genetically engineered plants.
   Adequate containment facilities now exist on the St. Paul campus.

3. Develop plans for expanded or modified facilities to meet the needs of new faculty or change in program focus.
   Facilities have been modified to meet the needs of new faculty when adequate need and funding has been identified. Adequate seed storage facilities continues to be an unmet need.

Civil Service Support Staff:

1. Review the Civil Service Recognition Award and look for additional opportunities to recognize support staff.

   Departmental endowment funds are now used to support activities by faculty, staff and students. An annual luncheon is held to recognize all of the contributions by staff. A luncheon with faculty, secretarial, and accounting staff is held annually. Monthly departmental coffees are well attended by staff, faculty and students and are hosted by various groups of employees during the academic year.

2. Review the performance standards and evaluation process and assure that both supervisor and support staff understand expectations.

   Faculty and supervisors are encouraged to conduct annual evaluations of staff and review performance standards to ensure they adequately reflect the current job responsibilities.

Branch Stations:

1. Consider extending the offer of tenure in the Department to agronomists holding tenure in the Experiment Station.

   The branch station agronomists that were present in 1992 have retired and been replaced with tenure and tenure-track faculty that conduct independent research and outreach activities. The Department of Agronomy and Plant Genetics is the tenure home for these appointments.

2. Plan for joint Department-Branch Station participation for filling agronomy vacancies at branch stations on a Department tenure track and research support.

   Faculty located at the Research and Outreach Centers have the opportunity to participate fully in all departmental activities.

3. Provide opportunities for branch station agronomists to participate in the graduate program.

   Faculty located at the Research and Outreach Centers have appointments on the Graduate Faculty and are encouraged to participate in graduate education.

Undergraduate Education

The Department of Agronomy and Plant Genetics participates in a wide range of undergraduate teaching within the University. The Department is the home to the Applied Plant Science (APS) and Agricultural Industries and Marketing (AIM) majors. Eleven of our faculty have teaching appointments and teach undergraduate courses in our department or collaborate to teach courses with faculty in other departments in CFANS. Courses taught include those that primarily serve the APS or AIM majors, serve other majors in the college, fulfill University liberal education requirements, or are taken as electives. All undergraduate students in CFANS are assigned a professional and an academic advisor when they enter the College. Currently 10 faculty members serve as academic advisors to AIM and APS students and more faculty play important roles as mentors for research experiences, internships, or act as faculty liaisons to student organizations. Work experience in faculty labs and faculty mentored research projects are important components of a student's learning portfolio. All of our APS and AIM students will complete at least one research, internship, or international learning experience before graduation and many complete multiple experiences. Students that graduate from our majors go on to careers in: agricultural finance, crop advising, crop consulting and scouting, farming, grain marketing and merchandising, research, seed production, seed technical services and sales, and numerous state agencies. A significant proportion of our students continue on to graduate school.

Trends in undergraduate education in the Department of Agronomy and Plant Genetics: We, like many areas of the country, have experienced declining enrollment in agronomy related majors. Nationally, the number of undergraduate students receiving Bachelor's degrees in agronomy and crop science has decreased by 32% from 1984 to 2003. The decline that we have experienced is likely due to changes in rural demographics, decreased interest in production related agricultural careers, and our location in a major metropolitan area. Specifically, we have seen a decline in students with an agricultural background. Until 2004, our department was active in three majors: AIM, Crops, Soils and Pest Management (CSPM), and Science in Agriculture. Science in Agriculture had several tracks of which most students belonged to the animal science emphasis with about a dozen in the plant science emphasis. In 2002, our Department began discussions to develop a new plant science major. This effort was initiated to increase enrollment, broaden the curriculum compared to our CSPM major, attract urban students to agricultural science, and deepen the engagement of our faculty in undergraduate education. These discussions grew to include the departments of Horticultural Science, Plant Pathology, Entomology, Food Science and Nutrition, and Plant Biology from the College of Biological Sciences. The result of this effort was the creation of the Applied Plant Science undergraduate major in the fall of 2004. Concurrent with the launch of this new major the CSPM and Science in Agriculture majors were dissolved. When the Science in Agriculture major was dissolved, the animal science students were absorbed into the Animal Science major and several of the plant science students switched to APS. Most of the CSPM majors opted to continue in that major to graduation. Currently our Department is the home for the 29 APS and 27 AIM majors (Tables 15 and 16).

Applied Plant Science (APS) Undergraduate Major: The APS major provides options for a broad course of study in plant sciences, as well as options to concentrate more specifically within an area of individual interest. It provides a solid science background and integrates knowledge of science, environment, production and industry in preparation for continuing study in graduate school or careers in improvement of the quality and benefits of plants and plant products; industry, government, and universities as research scientists; agencies and organizations concerned with natural resource management; advisory, inspection and certification services; bio-safety and food security; related fields of biology and agricultural education.

A key to the APS program is its flexibility. Students choose from three areas of emphasis: agroecology, plant improvement, or plant utilization. Students tailor the program to their interests by designing a

course plan that includes courses from within one of three areas of emphasis as well as up to 22 "free-elective" credits. In addition to these courses, the program emphasizes learning through experiences outside of the classroom. There are numerous opportunities for students to meet with plant science professionals at the University and in private industry through seminars and informal meetings. Structured two–day field experiences around the state during the freshman year introduce students to agroecosystems and factors that influence agroecosystems. During the junior or senior year, students work with a faculty advisor(s) to design an Integrative Learning Experience of 3 to 10 credits in one or more of the following activities: research thesis, study abroad, or internship. Through these experiences students deepen their understanding and gain skills in one or more of the following areas: professional fields of work in public and private sectors, scientific research, international study or development issues, civic issues, and engagement.

Table 15. APS Enrollment and Degrees Awarded

Academic year	Fall enrollment	Spring enrollment	Degrees awarded
2003-04	0	0	0
2004-05	8	8	1
2005-06	15	16	2
2006-07	24	25	1
2007-08	27	34	8
2008-09	29	NA	NA

Agricultural Industries and Marketing (AIM) Major: The AIM major prepares students for careers in agricultural industries. Industries related to modern agriculture include manufacturers and distributors of farm production inputs (such as equipment, structures, health products, seeds, fertilizers, and crop protection products); assemblers, processors, manufacturers, and distributors of products originating from farms (products such as meat, milk, eggs, wool, grains, fruits, vegetables, nursery crops, flowers, and turf); and finance and insurance industries providing agricultural credit. Agribusinesses such as these, as well as state, federal, and marketing agencies, need individuals who have a broad education in the scientific and technical aspects of agriculture, effective work and communication skills, and quantitative and qualitative skills to solve business problems.

The scientific knowledge and technical skills necessary to become an effective agribusiness professional are provided through requirements in the basic and agricultural sciences and are strengthened by selection of one of three areas of emphasis: crops and soils industries, food industries, or an individualized emphasis.

With 21 free standing elective credits, all AIM majors are encouraged to pursue a CFANS or other minor. Only 6 credits in the AIM major may also be counted towards a minor. For students interested in preparing for the Certified Crop Advisor (CCA) exam or the Certified Professional Agronomist (CPAg) programs, a minor in agronomy is highly recommended.

Table 16. AIM Enrollment and Degrees Awarded

Academic year	Fall enrollment	Spring enrollment	Degrees awarded
2003-04	55	55	11
2004-05	49	50	17
2005-06	46	47	15
2006-07	58	47	20
2007-08	43	35	11
2008-09	27	NA	NA

Highlights in the last five years:

Development of New Applied Plant Science Undergraduate Major. As described above, this major was launched in 2004 to provide a broader and more flexible major in the plant sciences that would attract more students and better prepare them for new and rapidly changing career opportunities in agricultural science. This major has attracted 8 to 13 new students each year. To date, 12 students have graduated in the major. Of these, four have gone on to graduate school and the others have taken government or private industry positions.

Enhancing Internship Experiences for Undergraduates. In 2004, we received a USDA Higher Education Challenge Grant aimed at strengthening learning through internships. The Student Engagement Program involves students in the collaborative efforts of University researchers and citizens aimed at solving challenging problems in agriculture. These efforts are focused on developing plant materials that enhance agricultural diversification and protect soil and water resources and on promoting enterprises connected to these systems. Through this program students learn first-hand about agricultural systems while also participating in the process of innovating and implementing change in agriculture.

The program utilizes approaches that are recognized as highly effective in motivating students and facilitating deep learning. Students work with University researchers, citizens, and other students to address a complex issue related to food, agriculture, energy and the environment. Undergraduate students assist with team efforts and also work collaboratively to solve a delimited problem and to create a product that represents what they have learned. The program emphasizes application of knowledge to real-life situations and approaches to solving problems. Faculty and staff engage students in reflecting on and learning from their experiences through an all-day retreat ("boot camp") at the beginning of the program and through written assignments and intermittent meetings during the course of the experience. Iowa State University and the Regional Sustainable Development Partners have been our cooperators on this project. In total, 40 students have completed work experiences that are generally 10 to 12 weeks in duration.

Incorporating Problem-based Learning in a Non-majors Biology Course. In the past five years, Kevin Smith, Mary Brakke, and Steve Simmons have developed and implemented a problem-based learning (PBL) strategy to teach a large lecture course (AGRO 1101) that fulfills the University liberal education requirements of biology core and environment theme. This effort was initiated by the instructors, and then sustained by participating in a Bush Foundation Program "Enhancing Student Learning in Large Lecture Classes". The PBL approach puts the problem ahead of the content and seeks to engage students in the process of problem solving in a way that is relevant to their own lives. One of the primary goals was to increase student engagement and enhance motivation to learn. Several survey instruments to measure changes in student's attitudes and motivation to learn are currently being analyzed.

Offering Agro-1103 as a College-in-the-Schools Course. This involves providing 24 hours of training to qualified high school agricultural education instructors and providing class and technical support to teachers who in turn teach the course to students in their classroom at their local school. The high school students earn University credits and generate an official transcript upon successful completion of the course.

Departmental Strengths:

Experiential Learning Opportunities. Experiential approaches to learning are an integral part of both the APS and AIM programs. Experiential learning in the classroom includes the use of problem-based learning, case studies, field trips and laboratories. We also emphasize learning from experiences, such as internships, research projects and travel abroad, which allow students to acquire skills and attitudes essential to succeed in professional settings.

Laboratory and Field Teaching Facilities. The new plant growth facilities that were completed in 2005 provide state of the art greenhouses, large work areas, classrooms with internet access and LCD projection, and facilities to carry out a wide range of laboratory activities. Field plots on campus include educational and research on a wide array of crop species and create an important outdoor laboratory. One example is the Student Organic Farm Planning, Growing, and Marketing course (AGRO 3131) which develops and implements a plan to grow and market organic products produced by students on the St. Paul campus.

Opportunities for Undergraduate Research. APS and AIM students participate in the Undergraduate Research Opportunities Program, ad hoc research projects, senior research theses, and work experience in research labs. All students have ample opportunities to gain research experience through a number of different experiences.

Internship Experiences. The Student Engagement Program has created a foundation on which we will continue to build the opportunities for students to learn and gain experience while addressing challenges in agriculture. As a result of this program, we possess a better understanding of how faculty can facilitate and add value to learning from experience. The successful experiences of the past will serve to promote student, faculty and community participation and help us to attract continued support for the program. We are well positioned to work with, and support, the College as it works to emphasize the importance of experiential learning in undergraduate programs.

Broad Participation of Faculty in Student Advising. Ten faculty in our department serve as academic advisors to the APS or AIM programs. These and additional faculty also participate as mentors for undergraduate research or internship experiences. Expanded distribution of advising responsibility in the department gives students greater access to a broader range of faculty and keeps faculty engaged in undergraduate education.

Scholarship Fnds to Recruit and Retain Students. Endowments in the Department generate a minimum of $30,000 annually to provide scholarships to students in our majors. We have worked with the College in recent years to coordinate scholarships so that top students are given early notification of award packages from the University, College, and Department to help recruit the best students.

Departmental Needs:

Recruiting from New Student Populations. The changing demographics of the student population at the University of Minnesota is creating a need to reach out to new groups. Already, a larger proportion of our students come from urban backgrounds with little or no first hand farm experience. They present new challenges to our programs. We also recognize that increasing ethnic diversity in the local and national population signals a need to effectively communicate with students from these groups. Many immigrant populations have close connections to the land and food production resulting in a potentially untapped pool of young people who should be receptive to careers in plant science or agricultural industries. Because it is important that agriculture reflects local and national diversity, we must carefully examine our ability to offer experiences that meet the needs and interests of diverse populations.

Enhancing Student Engagement. A strong sense of community is an essential element of good undergraduate programs. Our department needs to expand social and community activities for our undergraduates by creating and sponsoring interesting events, supporting student clubs, and engaging with students outside the classroom. Our students have expressed a need for better communication to identify the wide range of extracurricular opportunities available at the University of Minnesota that are relevant to their area of study. This should be implemented by direct contact with faculty and staff through events, advising, and mentoring as well as enhanced email and web-based information delivery to keep students connected.

Continued and Enhanced Education and Curriculum Development Support Staff. The need for innovation in teaching and delivery of experiential learning opportunities benefits greatly from the leadership and support of educational staff. This support has eroded in recent years and will limit our ability to create and implement new courses and deliver strong field and laboratory experiences in our curriculum.

Cultivate Relationships with Stakeholders. As we graduate students in our majors and look to future changes in curriculum to address cultural diversity, we must maintain contact with our current stakeholder groups and seek out new partners. Stakeholder involvement in the department is essential to provide guidance on our educational programs and career opportunities for our graduates.

New Course Development. Several courses were planned as part of the new APS major that would provide continuity in the sophomore and junior years between the freshman learning community and senior capstone. We are in the process of designing and implementing these courses in the next two years.

Reevaluation of Minors. Recently developed majors within CFANS have designed flexibility that provides space to accommodate minors. We must examine the Agronomy and Sustainable Agriculture minors that we currently manage in our department and determine how they fit in the current slate of CFANS majors and how they might best enrich the educational experience of students in other majors in the college or University.

New Faculty Positions. Recent and upcoming retirements will result in the loss of significant teaching appointments in our department. As we look to hiring several new faculty positions in the next few years, we need to be strategic and intentional about fulfilling our teaching needs.

Mapping APS and AIM Programs with University Student Learning Outcomes. The University has recently developed a set of Student Learning Outcomes. To align our majors with this University initiative and better define our own programs, we need to define the learning outcomes from our own majors and map them into the University Student Learning Outcomes.

Building Interest and Activity in the Scholarship of Teaching and Learning. Our department has historically had a strong publication record in teaching and learning. An effective way to engage teachers in discussion of teaching and learning, and encourage innovation in teaching, is to foster an environment conducive to the scholarship of teaching and learning. Several campus facilities and programs provide excellent support for this activity and are underutilized in our department.

Cross-discipline Collaborative Teaching. A number of emerging issues and interest areas provide opportunities to offer collaboratively taught courses in other departments or colleges. A significant barrier to cross-discipline collaboration in teaching is the lack of means to share tuition revenue across institutional boundaries. A system that eliminates this barrier should provide incentive for new multidisciplinary courses and lead to better sharing of teaching resources. Potential courses include a course in the production and processing of plants for renewable energy that might be jointly taught by faculty in APS and BioProducts and BioSystems Engineering or a production and processing of plants for nutraceuticals or other phytochemicals might be a joint offering in APS and business programs.

International Travel/Study and International Agriculture Opportunities. There is a real need to increase students' exposure to international perspectives on issues concerning agricultural production, marketing and environmental challenges and to help students gain cross-cultural competencies. Because travel costs are often beyond the reach of students and their families, scholarships for travel and Departmental participation in internet-based forums such as Global Seminars need to be explored further.

Future outlook and goals: The need for students educated in agronomy and crop science is growing and the current pool of students graduating in these areas is not sufficient to meet that need. Large seed companies have expressed concern about the ability to fill new positions in areas such as plant breeding. While many of these positions require advanced degrees, declining numbers of BS graduates eventually translates to declining enrollment in graduate programs. Partnerships with many companies such as Pioneer Hi-Bred International, Monsanto, and Syngenta will be essential to attract high achieving students, enrich and keep our educational programs relevant, and make career opportunities visible to students. Doubling of our current enrollment in the AIM and APS majors will help meet the growing need for graduates, but still maintain modest size programs that can deliver a high quality educational experience. All of our new faculty hires should participate in the undergraduate teaching mission of the Department whether formally in the classroom or as advisors or research mentors. At a time when agriculture is undergoing such rapid change and is more intimately connected with many aspects of our lives, we need to challenge and engage students to help shape that future.

Agronomy and Plant Genetics Undergraduate Courses:

AGRO 1007-Horse in Your Backyard. This course discusses the role of horses in society. The course addresses how to keep a horse well fed and healthy by discussing proper nutrition, feedstuffs, pasture management, and health. Students will learn how to seek and interpret information on vaccination, worming, nutrition, grazing management, hay selection, manure handling, and use of dietary feed additives and enhancers.

AGRO 1093-Directed Studies. In-depth research or studies in agronomy. Intended for students who wish to pursue aspects of agronomy in greater depth than that offered in formal courses or who wish to investigate areas not presently offered in courses.

AGRO 1101-Biology of Plant Food System and the Environment. This course is designed for students who are not majors in a life science program, but who wish to acquire a better understanding of biological concepts especially as they relate to their lives. This course fulfills the University's Council on Liberal

Education Diversified Core requirement for a biology course with lab and the Designated Theme environment. Throughout this course, we will examine in depth, current issues related to food, food production and the environment. These issues will provide the context in which we investigate fundamental concepts of biology and examine ecological principles including productivity, energy, genetic change in populations, and environmental responses to human activity.

AGRO 1103-Crops, Environment, and Society. Life on earth is dependent on plants. Learn about food, fiber, fuel and medicinal plants that are important to our society, their impact on environmental quality, and how they are improved and cultured. Discuss currently important topics such as genetic engineering, food safety, water quality, organic agriculture, biofuels and species preservation. In a laboratory, learn about how plants grow, and about food products derived from plants. This course is intended for undergraduate majors and non-majors interested in a general understanding of food and fiber production from crop plants. In the class, we use several approaches to learning, such as case studies, and minimize lecturing.

AGRO 1660-First-Year Colloquium: Experience in Agroecosystmem Analysis. This course serves to foster academic integration and orientation for students in the Applied Plant Science and Agricultural Industries and Marketing majors. Through this course you will gain an understanding of and make curricular plans for your major, as well as explore opportunities beyond completion of your undergraduate education. Through a field trip and in-class discussions you will consider real problems that concern agricultural ecosystems and landscapes, the environment, and rural communities of Minnesota. AGRO 1660 is one of the College of Food, Agricultural, and Natural Resource Science's First Year Experience Seminars and, as such, you may also be jointly enrolled in AGRO 1103 (Crops, Environment and Society), BIOL 1009 (General Biology), CHEM 1021 (Chemical Principles I), or WRIT 1301 (University Writing). AGRO 1660 utilizes these courses, as well as other common experiences such as the field trip to help integrate your learning across academic disciplines.

AGRO 2101-Science of Food, Land, People, and the Environment. Intended for elementary education majors. This course explores the biological basis of food, land, people, and environmental systems. Topics explore biology at the cellular, organism and ecosystems level in relation to human activity systems. Biological science is the core of food, fiber, soil and environment for all people, yet the science is not well understood by citizens. For teachers, as well as all learners, food, fiber, soil and environment provide context and content for many of the basic concepts in science, especially biological sciences. The course explores the molecular, but focuses on the organism and ecosystem level of biology. The course identifies major biological concepts using topics related to food, land, people and environment. Each lecture/weekly topic allows students to engage in active learning about a basic biological concept within a specific context, i.e., food production is global; land is the resource base for the majority of our global plant and animal species, cultivated and wild; all organisms and humans interact with and are influenced by the biological and physical components of the environment and in-turn alter the environment on a local and global scale. The major topics needed to appreciate and in part understand the complexity of life sciences with all of the interdependence and interactions are illustrated through the whole organism and ecosystem perspective covered by the outline.

AGRO 2501-Plant Identification for Urban and Rural Landscapes. Plant and weed species are important in turf, horticulture, forestry, and crop production systems. Emphasizes the identification of native grasses and forbs, field crops, and weed species in Minnesota and Upper Midwest. Plant life cycles, habitats, and relationships to humans are investigated.

CFAN 3001-Pests and Crop Protection. Introduction to biology and identification of insects, weeds, and diseases that affect agricultural crops. Management of these organisms based on principles of integrated pest management.

AGRO 3131-Student Organic Farm Planning, Growing, and Marketing. Students plan and implement cropping and marketing strategies for organic produce and flowers from Student Organic Farm on St. Paul campus.

AGRO 3203-Environment, Global Food Production and the Citizen. Sustainable production of food is crucial to human survival. Different agricultural ecosystems have developed around the world that are influenced by and have an impact on the environment. Course examines how the environment constrains the capacity to produce food and the impact of agriculture on the environment. Topics include ecological properties of agricultural ecosystems, issues of biodiversity, natural resource conservation, pollution, water and waste management. The course utilizes interactive television to provide a media experience and features teaching methods that will allow students to resolve actual dilemmas. Students with no prior exposure to agriculture are encouraged to enroll.

AGRO 4005-Applied Crop Physiology and Development. General course objectives are to examine the following physiological processes underlying growth and development in crop plants: 1) transpiration, 2) photosynthesis, 3) synthesis and utilization of sugars, starches, lipids and proteins, 4) transport and translocation, 5) uptake and utilization of minerals, 6) respiration, 7) germination, and 8) growth and development. To compare the effects and interactions of the biotic and abiotic factors upon crop growth and development i.e., water, light, temperature, air, soil, insects, weeds and diseases and to provide a physiological basis for crop management decisions e.g.: crop or varietal selection, date of planting, seeding methods, row spacing, plant population, fertilizer use and tillage methods upon yield stability, winter survival, drought tolerance, and damage due to insects, diseases, and weeds. Intended for students in the related areas of agriculture who desire an understanding of basic physiology of field crop growth, development, and culture.

AGRO 4093-Directed Studies for Advanced Student. Allows study of agronomy in greater depth or in areas not currently offered in formal courses. Tutorial instruction under staff guidance.

AGRO 4096-Professional Experience Program: Internship. Supervised professional experience in agribusiness firms or government agencies; evaluative reports and consultations with faculty advisers and employers.

AGRO 4103-World Food Problems. This course provides a multi-disciplinary look at problems (and some of the possible solutions) affecting food production, storage, and utilization. Presentations and discussions introduce and discuss sometimes conflicting views on population control, use of technology, as well as the ethical and cultural values of people in various countries of the world. Emphasis is placed on the need for governments, international assistance agencies, international research and extension centers, as well as the private business sector to assist in solving these complex problems. Students can enroll in either Agro 4103 or ApEc 4103.

Agro 4401 Plant Genetics and Breeding. Principles of plant genetics and environmental variation. Applications of genetics to crop evolution and breeding of self-pollinated, cross-pollinated, and asexually propagated crops. Laboratory experiments in hybridization, variation, and selection.

Agro 4505 Biology, Ecology, and Management of Invasive Plants. Ecology and biology of invasive plant species (weeds). Principles of invasive plant management in agricultural, horticultural, urban, wetland, aquatic, and other non-cropland landscape systems, utilizing biological, cultural, and chemical means. Management strategies to design systems that optimize invasive plant management in terms of economic, environmental, and social impacts.

Agro 4603 Field Crop Scouting and Problem Diagnosis. This is a summer field based course meeting in May, July and September for students who have completed a minimum of 12 credits in the plant and soil sciences. Upon completion of this course, you should: 1) know the principles of crop scouting and problem diagnosis, 2) be able to properly determine growth stages of common crops and weeds, 3) be able to identify common weed species in the seedling and vegetative stages and insects and diseases of major crops, 4) be able to recognize nutrient deficiency symptoms, weather damage, symptoms, bird, rodent, other animal damages, herbicide injury and soil related problems, 5) know the scouting procedures for monitoring fields, 6) be able to use site-specific management tools, 7) be able to use growing degree day (GDD) in decision management, 8) be able to select appropriate sprayer parts needed to design sprayer systems for a wide range of weed and pest management needs, 9) be able to calibrate pesticide application equipment for accurate applications, and 10) be able to use pesticides in a manner that limits impact on human and environmental health.

Agro 4660 Senior Capstone: Leadership, Decision Making, and Problem Solving. This course examines the complexities of agricultural issues through a series of discussions. The course also engages students in exercises and discussions that integrate previous educational situations. This course is linked to undergraduate internships and other experiential learning opportunities such as thesis or direct studies and service learning. Written and oral assignments are based on internships or other learning experiences.

Agro 4888 Issues in Sustainable Agriculture. Study the social, economic, political and environmental aspects of a sustainable agriculture through discussions with experts in the field. Specific topics can include: the history of agriculture and the family farm, government farm policy, the importance of biodiversity for healthy landscapes, rural communities, quality of life, community supported agriculture, organic agriculture, landscape health and non-profit organizations. Teaching approaches will include student, faculty and producer-led discussions. The course will include on-farm visits. Target audience: non-majors and majors interested in sustainable agriculture.

Table 17. Student Enrollment by Course

Course	1999	2000	2001	2002	2003	2004	2005	2006	2007
AGRO / ANSC 1007-Horse in Your Backyard	0	0	0	25	30	23	35	45	45
AGRO 1093-Directed Studies	0	0	0	4	7	0	0	1	0
AGRO 1101-Bio of Plant System	62	55	65	107	112	98	53	68	88
AGRO 1103-Crops, Environment & Society	57	50	60	39	44	42	29	44	37
AGRO 1660-First-Year Colloquium	0	0	0	0	0	0	9	7	13
AGRO 2101-Biol Food, Land, People, Env.	0	0	0	0	0	11	18	8	4
AGRO 2103-Grain Grading & Crop Utiliza	8	0	4	0	0	0	0	0	0
AGRO 2104-Grain and Seed Technology	0	0	0	5	10	0	0	0	0
AGRO 2105-Seed Technology	8	3	4	0	0	0	0	0	0
AGRO 2501-Plant ID:Urban&Rural Landsc	0	0	0	22	0	18	0	12	0
AGRO 2501-Weed Biology & Systematics	21	11	0	0	0	0	0	0	0
CFAN 3001 Pests and Crop Protection	0	16	19	14	17	13	18	22	17
AGRO 3003-Intro to Integrated Weed Mmgt	15	0	0	0	0	0	0	0	0
AGRO 3005-App Crop Phys & Dev	11	11	5	0	0	0	0	0	0
AGRO / HORT 3131 - Student Organic Farm	0	0	0	0	0	0	0	0	11
AGRO / ANSC 3203-Env, Food Prod & Citizen	55	60	56	57	64	56	61	62	65
AGRO 4005-App Crop Phys & Dev	0	0	0	13	5	6	15	13	17
AGRO 4093-Dir Studies for Adv Student	5	3	4	3	2	15	2	1	1
AGRO 4096-PEP:Internship	8	8	8	4	6	10	11	14	12
AGRO 4101-Ag Decision Making/Experiment	0	0	0	0	7	0	0	0	0
AGRO 4101-Exp Design/Plot Techniques	7	15	0	0	0	0	0	0	0
AGRO/ APEC/ FSCN 4103-World Food Problems	59	59	61	43	32	49	20	31	34
AGRO 4305-Crop Harvest, Stor, Proc & Uti	19	13	10	0	0	0	0	0	0
AGRO / HORT 4401-Plant Genetics & Breeding	30	38	34	21	34	37	35	32	15
AGRO 4505-Bio/Eco/Mgmt Invasive Plants	0	0	0	7	6	10	2	11	4
AGRO 4603-Field Crop Scout & Prob Diag	0	0	0	0	0	0	0	4	5
AGRO 4605-Mgmt Tech for Crop Prod	6	7	12	6	0	9	0	0	0
AGRO 4660-Senior Capstone	6	8	8	6	1	9	4	13	13
AGRO 4888-Issues in Sustainable Agriculture	0	0	13	6	4	7	7	6	6
Total	389	357	363	382	381	413	319	394	387

Graduate Program

Note: The Applied Sciences (APS) Graduate Program underwent a USDA-CSREES review in April 2007. A review of the graduate program is not within the scope of the current Departmental review. Therefore, only summary information from the 2007 review follows.

Overview of APS Program: The APS Web page (http://www.appliedplantsciences.umn.edu) proudly states that "*Biological solutions to real-world problems come to life in the Applied Plant Sciences graduate program at the University of Minnesota*." The objective of the APS graduate program is to educate, train, and mentor graduates who:

1. Have a foundational knowledge of plant biology;
2. Have a mastery of principles and concepts and a disciplinary literacy in their chosen area of specialization;
3. Recognize the interrelatedness and complexity of research problems in the applied plant sciences;
4. Conduct research responsibly and understand the use of different tools, resources, and research methodologies in the applied plant sciences;
5. Communicate scientific information and ideas in different ways and to different audiences; and
6. Effectively use their knowledge and skills to formulate and lead research-based solutions to problems in food, agriculture, and the environment.

The APS graduate program offers M.S. and Ph.D. degrees in four specializations:

Agronomy/Agroecology. Graduate students in Agronomy/Agroecology conduct research in crop ecology and cropping systems; environmental physiology of agronomic crops; plant nutrition; sustainable agriculture; and weed science. Emphasis is on improving production efficiency and profitability in an environmentally sound approach that benefits society.

Horticultural Science. Graduate students in Horticultural Science conduct research on plant materials such as fruits, vegetables, potatoes, flowers, landscape trees and shrubs, and turfgrasses. Research areas include the effect of horticultural commodities on human health; plant hormonal and stress physiology; plant growth and development; integrated pest management; postharvest physiology; and cropping systems.

Plant Breeding/Molecular Genetics. Graduate students in Plant Breeding/Molecular Genetics conduct research ranging from applied plant breeding projects emphasizing breeding procedures and methodologies, to molecular genetics projects emphasizing genomics and biotechnology of agronomic and horticultural species.

Applied Plant Sciences. Graduate students in the general Applied Plant Sciences curriculum create an integrated, individualized program combining a breadth of courses from several disciplines, including plant biology at the organismal level; plant breeding and genetics; cropping systems; invasion biology and restoration ecology; and production and ecology of crop or native species.

The APS program is currently led and managed by a Director of Graduate Studies (Dr. Stan Hokanson, Department of Horticultural Science) and Associate Director (Dr. James Anderson). An individual serves two years in each position with the Associate Director succeeding the Director. The APS Steering Committee comprises the Director and Associate Director of Graduate Studies, the coordinators of each of the four specializations, and two graduate student representatives. A half-time APS Graduate Program Assistant (Ms. Lynne Medgaarden) provides office and logistical support to the program.

In the past five years, all but six graduate students in the department have enrolled in the APS program. Three students each were enrolled in the Plant Biological Sciences and Conservation Biology graduate programs. The APS program currently has 46 graduate students (32 advised by Agronomy and Plant Genetics faculty) and draws its strength from the combined expertise of 55 graduate faculty, primarily from the Department of Agronomy and Plant Genetics and the Department of Horticultural Science. Since its inception in 1999, the program has graduated 54 M.S. students and 20 Ph.D. students. Graduates have excelled in careers in different universities, government agencies, research institutes, and private companies.

Funding of Graduate Education: The current cost of an M.S. or Ph.D. student in APS is about $37,000, including $11,600 in tuition and fees. Stipends vary slightly according to the source of funding, with most students being supported through competitive grants (Table 18).

Table 18. Sources of funding for graduate students

Source	Amount	No. of Students
Full Stipend		
Graduate School Fellowship	$22,000	1
Doctoral Dissertation Fellowship	$22,000	1 (2 in Hort)
DOVE (Diversity of Views and Experiences)	$22,000	(1 in Hort)
USDA National Needs Fellowship (Plant Breeding)	$24,000	2
Pioneer Hi-Bred Plant Breeding Fellowship	$20,311	2
MAES-CFANS Research Assistantship	$20,311	2 (1 in Hort)
Compton International Fellowship	$20,000	1
Project AgGrad Fellowship (Methodist Church)	$20,311	1
Research Assistant, Competitive Grants	$20,311	20 (11 in Hort)
Teaching Assistantship (1/4 time)	$10,150	1
Teaching Assistantship (1/2 time)		(3 in Hort)
Syngenta supported students		2
Rush Creek Golf Course supported student		(1 in Hort)
Regent's Scholarships (U of M or MAES employees receive free tuition)		2
Supplemental Support		
Hueg-Harrison Fellowship	$13,000	1
Alexander and Lydia Anderson Fellowship	$3,000	1
Departmental Fellowship	$2,000	16

The Graduate School provides support in the form of Block Grants. The Block Grant allocation for APS in 2007 to 2010 is $35,000 each year. The APS program has used Block Grant funds to: 1) Help recruit outstanding students. For new students, the APS program typically supplements assistantship offers with $1,500-3,000 in one-time fellowships from Block Grant funds to help entice the students to our program; 2) Allow students to obtain specialized training not readily available on campus. Through Block Grant funds, APS students have participated in the NSF Summer Institute in Statistical Genetics at North Carolina State University/University of Washington, and in ad hoc training periods at laboratories of leading researchers in Germany and in New Zealand; 3) Unencumber Ph.D. students from their assistantship duties while they write their dissertations; and 4) Provide support for Ph.D. students who may need a few more months of support after his or her assistantship funding ends. The Graduate School has also provided $1,500 to $2,500 in funding each year to help defray the costs of campus visits by prospective students.

Self-assessment Summary for USDA-CSREES Review (Spring 2007)

Perceived strengths of the APS graduate program are its (1) depth and diversity in faculty expertise (from biofuels and bioinformatics to weed science and winter hardiness); (2) diversity in plant species (from alfalfa and apples to wheat and wild rice); (3) flexibility of the curriculum, where core courses common to all specializations within APS are complemented by courses that students can choose according to their interests and needs; and (4) quality and availability of facilities and resources for graduate research. Perceived weaknesses of the APS graduate program include (1) a lack of a funding base for research assistantships and of incentives to hire research assistants instead of postdoctoral research associates or technicians; (2) an insufficient number of upper-level graduate courses, with available courses being offered infrequently; (3) a low publication rate in peer-reviewed journals, especially among M.S. graduates; and (4) a lack of communication and community among APS faculty in different departments.

To remain competitive, we believe we must (1) obtain financial resources to make timely, unconditional offers of admission and financial support to top prospective students and provide bridge funding to current students when necessary; (2) re-examine our course offerings together with allied graduate programs, and consider offering advanced, modular courses on specific topics of interest; (3) disseminate the results of APS graduate-student research by publishing at least one peer-reviewed manuscript from each M.S. and Ph.D. thesis; and (4) develop an APS culture that encourages and provides opportunities for interaction among all APS faculty and graduate students.

USDA-CSREES Review Summary (2007)

The committee was very impressed by the quality of the faculty research and teaching, as well as with the quality of the graduate students it attracts and the success they enjoy in obtaining positions after graduating. We believe that all the building blocks are here to make a top tier and dynamic graduate program that will attract increasing numbers of students, but what is lacking is a clear vision of what APS can become. At this point the program lacks cohesion and a clear identity. This is not particularly surprising given the state of flux and transition being experienced in agriculture programs at Land Grant universities across the country. Further, the changing administration at U. Minn. over the past few years has exacerbated the problem. APS is in the process of having to shift from a long established culture of stable, and generous core funding from the state and federal funding of Land Grant universities, to the more typical diverse funding base driven in large part by the ability to raise external funds. The essence of our recommendations is the need to initiate a planning and visioning effort as soon as possible so the faculty can create a strategy for redefining what APS should evolve into given the shifts in future directions of agriculture. In the process the program would develop a clear and marketable identity that can be used to raise the profile, stature and recognition of the excellent and critical work that is being done, particularly within the University itself. We observed low morale in many of our interactions that relate in part to a sense of powerlessness to change the programs trajectory, and a lack of respect and value placed on the work faculty are doing. This needs to change, and empowering the faculty to drive the change themselves with strong campus support is the best way to do this. The following were identified as key issues to be addressed:

1. Lack of conceptual framework and vision of what the graduate program should be, lack of cohesiveness among faculty within APS.
2. Where will the leadership necessary to create a new program vision and identity come from?
3. High graduate student costs and insufficient funding for students.
4. Curriculum issues.
5. Coordinated planning of new hires across departments to address interdisciplinary needs and CFANS strategic goals.

Multifunctional Agriculture

Multifunctional agriculture is a central organizing theme for Department of Agronomy and Plant Genetics faculty concerned with agronomy and agroecology. Multifunctional agriculture is the joint production of agricultural products and ecological services, including 'environmental commodities' sold in markets and other positive externalities. At present, most agricultural land use has a low degree of multifunctionality. Broadly, faculty are working to explore and refine new designs for cropping systems, agroecosystems and agricultural landscapes that will produce new economic opportunities for farmers, rural communities and society at large. For example, society at large will benefit if multifunctional agriculture can offer a cost-effective source of certain highly valuable ecological services, such as better management of quality and quantity of water resources in the face of climate instability associated with global environmental change.

Trends in multifunctional agriculture: Over the past 50 years our society has shifted its expectations of agriculture. This time frame has seen more than a doubling of the world's population resulting in an increase in demand for relatively cheap and abundant food. Heightened awareness and concern over the impact of agriculture on its natural resource base and the ever increasing demands of the ever increasing population have resulted in increased realization that a more efficient agriculture that takes into account not only production, but also sustainable and enhanced ecological benefits is required.

Faculty are working to increase multifunctionality in agriculture by focusing on key issues of strategic diversification and perennialization of cropping systems and agroecosystems. In the coming decades, faculty expect that annual agriculture will continue to be highly important in the Upper Midwest region. However, there appears to be considerable potential to increase the multifunctionality of agriculture by well-targeted diversification and perennialization of current forms of agricultural land use. The addition of diversity and perenniality to environmentally sensitive sites in agricultural landscapes has been shown to be a highly efficient and cost-effective strategy for increasing multifunctionality. Department of Agronomy and Plant Genetics faculty envision that the agricultural landscapes of the Upper Midwest will shift to mosaics of annual and perennial agriculture, with principles of landscape design used to efficiently produce enhanced ecological services from these landscapes.

Departmental strengths:

Management of Diversified Annual-Based Cropping Systems. Faculty are working to develop more integrative methods of weed management and fertility management, as well as to add diversity in the form of cover crops and 'third crops' to augment corn-soybean based systems presently predominant in much of the region.

Development of Perennial-Based Cropping Systems. Faculty are addressing a wide range of options for perennial agriculture, including herbaceous and woody perennials. Production systems of interest including grazing, agroforestry systems integrating woody perennials with other crops, and grass-based 'energy cropping' systems. Many aspects of these perennial-based systems, ranging from agronomy and management to weed and plant invasion to plant-soil interactions, plus the development of new perennial germplasm are being investigated.

Development of Multifunctional Agricultural Systems. Faculty are working to integrate both annual and perennial crops and other biodiversity into systems that produce agricultural and environmental commodities efficiently and profitably. Multifunctional systems are understood as 'coupled human-natural systems' where both biophysical and social components are seen as important concerns.

Bioproducts. Associated with the effort to further develop multifunctional agricultural systems, faculty are actively engaging with collaborators to develop new marketable bioproducts. Examples include working with Aveda Corporation on identifying plants with specialty oils and with manufacturers of corn and wood pellet burners to evaluate how the meal byproduct from an oilseed press performs in their products.

Core Agronomic Research. Finally, we note that while a considerable part of the current research effort of many agronomy and agroecology faculty in the Department of Agronomy and Plant Genetics address knowledge gaps that are directly related to multifunctional agriculture, they are of course also working to meet a variety of other research needs related to agronomy and agroecology. These needs include traditional agronomic, weed science, and economic issues related to core commodity crops such as corn, soybean, alfalfa, and wheat and other small grains.

Cooperation and Collaboration. There is a culture of cooperation and collaboration within the Department and especially between this Department and other entities. Department of Agronomy and Plant Genetics faculty are also addressing multifunctional agriculture in the context of a number of broad collaborative efforts, including the Green Lands, Blue Waters Consortium (a confederation of Midwest Land-Grant Universities and NGOs from agricultural, environmental, energy and rural-development sectors), and a project facilitating more multifunctional land-use as the Twin Cities-St. Cloud Corridor develops over the next two decades. University of Minnesota partners include CINRAM, IonE, IREE, MISA, Division of Plant Sciences, and Extension. Other partners include commodity groups; industry cohorts; foundations; NGOs; state agencies [Natural Resource Conservation Service, Department of Natural Resources, Minnesota Pollution Control Agency (MPCA)]; and federal agencies (USDA and EPA).

Federal Funding. The agronomy and agroecology programs have been funded from a variety of federal competitive programs, including NSF, USDA-CSREES-IOP, and USDA-CSREES-NRI-National Needs Fellowship. As examples, faculty are directing research evaluating the benefits of grazing systems and assessing the risks associated with organic production techniques. Projects have also been supported through commodity groups and special grants from the state of Minnesota and the federal government.

Graduate Students. Graduate students are an important product of the agronomy and agroecology faculty. Three Ph.D. and six M.S. students have graduated in the last five years in the Agronomy and Agroecology track, and two Ph.D. and six M.S. students have graduated in the general Applied Plant Science track. These students have taken positions in academia and industry and have become or will become leaders in their field. Examples of recent students are Jenipher Bisikwa (faculty at MaKerere Univeristy in Kampala, Uganda), Jason De Bruin (scientist at Iowa State University), Julie Grossman (faculty at North Carolina State University), Krishona Martinson (faculty at University of Minnesota), Ryan Miller (University of Minnesota Extension), and Kristin Mercer (faculty at The Ohio State University).

Examples of major research projects:

Biological Control of Garlic Mustard. Develop and implement practices utilizing biologicals for the control of garlic mustard. Support: MnDNR, US Forest Service and Legislative-Citizen Commission on Minnesota Resources (LCCMR) 2003-08. (Becker)

Lower Minnesota River Multifunctional Biomass Production System. Development production of perennial biomass and 'environmental commodities' in Lower Minnesota River Watersheds, as well as related economic issues, with focus on high-profile Koda Energy Project at Shakopee, MN. Support: Xcel Renewable Energy Fund Grant, 2008-2012. (Wyse, Sheaffer, Jordan)

Wildlife Conservation in Biomass Production Systems. Conditions for wildlife in Minnesota could be enhanced by proper biofuel practices using diverse native grasslands. The project aims to identify management practices that will promote wildlife conservation and associated habitat biodiversity on future working prairies used for biofuel in the state. Support: LCCMR, 2008-2010. (Wyse, Sheaffer)

Dynamics of Multifunctional Grazing Systems. Do sustainable grazing systems produce multiple benefits (ecological services and environmental commodities) and develop supportive social networks? Support: NSF, 2007-2010. (Jordan)

Polyculture Biomass Production Systems. Native perennial herbaceous grassland species have been identified as a potential feedstock for energy production. Prairie plants are ideal candidates because they are adapted to low nutrient environments, generate significant biomass, and provide a plethora of ecological services. Support: Legislative appropriation, 2007-2008. (Wyse, Sheaffer, Ehlke)

Monoculture Biomass Productions Systems. Determine the biomass and biomaterial production potential, water use and carbon storage of 23 woody and herbaceous perennial species in diverse ecoregions. Support: Legislative appropriation, 2007-2008. (Wyse, Sheaffer, Ehlke)

On-farm Biofuels from Oilseed Crops. Assess the feasibility and constraints of small-scale biofuel production from oilseed crops, including utilizing the meal as both animal feed and an energy source and the oil as straight vegetable oil or converted to biodiesel. Support: North West Regional Sustainable Development Partnership, MPCA, and legislative, 2007-2009. (Porter)

Tools for Managing Pest and Environmental Risks to Organic Crops in the Upper Midwest. Develop a tool to assist in managing weeds, insects, and climatic risks in organic production systems. Support: USDA, Risk Management Agency, 2005-2008. (Sheaffer, Wyse)

Beyond Corn snd Soybean: Alternative Organic Crops for The Upper Midwest. Assess several alternative crops in organic production systems. Support: USDA-CSREES, 2006-2009. (Sheaffer, Wyse)

White Earth and East-Central Minnesota Biomass Assessment. Gather available data to estimate the contribution of 1) forest management activities 2) agricultural systems 3) brushlands, and 4) grasslands. Support: Legislative appropriation, 2008-2009. (Wyse, Sheaffer, Ehlke)

Developing Carbon-Positive Organic Systems through Reduced Tillage and Cover Crop-Intensive Crop Rotation Schemes. Support: CSREES-Integrated Organic Program, 2007-2010. (Haar, Porter)

Integration Science in Support of Multifunctional Landscapes. Support a project group developing a multi-college program on multifunctional land use at the University. Support: CFANS, 2008-2010. (Murray, Jordan, Wyse)

Integrating Sustainability Science and Design in Participatory Land Use Planning and Implementation. Identify, test and refine novel approaches that enable decision makers to better achieve integrated ecological and socio-economic objectives. Support: IonE, 2008-2010. (Jordan, Wyse)

Overcoming Barriers to Facilitate the Commercialization of Willow Biomass Crops as a Feedstock for Biofuels, Bioenergy and Bioproducts. Support: USDA/DOE Biomass Research and Development Initiative, 2007-2010. (Johnson)

Publications: The faculty regularly publish agronomic and agroecology articles of national and international appeal. These include articles in *Science* on sustainable development of the agricultural bio-economy and on biofuels from low-input high-diversity grassland biomass. Multiple articles were published in *Agronomy Journal*, *Crop Science*, and *Weed Science* on diverse issues involving forages, cover crops, diversity in native species, crop rotations, organic systems, invasive plants, knowledge networks, weed growth and weed management.

Highlights in the last five years:

- 3 Ph.D. and 6 M.S. students completed degrees in the APS Agronomy and Agroecology track
- 2 Ph.D. and 6 M.S. students in general APS track
- Developed the regional effort on Green Lands, Blue Waters
- Developed the regional effort on the Midwest Cover Crop Council
- NSF funding for multifunctional grazing systems
- Three USDA-Integrated Organic Programs for alternative organic crops
- Several Legislative Citizens Commission for Minnesota Resources grant for native plants research
- USDA/CSREES Higher Education Challenge Grant for internships
- USDA/Risk Management Agency for organic systems
- Multiple MN Department of Agriculture Grants for biomass and biofuels
- Publications in *Agriculture, Ecosystems and Environment; Agronomy Journal; Biological Invasions; Biometrics; Crop Management; Crop Protection; Crop Science; Ecological Applications; Forage and Grazinglands; Journal of Natural Resources and Life Science Education; Journal of Nematology; Renewable Agriculture and Food Systems; Science; Soil Science Society of America Journal; Weed Science; and Weed Technology*.

Departmental needs:

Landscape Agroecologist. Agricultural landscapes are in flux, as the importance of improving the environmental and economic performance of these landscapes is increasingly recognized. In particular, performance of the predominant annual-based cropping systems will benefit from strategic diversification and greater use of perennial crop species. Biomass production, 'organic' production, localized food systems, and production of new bio-based products provide new economic opportunities from these diversified landscapes, as does the production of 'environmental commodities' such as C storage and flood protection. However, additional landscape-level research is needed to increase the range and magnitude of ecological and economic benefits provided by diversified landscapes. To do so, landscape agroecology analyzes the effects of plant species and plant communities on agroecological processes and patterns that in turn affect production of both agricultural and environmental commodities. Landscape-scale research is required because many valuable ecological services (e.g., conservation of biodiversity, regulation of hydrology) are produced by whole landscapes. With this in mind, the Department of Agronomy and Plant Genetics is committed to hiring a landscape agroecologist.

Alternative Crop Germplasm Development. There is a realization by the agronomy and agroecology faculty that new germplasm needs to be identified to obtain the desired objectives of a more multifunctional agriculture. Traditional plant breeding efforts with promising perennial crops and cover crops integrated with genomic technologies is very possible, especially with the formation of a Center for Plant Breeding and Genomics.

Research Instrumentation. Instrumentation for monitoring gas exchange and water quality on a landscape scale would further the research objectives of the Department of Agronomy and Plant Genetics faculty. Along with the instrumentation, it is imperative to have the supporting technical infrastructure to maintain such facilities. Traditionally, most researchers have conducted small plot research on uniform parcels of land. Such research often fails to capture the dynamics which occur on a landscape scale.

Long-Term Team Support. During the last five years, University of Minnesota faculty have organized intra-specific and inter-specific college initiatives using a multidisciplinary philosophy to approach complex landscape problems. These initiatives are in need of substantial long term support. There is a need to support the development of the infrastructure necessary to sustain support for large multidisciplinary teams.

Future outlook and goals: There will be high demands on the landscapes of the future, which will have to serve simultaneously the following functions: ecological (as an area for living), economic (as an area for production), socio-cultural (as an area for recreation and identification), historical (as an area for settlement and identity), and aesthetic (as an area for experiences). Depending on people's different ways of using the landscape, it has a different meaning for them. In this regard, landscape is a very complex phenomenon. Single disciplines can only discover, describe, and alter small parts of the landscape as a whole. To understand landscapes fully and address their challenges, discrete disciplines have to work together. Accordingly, the University of Minnesota is well positioned in the world to lead the exploration of various approaches to the sustainable development of multifunctional landscapes.

Monsanto Multifunctional Agriculture and Food System Fellowship Collaborative. A proposed collaboration between the University of Minnesota and Monsanto will create a research and education environment at the University that attracts top-flight students into the agricultural sciences. The focus of this effort is on multifunctional agriculture and food systems.

Internationalization of Our Effort in Multifunctional Agriculture. We live in an ever increasing mobile and global society. Our research and teaching efforts will by necessity be internationalized.

Crop Improvement through Translation of Basic Biology and Crop Science

The crop improvement area of the Department is composed of faculty in two general areas: plant breeding and genomics. Although there is not a strict boundary between breeding and genomics faculty within the Department, it is divided here for simplicity. Faculty that direct breeding programs are focused on developing novel breeding methodologies, incorporating molecular markers in breeding programs, and developing germplasm and varieties for corn, soybean, wheat, barley, oat, alfalfa, turf grasses, and forage legumes and grasses. Genomics faculty are developing enabling technologies (e.g., markers, reverse genetics populations), exploiting plant transformation technologies and studying gene function in wheat, barley, corn, oats, alfalfa, and soybean. In addition, the use of model organisms like *Medicago*, rice and *Arabidopsis*, and the development of genomics tools for the model organism *Brachypodium distachyon* are key aspects of the work involving genomics faculty.

Trends in breeding and genomics: Plant breeding has radically changed in the last ten years. Traditional plant breeding required statistical skills, a knowledge of breeding strategies, and an understanding of the genetics, biology and physiology of the crop. In addition to these skills, modern breeding programs require skills in bioinformatics, molecular marker development and deployment, quantitative genetics, and the ability to integrate genetically-engineered germplasm. At the same time breeders are being asked to take on these new skill sets, there are emerging diseases (e.g., Ug99 stem rust of wheat) that threaten global crop production, and abiotic stresses (e.g., drought, heat) brought on by global warming. Consumers and the bioenergy industry are also asking for more healthful foods and feedstocks, respectively. Thus, breeding programs are required to develop germplasm that satisfies farmers, processors, consumers and the biofuels industry. In the future, the competing goals of food, health and bioenergy production will push plant breeders to develop multiple-use crops.

Frustratingly, as plant breeding has become more sophisticated and breeding companies and universities require increased expertise, there has been a reduction in funding for breeding programs and an increase in graduate student expenses, resulting in fewer graduate students being educated in plant breeding. This trend has occurred across the country and future funding for public breeding programs is threatened. To begin to counteract these trends, the Plant Breeding Coordinating Committee has been formed nationally (http://cuke.hort.ncsu.edu/gpb/pr/pbccmain.html) with the mandate to provide a "forum for leadership regarding issues, problems and opportunities of long-term strategic importance to the contribution of plant breeding to national goals." Recently, breeding companies have begun to address this problem by providing funding for graduate student assistantships, and the USDA-CSREES-NRI Coordinated Agricultural Project (CAP) program has begun to infuse breeding communities with funding to coordinate breeding activities. However, to date the demand for highly-trained plant breeding students exceeds the supply.

Genomics technologies have altered the approaches to understanding plant genomes and gene function. Previously, geneticists studied single genes. Now, genomics technologies provide the ability to study the function and interaction of all genes in the genome. Genome sequencing of maize, soybean and rice provides a rich resource for identifying molecular markers, gene discovery and comparative genomics studies. The *Arabidopsis*, *Brachypodium distachyon* and *Medicago* genome sequences provide the opportunity for comparative genomics and efficient gene discovery. In the near future, genome sequences of most crop plants will be available. Next generation sequencing technologies will provide the opportunity to identify and exploit variation in breeding programs and to assign genes to traits. The "omics" technologies (e.g., transcriptomics, proteomics, metabolomics, etc.) are providing the opportunity to develop hypotheses for gene function. Large mutant collections are making it possible to quickly assign genes to function. Databases and bioinformatics tools will attempt to tie these different data types into a tractable system for structural genomics, gene function studies, and crop improvement.

Genetic engineering can be used to study gene function, to increase the variation for a trait or add new traits. Within the last 10 years, the majority of the corn and soybean crop grown in the U.S. has become genetically engineered. Thus, genetically engineered crops have altered the landscape of U.S. agriculture. Taken together, genomics technologies provide unprecedented tools for studying genomes, gene function and increasing the speed of crop improvement.

Incorporation of genomics technologies (high-throughput marker genotyping, bioinformatics, computation, genetically-engineered plants) into breeding programs has been pioneered in breeding companies. University breeding programs are just beginning to integrate genomics technologies into breeding programs. Thus, a real challenge in the future for the breeding and genomics faculty will be to develop an educational platform that provides students the theoretical and applied framework to succeed in academia or industry.

Departmental strengths:

Breeding Programs. The plant breeding and genomics faculty are poised to address the future trends described above. Active breeding programs in corn, wheat, soybean, barley, oat, turf, legume and forage grasses, alfalfa, and soybean develop new varieties and germplasm for the major crop plants in the state of Minnesota. Breeding objectives are developed in collaboration with commodity groups and end users. Germplasm released from these programs in the last ten years include: five wheat varieties, four forage legume releases, one forage grass variety, one alfalfa germplasm, 42 conventional, Roundup Ready, and specialty soybean varieties, two barley varieties, five oat varieties, one wild rice variety and three corn germplasm releases (Table 19). In addition, plant breeding faculty are developing novel breeding methodologies that capitalize on computational approaches, association genetics and quantitative genetics. To further strengthen this area of the department, we began a national search in the fall 2008 for a tenure track position focused on Computational Biology for Plant Breeding and Genetics.

Genomics Programs. Genomics projects in soybean, legumes, barley, wheat, oat, *Brachypodium distachyon* and maize study a range of traits important to agriculture including: biotic and abiotic stresses, growth and development, seed quality and bioenergy-related traits. These programs complement the breeding programs in regard to developing enabling technologies (e.g., molecular markers, locations of loci controlling important traits, gene discovery, and plant transformation capacity) for crop improvement. Traditionally, complementation has been in the arena of marker development and quantitative trait locus (QTL) detection. More recently, this has been in the area of gene discovery.

Cooperation and Collaboration. There is a culture of cooperation and collaboration within the department and especially between the plant breeding and genomics faculty. The faculty has collaborated to develop genetic maps and identify QTL for regions of crop genomes controlling important traits. Examples include: mapping the oat genome and identifying QTL for oil content, the Barley Coordinated Agricultural Project, and Fusarium head blight resistance in barley and wheat. Our breeding and genetics faculty also collaborate extensively with the Department of Plant Pathology and the USDA-ARS Cereal Disease Laboratory and maintain collaborations with faculty in many departments including Food Science and Nutrition, Horticultural Science, Plant Pathology, and Animal Science.

Funding. Both the plant breeding and genomics programs have been funded from a variety of federal competitive programs including: NSF, USDA-CSREES-NRI, USDA-CSREES-NRI-Coordinated Agricultural Project program, USDA-CSREES-NRI-National Needs Fellowship, and the USDA-DOE Genomics for Plant Feedstocks program. As examples, faculty are directing the Barley CAP and participating in the Wheat CAP. In addition, these projects have been supported through commodity groups and special grants from the state of Minnesota and the federal government.

Graduate students. The most important products of the plant breeding and genomics faculty are graduate students. We have graduated 11 Ph.D. and 20 M.S. students in the last five years. These students have taken positions in academia and industry and have become leaders in this field. Examples of recent students are Jianming Yu (Kansas State University), Jean-Luc Jannnik (USDA-ARS, Ithaca, NY), Jennifer Jacobs (Monsanto Company), Wade Odland (Pioneer), Xiuling Zhang (Pioneer), Timothy Dabbert (Monsanto Company), Federico Condon (INIA, Uruguay), Martin Medina (Monsanto), Alejandra Larriera (Monsanto), and Brent Hulke (USDA-ARS, Fargo, ND).

Examples of major research projects:

Barley and Wheat Coordinated Agricultural Projects (CAP). Faculty members are key players in the USDA-CSREES-NRI funded Barley and Wheat CAPs. Muehlbauer is the Project Director of the Barley CAP. Smith and Bernardo are co-PIs on the Barley CAP and Anderson is a co-PI on the Wheat CAP. These are comprehensive projects that incorporate expertise from across the barley and wheat research communities with the overall goal to integrate genomics technologies in breeding programs for more effective and efficient crop improvement. (Anderson, Bernardo, Muehlbauer, Smith)

Oat-Maize Radiation Hybrids. An NSF funded project was conducted to develop and utilize oat-maize radiation hybrids. This project resulted in the development of unique genetic stocks for mapping and characterizing the maize genome. Numerous research groups around the world have used these genetic stocks for mapping and studying maize chromosome biology. (Phillips, Rines)

Wheat EST and SNP Mapping. Two large collaborative NSF-funded projects to map expressed sequence tags (ESTs) and single nucleotide polymorphisms (SNPs) were conducted. More than 8,000 ESTs were mapped to deletion bins in the wheat genome and more than 1,200 SNPs were developed. (Anderson)

Wheat and Barley Scab. Wheat and barley scab is a major disease problem in these crops around the world. The Department of Agronomy and Plant Genetics plays a key role in leading the effort to confront this disease. Faculty members have identified key loci for resistance to scab in wheat and barley, examined the molecular interactions between the hosts and pathogen, and developed germplasm and varieties with increased resistance. (Anderson, Garvin, Muehlbauer, Smith)

Wheat and barley Genomics. USDA-NRI-IFAFS grants in barley and wheat were funded to Muehlbauer and Anderson, respectively. The Barley IFAFS grant resulted in the initiation of an integrated physical map of barley, and the development and utilization of the Affymetrix Barley1 GeneChip, the first commercially available GeneChip for a crop plant. The development and use of the GeneChip paved the way for Affymetrix to develop GeneChips in other agricultural plants and animals. The wheat-IFAFS project focused on using marker-assisted selection to develop novel germplasm for wheat improvement. This grant provided the ground-work for the successful wheat CAP grant. (Anderson, Muehlbauer)

Statistical Genomics. A USDA-CSREES-NRI study was funded to conduct research on exploiting cheap and abundant molecular markers in plant breeding. This work resulted in developing approaches for QTL detection from unbalanced and messy phenotypic data that are routinely generated in performance trials. (Bernardo)

Corn Bioenergy Studies. A USDA-DOE funded study is being conducted to use marker-based selection methods that do not require QTL mapping (i.e., genomewide selection) to improve maize for both grain yield and stover quality for ethanol production (Bernardo, Jung). A University of Minnesota IREE grant was funded to genetically and economically study high oil corn as well as developing bioprocess technologies (Phillips).

Legume genomics. We have contributed to sequencing more than 60,000 ESTs in *Medicago*, *Lupinus*, and *Phaseolus*. Our genomics efforts have focused primarily on plant genes involved in symbiotic nitrogen fixation, root biology, and nutrient stress. We were the first to do a complete *in silico* genome analysis of ESTs in *Medicago*. Moreover, we have successfully performed gene-silencing experiments in roots of *Medicago* and *Lupinus* (Vance). Genomics approaches are being used to study oil and protein content in soybean seed, gene expression in duplicated regions of the soybean genome, and the molecular genetics of flowering time in soybean. (Muehlbauer, Orf, Stupar, Vance)

Developing Brachypodium distachyon as a model species. The development of *Brachypodium distachyon* as a model organism is a major activity in the Garvin laboratory. His laboratory is at the forefront in expanding and exploiting genomics resources for this species. The core set of *Brachypodium* reference genetic stocks now being used by researchers in more than 20 countries was developed in his laboratory as well as the establishment of growth conditions for high-throughput growth and evaluation of the species, and development of the largest known set of segregating *Brachypodium* populations. In addition, he is co-director of a DOE-sponsored project to determine the *Brachypodium* genome sequence, which will be the first temperate grass genome sequenced. (Garvin)

Publications: Numerous papers have been published in first-rate journals by the faculty in this research area. These include papers in the *Proceedings of the National Academy of Sciences* on isolating a gene controlling flowering time in maize and the oat-maize radiation hybrids. Another paper was published in *Science* on the *Fusarium graminearum* genome sequence. Multiple papers were published in *Genetics* on mapping in wheat and barley. Genomics papers on legumes, maize and barley were published in *Plant Physiology*, *The Plant Journal* and *The Plant Cell*. Seminal papers on statistical genomics were published in *Crop Science* and *Theoretical and Applied Genetics*.

Highlights in the last five years:

- 11 Ph.D. and 20 M.S. students completed degrees
- 42 varieties and germplasm releases
- NSF funding for oat-maize radiation hybrids
- USDA-CSREES-NRI funding for the Barley and Wheat CAPs
- Two NSF grants to fund wheat gene mapping
- USDA-IFAFS grants for wheat breeding and barley genomics
- USDA-DOE grant for corn bioenergy
- Developing *Brachypodium distachyon* as a model organism
- Publications in *Science, Proceedings of the National Academy of Sciences, The Plant Cell, The Plant Journal, Genetics, Plant Physiology, Crop Science, Theoretical and Applied Genetics*

Departmental needs:

Seed Storage Facility. Germplasm characterization and maintenance is becoming an increasingly important tool of breeding and genomics projects. Breeding programs require extensive germplasm collections to ensure the necessary variation for important traits, while genomics programs require this resource for gene discovery. In addition, new genomics and bioinformatics technologies provide an unprecedented opportunity to exploit these resources. However, the ability to characterize and maintain germplasm is limited at the University of Minnesota due to the inadequate seed storage facilities.

Field Space. Currently, the Department has access to field space on the St. Paul campus for research, education and extension programs. Recent construction on this space and University expansion plans has and will reduce the amount of space available for these activities. The Department would like to maintain

an adequate amount of space on the St. Paul campus. To ensure that this occurs, the Department would like a voice in its future use.

Plant Physiologist. The advent of genomics technologies has resulted in the reduction of faculty that understand the physiology and agronomy of crop plants. Until recently, the bottleneck in many plant breeding programs has been the expense and labor costs of marker technologies. This is no longer the case and the bottleneck is now obtaining robust phenotypic data. In addition, to fully take advantage of genomics for gene discovery, strength in plant physiology is required. Thus, we are in need of new faculty with this type of expertise. Indeed, one of our new position requests is for a plant physiologist.

Graduate Student Funding. Over the past 5 - 10 years the stipend, tuition, and health insurance costs for graduate students have reached a level that it is more cost effective for faculty to hire a technician or postdoctoral research associate. At the same time University funding for graduate students has been severely reduced. As described above, at a time when plant breeding is becoming increasingly important, the lack of funding has resulted in fewer plant breeding students available for industry and academic positions. To counteract this problem, the department obtained a USDA-CSREES-NRI National Needs Fellowship grant and a gift from Pioneer Hi-Bred to support graduate students in plant breeding and genomics. However, this funding is still insufficient for long-term support that breeding and genomics programs require.

Plant Transformation Facility. Plant transformation can be used to validate gene function and develop novel germplasm. Thus, plant transformation is an essential component of utilizing genomics tools and resources. Currently, only a few crop plants can be transformed within the department and these are generally funded through grant programs. A plant transformation facility that has the capacity to transform all or most of the crop plants studied within the department would greatly benefit functional genomics studies and germplasm enhancement.

Future outlook and goals: The faculty are poised to take advantage of genomics tools and resources for studying plant genomes, conducting functional genomics studies, and integration into breeding programs for crop improvement.

Integration of Breeding and Genomics. Integration of genomics technologies into breeding programs is a major challenge for public institutions. The Barley and Wheat CAP grants help the integration in these two crops but additional integration is necessary in other crops. The cost reduction in genomics technologies should spur this integration. However, to move rapidly in this direction may require additional faculty training that could be delivered by a potential Center for Breeding and Genomics (see below) and hiring a faculty member in Computational Biology for Plant Breeding and Genetics.

Develop Health and Bioenergy as Targets for Crop Improvement. In addition to the core traits of yield, biotic and abiotic stress tolerance, and quality that are the primary focus of the breeding and genomics programs within the department, faculty will identify health and bioenergy targets. The health targets will be identified through collaboration with faculty from the Academic Health Center and the Department of Food Science and Nutrition. Bioenergy traits will be identified as the plant requirements for biofuels are identified.

Graduate Student Funding. One of our goals is to develop a secure, long-range funding strategy for graduate students. This will be pursued by a combination of industry, commodity group, foundation and federal funding.

Upper Midwest Center for Plant Breeding and Genomics. One of our goals is to develop a Center for Plant Breeding and Genomics. This Center will service faculty, student and postdoctoral research

associates within the department and at universities and industries in neighboring states. The mission of this Center will be to act as a site for plant breeding and genomics educational activities. As described above, modern plant breeding requires additional skill sets, and the Center would help facilitate the development of these skill sets. Examples of activities would include graduate student internships, workshops on breeding and genomics, and symposia on plant breeding and genomics. Initial activities include a workshop in QTL detection, association genetics and marker-assisted selection hosted by the barley CAP in the summer of 2008. In addition, we hosted a graduate student-developed symposium on plant breeding and genomics in the winter of 2008. Both of these activities could become templates for future workshops and symposia.

Table 19. Cultivar, germplasm and genetic stocks released by the Minnesota Agricultural Experiment Station since 1997.

Crop Species	Cultivar Designation	Year	Intellectual Property Developer(s)	Novel Trait(s)
Alfalfa	UMN3176	2000	Samac, Lamb	Ineffective nodulation, regeneration in tissue culture
Barley	Lacey	2000	Rasmusson, Smith	High yield malting variety
	Rasmusson	2008	Smith, Rasmusson	High yield malting variety, higher malt extract
Birdsfoot trefoil	Nueltin	2001	Ehlke, Wyse	Glyphosate tolerance
	Roseau	2001	Ehlke, Wyse	Glyphosate tolerance
Brachypodium distachyon	Bd1-1, Bd2-3, Bd3-1, Bd18-1, Bd21	2004	Garvin	Diploid inbred genetic stocks of this new model grass species
Cicer milkvetch	HiPal	2001	Ehlke, Sheaffer, Martin	High palatability
Corn	Genetic stocks	2005	Phillips	BC6 mutant types and translocations in three genetic backgrounds deposited in Maize Genetics Stock Center
	3 lines	2008	Phillips	High methionine lines
Illinois bundleflower			Ehlke, Sheaffer, Wyse	Regional ecotypes, winter hardiness
Kentucky bluegrass	A99-2626	2008	Ehlke, Watkins, Meyers	High quality turf and seed production
Kura clover	NF-93	2002	Ehlke, Sheaffer	Seedling vigor and biomass production
Oat	Richard	1999	Stuthman, Rines	Yield, rust resistance and lodging resistance
	Sesqui	2001	Stuthman, Rines	Yield
	Wabasha	2001	Stuthman, Rines	Yield and early maturity
	Leonard	2002	Stuthman, Rines	Yield and BYDV resistance
	Winona	2005	Stuthman, Rines	Yield and early maturity
Perennial ryegrass	Polar Green	2006	Ehlke, Wyse	Winter hardiness
	Ragnar	2002	Wyse, Ehlke	Herbicide tolerance
	Ragnar II	2005	Wyse, Ehlke	Herbicide tolerance and improved turf quality
	Arctic Green	2007	Wyse, Ehlke, Watkins, Meyers	Herbicide tolerance, improved turf quality and disease resistance

Quackgrass	Everett	2001	Wyse, Ehlke, Sheaffer	High rhizome production
Soybean	MN0301	1997	Orf	Yield
	MN1301	1997	Orf	Yield
	UM3	1997	Orf	Small seeded
	Surge	1997	Scott (Roy), Orf	Yield, higher protein
	Stride	1997	Scott (Roy), Orf	Yield
	MN0203SP	1997	Orf	Small seeded
	MN0303SP	1997	Orf	Small seeded
	MN1401	1998	Orf	Yield
	MN1601SP	1998	Orf	Large seeded, higher protein
	MN0901	1999	Orf	Yield
	MN1801	1999	Orf	Yield
	MN2001SP	1999	Orf	Large seeded, higher protein
	MN0902CN	2000	Orf	Soybean cyst nematode resistant
	MN0201	2001	Orf	Yield, chlorosis tolerant
	MN1303SP	2000	Orf	High protein
	MN1602SP	2000	Orf	High protein
	MN1901SP	2000	Orf	Large seeded, higher protein
	Black Kato	2000	Orf	Black seed coat
	MN0302	2001	Orf	Yield, Phytophthora resistant
	MN1302	2001	Orf	Yield, Phytophthora resistant, possible rust tolerant
	MN1101SP	2001	Orf	Large seeded, higher protein
	MN1502SP	2002	Orf	High protein
	MN1102SP	2002	Orf	Large seeded, higher protein
	MN0091	2003	Orf	Yield, white mold resistant
	MN0904RR	2003	Orf	Yield, Roundup Ready
	MN1103SP	2003	Orf	Low linolenic acid
	MN0071	2004	Orf	Yield
	MN1005	2004	Orf	Yield, brown stem rot resistant
	MN1006CN	2004	Orf	Soybean cyst nematode resistant
	MN1504RR	2004	Orf	Yield, Roundup Ready
	MN1607SP	2004	Orf	Large seeded, higher protein
	MN1306SP	2004	Orf	Small seeded
	MN0803SP	2004	Orf	Small seeded
	MN0205SP	2004	Orf	Small seeded
	MN1009	2005	Orf	Yield, Phytophthora resistant

	MN1007SP	2005	Orf	Small seeded, diverse parentage
	MN1307	2006	Orf	Yield
	MN0101	2006	Orf	Yield
	MN0602CN	2006	Orf	Soybean cyst nematode resistant
	MN1104SP	2006	Orf	High protein
	MN0906SP	2006	Orf	Small seeded
	MN1608SP	2006	Orf	Large seeded
	MN1011CN	2007	Orf	Soybean cyst nematode resistant
	MN1410	2007	Orf	Yield
	MN0102SP	2007	Orf	Small seeded
	MN0603SP	2007	Orf	Small seeded
	MN0105	2008	Orf	Yield, Phytophthora resistant
	MN0501SP	2008	Orf	Small seeded
	MN0403SP	2008	Orf	Small seeded
Wheat	McVey	1999	Busch, Anderson	Scab resistance
	Oklee	2003	Anderson, Busch	Scab resistance, wide adaptation
	Ulen	2005	Anderson, Busch	Yield
	Ada	2006	Anderson, Busch	Yield, quality
	N1 through N56	2006	Garvin	Near-isogenic line series of cv Norm with one of 4 different FHB resistance QTLs introgressed
	W1 through W65	2006	Garvin	Near-isogenic line series of cv Wheaton with one of 5 different FHB resistance QTLs introgressed
	RB07	2007	Anderson, Busch	Scab resistance, yield
Wild Rice	Dawn SR	2008	Porter, Phillips, Kahler	Early maturity and shattering resistance

Extension Education

The extension area of the Department is composed of five faculty who hold 3.5 FTE's in extension, one faculty member who is the Dean of Extension and one faculty member of Professional and Academic rank with a 0.70 FTE extension appointment. This group provides core extension programming and applied research in the following areas:

Corn production and management
Forage production and management
Small grain production and management
Soybean production and management
Weed management systems – corn and soybean
Weed management systems – small grains
Weed management systems – sweet corn, forage and invasive species

The mission of the Department of Agronomy and Plant Genetics Extension faculty is to deliver high quality and relevant educational programs and information to the citizens and communities of Minnesota. The faculty recognizes that educational program quality and relevance is highly linked to applied-research efforts with an unbiased perspective and seeks grant dollars to support their research effort. Extension programming is directed to a number of key audiences that include: crop producers, livestock producers, commodity groups, crop consultants, agribusinesses and government agencies (e.g. Minnesota Department of Agriculture). To better serve the diversity of audiences, programming efforts may be conducted within a crop or discipline (e.g., corn and soybean management), within an audience classification (e.g., the Ag Professional Update program) or across crops and disciplines (e.g. the Crop Pest Management Short Course). Program efforts are organized around program teams that include faculty from other departments and Education Educators. The program teams are involved in all steps of the programming process from needs assessment with key stakeholders through program evaluation and impact. Programming efforts are generally focused on the following topics: profitability, economic risk, environmental risk, environmental stewardship, and public health.

Trends: In January 2004, University of Minnesota Extension underwent a significant transformation in response to changing economic needs and to enhance programmatic efficiency. The reorganization resulted in a transition from having Extension Educators in all 87 counties to a network of 18 regional Extension Centers with the option for counties to negotiate and purchase local Extension Educator positions based on their specific needs. In this new model, Extension State Faculty are linked with Extension Educators who operate at the local and regional level via programming areas. Dr. Jeffrey Gunsolus currently serves as the program leader for the Regional Educators working in the Crops Program Area. Dr. Gunsolus's 25% administrative appointment is dedicated to the supervision of 10 Regional Extension Educators in the Crops Program Area. For more details regarding the 2004 transformation of University of Minnesota Extension please go to the Appendix article, "Minnesota Extension's Mixed Regional/County Model: Greater Impacts Follows Changes in Structure."

Not all Department of Agronomy and Plant Genetics Extension faculty activities reside under this new Extension program model. For example, the invasive species and biocontrol activities of Dr. Roger Becker lie outside of this new program model. The next section outlines current Extension Program Areas that involve Extension Agronomy Faculty.

Programs involving Department faculty: As a result of the transformations described in the section above, the extension programs within the Department of Agronomy and Plant Genetics are a part of the greater College of Food, Agricultural and Natural Resource Sciences, Extension Center for Food,

Agricultural and Natural Resource Sciences (EFANS). Within the EFANS structure, Department of Agronomy and Plant Genetics Extension faculty are an integral part of the organization and effective programming with the following five program teams:

1. Commodity Crop Production

Program Description: The primary commodity crops produced in Minnesota are corn, small grains (spring wheat, barley and oat) and soybean. These crops produce approximately $3 billion dollars in cash receipts to Minnesota farmers, contributing economically to Minnesota's rural communities and to the state as a whole. The Commodity Crop Production program focuses on the delivery of timely and relevant research-based information and sound agronomic production principles in order to accelerate the adoption of production practices that increase profitability and reduce economic and environmental risks that face commodity crop producers in Minnesota.

Faculty: Jeffrey Coulter
Beverly Durgan
Jeffrey Gunsolus
Seth Naeve
Jochum Wiersma

2. Institute for Ag Professionals

Program Description: The University of Minnesota Extension has been a pioneer in conducting crop production education programming for agricultural professionals. For two decades, the Institute has been working with retail dealers, crop consultants, sales personnel, and county extension staff to pass on research-based information relating to crop management. Keeping Ag Professionals on top of current production techniques helps to ensure that economically- and environmentally-responsible cropping decisions are made throughout the state.

The Institute's offerings include a core of three annual events.

- The Field School for Ag Professionals is a 2-day program completely taught in the field, with hands-on activities examining current pests, diseases, varieties, and other crop issues. The location of the School rotates around to Research and Outreach Centers throughout the state in order to highlight different regional issues and reach regional audiences. Approximately 12 CEUs offered to approximately 100 participants per field school.
- The Crop Pest Management Short Course has been conducting seminar- and discussion-based programming on current and emerging issues in Minnesota agriculture for 25 years. In 2006, this popular short course joined with the Minnesota Crop Production Retailers Trade Show for expanded opportunities. Approximately 8.5 CEUs offered per short course.
- The Research Updates for Ag Professionals focus on issues currently confronting the crop production industry. The half-day sessions are held in six locations strategically located throughout the state. The speakers are University Extension Specialists, giving regionally specific crop management information directly based on their current research. Approximately 4.0 CEUs offered per update session.
- Starting in 2008, single topic advanced workshops such as the recently held “Soybean Sudden Death Syndrome Workshop” and a “Forage School” have been added to the IAP program offerings.

Faculty: Jochum Wiersma - Director of the Institute for Agricultural Professionals
Jeffrey Coulter
Beverly Durgan
Jeffrey Gunsolus
Seth Naeve
Paul Peterson

3. Forage Management and Use

Program Description: The quality of forage is of vital importance to animal health and farm profitability. Meat and milk quality and quantity can be determined by forage management decisions. Forage production is an important component of crop production systems because it provides a viable rotation option, aids in the prevention of soil erosion, and increases soil quality and fertility. Growing forages improves environmental quality by providing a buffer strip near waterways, creating wildlife habitat, and potentially providing an alternative source of energy. Educating producers and professionals about proper management and use of forages and their economic and environmental value is an important program of the University of Minnesota Extension Service.

Faculty: Paul Peterson

4. Pesticide Safety Education

Program Description: The responsible management of both pests and pesticides is essential from the perspective of public health, as well as healthy, functioning ecosystems. The management of pests is important in many Minnesota industries, such as: crop and livestock production, forestry, turf, horticulture, fisheries, food processing, waste management, commodity transportation, and tourism. Pest and pesticide management in sensitive public and urban areas, such as parks, golf courses, schools, stores, homes, lakes and rivers, and business offices, are important for both economic and aesthetic reasons, but also require additional expertise and knowledge to protect the public. Pesticide safety and security, of which education and outreach play a central role, have emerged as recognized priorities for national security.

Faculty: Roger Becker
Beverly Durgan
Jeffrey Gunsolus

5. Commercial Vegetable & Fruit Production

Program Description: Minnesota's local and regional food system includes the production of sweet corn, peas, tomatoes, potatoes, onions, squash, pumpkins, green beans, apples, grapes, strawberries, blueberries, and carrots. Unlike many sectors of the agricultural economy, commercial vegetable and fruit production in Minnesota is increasing steadily. Commercial growers of all farm sizes continue to seek new research information and educational opportunities to refine their production and marketing practices to produce healthy foods and enhance profitability. The Commercial Fruit & Vegetable Program seeks to research and educate on early-season stand establishment and development of integrated cropping systems that improve production efficiency while reducing inputs and protecting our natural resources.

Faculty: Roger Becker

Program strengths and highlights:

Due to the diversity of programs that the Extension Faculty are involved in only selected programs will be addressed in this section. The focus will be on the three commodity-based programs that involve most of our Extension faculty's time and Dr. Roger Becker's activities within the area of invasive species and biological control.

General Strengths

- Faculty are well connected with a very wide range of key departmental stakeholders
    - Producers
    - Ag professionals
    - Ag chemical and seed industry researchers and marketers
    - Commodity organizations
    - Government agencies
- Faculty have a broad range of programmatic and research interests and are often in a position to act in bridging roles both within the Department and University and with key stakeholders.
- We have the research capacity (e.g. field equipment and out state connections) to carry out a significant amount of the Department's applied research and could act in proof-of-concept for more basic research projects in the future

Commodity Crops and Forages

Web Presence: provides a depth and breadth of constantly available information.

- Small Grains website (http://www.smallgrains.org) - one of the first of its kind – this web site was established in 1995 before the University of Minnesota Extension Service had a presence on the World Wide Web.
- Soybean website (http://www.soybeans.umn.edu)
- Forages website (http://www.extension.umn.edu/forages)
- Applied Weed Science website (http://appliedweeds.cfans.umn.edu)
- Agbuzz Blog (http://minnesotafarmguide.com/blog/)

Collaborative Applied Research and Programming:

- Collaborative applied research and programming is often organized and conducted with appropriate Regional and Local Extension Educators in coordination with the appropriate Commodity Organization.

Institute for Ag Professionals

The programs organized by the Institute for Ag Professionals are perceived to have high value by the clientele, generate revenue for future programming, and targets agricultural professionals, who in turn share information with their clients, allowing them to make economically and environmentally-sound decisions that can benefit the state as a whole. The program fits into the College of Food, Agricultural, Food and Environmental Sciences published priorities, and was recognized by University of Minnesota Extension in 2002 as an Agriculture, Food and Environment Capacity Area Signature Program.

- The Crop Pest Management Short Course is a pre-eminent seminar-based and discussion-based program focusing on current and emerging issues in Minnesota agriculture over the past 25 years. With the program's merger of the MCPA, Trade Show attendance has

ballooned to over 1000 agricultural professionals attending the combined CPM Short Course and MCPR Trade Show in the past two years.

- The Research Updates for Agricultural Professionals program has been held 16 years. It continues to be the second best attended IAP program, with nearly 400 agricultural professionals attending one of the seven one-half day meetings held across the State.
- The Field School's 2-day, "hands-on" in-field curricula was conceived in the late 1980's and provides an in-depth educational experience to approximately 100 participants per field school. Anonymous selected comments from this year's program are as follows:

Selected Comments:

Anonymous, 2008 – 'This is my "Got to do program of the season" – don't change'
Anonymous, 2008 – 'Have attended Field Schools in Nebraska and Iowa. Your Field School is the best and your faculty are knowledgeable and committed'

Invasive Species and Biological Control

Cooperative efforts with U of M faculty in Entomology, USDA/ARS and with Minnesota state agencies have resulted in successful biological control programs in Minnesota for purple loosestrife and leafy spurge, and in current involvement in the control of garlic mustard.

The purple loosestrife biological program has been so successful that this weed is no longer consided a significant management target in Minnesota and the leafy spurge biological control program has resulted in significant reductions of herbicide use in Minnesota.

Key education efforts on invasive species include, in 2006, organizational programming efforts through the North Central Weed Science Society and the Midwest Invasive Plant Network resulting in the first joint meeting of these two groups. The integration of these two organizations improved their efficiencies of scale and enhanced their knowledge base and capacity. In 2007, Minnesota hosted the first Minnesota Invasive Terrestrial Plant Management Conference which has evolved in 2008 to encompass all invasive species.

Future directions and needs: As traditional funding for Extension declines, it will be important to organize Extension in a manner that will increase its ability to attract grant dollars from agencies and industry as well as generate revenue for sustainable fee-based programs. The program areas described above are designed to accomplish these objectives. Future directions for Extension will include the need to broaden programmatic scope in response to the breadth of issues now facing agriculture and the environment. To illustrate, a search has just begun for a Regional Extension Educator position that will begin to address the development of sustainable cropping systems for renewable energy feedstocks to support efficient bioenergy production systems.

To increase the ability to attract extension and applied research dollars to extension programming, it will also be necessary for the Extension program team members to continue to organize and improve coordination of programming and research issues across our various crops, discipline and audience boundaries. Recently Extension has converted 50% of a Regional Educator position to a Program Coordinator role for the Institute for Ag Professionals program area. Increasing the leadership capacity of our existing Extension faculty will further improve our ability to communicate and provide more effective program leadership. Also, increasing our capacity and ability to use newer electronic media delivery systems could improve our ability to communicate more efficiently. Increasing Extension's and the Department's "digital capacity" will also help us to better serve our diverse clientele by increasing and improving web presence and helping Extension faculty to properly use technology for existing and future programming needs and audiences.

At the college and programmatic level, it will also become increasingly important for faculty to increase their ability to better evaluate and, where appropriate, document programmatic impact. Extension has begun to address this need and continuous improvement in this area should help to sustain, or perhaps increase funding from government agencies and industry.

Future outlook and goals: As increasingly complex and integrated issues involving agriculture and other natural resources emerge, the citizens of Minnesota are going to be asking us how to best handle these issues. To illustrate, how do we address energy production and biofuels or agricultural production profitability and water quality? The research and educational capacity for these and many other issues does not reside solely within Extension. Therefore, a future goal would be to increase the linkages of our existing extension programming capacity to faculty that do not have extension appointments. To some degree this is occurring, but as the complexity of the issues increases so does the need for extensive interactions.

Another trend that is very tangible at this time is a lack of interested and qualified candidates for faculty positions in applied crop science / extension positions. This lack of young scientists that want to choose Extension as a career is highlighted in job searches throughout the country where search committees deal with making faculty selections from a low number of qualified applicants. There are likely many reasons for this problem, but as senior Extension faculty change appointments or retire or new positions are developed the problem will manifest itself in difficulty to find faculty that can meet the future challenges in agriculture. One possible goal that could be addressed within the Department that could help alleviate this problem would be to increase linkages to the graduate program and increase student exposure to the challenges and rewards of applied research and extension.

Table 20. University of Minnesota Key Collaborations of Faculty (2003-2008).

Faculty/Collaborator	Affiliation	Nature of Collaboration
Anderson, James		
Jim Kolmer	USDA-ARS, Plant Pathology	Leaf rust screening and mapping
Yue Jin	USDA-ARS, Plant Pathology	Stem rust screening and mapping
Ruth Dill-Macky	Plant Pathology	Fusarium head blight screening and mapping
Jochum Wiersma	NWROC	Performance testing of advanced lines, intensive management
Gary Muehlbauer	Agronomy & Plant Genetics	Expression analysis of FHB NILs, Response to density stress
Rex Bernardo	Agronomy & Plant Genetics	Statistical consultation, Response to density stress
Kevin Smith	Agronomy & Plant Genetics	Response to density stress
Nathan Springer	Plant Biology	Response to density stress
Becker, Roger		
Vince Fritz	Horticultural Science	Processing vegetable weed management
Milt Haar	Agronomy and Plant Genetics	Canada thistle management
Craig Sheaffer	Agronomy and Plant Genetics	Forage and biomass establishment and weed management
David Ragsdale	Entomology	Biological Control of Weeds
Bernardo, Rex		
Hans J.G. Jung	USDA-ARS	Marker-based breeding for grain yield, agronomic traits, and stover-quality traits for ethanol production in maize
Ronald L. Phillips	Agronomy and Plant Genetics	Breeding and genetics of a unique strain of high-oil maize
Craig C. Sheaffer	Agronomy and Plant Genetics	Breeding potential of dwarf corn
Kevin P. Smith	Agronomy and Plant Genetics	Development of QTL Miner software for the Barley Coordinated Agricultural Project
Nathan Springer	Plant Biology	Genetic variation for response to high plant population density stress in maize
Cardwell, Vernon		
Susan Anderson	CFANS Education Specialist	Co-facilitator for K-12 Improving Teacher Quality (ITQ) Workshops; Co-facilitator for Food, Land and People workshops
Pauline Nichols	Head, SWROC	Co-PI for ITQ grants
Mary Brakke	Agronomy and Plant Genetics	Agro 1011 labs
Don Wyse	Agronomy and Plant Genetics	Agro 4603-team teaching
Sue Henderson	College of Continuing Education	College-In-The-Schools (CIS)
Brad Greiman	Work and Human Resources Education (Ag Education)	State FFA and MEd degree programs; CIS workshops for potential teachers of Agronomy
Coulter, Jeffery		
Dean Malvick	Plant Pathology	Foliar fungicide timing and rates in continuous corn.

		Corn response to foliar fungicide as affected by hail damage.
Daniel Kaiser	Soil, Water, and Climate	Optimization of remote sensing for supplemental nitrogen application in corn.
John Lamb	Soil, Water, and Climate	Optimization of remote sensing for supplemental nitrogen application in corn.
Tom Hoverstad	SROC	Corn response to planting date and plant population. Analysis of a long-term corn hybrid trial database.
Steve Quiring	SWROC	Corn response to planting date and plant population. Analysis of a long-term corn hybrid trial database.
Jeffrey Vetsch	SROC	Evaluation of starter fertilizer and plant growth promoters in corn cropping systems.
Lizabeth Stahl	Regional Extension Center – Worthington, MN	Soil structure and organic matter response to the adoption of conservation tillage.
Cuomo, Greg		
Paul Peterson	Agronomy and Plant Genetics	Annual ryegrass and native legume management
Lanny Schmidt	Chemical Engineering	Catalysts and management of anhydrous ammonia production.
Roger Ruan	Bioproducts and Biobased Systems Engineering	Catalysts for anhydrous ammonia production
Vance Morey	Bioproducts and Biobased Systems Engineering	Biomass densification
Vernon Eidman	Applied Economics	Ethanol economics
Jun Zhu	SROC	Swine manure for methane production
Nancy Carpenter	Chemistry: UM - Morris	Renewable energy undergraduate research opportunities.
Durgan, Beverly		
Frank Forcella	USDA-ARS	Weed management models
Jeff Gunsolus	Agronomy and Plant Genetics	Weed management systems – management model
Jochum Wiersma	Agronomy and Plant Genetics	Small grain production and weed management
Gregg Johnson	Agronomy and Plant Genetics	Site specific weed management
Krishona Martinson	University of Minnesota Extension	Weed management systems in small grains
Ehlke, Nancy		
JoAnn Lamb	USDA-ARS	Legume breeding for turf applications
Gary Muehlbauer	Agronomy and Plant Genetics	Genetic diversity of native species
Craig Sheaffer	Agronomy and Plant Genetics	Kura clover evaluations, polycultures, warm and cool-season grasses for biomass, native legumes
Eric Watkins	Horticultural Science	Turf grass breeding and seed production
Donald Wyse	Agronomy and Plant Genetics	Perennial ryegrass breeding, turf and legume seed production, polycultures and grasses for biomass, native legumes
Gunsolus, Jeffery		
Gregg Johnson	SROC	Applied weed management research
Tom Hoverstad	SROC	Applied weed management research
Jodie Getting	SWROC	Applied weed management research
Fritz Brietenbach	IPM Specialist - Rochester	Applied weed management research
Roger Becker	Agronomy and Plant Genetics	Learning groups for implementation of IPM

Nick Jordan	Agronomy and Plant Genetics	Learning groups for implementation of IPM
Bev Durgan	Agronomy and Plant Genetics	Applied weed management research and graduate training

Haar, Milton		
Roger Becker	Agronomy and Plant Genetics	Canada thistle dispersal and management
Senyu Chen	SROC – Plant Pathology	Soybean cyst nematode management
Carmen Fernholz	SWROC	Organic agriculture no-till and transition
Jeff Gunsolus	Agronomy and Plant Genetics	Glyphosate time of application
Ian MacRae	IPM	Soybean pest management
Albert Markhart	Horticultural Science	Natural product herbicides
Paul Porter	Agronomy and Plant Genetics	Organic crop production
Bruce Potter	IPM	Soybean pest management
Craig Sheaffer	Agronomy and Plant Genetics	Risk management organic crop production
Donald Wyse	Agronomy and Plant Genetics	Cover crops for carbon sequestration and no-till crop production

Johnson, Gregg		
Craig Sheaffer	Agronomy and Plant Genetics	Legume production for biomass, evaluation of alternative plant material, production of forage polycultures.
Jeff Gunsolus	Agronomy and Plant Genetics	Weed management trials
Ulrike Tschirner	Bioproducts and Biosystems Eng.	Evaluation of fiber length in biomass crops
Donald Wyse	Agronomy and Plant Genetics	Evaluation of alternative plant material, Canada thistle management in organic systems, water quality in perennial cropping systems.
Hans Jung	USDA ARS	Evaluation of fermentable sugars in biomass crops
Dean Current	UM CINRAM	Economic analysis of biomass cropping systems
Ken Brooks	Forest Resources	Water quality in perennial cropping systems
Sudipto Banerjee	Biostatistics	Statistical modeling
Bill Berguson	UM NRRI	Poplar production
Senyu Chen	Plant Pathology	Alternative crops

Jordan, Nicholas		
Donald Wyse	Agronomy and Plant Genetics	Multifunctional agriculture, perennial production systems
Helene Murray	Agronomy and Plant Genetics	Green Lands Blue Waters project, sustainable grazing
Craig Sheaffer	Agronomy and Plant Genetics	Sustainable grazing, perennial production system
Gary Muehlbauer	Agronomy and Plant Genetics	DNA-based analysis of mycorrhizal fungi communities
David Mulla	Soil, Water and Climate	Multifunctional agriculture and land-use
Linda Kinkel	Plant Pathology	Ecology of plant-soil microbial interactions
Kristen Nelson	Forest Resources	Sustainable grazing
Diane Larson	Ecology, Evolution and Behavior	Ecology of plant-soil microbial interactions
Steven Manson	Geography	Sustainable grazing systems
Dean Current	Forest Resources	Multifunctional agriculture

Muehlbauer, Gary		
Kevin Smith	Agronomy and Plant Genetics	FHB mapping, Barley CAP, RNA profiling barley during germination, mapping disease resistance loci in wild barley, linkage disequilibrium and origins of wild barley
Brian Steffenson	Plant Pathology	Barley CAP, linkage disequilibrium and origins of wild barley, mapping disease resistance loci in wild barley, RNA profiling wild barleys during infection
David Garvin	USDA-ARS, St. Paul	Physical mapping of genes to barley chromosomes, developing fast cycling wheat for FHB studies
Carroll Vance	USDA-ARS, St. Paul	Genomics of oil and protein in soybeans
Corby Kistler	USDA-ARS, St. Paul	Genomics of Fusarium graminearum
Ruth Dill-Macky	Plant Pathology	Testing transgenic wheat for resistance to FHB
Rex Bernardo	Agronomy and Plant Genetics	Barley CAP
Nancy Ehlke	Agronomy and Plant Genetics	Diversity of native plants in Minnesota
Nick Jordan	Agronomy and Plant Genetics	Diversity of arbuscular mycorrhizal fungi
Jim Anderson	Agronomy and Plant Genetics	Genomic characterization of the wheat chromosome 3BS FHB resistance QTL
Naeve, Seth		
James Orf	Agronomy and Plant Genetics	Cooperate on research on seed quality traits. Conduct two surveys of the US soybean crop each year for international marketing purposes.
George Rehm (retired)	Soil, Water, and Climate	Collaborated on several iron deficiency chlorosis research projects
Dean Malvick	Plant Pathology	Collaborate on many soybean extension projects
Bruce Potter	SWROC	Collaborate on applied soybean research projects dealing with diseases, insects and plant physiological responses to these and the environment
Yung-Tsi Bolon	USDA-ARS, St. Paul	Collaborate on a large soybean mutagenesis project focused on development of populations with unique seed quality characteristics
Orf, Jim		
Senyu Chen	Plant Pathology (SROC)	Soybean cyst nematode
Sue Gibson	Plant Biology	Soybean genomics
Jim Kurle	Plant Pathology	Soybean diseases
Mindy Kurzer	Food, Science and Nutrition	Soybean isoflavones
Seth Naeve	Agronomy and Plant Genetics	Protein and oil content of soybean varieties
David Ragsdale	Entomology	Soybean aphid
Lori Scott	Agronomy and Plant Genetics	Iron deficiency chlorosis
Craig Sheaffer	Agronomy and Plant Genetics	Forage soybeans
David Somers	Agronomy and Plant Genetics	Soybean seed polysaccharides
Nevin Young	Plant Pathology	Soybean cyst nematode
Peterson, Paul		
Craig Sheaffer	Agronomy & Plant Genetics	Alternative legume, grass, and alfalfa management; forage quality evaluation; forage varietal trials
Greg Cuomo	WCROC, UMore Park	Pasture management research
Russell Mathison	NCROC	Grass and alfalfa-grass mixture research

Doug Holen	Extension	Emergency forage and alfalfa research; forage Extension programming
Krishona Martinson	Extension	Forage and equine Extension programming
Jim Linn	Animal Science	Alfalfa and grass dairy feeding research
Ryon Walker	Extension	Beef forage research and Extension programming
Dan Martens	Extension	Forage Extension programming
Hans Jung	USDA-ARS	Alfalfa and grass dairy feeding research
Phillips, Ronald		
Howard Rines	USDA-ARS, St. Paul	NSF grant on oat-maize addition lines
Hans Jung	USDA-ARS, St. Paul	Improving fiber digestibility by reducing ferulate esters
Rex Bernardo	Agronomy and Plant Genetics	Evaluating high-oil trait in elite corn lines
Roger Ruan	Bioproducts /Biosystms Eng.	Embryo fractionation with high-oil maize
Doug Tiffany	Applied Economics	Determining economic value of high-oil corn
Nathan Springer	Plant Biology	Expression profiling analyses
Raymie Porter	NCROC	Wild rice molecular genetics
F. Diez-Gonzalez	Food Science and Nutrition	Transgenic maize effective against *E. coli* 157:H7
Georgiana May	Ecology, Evolution, & Behavior	QTL analysis of *Ustilago maydis* resistance
Deon Stuthman	Agronomy and Plant Genetics	QTL analysis of oat crown rust
Porter, Paul		
John Baker	USDA-ARS St. Paul	Rye growth and development as a cover crop
Bud Markhart	Horticulture	Student organic farm
George Heimpel	Entomology	Aphids in soybeans grown into rye
Kent Olson	Applied Economics	Profitability of organic crop rotations / teaching
Gary Sands	Bioproducts and Biosystems Engineering	Modeling of rye growth and development as a cover crop
Mike White	Animal Science	Teaching
Sheaffer, Craig		
JoAnn Lamb	USDA-ARS	Alfalfa for biofuels
John Lamb	Soil, Water and Climate	Fertilization of biofuels
Marcia Hathaway	Animal Science	Feeding trials of alternative crops
Don Wyse	Agronomy and Plant Genetics	Organic agric.; native biofuels
Greg Johnson	Agronomy and Plant Genetics	Native plant biofuels
Milt Haar	SWROC	Organic agriculture
Ken Brooks	Forest Resources	Water quality measurement
Nancy Ehlke	Agronomy and Plant Genetics	Kura clover evaluation
Hans Jung	USDA-ARS	Biofuels
Smith, Kevin		
Gary Muehlbauer	Agronomy and Plant Genetics	Barley genomics and genetics, gene discovery for Fusarium head blight resistance and malting quality
Brian Steffenson	Plant Pathology	Genetics of disease resistance to Fusarium Head Blight, Septoria Speckled Leaf Blotch, Net Blotch
Ruth Dill-Macky	Plant Pathology	Breeding for resistance to Fusarium head blight and net blotch in barley
Rex Bernardo	Agronomy and Plant Genetics	Development of QTL Miner software for the Barley Coordinated Agricultural Project
Jim Anderson	Agronomy and Plant Genetics	Density dependent stress response

Jochum Wiersma	Agronomy and Plant Genetics	Barley variety evaluation
Nathan Springer	Plant Biology	Density dependent stress response
Mary Brakke	Agronomy and Plant Genetics	Problem-based learning in undergraduate non-majors biology course
Stuthman, Deon		
Martin Carson	USDA-ARS	Durable crown rust resistance
Ruth Dill-Macky	Plant Pathology	Smut resistance
Jim Anderson	Agronomy and Plant Genetics	Wet lab facility for grad student
Howard Rines	USDA-ARS	Genetics of oats, markers
Tom Hoverstad	SROC-Waseca	Variety testing
Steve Quiring	SWROC-Lamberton	Variety testing
George Nelson	WCROC-Morris	Variety testing
Katherine Klink	Geography	Impact of climate change on small grain productivity
Jochum Wiersma	NWROC-Crookston	Variety testing and impact of climate change on small grain productivity
Stupar, Robert		
James Orf	Agronomy and Plant Genetics	Co-advising graduate student Dhananjay Mani on soybean breeding and genomics
Donald Wyse	Agronomy and Plant Genetics	Co-advising graduate student Mikey Kantar on perennial sunflower project
Nevin Young	Plant Pathology/Plant Biology	Soybean intraspecific allelic variation
Nathan Springer	Plant Biology	Maize intraspecific allelic variation
Wiersma, Jochum		
Beverly Durgan	Agronomy and Plant Genetics	Herbicide evaluations and wild oat emergence modeling
James Anderson	Agronomy and Plant Genetics	Variety testing
Kevin Smith	Agronomy and Plant Genetics	Variety testing
Deon Stuthman	Agronomy and Plant Genetics	Impact of climate change on small grain productivity
Katherine Klink	Geography	Impact of climate change on small grain productivity
Jeff Strock	SWROC-Lamberton	Winter wheat management
Dan Kaiser	Soil, Water and Climate	N and S management
Albert Sims	NWROC-Crookston	N and S management
Wyse, Donald		
Craig Sheaffer	Agronomy and Plant Genetics	Organic systems, polyculture, warm and cool-season grasses for biomass, water quality and environmental services
Peter Graham	Soil, Water and Climate	Nitrogen fixation in native legumes, biomass systems
Eric Watkins	Horticultural Science	Turf grass breeding and seed production
Nancy Ehlke	Agronomy and Plant Genetics	Perennial ryegrass breeding, turf and legume seed production, polycultures and grasses for biomass, native legumes
Ruth Shaw	Ecology	Gene flow in sunflower
Milt Haar	Agronomy and Plant Genetics	Cover crop management—organic systems

Micheal Russelle	USDA Plant Science Unit	Water quality and leaching in tileline systems
Dean Current	CINRAM	Development of multifunctional landscape systems
Ken Brooks	CINRAM	Hydrology of multifunctional landscape systems
John Nieber	Biosystems Engineering	Mapping of invasive species in DOT systems

Adjunct USDA-ARS Faculty Housed in the Department of Agronomy and Plant Genetics

Garvin, David		
Ruth Dill-Macky	Plant Pathology	Fusarium head blight resistance improvement in wheat
Gary Muehlbauer	Agronomy and Plant Genetics	Physical mapping of genes to barley chromosomes
Yue Jin	USDA-ARS, Plant Pathology	Stem rust resistance in wheat
Jim Kolmer	USDA-ARS, Plant Pathology	Leaf rust resistance in wheat
Les Szabo	USDA-ARS, Plant Pathology	Stem rust resistance in *Brachypodium distachyon*

Gronwald, John		
Carroll Vance	USDA-ARS, St. Paul	Developing alfalfa as a biofuel feedstock
Hans Jung	USDA-ARS, St. Paul	Developing alfalfa as a biofuel feedstock
JoAnn Lamb	USDA-ARS, St. Paul	Developing alfalfa as a biofuel feedstock
Deborah Samac	USDA-ARS, St. Paul	Developing alfalfa as a biofuel feedstock
Wayne Xu	Supercomputing Institute	Alfalfa bioinformatics

Jung, Hans-Joachim		
JoAnn F. S. Lamb	USDA-ARS, St. Paul	Alfalfa breeding for livestock feed and bioenergy
James G. Linn	Animal Science	Forage fiber utilization by dairy cows
Donna Z. Bliss	School of Nursing	Dietary fiber to treat fecal incontinence
Rex Bernardo	Agronomy and Plant Genetics	Breeding for corn stover quality in bioenergy
Ronald L. Phillips	Agronomy and Plant Genetics	Development of corn mutant with reduced cross linking
Paul Peterson	Agronomy and Plant Genetics	Forage fiber utilization by dairy cows
Don Wyse	Agronomy and Plant Genetics	Evaluation of bioenergy crops
Craig C. Sheaffer	Agronomy and Plant Genetics	Evaluation of bioenergy crops
Gregg A. Johnson	Agronomy and Plant Genetics	Evaluation of bioenergy crops

Lamb, JoAnn		
Nancy Ehlke	Agronomy and Plant Genetics	Alfalfa for turf applications
Hans Jung	USDA-ARS	Breeding for improved fiber digestibility and biofuel conversion efficiency in alfalfa.
Deborah Samac	USDA-ARS	Evaluating germplasms for disease resistance and biomass production
Craig Sheaffer	Agronomy and Plant Genetics	Evaluating and selecting alfalfa for bioenergy production
Michael Russelle	USDA-ARS	Nutrient cycling, N uptake, N_2 fixation and manure tolerance in alfalfa.
Michael Schmitt	Soil Water and Climate	Manure tolerance in alfalfa.

Rines, Howard		
Ron Phillips	Agronomy and Plant Genetics	Generation and characterization of oat-maize chromosome addition lines and radiation hybrids
Deon Stuthman	Agronomy and Plant Genetics	Development and field testing of oat germplasm

		lines
Marty Carson	USDA-ARS Cereal Disease Lab	Identification and introgression of oat crown rust resistance from lower ploidy oat species
Nathan Springer	Plant Biology	Gene expression in oat-maize addition lines
Carroll Vance	USDA-ARS, St. Paul	Generation of oat cDNA libraries
Vance, Carroll		
Deborah Allan	Soil, Water and Climate	Lupin adaptation to phosphorus stress
Steve Gantt	Plant Biology	Genomics and molecular aspects of Medicago
Michael Sadowsky	Soil, Water and Climate	Bioremediation of atrazine
Gary Muehlbauer	Agronomy and Plant Genetics	Soybean genomics
John Gronwald	USDA-ARS, St. Paul	Medicago genomics
Debby Samac	USDA-ARS, St. Paul	Medicago genomics
Kate VandenBosch	Plant Biology	Medicago genomics
Peter Graham	Soil, Water and Climate	Symbiotic nitrogen fixation legumes

Table 21. External Key Collaborations of Faculty (2003-2008).

Faculty/Collaborator	Affiliation	Nature of Collaboration
Anderson, James		
Gary Hareland	USDA-ARS, Fargo, ND	End-use quality testing of wheat lines
Shiaoman Chao	USDA-ARS, Fargo, ND	Marker genotyping
Mohamed Mergoum	North Dakota State University	Cooperative testing of advanced wheat lines
Karl Glover	South Dakota State University	Cooperative testing of advanced wheat lines
Jorge Dubcovsky	University of California-Davis	WheatCAP project: mapping and MAS
Bikram Gill	Kansas State University	*Fhb1* cloning
Mark Sorrells	Cornell University	Stem rust mapping
Mike Pumphrey	USDA-ARS, Manhattan, KS	*Fhb1* cloning
Ravi Singh	CIMMYT	Leaf rust screening, germplasm evaluation
Justin Faris	USDA-ARS, Fargo, ND	Disease resistance mapping
Becker, Roger		
Luke Skinner	MnDNR	Biological control of purple loosestrife, garlic mustard, buckthorn and Canada thistle management.
Chuck Dale	MDA	Weed management, noxious weed management, biological control of weeds.
Anthony Cortilet	MDA	Weed management, noxious weed management, biological control of weeds.
Joe Zachmann	MDA	Water quality and herbicides
Marty Williams	USDA-ARS, Urbana, IL	Sweet corn weed management
Chris Boerboom,	UW-Madison	Sweet corn weed management
Mark Renz	UW-Madison	Invasive weed management.
Jerry Doll	UW-Madison	Invasive weed management.
Rod Lym	NDSU	Invasive weed management.
Bernardo, Rex		
Dwight Bostwick	Syngenta Seeds	Exploiting doubled haploids and molecular markers in maize breeding
Alain Charcosset	Institut National de la Recherche Agronomique	Marker-assisted breeding for complex traits in maize
Laurence Moreau	Institut National de la Recherche Agronomique	Marker-assisted breeding for complex traits in maize
Bertrand Parisseaux	Limagrain Verneuil Holding	Mixed-model mapping of quantitative trait loci
Bruno Poupard	Limagrain Verneuil Holding	Applications of machine learning in breeding for complex traits in plants
Jianming Yu	Kansas State University	Genomewide selection in plants
Cardwell, Vernon		
Alan Withers	MN Dept of Agriculture	Minnesota Ag-In-The-Classroom
Tom Loynachan	SSSA and ISU	SSSA-S591 K-12 Committee
John Davis	National Food Land & People Project	Directing K-12 Ag literacy efforts
Chyrstal Dunker	Director of the Prairie Ecology Bus Center	Co-Facilitator ITQ K-12 teacher workshops

Coulter, Jeffery		
Emerson Nafziger	University of Illinois	Corn response to twin rows and plant population in southern Minnesota. Residue, tillage, and nitrogen influences on soil productivity in continuous corn.
Nicolas Martin	Syngenta – Stanton, MN	Analysis of a long-term corn hybrid trial database.
Cuomo, Greg		
Vance Owens	South Dakota State University	Native gasses for biomass
Durgan, Beverly		
Richard Zollinger	North Dakota State University	Wild oat herbicide resistance
Alan Dexter	North Dakota State University	Herbicide resistance weeds
Ehlke, Nancy		
Arvid Boe	South Dakota State University	Biomass and polycultures for energy
Michael Casler	USDA-ARS DFRC	Biomass and forage grass evaluations
William Meyers	Rutgers University	Turf grass breeding and genetics
Shaun Bushman	USDA-ARS FRRL	*Lolium* molecular genetics
Michael Peel	USDA-ARS FRRL	Kura clover evaluation
Heathcliff Riday	USDA-ARS DFRC	Kura clover evaluation
Gunsolus, Jeffery		
Frank Forcella	USDA/ARS, Morris, MN	Weed management research and graduate training
Sharon Clay	South Dakota State University	Weed management research and graduate training
Chris Boerboom	University of Wisconsin	Extension weed management educational programming
Bob Hartzler	Iowa State University	Extension weed management educational programming
Haar, Milton		
Patrick Carr	North Dakota State University	Cover crops for no-till organic agriculture
Kathleen Delate	Iowa State University	Reduced tillage in organic agriculture
Walter Goldstein	Michael Fields Institute	High methionine corn varieties
Matthew Harbur	Alfred State College	Risk management organic crop production
Jeff Moyer	Rodale University	No-till organic agriculture
Erin Silva	University of Wisconsin	Reduced tillage in organic agriculture
Johnson, Gregg		
Tim Volk	SUNY – Syracuse	Willow production for biomass
Don Riemenschneider	US Forest Service	Poplar production for biomass
Adam Davis	USDA ARS – Illinois	Weed Ecology
Jordan, Nicholas		
Scott Peters	Cornell University	Civic engagement in Land-grant food system research
Maggi Adamek	Kellogg Foundation	Civic engagement in Land-grant food system

		research
Cynthia Pansing	Mississippi River Basin Alliance	Green Lands Blue Waters Consortium development
Keith Warner	Santa Clara University	Multifunctional agriculture
David Clements	Trinity Western University	Adaptation in weed populations
Muehlbauer, Gary		
Robbie Waugh	Scottish Crop Research Institute, Scotland	SNP mapping, gene expression atlas of barley, barley TILLING population
Timothy Close	UC, Riverside	SNP mapping, integrating barley genetic and physical maps
Roger Wise	USDA-ARS, Ames, IA	Developed Barley1 GeneChip
Patrick Hayes	Oregon State University	Barley CAP, mapping disease resistance in wild barley
Peter Langridge	University of Adelaide, Australia	Gene expression atlas of wheat
Andy Kleinhofs	Washington State University	Integrating barley genetic and physical map, developed Barley1 GeneChip
Shahryar Kianian	North Dakota State University	Characterizing low tillering wheat mutants
Mike Scanlon	Cornell University	Genetic control of maize shoot apical meristems
Nils Stein	Institute of Plant Genetics and Crop Plant Research, Germany	SNP mapping
Andy Flavell	University of Dundee, Scotland	Characterized a barley transposon
Naeve, Seth		
Palle Pedersen	Iowa State University	Co PI on eXtension program and Co-PI on an upcoming (2008-2010) United Soybean Board Research Project
Chad Lee	University of Kentucky	Co PI on eXtension program and Co-PI on an upcoming USB research project
Kurt Thelen	Michigan State University	Upcoming USB research project
Jeremey Ross	University of Arkansas	Upcoming USB research project
James Board	Louisiana State University	Upcoming USB research project
Orf, James		
Roger Boerma	University of Georgia	Molecular genetics of soybean
Joe Burton	USDA-ARS – NC State	Increased soybean protein lower phytate
Tommy Carter	USDA-ARS – NC State	Drought tolerance in soybean
Brian Diers	University of Illinois	Soybean aphid
Walter Fehr	Iowa State University	Altered fatty acids in soybean
Ted Helms	North Dakota State University	Soybean breeding and genetics
Randy Nelson	USDA-ARS – Urbana, IL	Soybean genetic diversity
Vince Pantelone	University of Tennessee	Soybean fatty acids and methionine
Roy Scott	South Dakota State University	Soybean breeding and genetics
Jim Specht	University of Nebraska	Drought tolerance in soybean
Peterson, Paul		
Dan Undersander	University of Wisconsin	Multi-state Extension and popular press writing,

		multi-state applied forage research projects
Philippe Seguin	McGill University	Kura clover no-till seeding research
Richard Leep	Michigan State University	Multi-state Extension and popular press writing, multi-state applied forage research projects
Edward Rayburn	West Virginia University	Co-authored NRAES book chapters
Doo-Hong Min	Michigan State University	Grass management research
Marvin Hall	Penn State University	Multi-state grass variety research, popular press writing
Jerry Cherney	Cornell University	Multi-state alfalfa maturation research
Dwain Meyer	North Dakota State University	Popular press writing and Extension programming
Geoff Brink	USDA-ARS DFRC	Extension programming, popular press writing
Phillips, Ronald		
Richard Kowles	St. Mary's Univ. Minnesota	Transfering C4 photosynthesis from corn to oat
Roberto Tuberosa	Univ. Bologna, Italy	Cloning a flowering QTL in maize
Nurul Faridi	Texas A&M University	Explaining genetic behavior of Chestnut via cytology
Noel Magor	IRRI	UofM/IRRI graduate student shuttle program
Mark Sorrells	Cornell University	Molecular genetic mapping of oats
Nick Tinker	Agriculture and Agri-Food Canada	Molecular genetic mapping of oats
George Fedak	Agriculture and Agri-Food Canada	Molecular genetic mapping of oats
Steve Molnar	Agriculture and Agri-Food Canada	Molecular genetic mapping of oats
Ivica Buhinicek	Univ. Zagreb	Breeding of high-oil corn
Porter, Paul		
Patrick Carr	North Dakota State University	Organic and alternative cropping systems
Louis del Rio	North Dakota State University	Disease issues (sclerotinia) in canola
Gary Feyereisen	USDA-ARS Pennsylvania	Modeling rye growth and development as a cover crop
Hans Kandel	North Dakota State University	Organic and alternative cropping systems
Mary Wiedenhoeft	Iowa State University	Teaching / alternative cropping systems
Sheaffer, Craig		
Ken Albrecht	University of Wisconsin	Kura clover-grass mixtures for grazing
Arvid Boe	South Dakota State University	Native plants for biomass production
Marvin Hall	Penn. State University	Forage software development
Dwain Meyer	North Dakota State University	Native plants for biomass production
Phillippe Seguin	McGill University	Kura clover and perennial legume evaluation
Don Undersander	University of Wisconsin	Alfalfa yield and quality testing
Smith, Kevin		
Rich Horsley	North Dakota State University	Barley breeding and genetics
Blake Cooper	Busch Agriculture LLC	Barley breeding and genetics
Mark Schmidt	USDA-ARS	Malting quality of barley
Stephen Neate	North Dakota State University	Disease resistance in barley
Shiaoman Chao	USDA ARS	Marker assisted selection

Paul Schwarz	North Dakota State University	Malting quality of barley
Pat Hayes	Oregon State University	Winter barley
Stuthman, Deon		
B. Rossnagel	CDC Sask. Sask.	Rust and smut evaluation, milling quality, and germplasm exchange
R. Barnett	Univ of Florida	Quaker International Oat Nursery
S. Harrison	Louisiana State Univ	Quaker International Oat Nursery
E. Jackson	USDA-ARS, Aberdeen, ID	Durable adult plant crown rust resistance
J. Jannink	USDA Cornell	Variety mixture suppression of crown rust
M. McMullen	North Dakota State Univ	Pre-regional trial
L. Hall	South Dakota State Univ	Pre-regional trial
K. Armstrong	Crop and Food, New Zealand	Winter Nursery
F. Kolb	Illinois	Crown rust and smut evaluation
M. Bonman	USDA-ARS, Aberdeen, ID	Durable adult plant crown rust resistance
Stupar, Robert		
Scott Jackson	Purdue University	Homeologous allelic variation
Jonathan Wendel	Iowa State University	Homeologous allelic variation
Brent Hulke	USDA-ARS, Fargo, ND	Perennial sunflower
Wiersma, Jochum		
Joel Ransom	NDSU	Winter wheat management, Small Grains Field Guide
Frank Forcella	USDA-ARS	Wild oat emergence modeling, WheatScout Decision Support System
Dave Torgerson	Minnesota Association of Wheat Growers	Small Grains website and Prairie Grains magazine
Wyse, Donald		
Brent Hulke	USDA-ARS Sunflower Lab-Fargo, ND	Breeding and genetics of perennial sunflower
Jason Fischbach	University of Wisconsin	Selection and development of hazelnut germplasm
Lee DeHaan	Land Institute, KS	Development of perennial grains
Bennasser Alaoui	AIV Rabat, Morocco	Natural products exploration
Brent McCown	University of Wisconsin	Development of hazelnut germplasm
Frank Young	USDA-ARS Pullman, WA	Development of oil seed crop for renewable energy
Dale Mutch	Michigan State University	Development of regional cover crops
Eileen Kldivko	Purdue, IN	Development of regional cover crops
Annie Verhallen	Guelph, Ontario, CANADA	Development of regional cover crops
Tom Kasper	USDA-ARS Ames , Iowa	Development of regional cover crops

Adjunct USDA-ARS Faculty Housed in the Department of Agronomy and Plant Genetics

Garvin, David		
Richard Amasino	University of Wisconsin	Cell wall trait variation in *Brachypodium distachyon*
Michael Bevan	John Innes Centre	Genome sequencing of *Brachypodium*

		distachyon
Lance Gibson	Iowa State University	Fusarium head blight improvement in triticale
Karl Glover	South Dakota State University	Root biomass effects on mineral micronutrient accumulation in wheat
Todd Mockler	Oregon State University	Transcriptome analysis of *Brachypodium distachyon*
Luis Mur	University of Wales	Metabolome analysis of grass-rust pathosystems
Nicola Pecchioni	University of Modena, Italy	Genetics of rust resistance in *Brachypodium distachyon*
John Vogel	USDA-ARS WRRC	Genome sequencing of *Brachypodium distachyon*
Jung, Hans-Joachim		
Kenneth P. Vogel	USDA-ARS, Lincoln, NE	Evaluation of switchgrass for bioenergy
Bruce S. Dien	USDA-ARS, Peoria, IL	Ethanol production from alfalfa stems
Akwasi A. Boateng	USDA-ARS, Wyndmoor, PA	Thermal-chemical conversion of alfalfa stems to bioenergy
Michael D. Casler	USDA-ARS, Madison, WI	Selection for reduced cross linking in perennial grasses
David R. Mertens	USDA-ARS, Madison, WI	Evaluation of fiber utilization by dairy cows
William F. Anderson	USDA-ARS, Tifton, GA	Evaluation of bermudagrass for bioenergy
Lamb, JoAnn		
Akwasi A. Boateng	USDA-ARS-ERRC	Biofuel conversion of alfalfa stems
Arvid Boe	University of South Dakota	Alfalfa biomass and polycultures for energy
Michael Casler	USDA-ARS-USDFRC	Alfalfa biomass and polycultures for energy
Burce Dien	USDA-ARS-FBRU-NCAUR	Bioenergy conversion technology
Mark McCaslin	Forage Genetics International	Evaluation of lignin pathway knockouts in biomass alfalfas
Heathcliffe Riday	USDA-ARS-USDFRC	*Medicago falcata* and *sativa* biomass yield trials
Don Viands	Cornell University	*Medicago falcata* biomass yield trials
Rines, Howard		
Eric Jackson	USDA-ARS, Aberdeen, ID	Identification of QTLs for partial resistance to oat crown rust
Nick Tinker	Agriculture Canada, Ottawa	Development of DArT molecular marker system for oat
Mitchell Wise	USDA-ARS, Madison, WI	Assay of oat grain for oil, protein, and beta-glucan
Vance, Carroll		
Gina Hernendez	UNAM Cuernavaca Mexico	Common bean genomics of P and N
Janine Sherrier	University Delaware	Medicago symbiosome proteins
Miguel Lara	UNAM Cuernavaca Mexico	Nitrogen assimilation in legumes
Joachim Schulze	Gottingen Germany	Physiology of nitrogen fixation
Randy Shoemaker	USDA/ARS Iowa State	Soybean genomics iron deficiency chlorosis
Michelle Graham	USDA/ARS Iowa State	Legume genomics N and P
Jim Hanan	University Queensland Australia	Medicago growth analysis