

Contact: Diana Gonzalez

**REQUEST TO CREATE NEW CENTER AT IOWA STATE UNIVERSITY:  
CENTER FOR ARTHROPOD MANAGEMENT TECHNOLOGIES**

**Action Requested:** Consider recommending approval of the request by Iowa State University to establish the Center for Arthropod Management Technologies in the Department of Entomology in the College of Agriculture and Life Sciences.

**Executive Summary:** The purpose of the proposed center is to streamline the efforts of industry, government, and academia toward development of technologies for effective management of arthropod pests. This proposal was reviewed by the Board Office and the Council of Provosts and is recommended for approval. Board of Regents Policy §6.08 requires that all centers and institutes be approved by the Board. This request addresses the Board of Regents Strategic Plan priorities to provide “educational excellence and impact” and “economic development and vitality,” Goal #7 - “Iowa’s public universities shall contribute to the expansion and diversification of the Iowa economy,” and Goal #8 - “Iowa’s public universities and special schools shall be increasingly efficient and productive.”

**Background:**

- ◇ **Description of proposed center.** The proposed center has three primary areas of emphasis to deliver value to its industry/government partners:
  - ⇒ Fundamental research focuses on pre-competitive research for transfer of knowledge to address industry relevant needs to develop new pest control technologies, including research on novel target sites, pest tolerant transgenic plants, RNA interference and development of new methodologies;
  - ⇒ Optimize and extend the versatility of current arthropod management technologies with a focus on overcoming insect resistance and optimization of current pest management methods; and
  - ⇒ Education and technology transfer with a focus on training the next generation of scientists proficient in broad arthropod management concepts and rapid transfer of information into practical applications for industry and government.
  
- ◇ **National Science Foundation (NSF) Center.** The proposed center will be a new National Science Foundation (NSF) Industry/University Cooperative Research Center (I/UCRC). ISU will be the lead institution and the University of Kentucky will be the sister institution. As an NSF I/UCRC, the Center for Arthropod Management Technologies is a true public-private partnership. Its main purpose is to foster industry/university collaborations in research and education that are critical to the productivity of the nation. In the consortium model of the I/UCRC program, industry and government agencies become members and pay a membership fee. For the proposed center, the membership fee will be \$50,000 per year. This represents a true commitment by member companies, and, in turn, universities provide real value to the members by bridging research, education, technology development, and practice. Currently, the center has seven industry members – BASF; Bayer CropScience AG; Bayer CropScience LP; Dow AgroSciences; DuPont Pioneer; FuturaGene; and Monsanto Company.

- ◇ Need for proposed center. Arthropod pests have a destructive impact on food production and human health and welfare on a massive scale. The pests of primary importance change over time with the accidental introduction of new species, development of insecticide resistance in managed pests, changing agricultural and environmental practices, and climate change which provides increased opportunity for a variety of pest species. The use of classical chemical insecticides was a major contributing factor to the increase in agricultural productivity in the 20<sup>th</sup> century and insecticide application remains the primary management practice in use today for the majority of arthropod pests. However, repeated application of chemicals frequently results in the development of insecticide resistance in the targeted pest; in fact, more than 500 species of insects and mites with insecticide resistance have been recorded.

As a result, chemicals that were effectively employed in the past are no longer useful against many pest species. Therefore, there is an urgent need for the development of pest control tools with new target sites. Recent advances in the development of genomic and post-genomic technologies provide enhanced means for identifying target sites and for screening assays to rapidly identify chemicals that function through these target sites. Due to the magnitude of economic loss associated with arthropods and the propensity for arthropods to develop resistance to management strategies currently in use, there is a critical need for industry to provide arthropod management products with novel modes of action. However, frequently there is insufficient understanding of the basic biology of the pest organisms to provide a foundation for such innovative technological solutions. The proposed center will conduct fundamental research essential for the development of new pest management technologies and for optimizing current strategies.

- ◇ Value of proposed center. The proposed center will provide significant savings to industry members, training for students and postdoctoral researchers who will benefit from employment opportunities at member companies and research publications, patent applications, and disclosures. Perhaps most importantly, increased interactions will result in additional funding obtained through university-industry partnerships. Since the proposed center's planning meeting in September 2012, new projects funded or pending as a result of interactions at that meeting total close to \$2 million. The benefits to companies include the following:

- ⇒ Access and ability to drive cutting-edge research
  - Influence directly the research priorities of the center.
  - Lower in-house R&D costs through use of R&D efforts at the center.
  - Leverage research funds from other center members and NSF.
  - Provide a competitive advantage through acquisition of new knowledge pre-publication.
  - Access to research conducted by state-of-the-art universities.
- ⇒ Tools and intellectual property
  - Access information to benefit in-house priorities.
  - First rights and access to developments including patents, licenses, and publications.
- ⇒ Recruitment and outreach
  - Access to a pool of talented students and postdoctoral researchers trained at the center.

- ◇ Proposed center activities and objectives. The proposed center will function according to the guidelines established by the NSF I/UCRC program. Faculty and students will work on research projects of shared value to industry members and the universities. Every six months, all university sites and members of the proposed center will participate in an Industry Advisory Board (IAB) meeting where projects will be presented, feedback and evaluation will be obtained, new projects will be selected, and workshops with industry that capture on-going and new challenges will be discussed. Between IAB meetings, in addition to project work, universities and members will pursue a variety of funding sources for additional resources to support the work of the proposed center.

The research activities of the center will be focused in five primary areas:

- ⇒ Insect resistance – focuses on the need to find new approaches to manage pests that are resistant to current pest management strategies, including chemical insecticides.
- ⇒ Novel target sites – focuses on the use of state-of-the-art genomic and post-genomic technologies to identify novel targets for new pest control measures.
- ⇒ Pest tolerant transgenic plants – focuses on optimizing the efficiency of pest tolerant transgenic plants for tissue specific expression, protein, and transcript stability.
- ⇒ RNA interference – focuses on identification of factors that restrict effective RNA interference-based technologies to Coleoptera (beetles) to fully exploit the potential of this new approach.
- ⇒ Methods – focuses on overcoming limitations associated with methodologies or tools that restrict research required for the development or full exploitation of pest control strategies.

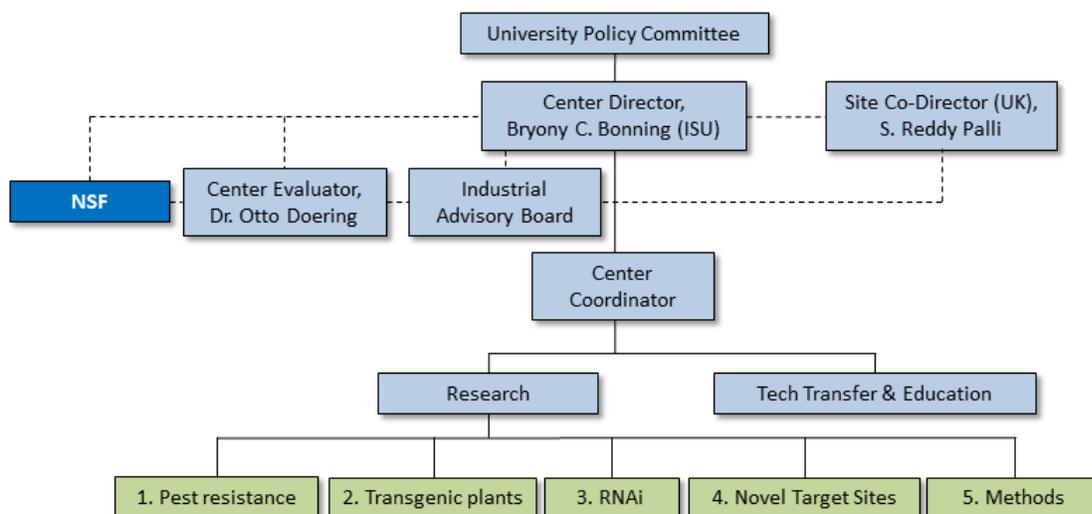
- ◇ Relationship of proposed center to University's Strategic Plan. The proposed center is well aligned with the mission, vision, and strategic plans of both the university and the college in advancing research in critical areas of need and transferring this knowledge to industry to support economic development in the state and the nation. One goal of the center is to prepare the next generation of students to develop new technologies and methods in collaborative research in a global economy. The NSF I/UCRC program provides a proven framework for the success of this public-private partnership upon which the proposed center will be built. Students working on research supported through the Center funding receive practical education as they work in collaboration with industry members to solve important industrial problems. The operation of the center requires active participation of industry members in advising the projects that are completed and selecting new projects for funding support. The success of the center rests on the ability of the faculty, staff, and students to provide value to the industrial partners while educating the next generation of leaders. The I/UCRC provides a unique environment in which academic researchers and industry partners can work together on research and technology issues that impact the country to be competitive with innovative and value-added arthropod management technologies.

- ⇒ Mission: The mission of the university is to create, share and apply knowledge to make Iowa and the world a better place. The mission of the college is to educate future leaders, conduct mission-oriented basic and applied research, and share new knowledge for the betterment of Iowa and the world.

- ⇒ Vision: The vision of the university is to lead the world in advancing the land-grant ideals of putting science, technology, and human creativity to work. The vision of the college is to lead the world in “science with practice” that shapes the future and improves lives and livelihoods.
- ⇒ Priorities: The University will be a magnet for attracting outstanding students who seek an education that prepares them to make a difference in the world; be a magnet for attracting outstanding faculty and staff who create, share, and apply knowledge to improve the quality of life; be internationally known for faculty, staff, and students who address the challenges of the 21<sup>st</sup> century; and be a treasured resource for Iowa, the nation, and the world.

The College will be known worldwide for addressing global challenges of the 21<sup>st</sup> century; produce and disseminate basic and applied research results that address food security, food safety, climate change, natural resources, renewable energy, and human health; enhance programs that promote economic growth and entrepreneurship; translate discoveries into viable technologies, products, and services to strengthen the economy; and build and enhance extension, outreach, and global partnerships that expand the impact of College programs.

- ❖ Proposed center structure and organization. The organizational structure of the proposed center complies with NSF requirements and includes an Industrial Advisory Board, a Center Director, a Research Site Director, and a University Policy Committee (see Appendix A). The center director will be Dr. Bryony Bonning; the site director at the University of Kentucky will be Dr. Subba Reddy Palli. The Industrial Advisory Board (IAB), which meets twice a year, includes one voting member from each member company, provides advice on research priorities, and makes recommendations on project funding. All members from all university sites are part of a single IAB and vote as a larger group. IAB members have privileges and rights to all projects in the center across university sites. All membership funds flow through the lead institution; each university receives base funding from NSF.



The site co-directors, in collaboration with the IAB, set goals and future directions of research, manage the day-to-day operation of the Center, and act as a liaison along with the university administration with member companies for tech-transfer. Activities discussed at regular leadership meetings may include planning (date and location) and format of IAB meetings; the development of or update to marketing materials such as the center web page, printed materials, and marketing presentations; discussion and planning collaborative projects for presentation to the IAB or other funding opportunities such as fundamental research grants. The IAB chair participates in the regular leadership meetings and communicates with the IAB when input, guidance, or assessments are needed outside of the IAB meetings.

The University Policy Committee, which consists of senior leaders from all Center universities, has the responsibility to ensure that the Center's activities are consistent with academic policies and procedures of the universities. In addition, the Center has an external NSF evaluator to monitor and evaluate research interaction between Center researchers and company members as stipulated in the NSF I/UCRC protocol.

The Center's patent policy complies with the standard policies of partner university sites and is well suited to the goals of cooperative research with industry. The Center's inventions are promptly reported to the University, and to the sponsors. Title to inventions made in the course of research funded by the Center for Arthropod Management Technologies normally vests in the university or its designee. The sponsor companies on the date of the invention disclosure receive an option to license any patents on the invention. Participating companies electing to exercise their license option must agree to share the patent costs in exchange for a royalty-free, non-exclusive license to use such an invention for the life of the patent protection obtained and must sign the standard non-exclusive license agreement with the university. Royalties from companies that license the invention will be distributed in accordance with the university's patent policy in effect on the date of disclosure.

The center coordinator will coordinate and support center operations including correspondence with members, tracking membership dues, providing updates to the center web site, coordinating meetings, preparing and coordinating reports required by NSF, industry, and universities. The center coordinator also supports membership recruitment and preparation of marketing materials.

- ◇ Relationship of proposed center to existing centers/institutes. The creation of the proposed center was driven and facilitated by funding from the ISU Plant Science Institute (PSI) for the Virus-Insect Interactions Initiative, and with support from the College of Agriculture and Life Sciences. The Virus-Insect Interactions Initiative, comprised of an interdisciplinary team of 26 from 15 ISU departments, works to address the challenge of plant protection against insects and viruses, and against viruses that harm beneficial insects, such as pollinators; to acquire fundamental knowledge of insect-virus interactions and to translate this knowledge to novel practical applications. The creation of the proposed center is a direct result of the activities of this team; the composition of the faculty involved in the center is also interdisciplinary. The increased interaction between industry representatives and ISU faculty members has already resulted in new research projects and industry recognition of expertise on the ISU campus.

There are four other NSF I/UCRC centers in the state of Iowa, all at Iowa State University.

- ⇒ *Center for Nondestructive Evaluation (CNDE)* is a single university center with a long history of success.

- ⇒ *Power Systems Engineering Research Center (PSERC)* is a multi-university center with 13 sites. Arizona State University is the lead institution and ISU is one of the sites also with a long history of success.
- ⇒ *Security and Software Engineering Research Center (SSERC)* conducts applied and basic research on software security, system security, and software technology problems of interest to its members. Ball State University is the lead institution of this 13 university center and ISU is one of the sites. The ISU site has a strong corporate presence with nationally recognized leaders in data protection and intrusion detection and it provides a strong pre-collegiate outreach program.
- ⇒ *Center for e-Design* integrates fundamental principles of science, mathematics, and engineering to develop, test, and implement new methods and technologies for designing products. This center was created in 2003 and has seven university sites; ISU is the lead institution.
- ◇ Existence of proposed center at other Iowa institutions. The proposed center does not exist elsewhere in the state or elsewhere; the proposed center is unique. The NSF is careful not to create competition between I/UCRC centers. If a university expressed an interest in forming a center with similar mission and objectives, the NSF would require that the university join an existing center. The requirements to do so include all the steps mandated by NSF - submitting a Planning Grant Proposal; holding a Planning Grant Meeting; soliciting industry members; and submitting an I/UCRC Proposal. The evaluation and decision regarding funding, the Planning Grant Proposal, and the I/UCRC Proposal follow the standard peer-reviewed NSF procedures.
- ◇ Unique features of Iowa State University to support the proposed center. (1) The center director has a strong record of leadership, innovation, and collaboration with industry partners; (2) CALS has a strong Department of Entomology from which the core faculty members of the center will be drawn; (3) ISU provides outstanding biotechnology and plant science facilities to support center activities; (4) ISU has a strong record of innovation, invention, and product development; and (5) all required steps related to receiving NSF funding for the center have been completed successfully (multi-disciplinary team formation, project proposals, planning meetings and workshops with industry and NSF, and receipt of membership commitments from industry).
- ◇ Inter-institutional and collaborative efforts with other entities. Other universities interested in joining the center as an additional site must follow all the steps mandated by NSF.
- ◇ Resources. The proposed center will include a diverse and multidisciplinary team of 12 faculty members from the following departments – Agricultural and Biosystems Engineering; Agronomy; Biochemistry, Biophysics and Molecular Biology; Entomology; Genetics, Development and Cell Biology; and Plant Pathology and Microbiology. The following related centers and institutes will partner in the ISU research site – ISU Plant Transformation Facility and USDA, ARS (Agricultural Research Service) Corn Insects and Crop Genetics Research.

The Center office, provided by the Department of Entomology, will be 403 Science II Hall. Research and personnel office space will be accommodated through existing space. In addition to the core space, ISU has outstanding centralized biotechnology and plant science facilities to facilitate Center research. Appendix B provides a detailed description of facilities available to support the Center for Arthropod Management Technologies. Existing equipment will be used for center research projects.

- ◇ Expected need. The proposed center has an initial grant from NSF for five years and is renewable for two additional five-year cycles for a total of 15 years. The long-term existence of the center is based upon memberships from industry and government agencies. The center is expected to be self-sustaining and remain in existence beyond the NSF funding period.
- ◇ Approval by existing campus structures. The Center proposal was reviewed and submitted to the National Science Foundation (NSF) by the Office of Sponsored Research Administration at ISU. This included approval and endorsements from the university's research office, legal counsel, and the College of Agriculture and Life Sciences. The VP of Research and Economic Development provided support by granting the waiver of indirect on industry memberships (typically granted for I/UCRC centers). The common required membership agreement and the Nondisclosure Agreement have been reviewed and approved by the university's legal counsel and sponsored programs offices.
- ◇ Costs and funding sources. The total cost to operate the proposed center will be \$967,000 in Year One and \$1,418,000 by Year 7. The funding model follows NSF solicitation/regulations that are required by the Industry/University Cooperative Research Centers Program. (Categories and explanations are color-coded.)

**CENTER FOR ARTHROPOD MANAGEMENT TECHNOLOGIES FUNDING FOR ISU SITE IN YEARS 1-7**

	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7
Total Member Fees	350,000	450,000	550,000	600,000	650,000	650,000	650,000
NSF Funding							
Award – ISU site base award	60,000	60,000	60,000	60,000	60,000	60,000	60,000
ISU as lead for 2 <sup>nd</sup> site	10,000	10,000	10,000	10,000	10,000	10,000	10,000
Operations and Communications	20,000	20,000	10,000	10,000	10,000	10,000	10,000
Evaluator Supports (ISU)	15,000	15,000	15,000	15,000	15,000	15,000	15,000
Award University Site #3				60,000	60,000	60,000	60,000
Award for Addl Admin. Support				10,000	10,000	10,000	10,000
Award for Addl Eval. Support				3,000	3,000	3,000	3,000
Total NSF Support	105,000	105,000	95,000	168,000	168,000	168,000	168,000
CALS 0.5 FTE center coord./misc	50,000	50,000	50,000	50,000	50,000	50,000	50,000
PSI misc costs	12,000	12,000					
Additional Research Funding	450,000	450,000	450,000	500,000	500,000	550,000	550,000
<b>Total Revenues</b>	<b>967,000</b>	<b>1,067,000</b>	<b>1,145,000</b>	<b>1,318,000</b>	<b>1,368,000</b>	<b>1,418,000</b>	<b>1,418,000</b>

<b>Memberships</b>
<ul style="list-style-type: none"> <li>7 initial memberships are committed for \$50,000 each. Modest growth in memberships is projected.</li> <li>Center projects are funded by memberships</li> </ul>
<b>Primary (base) Funds as a Center Site</b>
<ul style="list-style-type: none"> <li>NSF support is intended to augment the support that a center receives from industry and other sources.</li> <li>The NSF base grant covers expenses for travel, IAB meetings, 0.5 FTE center coordinator, and materials.</li> <li>The I/UCRC program uses the following funding formulas. Multi-institutional center sites with annual industry membership participation between \$150,000 to \$300,000 can receive up to \$60,000 annually. (Note – the center must obtain a total of \$300,000 in membership participation to receive an award.) Multi-university research sites with \$300,000 or more in annual memberships can receive up to \$80,000 annually.</li> <li>All costs for conducting research projects are covered by membership fees and additional research funding (see below).</li> </ul>
<b>Multi-University Center Coordination</b>
<ul style="list-style-type: none"> <li>Additional Supplemental Funding and Support for the Lead Administrative Institution.</li> <li>The lead administrative institution is defined by the I/UCRC program as the institution that assumes primary coordination, general management and operations responsibilities including marketing, communications, dissemination, and evaluation of a multi-university center. Additional funds are used by the lead institution to support these functions. Active centers with changes in their number of sites request support via a supplement. The lead administrative institution makes an annual request for supplemental funding consistent with the center’s award phase and the current number of sites within the center.</li> <li>The lead administrative institution for a Phase I and Phase II center receives an additional \$10,000 per year for each added institution in the center to offset the added administrative functions. The lead administrative institution of a Phase III center receives a fixed amount of \$25,000 independent of the number of sites.</li> <li>The Center for Arthropod Management Technologies budget is based on addition of 1 site in Year 4.</li> </ul>
<b>Operations and Communications</b>
<ul style="list-style-type: none"> <li>Funding in the amount of \$20,000 for years 1 and 2 and \$10,000 for years 3 to 5 are provided by NSF for costs associated with general Center operations and communications</li> </ul>
<b>Evaluator Support</b>
<ul style="list-style-type: none"> <li>In addition, NSF will provide the lead administrative institution with annual funds for an evaluator for Phase I and II awards as outlined below. The lead institution receives the following each year, all of which must be paid to the evaluator and be reflected in the budget.</li> </ul>
A one site center receives \$9,000 for the evaluator.
A two site center receives \$15,000 for the evaluator.
A three site center receives \$18,000 for the evaluator.
A four or more site center receives \$21,000 for the evaluator.
<b>CALS</b>
<ul style="list-style-type: none"> <li>CALS will provide funds to cover half of the \$55,200 salary + benefits with a 3% increase each year for the Center Coordinator (Program Coordinator II). The other half of the salary and benefits is covered by the primary NSF award.</li> <li>Miscellaneous other expenses (travel, meeting costs, etc.) will also be covered by CALS.</li> </ul>
<b>PSI</b>
<ul style="list-style-type: none"> <li>Miscellaneous other expenses (travel, meeting costs, etc.) are covered by PSI through the Virus-Insect Interactions Initiative to facilitate establishment of the Center for the first 2 years.</li> </ul>
<b>Additional Research Funding</b>
<ul style="list-style-type: none"> <li>Additional Research Funding is expected from NSF funding opportunities germane to the I/UCRC program and through direct contracts between individual member companies and ISU CAMTech laboratories that result directly from center activities.</li> </ul>

- ◇ Plan to obtain external funds. The Center will be supported primarily by NSF funds and membership fees. A marketing plan has also been developed. The ISU site will use a variety of mechanisms and strategies to promote the center including the following:
  - ⇒ Presentations to the advisory board whose membership includes representatives from industry and/or agencies (e.g., College of Agriculture and Life Sciences, Departments of Entomology, Agronomy, and a variety of multidisciplinary institutes).
  - ⇒ Presentations to and meetings with visitors from industry identified by the College and University development offices.
  - ⇒ Attractive and engaging web site and materials.
  - ⇒ Printed promotional materials.
  - ⇒ Use of current industry contacts to recruit new members.
  - ⇒ Contacts with a variety of government agencies (not limiting membership to industry).
  - ⇒ Use of national and local events (workshops, conferences, etc.) to make personal contacts and promote the benefits of the center.
  - ⇒ Actively promote and market students who have worked in the center.

New marketing strategies will be considered continuously based on suggestions at the NSF I/UCRC Annual Directors meetings, from other centers, suggested by the research team or administration, or members of the IAB.

**PROPOSED CENTER COSTS AND FUNDING SOURCES**

	TOTAL COSTS	TOTAL NEW COSTS*
Year 1	\$967,000	\$967,000
Year 2	\$1,067,000	\$100,000
Year 3	\$1,145,000	\$78,000
Year 4	\$1,318,000	\$173,000
Year 5	\$1,368,000	\$50,000
Year 6	\$1,418,000	\$50,000
Year 7	\$1,418,000	\$0

\*Sources of funds include NSF; industry memberships; additional industry funding of projects; and funding from other federal agencies.

- ◇ Additional information. The proposed center will contribute significantly to the successful development and preparation of graduate and undergraduate students across multiple departments and provide for excellent networking opportunities with the industrial sector. Students associated with the center will receive exceptional career development opportunities, including attendance and presentations at interdisciplinary conferences and workshops, participation in interdisciplinary activities and journal publications, and training in the ethical conduct of research. The center director will add to the diversity of I/UCRC leadership. Minority and women graduate and undergraduate students will be actively recruited. Faculty members participating in the center have a strong record of working with students from underrepresented groups and a policy of promoting diversity within the center will be maintained. Research findings will be disseminated internationally and will have significantly broader impact through industry collaboration and technology transfer.
- ◇ Implementation. After obtaining Board approval, the College of Agriculture and Life Sciences will proceed with implementation of the Center.

STAFFING PLAN AND RESPONSIBILITY MATRIX

ROLE	ISU PARTICIPANTS	RESPONSIBILITIES
Leadership	<b>Bryony C. Bonning</b> , Director	<ul style="list-style-type: none"> <li>-Leadership</li> <li>-Coordination of site research team and with UK sites</li> <li>-Recruitment of members</li> <li>-Record keeping</li> <li>-Supervision of staff</li> </ul>
Research Team	12 Faculty members Graduate and undergraduate students, postdoctoral researchers	<ul style="list-style-type: none"> <li>-Recruitment of members</li> <li>-Interface/ collaborate with members on projects</li> <li>-Project presentations and reports</li> <li>-Supervision of students and postdoctoral researchers</li> </ul>
Administration	Administrative Assistant (The College of Agriculture and Life Sciences, and the NSF will provide support for a full-time administrative assistant.)	<ul style="list-style-type: none"> <li>-Recruitment of members</li> <li>-Development of PR materials</li> <li>-Maintenance of Center web site</li> <li>-Invoicing and recording</li> <li>-Handling membership fees</li> <li>-Preparation of annual reports</li> <li>-Coordinate preparation of materials and plans for IAB meetings</li> <li>-Communicate with UK site, evaluator, IAB chair, members and others as appropriate.</li> </ul>
Development	Leadership team, research team, administrative assistant, College of Agriculture and Life Sciences	<ul style="list-style-type: none"> <li>-Leveraging of existing industry contacts</li> <li>-Representation at national and international meetings and workshops</li> <li>-Distribution of PR materials and information</li> </ul>
Intellectual Property and Legal Matters	<ul style="list-style-type: none"> <li>-ISU Research Foundation,</li> <li>-Office of Sponsored Programs Administration,</li> <li>-Legal Counsel</li> </ul>	<ul style="list-style-type: none"> <li>-Processing of documents for contracts and grants</li> <li>-Interface with industry counsel and UK as needed</li> </ul>

## FACILITIES

### 1. Research Facilities

In addition to outstanding library resources and support for laboratory, greenhouse, and field-based science, ISU has a full set of centralized facilities overseen by the Biotechnology Council to facilitate the research projects outlined in this I/UCRC proposal. ISU has a strong emphasis in the plant sciences with the ISU Plant Sciences Institute (PSI) playing a major role in promoting plant science research and also supporting plant science-related facilities. ISU is dedicated to increasing its stature as a top research institution in biotechnology and plant sciences. Toward that end it will continue to operate and update state-of-the-art biotech and plant growth facilities as readily accessible, customer-oriented research services.

ISU has exceptionally strong, state-of-the-art biotechnology facilities available to all researchers that provide services at cost or less. Biotechnology-related facilities include the Bimolecular Nuclear Magnetic Resonance Facility, Confocal Microscopy Facility, GeneChip Facility, Macromolecular X-ray Crystallography Facility, Plant Transformation Facility, Protein Facility. Details of some of the facilities relevant to CAMTech are listed below.

The *ISU DNA Facility*, operated around the clock, by a faculty member and numerous technicians, performs DNA synthesis; DNA sequencing; high-throughput DNA sequencing; massively parallel (Next Gen) sequencing; plant genomic and plasmid DNA extraction; automated fluorescent genotyping; quantitative, real-time PCR; and automated microarray slide hybridization. Sequencing samples are run on the DNA Facility's Applied Biosystems 3730xl DNA Analyzer. The AB 3730xl uses a four-color dye system and provides up to 900 bases of usable sequence data per reaction. Results are generally returned within 24-48 hours after receipt of the samples. The facility also provides a primer walking service. For High-Throughput DNA sequencing, the DNA facility extracts and prepares plasmid templates in a 96-well format prior to 96-well high throughput sequencing. OnCore software allows the customer to retrieve sequence data directly from the facility by Ethernet with full access to ABI Autoassembler and Fatura DNA sequence assembly software. Equipment includes an Applied Biosystems 3730xl DNA Analyzer, and Illumina Genome Analyzer II.

*Microscopy and Nanolmaging Facility (MNIF)*: MNIF provides a variety of instrumentation, technical assistance, consultation and training to individuals and groups of life sciences and biotechnology researchers who want to use photomicrography, light microscopy, scanning and transmission electron microscopy, cryopreservation, cytochemistry, autoradiography, tomography, x-ray microanalysis and image analysis. In addition to the round-the-clock open hours, the MNIF carries out service work. The director and assistant scientist of the MNIF are available for consultation and individual help. Equipment includes 200kV JEOL 2100 scanning/transmission electron microscope (STEM) with elemental analysis, cryo-imaging, tomography, and image analysis systems, and a variable pressure JEOL 5800LV scanning electron microscope (SEM) with elemental and image analysis systems; a Zeiss Axioplan II compound microscope equipped with AxioCam color and B/W digital cameras and the following optical modes – bright-field, phase-contrast, polarizing, dark-field, fluorescence and Nomarski (DIC).

*Bioinformatics and Computational Biology (BCB)*: ISU has a strong bioinformatics program with associated resources which will benefit the proposed research. Resources include those within the Laurence H. Baker Center for Bioinformatics and Biological Statistics, and the BCB graduate program. Graduate students in the BCB program work *gratis* with faculty in the biological sciences on bioinformatics projects to broaden their bioinformatics experience.

Project investigators have access to fully equipped laboratories to conduct the proposed research.

## **2. Office**

Office space, other suitable work space, and office equipment are available for team members, graduate students, undergraduate students, and staff who will support the Center. PI Bonning's office is located in 401 Science II Hall on the ISU campus. The office adjacent to Bonning's office, 403 Science II has recently been renovated and will be used by the Center Coordinator, and as the CAMTech headquarters. ISU will provide computer and advanced information technology support to all personnel involved with CAMTech, including components that require specialized hardware and software.

## **3. Other Resources**

Several buildings on the ISU campus house multi-user equipment facilities available to CAMTech participants, including in Science II Hall (Autoclave, Beckman Ultracentrifuge, UV-VIS spectrophotometer, Liquid scintillation counter, Sorvall refrigerated centrifuge, Ice machine) and Bessey Hall: The fourth floor of Bessey Hall houses the Plant Science Institute *Center for Plant Responses to Environmental Stresses (CPRES)* Core Facility. The CPRES core facility houses a variety of common-use instrumentation needed for plant molecular biology.

*ISU Environmental Health and Safety* oversees radiotracer work. Support services include departmental secretarial staff, a campus Engineering Research Institute Technical Services Department, and the Chemistry Machine Shop. All of these facilities are available for the proposed projects as required.