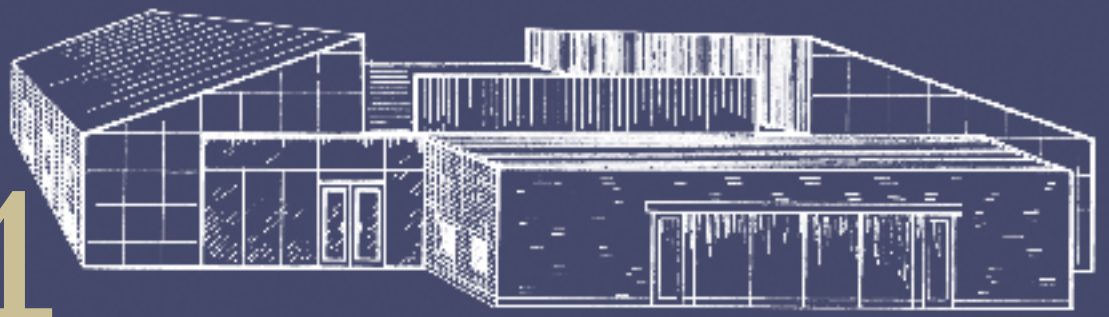
seed biotechnology center

Annual Report

2004



October 15, 2003 Celebration

Director's Message

Kent J. Bradford
Director, Seed Biotechnology Center

As the Seed Biotechnology Center (SBC) completes its fifth year, it is a good time to reflect on its initial goals and the extent to which those have been achieved. The SBC was conceived as a partnership between the seed and plant biotechnology industries and the University of California, Davis, to facilitate access to new technologies and their commercialization in seed products benefiting growers, processors and consumers. The initial goals, targeted to the seed and biotechnology industries, were to:

- Develop research capacity and facilities.
- Develop and offer educational programs.
- Conduct public service and outreach programs.
- Provide expertise and infrastructure for collaborative research.
- Serve as a scientific resource and voice on policy issues.

How has the SBC done in achieving these goals?

- An open house on October 15, 2003 celebrated the completion of the Plant Reproductive Biology building, constructed in part with funds from the seed industry. This modern laboratory and bioinformatics facility houses the SBC, and by Fall 2004, a group of faculty focusing on seed and fruit quality will be collocated there as well. The SBC was also instrumental in establishing the Ralph M. Parsons Foundation Plant Transformation Facility, which is now serving the needs of both UC faculty and external clientele.
- University extension courses on *Seed Biology, Production and Quality*, on *Identity Preservation of Agricultural Commodities* and on *Breeding with Molecular Markers* have been well attended. Other short courses and information sessions have been offered for specific groups, such as the California Seed Association and the California Cotton Growers and Ginners Association.
- Public service projects have included the development of a web-based field isolation mapping program for California seed producers and an economic survey of the California seed industry. The publication of a special issue of *California Agriculture* on biotechnology for horticultural crops resulted from a workshop organized by the SBC and the UC Agricultural Issues Center.
- The addition of a research specialist to the SBC staff and new laboratory facilities enabled collaborative projects in pollen flow, molecular marker development, and functional genomics.
- The SBC has provided scientific expertise on diverse topics related to seeds and agricultural biotechnology for newspapers, TV, filmmakers, legislators, and the general public through interviews, workshops, websites and publications.

I believe that the SBC staff and its partners in the seed industry and the University can be justifiably proud of this list of accomplishments. Instead of being satisfied, however, and with the assistance of its Advisory Council, the SBC is reviewing its goals and objectives and renewing its efforts to listen to its clientele. A clear vision of the role that the California seed industry wishes the SBC to play and a high level of commitment and support from both the University and the industry are critical for its continued success. We look forward to engaging you in this discussion during the coming year.

Message from Bill Van Skike

Bill Van Skike
President, California Seed Association

Serving on its Advisory Council for the past five years, as well as the Chair of the Seed Advisory Board, and now President of the California Seed Association, I have had a keen interest in the development of the Seed Biotechnology Center.

The Annual Report documents the continuing activities of the SBC that provide tangible research, educational and public service benefits to the seed industry.

In considering the development of the SBC to present, one point is evident: relatively modest investment by the seed industry has resulted in significant returns. The capital campaign to build facilities for the SBC, in collaboration with the UC Davis campus, resulted in a state-of-the-art laboratory and office building where cutting-edge research of benefit to California's agricultural indsutry is being conducted.

The SBC staff, supported by industry funds, has successfully competed for grants and contracts totaling over $1,000,000 for the 2002-2007 period. Without the SBC, that research, which will provide information and scientific advances as the basis for commercial opportunities, would not be available.

The political challenges facing the industry, including the movement to ban genetic engineering approaches to crop improvement, makes the need for scientific knowledge crucial. The SBC's role as an educational and scientific conduit for such an issue is extremely beneficial to the industry, as well as to the general public.

With the increasing pace of technological development, maintaining the training and knowledge base of personnel is a difficult task for individual companies. By joining together to support the SBC, coursework, training programs and publications have been developed that benefit us all.

However, a principle of business is that to avoid complacency and decline, the time to start planning for the next phase of investment is when things are going well. With that in mind, the SBC Advisory Council has been working with SBC staff to critically evaluate the goals and objectives of the center for the next five years.

The SBC is now staffed and active with knowledgeable and talented personnel who work determinedly to meet the needs of its diverse clientele, resulting in a wide range of projects and accomplishments. The SBC Advisory Council believes that the seed industry deserves a world-class research and educational center where development of knowledge and technology will allow the state of California to continue to be recognized as one of the premier locations for germplasm development and seed production.

The possibilities and opportunities that will present themselves to the SBC in the next five years will also become the achievements and benefits of California's agricultural destiny.

Let us build on the solid foundation that we have established in the last five years and give generous support for continued growth of the SBC in the coming years.

Seed Biotechnology Center Dedication

Kent Bradford addressing Dedication audience.

More than 300 visitors from on and off campus attended the October 15th Plant Science Facilities Open House. The event celebrated the completion of a complex of new buildings, including state-of-the-art greenhouses, a plant-science teaching facility and the Plant Reproductive Biology building that houses the Seed Biotechnology Center. Tours were also conducted in Robbins Hall on campus, where the College of Agricultural and Environmental Sciences Genomics Facility contains new laboratories for DNA sequencing and analysis, and the Ralph M. Parsons Foundation Plant Transformation Facility provides gene transfer services for both UC and private researchers.

Several speakers, including UC Davis Chancellor Larry Vanderhoef and College of Agricultural and Environmental Sciences Dean Neal Van Alfen, welcomed the group and recognized the partners involved with the projects. Dr. Kent Bradford, director of the Seed Biotechnology Center, acknowledged seed industry leaders who supported the early vision of constructing such a facility. Bill Van Skike, chairman of the California Seed Advisory Board, stated "in these walls, new discoveries await, problems will be solved and the education of many students will be achieved." The Chancellor also stated, "Over the years, the plant sciences have really thrived on campus. The new plant sciences facilities will help further that success."

The Whiteakers and Kent Bradford at the Dedication.

Following the ceremony, visitors toured the new buildings, learned about research projects and took home fruits, nuts and vegetables grown on campus.

UC Davis Plant Sciences Department

Following a series of discussions and strategic planning exercises, four departments at UC Davis, Agronomy & Range Science, Environmental Horticulture, Pomology and Vegetable Crops, voted to merge into a single Plant Sciences department. Loss of faculty positions due to retirements and budget cuts had created gaps in expertise in individual departments, and changing scientific opportunities and societal needs required new interdisciplinary alignments. The merger will create one of the largest departments on campus, with over 80 faculty members. The reorganization will preserve and enhance existing excellence in research, education and extension. A new vice-chair will have specific responsibility for maintaining and expanding outreach to clientele of the new department. Agricultural commodities served by the department represent about two-thirds of California's crop production, accounting for over $17 billion in annual value. 2004 will be a transition year, with official establishment of the Plant Sciences department expected in 2005.

An example of new research groups in the Plant Sciences department is the expected relocation of five faculty research programs with a focus on seed and fruit quality to the new Plant Reproductive Biology building during Fall 2004. This, in turn, will release space in existing buildings for other faculty to collocate in programmatic groups, including postharvest biology, restoration biology, and environmental stress biology.

Research

The SBC has a well-equipped laboratory in the new Plant Reproductive Biology building. The Center engages in collaborative research with faculty from UC Davis and campuses across the country, as well as with industry partners. It focuses on research that will develop new crop products and facilitate their commercialization. Research activities include identification of molecular markers to help incorporate traits into new varieties, development of new phenotypes through mutation and transgenics, as well as being involved at the policy level to shepherd biotechnology products safely to consumers. Further information on these projects can be found at the SBC web site: http://sbc.ucdavis.edu.

Alfalfa pollen flow study required large distances between plots and six miles of isolation.

Pollen Flow in Alfalfa

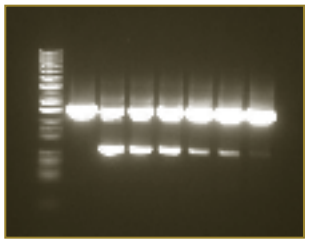
In collaboration with industry sponsors and UC researchers, the SBC conducted a study on pollen movement in alfalfa seed production using honeybees. Herbicide tolerance (HT) was used as a marker for pollen flow between HT and herbicide-susceptible alfalfa up to 2.5 miles away in two directions. Pollen flow decreased exponentially with increasing distance, being less than 1% at about 0.5 miles and less than 0.5% at approximately 1 mile from the source. These initial data will be combined with data from future honeybee-pollinated field studies to guide seed production management recommendations so that seed producers may achieve specific seed quality goals.

Student researchers count seedlings to assess pollen flow from herbicide-tolerant alfalfa.

Disease Control in Rice

The SBC worked with UC Cooperative Extension, the California Rice Experiment Station and the California Rice Research Board to test the efficacy of ozone in controlling Bakanae, a seed-borne disease in rice. Portable ozone generators would allow seeds to be treated in bins as they are soaked prior to seeding. Ozone rates were established with lab and greenhouse assays. Three ozone doses were tested against fungicide and bleach treatments in four field locations in northern California. Data from a single season showed that ozone can decrease Bakanae in rice, although the cost of application currently exceeds that of equally effective chlorine treatments.

Deletion-Mutant Populations for Breeding and Functional Genomics



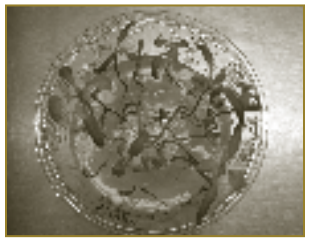
The SBC is working with the McClellan Nuclear Research Center (MNRC) in Sacramento and UC Davis researchers to determine the feasibility of using mutations induced by irradiation, in conjunction with sensitive screening techniques, to develop improved traits for California crops. Mutations offer an alternative method to transgenics for developing new traits. Modern techniques allow the efficient screening of large populations to identify mutations in specific genes. The SBC has established a mutation population resource in tomato and is testing the feasibility of using this approach to identify mutations in specific target genes having known functions. This project is funded by the MNRC and the California Tomato Research Institute.

DNA Extraction from Seeds

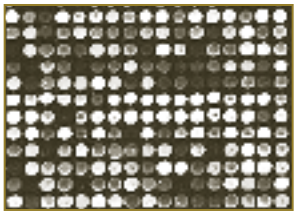
The SBC is working with seed industry partners to develop and verify high-throughput protocols for DNA extraction from seeds of a wide range of crops and seed types. The SBC developed an efficient system to grind and extract DNA from vegetable seeds. Protocols were developed to extract high-quality DNA from 11 seed types in a high-throughput format. The DNA can be used for variety identification, hybridity screening, marker-assisted selection, or other purposes. This project was funded jointly by eight seed company sponsors.

Testing Genes from Model Systems in Tomato

The SBC is continuing to work on a 3-year project with a California-based genomics company to evaluate genes that have been identified in the model plant, Arabidopsis, for their potential to improve yield and fruit quality in tomato. The Ralph M. Parsons Foundation Plant Transformation Facility is also involved in this project, which is funded jointly by the participating company and the UC Discovery Grants program. This program provides UC funding to match contributions from private collaborators. Information about UC Discovery Grants can be obtained at http://ucdiscoverygrant.org/welcome.asp.



Sampling Nucleotide Diversity in Cotton



Cotton breeding germplasm has a relatively narrow genetic base. The SBC worked with Cotton Inc. and major cotton seed companies to determine the best method to develop DNA-based genetic markers (single nucleotide polymorphisms or SNPs) in this crop. The SBC is now applying this knowledge to discover SNPs that are useful for cotton breeding. The availability of such markers could assist cotton breeders in introducing new germplasm into commercial cotton varieties to improve fiber quality or other traits.

Grants Awarded

Developing DNA Markers for Breeding in Tomato

Like cotton, tomato breeding germplasm has a relatively narrow genetic base. Tomato has many DNA-based genetic markers derived from wide inter-species crosses, but most are not useful in commercial breeding germplasm. The SBC is partnering with tomato breeders at Ohio State University and private industry to develop and characterize high-throughput DNA markers (SNPs) that can be used in current breeding germplasm. These markers will be applied to incorporate fruit quality traits into elite breeding lines. DNA markers allow breeders to characterize their germplasm and to more effectively combine important traits through hybridization and backcrossing. This project is supported by a USDA National Research Initiative Competitive Research Grant beginning August 2004 through July 2007.

Characterizing Lettuce for Novel Traits

The SBC is partnering with a California-based lettuce company and the USDA-ARS Salinas Agricultural Research Center to characterize a

diverse lettuce genetic population for seed germination and disease traits. DNA-based markers will be developed for the novel traits so that they can be efficiently incorporated into commercial lettuce varieties. This project is co-funded by the UC Discovery Grant Program and will run from August 2004 through July 2006.

Testing Genes from Model Systems in Tomato

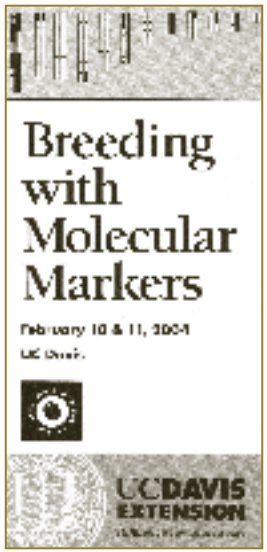
The SBC extended its collaboration with a California-based genomics company to evaluate genes previously characterized in Arabidopsis to improve tolerance to stress and nutrient utilization. This grant was co-funded by the UC Discovery Grant program and will run from August 2004 through July 2007.

Summary of Grant Funding Acquired 2003-2004:

Grant	Total $	03-04	04-05	05-06	06-07
Alfalfa	120,000	60,000			
Rice	15,280	11,460			
MNRC	54,100	57,325	8,250		
CTRI	10,000	10,000			
DNA Extraction	21,600	21,600			
Tomato Fruit	304,000	98,519	98,519	98,519	
Cotton SNP	80,000	60,000			
Tomato SNP	400,000		133,333	133,333	133,333
Lettuce	188,000		94,000	94,000	
Tomato Stress	359,000		176,363	104,364	78,273

The values above reflect the total funds of which the SBC received $258,904 in 2003-2004 and will receive $1,131,000 over the course of the grants.

Education and Outreach



Breeding with Molecular Markers Course

On Feb 10-11th, the Seed Biotechnology Center and University Extension held a course on "Breeding with Molecular Markers" at UC Davis. The course hosted over 70 industry professionals, including breeders, researchers and executives from as far as Brazil and Denmark. Leading experts in the field from both public and private institutions instructed participants in application of current technology and analysis of molecular markers in breeding programs and led a hands-on computer lab session on mapping software.

California Agriculture Issue Dedicated to Horticultural Biotechnology

Peer-reviewed articles published in the April-June 2004 issue of the University of California's *California Agriculture* journal explore the reasons why genetically engineered field (also called "agronomic") crops have succeeded in the U.S. market, while the commercialization of biotech horticultural crops -- including fruits, vegetables, nuts and ornamentals -- has virtually ground to a halt. In 1999, 374 field-test permits or notifications were filed for biotech horticultural crops; in 2003, the number was only 94. By contrast, during the same period field permits for biotech cotton, corn and soybeans remained steady at about 500 annually. The publication is based on the Workshop on Biotechnology for Horticultural Crops: Challenges & Opportunities held in Monterey in 2002 that was convened by the SBC and the UC Agricultural Issues Center. Dr. Kent Bradford served as co-editor of the special issue.

Web-based Field Isolation Maps

Seed crops require isolation to prevent undesired cross-fertilization between different varieties of the same species or between closely related species. Crop isolation can be achieved either by spatial (distance) or temporal (time) factors. This internet isolation or "pinning" map is designed to allow seed growers to identify the location, species and planting date of seed crops produced in California. Seed production personnel can electronically mark or "pin" fields from their offices on this secure web site to allow real time tracking of seed production activities. The mapping system does not enforce field isolations, but rather is available as a tool to assist seed companies and/or growers to work cooperatively to ensure high genetic purity.

The map can be previewed at http://ccia.ucdavis.edu, or contact the SBC for more information.

Two training sessions were held this year for new and continuing users. Recent enhancements include automatic email notices to subscribers identifying recently added pins. The service was developed as a result of the financial support and advice of numerous vegetable and field seed companies, the California Crop Improvement Association (CCIA) and the SBC.

PIPRA to be Established at UC Davis

Public Intellectual Property Resource for Agriculture (PIPRA) is an initiative by universities, foundations and non-profit research institutions to make agricultural technologies more easily available for development and distribution of subsistence crops for humanitarian purposes in the developing world and of specialty crops in the developed world. Although public-sector institutions have made many of the discoveries underlying agricultural biotechnology, most of these have been licensed to private companies or remain underutilized. PIPRA seeks to develop a consolidated database and clearinghouse of publicly available technologies that could be used to develop improved crop varieties, particularly for minor and subsistence crops. The SBC contributed to research evaluating the intellectual property holdings of both the public and private sectors and in developing support for the PIPRA initiative among universities, USDA and non-governmental organizations. PIPRA's director, Dr. Alan Bennett, and staff will be located in the Plant Reproductive Biology building along with the SBC. For more information see http://www.pipra.org .

USAID-MSU

The SBC designed a one-day program on agricultural biotechnology on October 6th as part of a short course organized by Michigan State University and USDA-Foreign Agriculture Service (USDA-FAS). SBC researchers and various UC scientists gave presentations that demonstrated the breadth of agricultural biotechnology research and gave the participants an appreciation for the different types of technical, intellectual property, and biosafety/regulatory issues arising with these areas of research. Participants represented Malaysia, Indonesia, Thailand, Philippines, Vietnam and China.

Measure H

The SBC worked diligently with other university researchers to provide science-based information prior to the vote on the Measure H initiative in Mendocino County in March which banned production of any genetically engineered organisms in the county. SBC director, Dr. Kent Bradford, spoke in a forum and visited with numerous journalists and reporters about the science behind biotechnology.

The SBC speaks frequently with journalists and reporters to explain the science of agricultural biotechnology. SBC staff participated in numerous interviews during the year.

SBC Web Site Gets a New Look

The center converted its website to a new system to make it more user-friendly. The SBC reorganized the content, created monthly highlights and added a search tool. The SBC will continue to work on the site upgrade in the upcoming year (http://sbc.ucdavis.edu).

SBC Reaches Out to High School and College Students

CSA sponsored tour visits the SBC.

The SBC was involved in a number of activities reaching a wide variety of students. The center organized a workshop for a group of college students from four California colleges who were participating in a seed industry tour sponsored by the California Seed Association. The SBC lab hosted visiting scientist Javiera Pinto from Chile for four months. Ms. Pinto helped with several SBC research projects during her stay. The center also organized a discussion and tour for a group of foreign exchange students in collaboration with Modesto Junior College.

Javiera Pinto, visiting researcher, works in the lab.

Tomas Stevenson, Post Graduate Researcher, working in the greenhouse.

Kevin Stoffel, Post Graduate Researcher, teaches a high school student about DNA.

For a complete list of outreach activities go to http://sbc.ucdavis.edu and refer to the 2004 Annual Report under Publications.

People Behind the SBC

Gabe Patin, Joseph Hurley, UC Davis Chancellor Larry Vanderhoef, Bill Van Skike, Kent Bradford, Francois Korn and College of Agricultural and Environmental Sciences Dean Neal Van Alfen visit at the Dedication.

SBC Advisors:

Philip W. Ashcraft, Harris Moran Seed Company
Michael L. Campbell, UC Merced
Richard W. Falconer, American Takii, Inc.
Gary A. Hudson, Gary Hudson Associates
Joseph G. Hurley, Ralph M. Parsons Foundation
Francois F. Korn, SeedQuest
George P. Kotch, Syngenta Seeds, Inc.
Roger W. Krueger, Monsanto
Ken G. Moonie, Ken Monnie & Company
Nathan K. Olivas, Progeny Advanced Genetics
Frank H. Plescia, Monsanto
Gabriel J. Patin, Sakata Seeds
Frederick J. Sundstrom, CA Crop Improvement Association
Bill W. Van Skike, California Planting Cotton Seed Distributors
David M. Tricoli, UC Davis
Mary M. Wadsworth, J. G. Boswell Co.

SBC People

Kent Bradford, Director

Allen Van Deynze, Biotechnology Specialist

Susan Webster, Program Representative

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Meg Hehner Pgs. one and twelve (drawing)
Neil Michel Pg. two (top left)
Larry Teuber Pg. four (honeybee)

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Margarita Camarena and Jen Kowskie

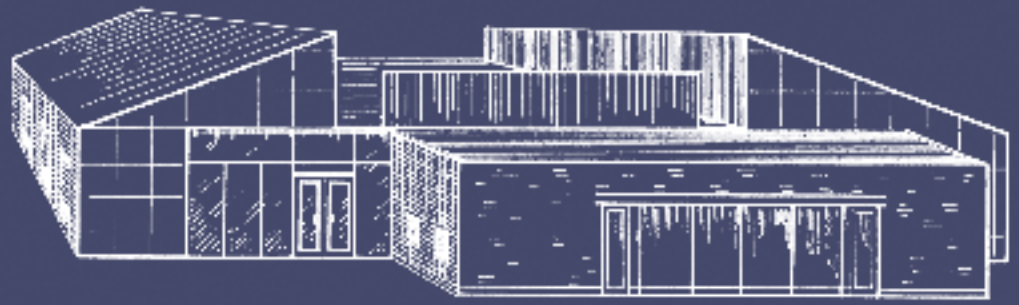
The university is grateful for the support it receives from alumni and friends. One of the ways our thanks is expressed is through listing the names of donors in various publications. Should you wish that your name not appear as a donor, please notify us, if you have not done so already.

It is the policy of the University of California, Davis, to utilize a portion of short-term investment income on current gifts and grants to support the cost of raising and administering funds.

The University of California does not discriminate in any of its policies, procedures or practices. The university is an affirmative action/equal opportunity employer.

Mission

The mission of the Seed Biotechnology Center is to mobilize the research, educational and outreach resources of the University of California, in partnership with the seed and plant biotechnology industries, and to facilitate discovery and commercialization of new seed technologies for agricultural and consumer benefit.



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Seed Biotechnology Center
University of California
One Shields Avenue
Davis, CA 95616
Phone: (530) 754-7333
E-mail: sbc@ucdavis.edu
Fax: (530) 754-7222
Web: http://sbc.ucdavis.edu