

ACES Genotyping Center

Executive Summary:

The funding received from C-FAR was used to build the ACES Genotyping Center. Building this center included remodeling a laboratory, purchasing equipment and supplies, and hiring a manager. This has been completed and the center is now a self sufficient service facility housed in the National Soybean Research Center. The Center is a core facility where researchers can utilize genetic research equipment and technology that allows them to efficiently apply genetic markers to their research programs. The Center has high throughput equipment that can be used to set up DNA amplification reactions, amplify DNA, and size these amplified DNA fragments at very affordable rates. These low rates are the result of the center being a self service facility where the post doctoral researchers, graduate students, and other researchers actually use the equipment. This has the added advantage of providing these researchers hands on experience in running this equipment. The ACES Genotyping Center has been used by researchers studying a wide range of topics from fish ecology to swine breeding, however, a major focus of research in the center has been plant breeding. This plant breeding research is centered on increasing the profitability of producers through increasing yield potential, enhancing pest resistance, and improving seed composition of the major crops of Illinois agriculture. The Genotyping Center's facilities have helped researchers map, select, and potentially clone important genes controlling these traits.

Primary Objectives and Goals:

The primary goal of the Genotyping Center is to provide a cost effective facility for genotyping organisms with genetic markers. Genotyping is done to genetically describe organisms and the results from these efforts can be used to map genes, select individuals or genetically describe populations. Although this genotyping analysis can be very useful in research, the high costs of these analyses have limited their application in research. The Genotyping Center was established to provide a way for researchers to genotype plant or animals with microsatellite genetic markers at a low cost.

A secondary goal for establishing the Genotyping Center was to create a laboratory in which students and postdoctoral researchers could obtain hands-on experience in the use of DNA sequencers and other high throughput genotyping equipment and gain knowledge in DNA genotyping analysis. This equipment needs to be in a center because individual researchers would not be able to each set up laboratories with the equipment in the Genotyping Center because this equipment is too expensive and a skill manager is needed to maintain it. The knowledge and experience researchers have gained in the center has been invaluable and has helped some students gain an edge over other applicants when interviewing for jobs. The diversity of disciplines among users represented at the Genotyping Center has also created an ideal environment for sharing of ideas and expertise and for creating new interdisciplinary teams.

Principle Investigators and Co-Investigators:

Brian Diers, Crop Sciences
Randall Nelson, USDA-ARS, Crop Sciences
Torbert Rocheford, Crop Sciences
Fred Kolb, Crop Sciences
John Juvik, NRES

Outcomes and Impacts:

Funding from C-FAR was used to remodel a laboratory in the National Soybean Research Center, purchase equipment for the laboratory, and hire a manager for the facility. This work has been completed and the center is working well and is self supporting through user fees. The laboratory has equipment for amplifying DNA, pipetting solutions into 96 wells in DNA amplification plates, and DNA sequencers that are being used to separate the amplified DNA fragments. In addition, the laboratory recently acquired a machine that can be used to assay single nucleotide polymorphism markers, which are a new type of genetic marker. The C-FAR funding also was used to purchase supplies for marker analyses and other miscellaneous equipment needed to start a laboratory.

A full time manager was hired to run the center when it was first established. This individual left to start graduate school and since then, the center has been managed by half-time managers. Employing a half time manager has worked out well for the center. The salary of the manager and other supplies used in the center are now mostly covered by user charges. We expect that these charges will allow the center to continue to operate into the future.

A number of research projects have been completed and are ongoing in the center. The table below lists principal investigators (PIs), users and brief descriptions of projects that have been done or are currently underway in the center.

List of past and present users of the center and their projects.

PI and Department	User(s)	Project(s)
John Beever Animal Sciences	S. Lyons-Sobaski, E. Wagner	Mapping genes in swine so these genes can be selected with markers.
Brian Diers Crop Sciences	S. Carlson, N. Chakraborty, T.J. Curley, P. Guzman, D. Nichols, C. Paine	Studying genetic diversity in soybean and mapping of genes controlling agronomically important traits such as yield, protein content and disease resistance.
John Epifanio INHS, NRES	T. Silich	Genetic fingerprinting of bluegill sunfish.
Glen Hartman Crop Sciences, USDA	C. Paul, D. Strutz, T. Vuong	Mapping of rust resistance genes in soybean.
John Juvik NRES	A. Brown	Mapping of glucosinolate production in broccoli.
Geoffrey Levin INHS, Plant Biology	V. Sagun	Determining boundaries and distribution of <i>Acalypha phleiodes</i> in Mexico
Randy Nelson Crop Science, USDA	D. Neece, S. Schultz	Identifying genes that increase seed protein concentration.
David Phillip INHS (CAE), Animal Biology	J. Parkos	Determinating nest origin in largemouth bass and sources of variance in nest-specific contributions to recruitment

Torbert Rocheford Crop Sciences	E. Nunes, C. Paul	Mapping genes controlling nutritional quality in corn.
Andrew Swarez Animal Biology, Entomology	C. Payne	Studying colony structure and competitive ability in Argentine ants.
Patrick Tranel Crop Science	F. Truoco, D. Volberg	Studying gene flow among weedy <i>Amaranthus</i> pigweed species.
Glen Hartman Crop Sciences	T. Vuong	Mapping of genes identified from genome wide gene expression studies.
David Whal INHS (CAE), Integrative Biology	B. Barthel	Genetic determination of nest origin in smallmouth bass.

Individual Research Project Impacts

Because the funding was used to start a core research center, specific research projects were not conducted through C-FAR funding for the Center. Instead, researchers use the Center to conduct their own research that is funded through grants from other organizations. Below are descriptions of projects that have been done or are being done in the Center.

Dr. Glen Hartman's research group has used the center to map genes conferring resistance to sclerotinia stem rot (also known as white mold) in soybean. They identified genes that changed their expression in response to disease infection and then designed markers to detect these genes. These markers were used to map the genes using the center's ABI 377 instruments. According to Dr. Hartman, "the Genotyping Center has provided our research with the tools needed for mapping genes that convey resistance to various soybean pathogens and pests. These services have accelerated our research on soybean disease resistance."

Dr. Torbert Rocheford's lab utilizes the Center in their corn diversity studies. They tested 300 diverse corn lines that had high levels of carotenoids in the Center with three candidate genes (y1SSR, zds, and pds) that are part of the carotenoid biosynthetic pathway. This testing allowed them to identify the SNPs responsible for carotenoid variation. According to Dr. Rocheford, "the Genotyping Center provides our lab with tremendous services for our biotechnology research, with highly technical advice and supportive assistance as required for graduate students and post docs."

Drs. David Phillip, David Whal and John Epifanio conducted studies of Largemouth bass, Smallmouth bass, and Bluegill fish in the Center. They used the Center's resources to investigate sources of variance in fish populations that these results are aiding in fisheries and wildlife game management.

Researchers from the labs of **Drs. Brian Diers** and **Randall Nelson** are using the Center to map genes that control soybean yield. These studies are focused on mapping yield increasing genes from exotic sources that can be used to increase the yield potential of soybean varieties in the US.

Dr. Brian Diers has students and post doctoral researchers that have used and are currently using the Center to precisely map the locations of genes that increase seed protein concentration and resistance to soybean cyst nematode in soybean. By precisely mapping the locations of these genes, they can more effectively select these genes with genetic markers and they are laying the groundwork for eventually cloning these genes.

Beneficiaries:

Since the inception of the Center, over 40 researchers across many disciplines have benefited from the services provided by the facility. These researchers have benefited by being able to obtain their genotypic data at a reduced cost compared to other facilities, which has allowed them to stretch their research dollars. This is resulting in more research being completed, which will benefit C-FAR constituents. In addition, these researchers have benefited through obtaining training on how to operate the equipment in the laboratory and through increased interactions with researchers from other programs and departments.

To evaluate the cost savings achieved by using the Marker Center, a user compared the cost of using the Marker Center with the campus Biotechnology Center. They analyzed 11,624 fragments in the Marker Center and paid \$1,724 for this work. By comparison, it would have cost \$2,761 to have this work done in the Biotechnology Center.

Outreach:

The outreach efforts of the Center have been primarily carried out by the manager of the facility. The manager has a training program for new users and works with each new user to be certain that they are trained on the equipment before they are allowed to work unsupervised. The manager also promotes the center to potential users throughout the campus to make certain they are aware of the services provided by the facility.

The manager of the Center has developed research protocols which enable researchers to improve the success of their genotyping methods. The center also was able to provide yet another cost savings service to researchers through the development of a universal primer for genetic markers. With the universal primer, center researchers can avoid buying multiple expensive individually fluorescently labeled PCR primers for their samples. By using less expensive unlabeled PCR primers and the Center's universal fluorescently labeled primers, researchers are able to continue their work at a fraction of their initial reagent costs.

The manager of the Center also coordinates development of new genotyping methods. The center has acquired a new single nucleic polymorphisms (SNPs) detection instrument and the manager is now developing protocols to use this instrument for SNP marker analysis. With this new SNP detection service, the Center will continue to provide an excellent resource in education and technology dissemination.

Leveraged Funding:

All research in the Center is being done with money leveraged from other sources. This includes money from the USDA-ARS, USDA-NRI, and state and national commodity boards such as the Soybean Checkoff Program.

Websites:

<http://genotyping.uiuc.edu>