Delivering Specialty Traits

Center Report
2004–2005
The Raymond F. Baker Center for Plant Breeding

—advances the science of plant breeding through hypothesis driven research,

—develops enhanced germplasm and superior cultivars for improved productivity, nutritional value, and adaptability,

—and trains the next generation of public and private plant breeders.
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*Nurturing a tradition of service to the people of Iowa, the nation, and the world.*
The Raymond F. Baker Center for Plant Breeding began in 2000 as a result of a generous endowment dedicated to continuing the work of Raymond F. Baker, a graduate of Iowa State University and renowned scientist with the Pioneer Hi-Bred Company in Johnston, Iowa. Mr. Baker's life-long objective was to produce basic, long-term research in plant breeding, and his vision serves as the mission for the Center. Members of the Center emulate Mr. Baker's high standards of research in crop improvement through the implementation of rigorous selection methods that improve yield stability, enhance germplasm, and create value-added traits for agronomic products. Center members work to improve agricultural crops essential to the economic health of Iowa, including corn, soybeans, forages, small grains, and potentially important new crops. The recent development of the low-linolenic soybean is one example of how advances by the Center's plant breeders can impact the economic health of Iowa farmers and producers and the physical health of Iowans. In addition, Center members lead projects on developing plants that can be used to produce energy from biomass, which may lead to renewed vigor of the agricultural industry.

The Center is committed to ensuring the future of plant breeding by recruiting and training the next generation of scientists. Center members serve as advisors on graduate committees for students working toward advanced degrees in Plant Breeding. More than 35 students studied for a graduate degree in Plant Breeding in 2004-2005. A mentoring program that pairs Center members with undergraduate students choosing the Plant Breeding and Biotechnology option was begun in fall 2005. Students will have the opportunity to learn about research conducted by Center members and pursue work and internship experiences that will augment their class work.

Members of the Raymond F. Baker Center for Plant Breeding are also dedicated to disseminating the results of their research to the general public and to Iowa farmers in particular. Center members are currently working in cooperation with the Iowa Crop Improvement Association to restructure the reporting of the Variety Testing Trials so that vital information about the performance of plant hybrids can be readily available when farmers are making crucial economic decisions. In addition, Center members conduct Field Day events for farmers and private sector industry representatives to communicate information about research projects and newly released inbred lines and cultivars.

The impact of the Center reaches far beyond the borders of Iowa, however. Members are involved in national forums that address the future of plant breeding and crop improvement, including the Seeds and Breeds II Conference, which evaluated the current state of public plant breeding programs. Members also travel around the world as invited speakers at conferences, symposia, and research centers. In the past two years, members have presented scientific research in several countries, including China, Serbia, Mexico, and South Africa. Dr. Jean-Luc Jannink, a Center member, is currently serving as an external member of a graduate panel for a student in France. Members of the Raymond F. Baker Center for Plant Breeding also collaboratively conduct research with several visiting international scientists each year. Scientists have traveled from Serbia, China, Japan, and Yugoslavia to work with members of our Center.

In this report you will see descriptions of the people and projects that contribute to fulfilling the mission set out by Raymond F. Baker. It is our hope that the work we do to improve agricultural crops leads to a strengthened economy for Iowa, improved health for its citizens, and increased diversity in plant germplasm. For updates on our research and news about people and events, visit our Web site at www.plantbreeding.iastate.edu.

Kendall R. Lamkey

Letter from the Director
The Raymond F. Baker Center for Plant Breeding is named after an extraordinary leader in Iowa’s agricultural history. Raymond F. Baker’s scientific rigor, his commitment to crop improvement, and his skillful leadership helped to foster a revolution in farming. His extensive research in corn breeding led to unprecedented innovations in the farming industry.

**A Growing Interest**

Raymond F. Baker’s interest in corn breeding began when he was attending Iowa State College, now called Iowa State University. In 1926, he met Henry Wallace who, working as a plant breeder, specialized in the development of high-yielding corn. Wallace persuaded Baker, then an agronomy student, to take some of Wallace’s inbred lines and make some experimental crosses. Baker agreed and asked his father to plant the special seeds during the spring planting season when Baker would be in Ames attending classes. His father agreed, but, as often happens on the farm, time grew short and his father decided to skip Raymond’s seeds in order to focus on planting the regular crop. Raymond’s mother, however, knowing Raymond’s interest in working with these plants, completed most of the planting herself, and helped to launch her son’s brilliant career as a hybrid-corn breeder. In fact, the next year, Baker’s hybrid crosses, developed from the seeds planted by his mother, won the highest honors in the Southern District of the Iowa Corn Yield Test.

**A Pioneering Plant Breeder**

During Baker’s senior year at Iowa State College, Henry Wallace hired him to work for the company Wallace had started—Hi-Bred Corn Company, later named Pioneer Hi-Bred Corn Company. Baker agreed, dropped out of college, and began his career as a plant breeder. (He completed his degree at Iowa State College a few years later.) Wallace mentored Baker in his early years at the Pioneer Hi-Bred Corn Company, teaching him techniques and procedures that took Wallace years of painstaking research. In 1933, when Wallace left for Washington to become Secretary of Agriculture in President Franklin Roosevelt’s administration, Baker was promoted to head Pioneer’s research program.

Raymond F. Baker worked as Pioneer’s lead plant breeder for 43 years, developing many of the company’s first cultivars. His rigorous scientific methods helped to lay the groundwork that made Pioneer Hi-Bred, International the successful seed corn company it is today.

**Far Ranging Pursuits**

Baker’s interests were far ranging. In 1934, he began working to develop the first hybrid chicken. Using many of the same techniques he learned from breeding corn, Baker produced chickens selected for increased egg production. The first hybrid chickens became available commercially in 1942. Trials proved that these chickens exhibited a 40%-50% increase in egg production over other chickens tested.

Even during his spare time, Baker’s passion for plant breeding flourished. As a weekend experimental project, he set about to cultivate the perfect watermelon. He grew inbred lines of the melons and crossed them into some excellent strains of watermelon hybrids. He often gave out packets of their seeds as gifts to very lucky colleagues.

Corn, chickens, watermelon—Raymond F. Baker was a man who, through the use of advanced scientific techniques and an understanding of plant selection and genetics, worked to change the future of farming and food production.
Kendall R. Lamkey, Corn Breeding
Director, Raymond F. Baker Center for Plant Breeding
Pioneer Distinguished Chair in Maize Breeding
Professor, Department of Agronomy
Ph.D. (Plant Breeding/Cytogenetics), 1985, Iowa State University
M.S. (Plant Breeding/Genetics), 1982, University of Illinois
B.S. (Agronomy), 1980, University of Illinois

E. Charles Brummer, Forage Breeding
Associate Professor, Department of Agronomy
Ph.D. (Agronomy/Plant Breeding), 1993, University of Georgia
M.S. (Agronomy/Plant Breeding), 1989, University of Georgia
B.S. (Agronomy), 1986, Pennsylvania State University

Walter R. Fehr, Soybean Breeding
Charles F. Curtiss Distinguished Professor in Agriculture
Professor, Department of Agronomy
Ph.D. (Plant Breeding/Genetics), 1967, Iowa State University
M.S. (Agronomy/Plant Genetics), 1962, University of Minnesota
B.S. (Agronomy), 1961, University of Minnesota

Arnel R. Hallauer, Corn Breeding
Distinguished Professor Emeritus, Department of Agronomy
Ph.D. (Plant Breeding), 1960, Iowa State University
M.S. (Plant Breeding), 1958, Iowa State University
B.S. (Plant Science), 1954, Kansas State University

Jean-Luc Jannink, Small Grains Breeding
Assistant Professor, Department of Agronomy
Ph.D. (Plant Breeding/Sustainable Agriculture), 1999, University of Minnesota
M.S. (Plant Sciences), 1995, University of Maine
B.A. (Biology), 1991, Haverford College

Michael Lee, Plant Breeding and Genetics
Professor, Department of Agronomy
Ph.D. (Plant Breeding), 1986, University of Minnesota
M.S. (Plant Breeding), 1984, University of Minnesota
B.S. (Plant Science), 1981, Rutgers University

Nurturing a tradition of service to the people of Iowa, the nation, and the world.
**THE PLANT BREEDING AND GENETICS PANEL**

Scientists in the Raymond F. Baker Center for Plant Breeding are also members of the Department of Agronomy’s Plant Breeding and Genetics Panel. The panel is a management unit in the Department of Agronomy and is chaired by Dr. Michael Lee. The panel considers current issues, programs, and needs in plant breeding and genetics research.

- Michael Lee (Chair), R. F. Baker Center for Plant Breeding
- Philip W. Becraft, Molecular Biology
- Madan Kumar Bhattacharyya, Agronomy
- Michael Blanco, USDA-ARS
- E. Charles Brummer, R. F. Baker Center for Plant Breeding
- Arden Campbell (Retired)
- Silvia Cianzio, Agronomy
- Jode Edwards, USDA-ARS
- Walter Fehr, R. F. Baker Center for Plant Breeding
- Candice Gardner, USDA-ARS
- David Grant, USDA-ARS
- HanPing Guan, BASF Plant Science, LLC
- Jean-Luc Jannink, R. F. Baker Center for Plant Breeding
- Kendall Lamkey, R. F. Baker Center for Plant Breeding
- Reid G. Palmer, USDA-ARS
- Peter A. Peterson, Agronomy
- Thomas A. Peterson, Molecular Biology
- Linda Pollak, USDA-ARS
- Patrick Schnable, Schnable Laboratory
- Paul Scott, USDA-ARS
- Randy Shoemaker, USDA-ARS
- Kan Wang, Agronomy
- Mark Widrlechner, USDA-ARS
- Kenneth Ziegler (Retired)

**USDA-ARS CORN INSECTS AND CROP GENETICS**

Since about 1922, scientists at Iowa State University have benefited from the presence of an outstanding United States Department of Agriculture-Agricultural Research Service (USDA-ARS) unit on campus working in the general area of plant breeding and genetics. Many members of the Raymond F. Baker Center for Plant Breeding maintain long-standing collaborations with the USDA-ARS Corn Insects and Crop Genetics Research Unit lead by Dr. Leslie C. Lewis.

- Leslie C. Lewis, Research Leader, Entomologist, Professor, Collaborator in Entomology
- Jode Edwards, Research Geneticist, Assistant Professor, Collaborator in Agronomy
- John C. Golden, Geneticist
- David M. Grant, Geneticist, Associate Professor, Collaborator in Agronomy
- Rex Nelson, Geneticist
- Reid G. Palmer, Geneticist, Professor, Collaborator in Agronomy
- Linda M. Pollak, Geneticist, Associate Professor, Collaborator in Agronomy
- Randy Shoemaker, Geneticist, Professor, Collaborator in Agronomy
- M. Paul Scott, Geneticist, Associate Professor, Collaborator in Agronomy
- Penny Meyerholz, Agricultural Science Research Technician
- Tracy D. Le, Biological Science Laboratory Technician
- Jody Hayes, Biological Science Technician
- Michelle Griffin, Biological Science Technician
- Lori Lincoln, Biological Science Technician
- Greg Peiffer, Biological Science Technician
- Merinda Struthers, Biological Science Technician
- Jill Van Wettering, Statistician
- Janet Erb, Secretary
The Raymond F. Baker Center for Plant Breeding, a Center affiliated with the Plant Sciences Institute and Iowa State University, is committed to the mission of the land-grant institution. It is a public sector breeding operation, responding to the needs of the people of Iowa. The Center works to develop and preserve elite germplasm and advocates its fair and public use for farmers, as well as public and private breeders.

The Center’s members have offices and lab space in Agronomy Hall on the campus of Iowa State University. In addition, facilities for cultivation, drying, and seed processing are housed at the Agronomy and Curtiss farms in Ames. Members also extensively use outlying research farms managed by the College of Agriculture for test plots and planting. Many of the Center’s constituents rent or lease crop land from Iowa farmers for plot work.

Members of the Center are full-time state employees who have primary faculty appointments in the Agronomy Department. They direct active plant breeding programs, advise graduate students majoring in plant breeding, and teach courses related to the plant breeding major.
**CENTER STAFF**

The Center employs talented and dedicated individuals who support the work of the members of the Raymond F. Baker Center for Plant Breeding. Many have advanced degrees in their field of study.

**Mike Barker**, Agricultural Specialist, Forage Breeding  
**Dan Duvick**, Research Associate, Soybean Breeding  
**James Jensen**, Field Specialist, Soybean Breeding  
**Susan Johnson**, Assistant Scientist, Soybean Breeding  
**Robbie Kerkove**, Office Coordinator  
**Diane Luth**, Assistant Scientist, Forage Breeding  
**Marcia Minear**, Administrative Specialist  
**George Patrick**, Research Associate, Small Grains Breeding  
**Kevin Scholbrock**, Research Associate, Soybean Breeding  
**Ronald Skrdla**, Agricultural Specialist, Small Grains Breeding  
**Mark Smith**, Agricultural Specialist, Forage Breeding  
**Grace Welke**, Assistant Scientist, Soybean Breeding  
**Paul White**, Field Lab Technician, Corn Breeding

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**VISITING AND POST-DOCTORAL SCIENTISTS**

The Raymond F. Baker Center for Plant Breeding attracts visitors from around the world. Center members work with visiting scientists on a variety of projects and research studies. In 2004-2005, the following scientists worked on research conducted at the Center.

**Sachiko Isobe**, National Agricultural Research Center, Hokkaido, Japan, worked with Dr. Brummer to identify genes associated with winter hardiness in alfalfa.

**Ksenija Markovic**, Maize Research Institute Zemun Polje, Belgrade, Yugoslavia, worked with Dr. Lee to identify methods to detect and use DNA polymorphism in maize breeding.

**Muhanad Akash**, worked with Dr. Jannink on QTL mapping in pedigrees and applying mixed model methodology to assess oat genotype competitive ability and selection for an ideal oat ideotype.

**Yudong (Mike) Zhang**, Postdoctoral Research Associate, worked with Dr. Lamkey to find alternative ways to analyze and discover epistatic interactions in maize.

**Goran Drinic**, Maize Research Institute Zemun Polje, Belgrade, Yugoslavia, worked with Dr. Lamkey on maize breeding.

**Xizhang (Henry) Song**, China, worked with Dr. Lamkey on maize breeding.

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Dr. Michael Lee and Research Associates Mary Jane Long and Wendy Woodman-Clikeman studied the effects of stress on genetic recombination.
The members of the Raymond F. Baker Center for Plant Breeding can list many achievements for 2004–2005. Included in their accomplishments are the development of germplasm that improves yield, increases nutritional value, enhances pest and disease resistance, and improves a plant’s tolerance to drought or extreme temperatures. These improvements to crops grown around the world are achieved through hypothesis-based research techniques, the careful selection of desired traits, and the application of genetic theory.

**Corn inbred lines licensed.** In 2004, 231 corn inbred line licenses were issued to 29 public or private institutions.

**Soybean inbred lines licensed.** In 2004, 430 soybean inbred line licenses were issued to 148 public or private institutions.

**New maize mapping population developed.** M. Lee conducted studies to advance the development of the IBM-10 maize mapping population for high-resolution genetic and physical mapping that is intended to replace the IBM-4 population. IBM-4 has become the standard-reference genetic map used by maize geneticists worldwide. It is available on the MaizeDB Web site and is a fundamental resource for the initiatives to determine the DNA sequence of the maize genome. When completed, the IBM-10 maize mapping population will be accessible from the Web and will be used by scientists worldwide to locate maize genes.

**Heterosis evaluated.** C. Brummer conducted testing to evaluate heterosis of alfalfa hybrids for increased crop yield.

**Genetic mapping completed.** C. Brummer completed studies to map the alfalfa genome to determine genetic influences on yield and winter hardiness.

**Selective phenotyping methods developed.** J.-L. Jannink reported on methods to more accurately locate genes that affect performance of crop varieties. These methods will improve the application of DNA marker technology to plant breeding.

**β-glucan studied.** J.-L. Jannink conducted research on enhancing β-glucan in oat, a soluble fiber that has been shown to lower cholesterol levels and reduce the incidence of diabetes.

**Large-seed, high-protein soybeans developed.** W. Fehr released to growers the foundation seeds of four new soybean varieties. These varieties exhibited elevated protein and large seeds favored by manufacturers of tofu, soy milk, and other food products.

**Soybeans developed for 1% linolenic acid content and low saturate oil.** W. Fehr selected for development varieties of soybeans that improve the quality of extracted oils. Oil with 1% linolenic acid and oil from beans with low saturate oil, both developed by W. Fehr, are currently being distributed to restaurants, food services, and Iowa schools.

**Methionine levels in corn measured.** K. Lamkey instituted a selection program to measure and raise the level of methionine, the most limiting essential amino acid in poultry feed. Studies are being conducted to determine the inheritance of methionine.

**Food-grade soybean varieties released.** Three food-grade varieties with yellow hilum were released by W. Fehr in 2005. Yellow hilum is preferred over black hilum by food producers to reduce the incidence of black specks in food.

**Low-phytate soybean lines studied.** W. Fehr began experiments to identify ways to evaluate the emergence potential of low-phytate soybeans. Currently, emergence can be evaluated only by field tests, a factor that limits the number of trials that can be conducted each year. Low-phytate soybeans have the potential to reduce the amount of phosphorous in animal waste, an environmental concern in large-scale animal production systems.
**GERmplasm Releases**

In 2004–2005, Center members released inbred lines of soybean and maize. Dr. Michael Lee released 360 inbred lines of maize from the IBM-10 population and, in collaboration with Pioneer/DuPont, deposited the lines at the Maize Genetics Stock Center operated by USDA-ARS. This set of inbred lines will be used to merge the physical and genetic maps of maize and help identify the functions of tens of thousands of genes and their roles in many traits. The information from these lines will help to improve the efficiency of maize breeding programs.

Fourteen new soybean inbred lines were released by Dr. Walter Fehr in 2004. Three lines, IA2069, IA2070, and IA2071, are low in saturate oil, and four lines, IA2072, IA2073, IA3024, and IA3025, contain 1% linolenic acid levels. Four lines, selected for higher protein and larger seed size, IA1017, IA1018, IA2074, and IA4003, were developed for the tofu industry. IA1015 and IA1016 are two lines that produce smaller seeds, a trait preferred by manufacturers of natto, a traditional Japanese food. IA1008LF, a lipoxygenase-free soybean, was developed to reduce undesirable flavors in soy-based foods. In November 2005, three new low-saturate varieties and one 1%-linolenic variety were released for seed increase during the winter. Seed from that winter’s harvest were used for the first commercial planting of these new varieties scheduled for 2006. An additional three food-grade soybean varieties with yellow hilum color and seven lines of maturity group II to IV with unique fatty acid composition were released to public and private researchers. Work continues on the development of soybeans with low-phytate lines, a potentially important tool in fighting polluting wastes in animal feedlots. The use of low-phytate soybeans in swine and poultry feed could lead to a reduction in the amount of phosphorous excreted in manure by these animals. Dr. Fehr is conducting experiments designed to evaluate the emergence potential of low-phytate soybean lines.

**A Conference in Support of Public Breeding Programs**

Dr. Kendall Lamkey and Dr. E. Charles Brummer were members of a national planning committee for *Seeds and Breeds II: A Conference to Reinvigorate the Breeding of Seeds and Animals for a Healthy 21st Century Agriculture*. The Conference, held September 11-14, 2005 in Ames, Iowa, brought together agricultural leaders from around the country. Participants developed strategies that will enhance the support of public plant and animal breeding programs, including possible legislative initiatives and lobbying efforts that focus on strengthening governmental support of agricultural development. The Raymond F. Baker Center for Plant Breeding, along with the Leopold Center and RAFI-USA, contributed financial support for the Conference. Presentations, audio files, and outcome summaries from the Conference are available on the Seeds and Breeds Conference Web site, www.agron.iastate/seedsandbreeds.
A Better Choice for Producers and Consumers

Dr. Walter Fehr, a soybean breeder with the Raymond F. Baker Center for Plant Breeding, has developed a soybean with the potential to change the way Americans eat. Choosing oil extracted from his soybean varieties will allow consumers to make healthier eating choices and equip food manufacturers with a commodity that will stay fresher and produce healthier food for the public.

A Public Health Concern

In 2006, American consumers will have an additional tool to help them make healthier dietary choices. Beginning in January, a new law will require that food packaging labels disclose the amount of trans-fat in food products. Trans-fats are the solid fats produced when liquid vegetable oil is heated in the presence of metal catalysts and hydrogen, a process called partial hydrogenation. When Americans limit or eliminate the consumption of trans-fat in their diets, health experts predict that many lives will be saved. According to a 1999 report by the Harvard School of Public Health, “By our most conservative estimate, replacement of partially hydrogenated fat in the U.S. diet with natural un-hydrogenated vegetable oils would prevent approximately 30,000 premature coronary deaths per year, and epidemiologic evidence suggests this number is closer to 100,000 premature deaths annually.” Manufacturers use the partial-hydrogenation process to increase the shelf-life of products and to extend the “frying life” of oils used for deep-frying, important economic considerations for restaurants and food service companies. Unfortunately, using oils that have been manipulated to extend their shelf-life can shorten your life. Finding sources of oil that will reduce, or eliminate, unhealthy fat components in the American diet has been a goal for doctors, consumers, food producers, and plant breeders for many years. Food manufacturers and cooking oil producers are eager to develop products that can be identified as low in trans-fat on the food labels of the future.

The Search for a Healthy Alternative

At Iowa State University, the search for healthy alternative oils has been in progress since the 1960’s when Dr. Earl Hammond, Department of Food Science and Human Nutrition, began to collaborate with Dr. Walter Fehr, soybean breeder and currently a member of the Raymond F. Baker Center for Plant Breeding. Their goal was to develop a variety of soybean that would produce a healthy substitute to the oils that were currently in use by the food industry. Funded by Unilever, Netherlands, Dr. Fehr began a breeding program whose objective was to reduce the linolenic acid, the component in soybeans that causes oil to taste stale or become rancid. Partial hydrogenation of oil destroys some fatty acids, including linolenic and linoleic, and thus, reduces these undesirable effects. Conventional soybeans contain 7% linolenic acid. Reducing the linolenic acid in soybeans would eliminate the need for hydrogenation. Breeding plants for this specialty trait became the mission of Dr. Walter Fehr.

Development of the Low-Linolenic Soybean

Through conventional breeding methods, three genes, designated fan1(A5), fan2, and fan3, were found to reduce linolenic acid (LA) from the common 7% level to 3.5%–5.0%. By combining these three genes, the LA was reduced to 1%. Lines of this 1% LA soybean were crossed with the best conventional varieties available to produce lines that would be true-breeding for 1% LA and for other important traits including high yield and standability. Two inbred lines proved to be superior—IA2064 and IA3017. Seeds from these lines were planted for seed production in 2001.
Going to Market

By 2004, farmers had planted about 30,000 acres of 1% linolenic soybean varieties for the production of seed. By 2005, both IA2064 and IA3017 1% linolenic soybean inbreds were grown for both seed and oil production. Indeed, it is projected that more than one million acres of the 1% linolenic varieties will be needed to meet the anticipated demand for the oil. In 2004, Asoya, an Iowa based corporation, produced and distributed the first units of oil processed from the 1% linolenic soybeans and planned to produce 20 million tons of oil in 2005. Other producers of 1% linolenic oil include companies in Iowa, Michigan, and Maryland.

Public and private breeders have licensed both of the low-linolenic soybean lines from Iowa State University Research Foundation and are actively breeding new varieties of soybeans with lower linolenic levels. An additional four foundation seed lines with 1% linolenic levels have been produced for planting and evaluation in 2005. These lines are IA2072, IA2073, IA3024, and IA3025. One hundred-forty five additional promising lines were evaluated in 2004, fourteen of which showed superior performance.

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Soybean breeding research at Iowa State University is supported by the Raymond F. Baker Center for Plant Breeding, the Hatch Act, the State of Iowa, the Iowa Soybean Promotion Board, and the United Soybean Board.

Vivan Jennings, CEO of Asoya, an Iowa company marketing low-linolenic soybean oil, examines some of the specialty soybeans planted near Columbus Junction, Iowa.

Photo by Jeff Caldwell
Courtesy of Asoya
Education is a vital part of the mission at the Raymond F. Baker Center for Plant Breeding. Each Center member has a faculty appointment in the Agronomy Department at Iowa State University. In addition to teaching graduate and undergraduate courses in plant breeding and genetics, members work closely with graduate students, serving as Major Professors or on Program of Study Committees. An internship program lead by one Center member gives undergraduate students a hands-on opportunity to learn about agriculture and plant breeding outside the classroom. The mission of the Center, however, reaches far beyond the Iowa State University academic community. Members lead Field Day events that inform farmers of advances in plant breeding and directions for future research. In 2004, members visited high schools and community colleges to promote the profession of plant breeding and helped to organize the genetics section of a science program attended by Iowa middle school students. Members are regularly invited to lecture at conferences held in the United States and around the world. In 2004 and 2005, these countries included Portugal, Germany, Canada, and Brazil. Center members also appeared on television and radio programs to discuss their projects. Educational materials written by Center members appear on the Web and in print publications, especially those produced by Iowa State University Extension.

Brandon Wardyn Receives National Award

The National Council of Commercial Plant Breeders selected Brandon Wardyn to receive the National Council of Commercial Plant Breeders Graduate Student Award for 2005. The $2,500 cash award was presented to Wardyn at the American Seed Trade Association Corn & Sorghum and Soybean Conference held in Chicago in December 2005.

Brandon Wardyn, a doctoral candidate in Plant Breeding and Genetics, works with Dr. Kendall Lamkey, Professor in Agronomy and Director of the Raymond F. Baker Center for Plant Breeding. Wardyn completed his Ph.D. in December 2005. His exemplary academic career and his research project to develop a model that quantifies the genetic variance of inbred and non-inbred individuals were factors that influenced the selection committee who conferred the award. Wardyn has received numerous awards and scholarships during his tenure as a student, including the C. R. Weber Award for excellence in plant breeding.

Wardyn’s research project focuses on understanding the quantitative genetic parameters influencing inbreeding depression, a condition that can lead to a loss in plant performance. He has developed a breeding design that makes use of a complex genetic model to describe the genetic variation among individuals, a model which increases to five the number of parameters that can be studied. The germplasm source for this study is the non-stiff stalk BSCB1 (C13) maize population developed at Iowa State University. Wardyn’s research will be used by plant breeders to increase their understanding of inbreeding depression, and indirectly hybrid vigor, and will likely lead to future studies in this area.

Wardyn began his work at Iowa State in 2002. He chose the Plant Breeding program at Iowa State because of its excellent reputation in crop improvement research. He particularly wanted to work with Dr. Lamkey, who is a leader in applied plant breeding and an expert in field-crop trials.
For 30 years, Dr. Walter Fehr has been conducting a program to introduce undergraduate students to the profession of plant breeding. Participants in this program, through hands-on experiences, learn the basics of plant breeding. By the end of the semester, they will have learned the genetics involved with plant breeding, most specifically, soybean breeding, worked in the field with plants bred for specific traits, learned methods for trait selection, and practiced techniques and procedures used by plant breeders. For their final project, each student designs a plant breeding program that includes a description of the specific trait selected for cultivar improvement and details the procedures for developing the cultivar.

In the fall of 2005, seven students were accepted into the internship program. Each student had completed classes in agronomy and had additional experience working with plants on farms or in private industry. In addition to classroom work, interns spend several hours each week working with field technicians on soybean plots located at Iowa State University research farms.

During harvest season, the students in Dr. Fehr’s internship class work about 40 hours a week. Because of this work schedule, the number of credit hours that students take for the semester is reduced, usually to about nine hours. Fortunately, students receive pay at an hourly rate for their labor, a benefit much appreciated by the interns. In addition, these students get hands-on experience learning tasks and procedures commonly used by plant breeders. Their work at the farm and in the lab is often supervised by Assistant Scientists Grace Welke and Susan Johnson.

A favorite job for most interns is operating the combine. This special single-row combine is used by plant breeders to obtain seeds from the smaller plots planted in breeding programs. The small sacks of seeds are carefully marked for the particular cultivar being harvested. Here Stacy Steinlage and Emily Hoffman operate the combines.

**Mentoring Program Begins for Students in Undergraduate Program**

A Mentoring Program for undergraduate students interested in Plant Breeding and Biotechnology was launched in fall 2005. The program is designed to encourage students to develop a flexible, on-going, individualized, professional relationship with faculty currently engaged in plant breeding research. The program will introduce students to people, programs, and practices in plant breeding. It is an optional component for students choosing Plant Breeding and Biotechnology as a focus for their study in agronomy.

The program was started by members of the Raymond F. Baker Center for Plant Breeding and pairs students with faculty active in plant breeding and biotechnology. It is hoped that an active collaboration between faculty and students will help to promote the study of plant breeding and biotechnology and encourage students to pursue study in these fields. Mentors will meet regularly with students and help to advise students on challenges and opportunities in plant breeding professions. Mentors might also recruit students to work in research programs conducted on campus or connect students with individuals in private industry, international centers and other institutions who offer job opportunities and internships.

Regular events are planned to introduce students to participating faculty. The first event, which launched the program, was held December 1, 2005. Seven students met with members of the Raymond F. Baker Center for Plant Breeding and agronomy academic advisors to learn about the program and get-acquainted with possible mentors. Additional events will be planned for the spring semester 2006.
An important component of the mission of the Raymond F. Baker Center for Plant Breeding is the work members do guiding and training future scientists in the plant breeding field. In 2004–2005, forty-four students worked toward an advanced degree in plant breeding. Listed below are their names, degrees sought, the place they call home, their expected year of graduation, and the focus of their study in plant breeding. Congratulations to Murli K. Reddy Gogula, Buppa Kongsamai, Muhammet Sakiroglu, and James R. Rouse for completing their degrees in Plant Breeding in 2004. Congratulations to Nicholas Bowser, Innan Cervantes-Martinez, Sue A. Duvick, Aaron J. Lorenz, Evelyn Ortiz-Perez, Curtis Scherder, Jessie L. Alt, Brandon Wardyn, and Elizabeth A. Popowski for graduating with Plant Breeding degrees in 2005.

Victor Abertondo, M.S. “Corn breeding.” Major Professor: Dr. Michael Lee

Jessie Alt (Minnesota), Ph.D., 2005, “Phenotypic and molecular analysis of oeate content in soybean.” Major Professor: Dr. Walter Fehr

Nicholas L. Bowser (Kansas), M.S., 2005, “Effect of seed treatments on data quality from small plots.” Major Professor: Dr. Kendall Lamkey

Innan Cervantes-Martinez (Mexico), Ph.D., 2005, “Soybean genetics and cytogenetics.” Major Professors: Dr. Reid G. Palmer, Dr. Harry T. Horner

Alona A. Chernyshov (Ukraine), Ph.D., 2006, “Additive and epistatic components of β-glucan content variance in oat.” Major Professor: Dr. Jean-Luc Jannink

Von Mark V. Cruz (Philippines), Ph.D., 2005, “Genetic diversity in Brassica.” Major Professors: Dr. Candice Gardner, Dr. E. Charles Brummer

Amy Curtis, M.S. Major Professor: Dr. Randy Shoemaker

Yara N. de Geus (Brazil), M.S., “Corn seed quality.” Major Professors: Dr. Linda Pollak, Dr. Susana Goggi

Thanda Dhlawayo (Zimbabwe), Ph.D., 2008, “Selection for resistance to maize weevil (Sitophilus zeamais Motchulsky) and its effects on the nutritional profile of maize.” Major Professor: Dr. Michael Lee

Susan Ann Duvick (Iowa), M.S., 2005, “Altering the fatty acid composition of corn belt corn through trispsacum introgression.” Major Professor: Dr. Linda Pollak

Mauricio Erazo-Barradas (Mexico), M.S., 2005, “Corn breeding.” Major Professors: Dr. Michael Lee, Dr. Kan Wang

Murli K. Reddy Gogula (India), M.S., 2004, “Selection of oat genotypes with table groat percentage under high temperature stress.” Major Professor: Dr. Jean-Luc Jannink

Barbara Gray (Iowa), M.S., 2005, “Corn breeding.” Major Professor: Dr. Linda Pollak

Lucia Gutierrez (Uruguay), Ph.D., 2006, “Genetic diversity in cultivated and wild Hordeum species.” Major Professors: Dr. Jean-Luc Jannink, Dr. John Nason

Sara Helland (Iowa), Ph.D., 2008, “QTL/gene detection and linkage disequilibrium after 4 and 10 generations of random mating in a maize inbred population.” Major Professor: Dr. Michael Lee

Laurie Hyrkas (Minnesota), M.S., 2007, “Heterosis of maize.” Major Professor: Dr. Kendall Lamkey

Bindu Joseph (India), Ph.D., 2007, “A structural analysis of a region of the soybean genome containing a major QTL for seed protein composition.” Major Professor: Dr. Randy Shoemaker

Buppa Kongsamai (Thailand), Ph.D., 2004, “Marker-assisted selection and prediction of hybrid performance in maize.” Major Professor: Dr. Kendall Lamkey

Travis J. Lee (Kansas), Ph.D., “Evaluation of recurrent selection in BS10 and BS11.” Major Professor: Dr. Kendall Lamkey

Bryce Lemke, Ph.D., “Corn breeding.” Major Professor: Dr. Kendall Lamkey, Dr. Jodi Edwards

Pedro A. Lopez (Mexico), Ph.D., 2005, “An evaluation of morphological, molecular, and chemical variability in coriander (Coriandrum sativum L.) germplasm.” Major Professors: Dr. Mark Widriechner, Dr. Ricardo Salvador

Aaron Lorenz (Minnesota), M.S., 2005, “Heritability of phytic acid and inorganic phosphorus in a maize population.” Major Professor: Dr. Kendall Lamkey

Gregorio Lozano (Iowa), M.S., “Corn breeding.” Major Professor: Dr. Michael Lee

Marcus M. Marine (Iowa), M.S., 2005, “Mapping the Glu-1 Dx5 transgene in maize.” Major Professor: Dr. Michael Lee
The Iowa State University plant breeding department is an international program which provides for immense educational and research opportunities. The ISU program focuses on vigorous field training—something few other places provide today.

An essential part of the plant breeding process is the evaluation of new and old hybrid crop varieties. Each year, members of the Raymond F. Baker Center for Plant Breeding evaluate hybrids and varieties of crops commonly grown in Iowa. The Iowa Crop Performance Test, cosponsored by the Iowa Crop Improvement Association, evaluates the performance of cultivars of corn, soybeans, oats, barley, alfalfa, perennial ryegrass and miscellaneous legumes, winter wheat, and winter triticale. Forage legumes and grasses testing is led by Dr. E. Charles Brummer. Dr. Jean-Luc Jannink manages tests conducted on small grain cultivars. Corn and soybean testing is directed by Dr. James Rouse, a recent graduate of Iowa State’s Plant Breeding Program. The results of these tests are public knowledge and are released on the Web and through Iowa State University Extension reports. This testing process informs farmers and plant breeders about the performance of new cultivars and those cultivars more commonly grown. The tests evaluate a number of factors, including yield and resistance to disease, insect infestation, and climate stressors. The testing process is overseen by the Crop Testing Technical Committee, chaired by Dr. Kendall Lamkey, Director of the Raymond F. Baker Center for Plant Breeding. The Crop Testing Technical Committee, a panel of seed industry professionals and public breeders, establishes the protocol for the testing program and assures the integrity of the testing procedures.

In 2004, alfalfa testing, led by Dr. E. Charles Brummer, focused on identifying varieties tolerant to potato leafhopper infestation and compared their performance to alfalfa grown with the use of pesticides. 2005 testing showed that potato leafhopper were present in significant numbers during the growing season. Dr. Brummer highly recommended planting leafhopper resistant varieties of alfalfa, especially if farmers did not use pesticide sprays, and particularly for crops planted in central or southern Iowa.

Twenty-seven spring oat varieties and sixteen spring barley varieties were evaluated for yield in 2004 testing led by Dr. Jean-Luc Jannink. One promising oat variety, ‘Spurs,’ was found to show good crown rust resistance. Winter wheat and winter triticale, both recommended as feed crops for Iowa farmers, were tested for yield. ‘NE426GT,’ a new variety of winter triticale, had the highest yield and third highest test weight of varieties tested in 2004. ‘NE426GT’ was developed jointly by scientists from the University of Nebraska and Iowa State University. In 2005, ‘Baker,’ a new oat variety developed at Iowa State University, showed the highest yield and groat percentages of all varieties in the test.

In 2004, about 11,500 plots were used to test 490 varieties of hybrid corn submitted by 55 private seed companies. Corn was tested for yield, standability, and grain quality. Test results are used by farmers and seed companies to make decisions on future planting. 2005 marked the 86th consecutive year for corn testing conducted by the Iowa Crop Performance Test.

About 450 varieties of soybeans were tested on plots located throughout Iowa. Tests compared soybeans grown using conventional herbicides, Roundup® herbicide, and special varieties developed to be resistant to soybean cyst nematodes. Soybeans were evaluated on yield, protein and oil content, and their resistance to soybean cyst nematodes.
Dr. Kendall Lamkey  
Editor, Crop Science

**PUBLICATIONS**


**Dr. Micheal Lee**  
Ad Hoc Reviewer, Journal of Crop Science  
Ad Hoc Reviewer, Journal of Theoretical and Applied Genetics  
Ad Hoc Reviewer, USDA-NRI

**PUBLICATIONS**


**PRESENTATIONS**

Dr. E. Charles Brummer
Associate Editor, Crop Science
Ad Hoc Reviewer, Crop Science
Chair, Committee on Available Breeding Lines, North American Alfalfa Improvement Conference
Member, Biotechnology Committee, North American Alfalfa Improvement Conference

Publications


Presentation
Dr. Arnel R. Hallauer

PUBLICATIONS


Dr. Walter R. Fehr

PUBLICATIONS


Dr. Jean-Luc Jannink

PUBLICATIONS


FINANCES

The Raymond F. Baker Center for Plant Breeding, an affiliate of the Plant Sciences Institute, receives support money from several sources. External funding includes money received from competitive grants, both funded by state and federal government agencies, and money from grants awarded by foundations and private companies. In addition, the Center receives money from the Plant Sciences Institute and income generated from an endowment established by Raymond F. Baker to support the scientific advancement of plant breeding and genetics. Money supports research projects, salaries, and Center expenses.

Income FY 2004

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<td>Raymond F. Baker Endowment Income</td>
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<td>Total Income</td>
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Expenditures

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Income FY 2005 (Projected)

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Expenditures

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<td>Total Expense</td>
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Don’t judge each day by the harvest you can reap, but by the seeds you can plant.

—Robert Louis Stevenson