big data & collaboration
IN THE LIFE SCIENCES

2015 *in* REVIEW

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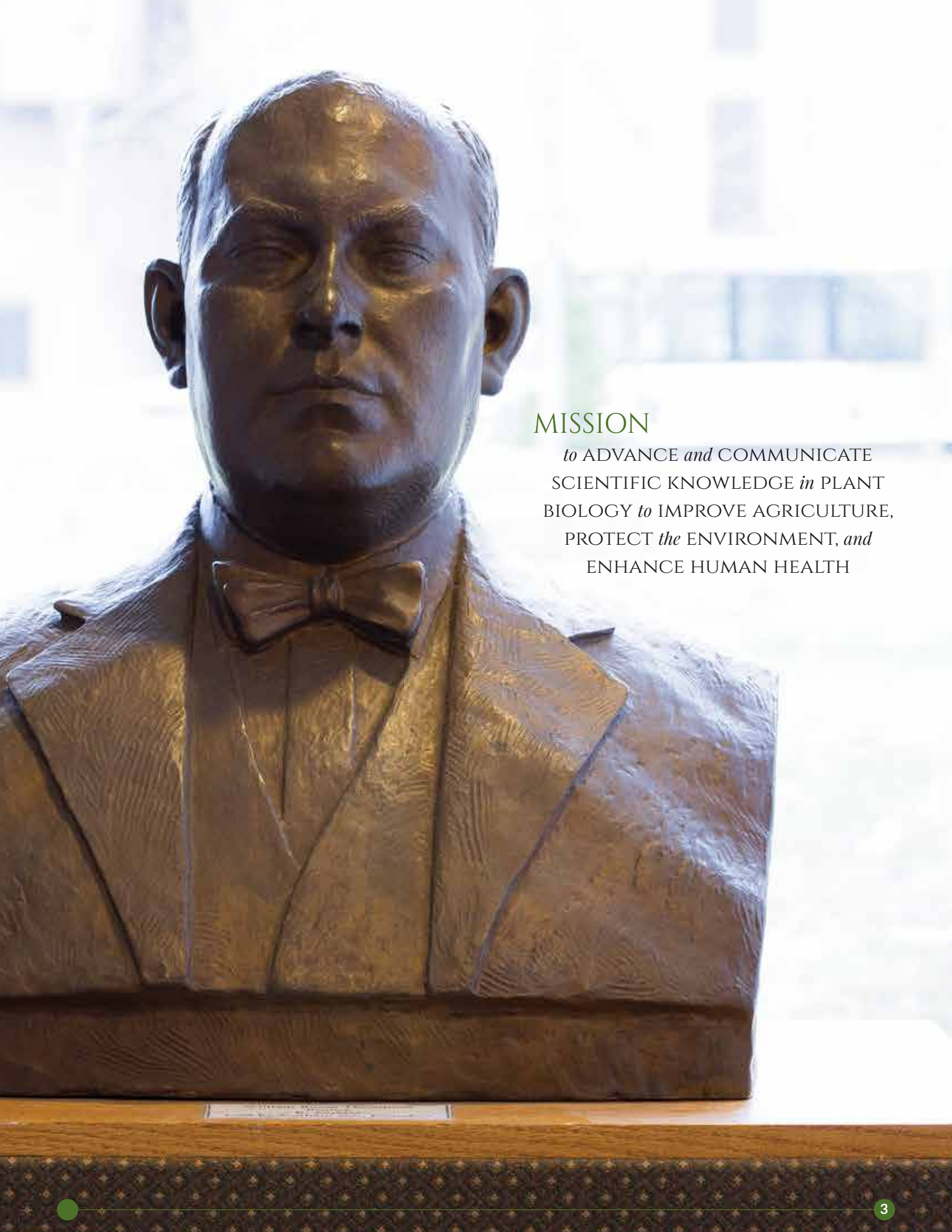
WE ARE GRATEFUL *for*

the distinguished board service provided by Crispin Taylor *(2005 to 2015)* and Peter Bruns *(2003 to 2015)*. Taylor's service is noted for his work connecting plant scientists at the grassroots and society levels, which has cemented and expanded the relationship between BTI, the American Society of Plant Biologists and the broader scientific community, and has served to solidify the formation of the National Plant Science Council. Among Peter Bruns' many contributions, he fostered the Postgraduate Society and supported career development for the scientists of tomorrow.



MISSION

to ADVANCE *and* COMMUNICATE SCIENTIFIC KNOWLEDGE *in* PLANT BIOLOGY *to* IMPROVE AGRICULTURE, PROTECT *the* ENVIRONMENT, *and* ENHANCE HUMAN HEALTH

LETTER *from* THE PRESIDENT

BTI researchers, led by our founder William Thompson's vision to "contribute something to the future of mankind" through the investigation of "the phenomena of life processes", have followed the natural and necessary course of discovery into these phenomena for 92 years. Presently, instigated by the intersection of disciplinary boundaries and an unprecedented abundance of data, we are reconceiving how we represent our work to others, by migrating from a portrayal of the work as being focused on plant science to a portrayal that is more broadly encompassing of the life sciences.

We are positioning ourselves for the future of BTI science at a time when BTI's original home in Yonkers, NY experiences rebirth. The main campus, once home to the Boyce Thompson Institute for Plant Research, reopens in autumn 2016 as the Boyce Thompson Center, a mixed-use medical and retail facility. Though the location will not house active plant research, various exhibits and artifacts throughout the building will offer visitors a glimpse into the history and purpose of BTI. Permanent displays will direct visitors to the institute's contemporary Ithaca location and will reflect both our new branding as a "life sciences" institute, and name shortening to the Boyce Thompson Institute. This new branding stems from the reality that several of our faculty members conduct research with organisms other than plants—or with no organisms at all. In this digital age, bioinformatics (the collection, querying and interpretation of large-scale data sets) drives and supports a substantial portion of current BTI research. So-called "Big Data" is not a substitute for careful, step-by-step discovery. Yet today's research environment is inconceivable without Big Data, something that was not even a pipedream at the dawning of BTI's history.

A research environment that is data-intensive and transdisciplinary —drawing upon multiple disciplines to solve complex questions —has significant implications on the practice and potential of plant science at BTI and around the world. The breadth of faculty competencies and the types of training we provide our students and postdoctoral fellows must keep pace with these trends, even as we maintain firm footing in the most fundamental and compelling unanswered questions in the life sciences. My new role in steering the Plant Science Research Network, a national organization for building a consensus vision for the future of plant science, offers an important forum for invigorating the spectrum of plant science studies—from ecosystem to molecule —while at the same time encouraging scientists to reimagine the standard of training for the next generation of discoverers.

"CONTRIBUTE SOMETHING *to the* FUTURE OF MANKIND" THROUGH THE INVESTIGATION OF "THE PHENOMENA *of* LIFE PROCESSES."

For all the foundational life science knowledge gained since BTI's inception, we still have tremendous opportunities to learn how plants adapt and interact with their environments, how to improve agricultural performance in an unpredictable climate, and how to unveil the myriad chemical secrets that plants and their interacting organisms may hold. The Boyce Thompson Center in Yonkers will tell the beginning of this story, and the Boyce Thompson Institute will carry on the study of life's phenomena through an ever-changing research landscape.

Rendering of the proposed Boyce Thompson Center expected to be completed in 2016. Credit: Design Development PLLC

Members of the Plant Science Research Network (PSRN) at the Steering Committee Meeting in Rockville, MD, February 2016. Photo: Philip Rosenberg Photography.

LETTER *from* THE BOARD CHAIR

With the rebranding of BTI in 2015 to "Boyce Thompson Institute: Discovery and Innovation in the Life Sciences," the Board of Directors has risen to the challenge of fully supporting the expanded BTI platform of research for agriculture, the environment and human health. Concurrent to the rebranding process, in which the scientists and leadership team considered the full spectrum and impact of BTI research, the Board of Directors considered our role and implemented a number of changes to enable even greater success for the institute we serve.

The Boyce Thompson Institute is a top-tier research institution and the discoveries in fundamental life science made by our researchers result from, and are reflected in, an enviable success rate in competitive research grants. The Board supports broadening the institute's base of support to allow for increased flexibility, and the opportunities such funding would afford. We lead the charge with 100% Board Member participation in meeting the institute's 2015 philanthropic goals and a remarkable achievement in total Board giving: an increase of 59% from the previous year.

In addition, we have expanded the Board's potential breadth by adding nine more seats. Some of these seats will be filled with individuals who have expertise in development and will support BTI leadership in development activities, but we are also adding capabilities across the board responsibilities from scientific, to fiduciary, governance and public policy. We have also added two new Board committees: the Major Gifts Committee, designed to provide capacity and oversight for large-scale fundraising initiatives, and the National Advisory Board, which provides a complementary alternative to Board service while allowing the institute to expand spheres of influence.

Throughout our work, the Board of Directors continues to collaborate with BTI leadership to build BTI and maintain our trajectory of success. The environment at BTI received recognition as one of 2016's Best Companies to Work for in New York State. The inspiration provided by the high caliber of our research, combined with the collaborative spirit that propels our success, is reflected in our ability to attract stellar board members who serve the institute as ambassadors for BTI in their many walks of life. It continues to be my privilege to serve beside them.

HONORABLE *mentions*

Boyce Thompson Institute was chosen as one of 2016's "Best Companies to work for in New York." Employees gave the institute high marks on satisfaction in leadership and planning, excellent supervisor-employee relationships and employee engagement. Many felt that BTI enables a culture of diversity where they feel they are making good use of their skills and abilities while enjoying the work they do. Daily, our BTI community strives to play an integral role in bringing BTI discoveries and innovations into the economy and society in helpful ways.

BTI PROVIDES A GREAT FACILITY *where* RESEARCHERS CAN PUT ALL *of their* FOCUS ON THEIR RESEARCH *and* TRUST THAT ALL OF THE EXTRA DETAILS TO FACILITATE THEIR WORK *are being* TAKEN CARE OF *by a* SKILLED *and* NIMBLE SUPPORT TEAM.

IT'S ALL IN PURSUIT *of an* EXCITING COMMON GOAL – ADVANCING HUMAN WELFARE THROUGH PLANT SCIENCE.

Shared by a BTI employee via the 2016 "Best Companies" survey

LETTER *from* THE VICE PRESIDENT *for* RESEARCH

BTI faculty and their research teams have enjoyed an extremely successful 2015. That success is reflected in part by the number of research publications from BTI laboratories—a total of 118, which represents an increase of 40% relative to the average over the past three years. In addition, the faculty continue to secure research grants from federal and private foundations in a challenging funding environment. BTI's productivity and competitiveness in science is evidenced by 2015's almost 40% success rate in competitive grant panels. Notable grants awarded in 2015 include a National Science Foundation grant to Zhangjun Fei, Jim Giovannoni and a collaborator to investigate genes involved in regulating tomato fruit quality; a Department of Energy grant awarded to Maria Harrison and a colleague to develop biosensors that detect phosphate concentrations in plant roots; and Michelle Cilia and Lukas Mueller's U.S. Department of Agriculture grant to develop the infrastructure needed to advance novel therapies for citrus greening.

Other research highlights over the past year include the launch of the Genomic and Open source Breeding Informatics Initiative (GOBII) project space at BTI dedicated to the development and application of computational tools to aid plant breeders. GOBII is funded by the Bill and Melinda Gates Foundation. It combines the efforts of Cornell researchers, including principal investigator Susan McCouch, and BTI Associate Professor Lukas Mueller, working in collaboration with major breeding centers in India, Mexico and the Philippines run by CGIAR, a global partnership of food research organizations. The objective of the project is to enable plant breeders to use data generated by genomic research to reduce the time, land and resources it takes to develop better varieties of crops. The new space at BTI is designed to house not only software developers, but visitors from the CGIAR centers who will be learning how to use this software in their breeding programs.

2015 saw a significant expansion in another key element of research infrastructure with the acquisition of a high-resolution mass spectrometer. Purchase of this new instrument, which joins the existing suite of machines in the BTI Mass Spectrometry Center, was made possible by generous support from the Triad Foundation. The new instrument enables researchers to identify the molecular identity of compounds in complex mixtures with more precision, sensitivity and speed than previously possible. This new instrument extends our research capability and cements BTI's leadership position as a center for small molecule analysis, enabling research into drugs and other small compounds, such as the Jander lab's investigation into how aphids breakdown and rebuild amino acids.

While space and instrumentation are critical, the most important element ensuring research excellence is the creativity and dedication of BTI scientists and staff. In early 2015, BTI began planning a search to identify and recruit a new faculty member. Based on these discussions, a search was launched in the summer with the objective of identifying a scientist who would expand our reach into new areas while bridging disciplines and forging connections among BTI faculty. Throughout the fall, the search committee met to consider many excellent applicants and invited the four leading candidates to share their research vision with the BTI and Cornell community in January of 2016. I wish to express my thanks to all the many members of those communities who contributed to the evaluation and interview process with thoughtful input, enthusiasm and insight. It truly takes a communal effort to build a vibrant and successful faculty, and I look forward to sharing more with you in the near future about a new member of the BTI faculty.

40%
increase in research publications

LEARN MORE AT
BTI.CORNELL.EDU/PUBLICATIONS

118
research publications

BRANCHING **OUT**

In 2015, Maria Harrison, William H. Crocker Professor at BTI, and her lab members made some transformative discoveries as part of her long-term research program investigating the beneficial relationship between plant roots and networks of soil fungi, called arbuscular mycorrhizal (AM) symbiosis. This interaction provides plants with valuable soil nutrients, and if optimized, could reduce the need for added fertilizers in agriculture.

THE GENETIC BASIS FOR ARBUSCULAR MYCORRHIZAL SYMBIOSIS

In a Triad Foundation-funded project, the Harrison lab partnered with Associate Professor Lukas Mueller's group to uncover a treasure trove of genes required for arbuscular mycorrhiza formation, greatly accelerating our knowledge of the underlying genetics. They used a plant genome comparison approach to identify genes present in plants that form the symbiotic relationship, but are absent from those that cannot. An understanding of the genes required for this relationship may lead to the breeding of crops that take up soil nutrients more efficiently.

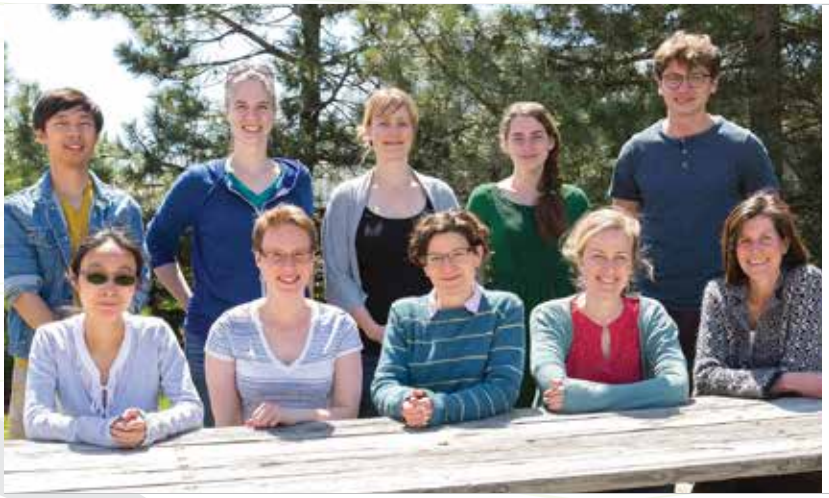
BIOSENSORS TRACK PHOSPHATE MOVEMENT

The Department of Energy has awarded Harrison and project lead Wayne Versaw, Associate Professor at Texas A&M University in College Station and a former postdoctoral researcher in her lab, a $1.2 million grant to develop biosensors to track and measure how phosphate moves from soil fungi into plant cells in real time. The new technology will be made widely available to the research community and may one day help farmers to grow food and bioenergy crops more sustainably.

SUPERCHARGED SORGHUM

Harrison will participate in a $13.5 million, multidisciplinary systems biology project with the University of Nebraska-Lincoln, to optimize sorghum crops for biofuel production. The team includes researchers from the Danforth Plant Science Center, the DOE-Joint Genome Institute and others. They aim to breed sorghum varieties that are more drought-resistant and more efficient at using nitrogen so that they can thrive on marginal lands with little added water or fertilizer.

THE HARRISON LAB



POSTDOCTORAL SCIENTISTS

Armando Bravo
Lidia Campos Soriano
Yi Ding
Sumin Guo
Sergey Ivanov
Wei-Yi Lin
Allyson MacLean
Lena Müller
Stephanie Watts-Williams

RESEARCH ASSISTANTS

Dierdra Daniels
Veronique Levesque T.

GRADUATE STUDENTS

Penelope Lindsay
Alexa Schmitz

UNDERGRADUATE STUDENTS

Alexander Loftus
Marshall Tyler
Jean-Luc LeClair

NEW VISIONS HIGH SCHOOL STUDENT INTERN

Cassandra Proctor

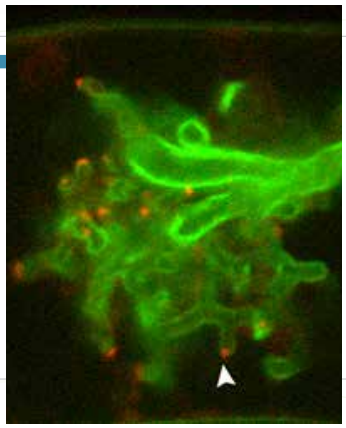
Pictured in photo:
Upper Row Yi Ding, Alexa Schmitz, Allyson MacLean, Penelope Lindsay, Sergey Ivanov *Lower Row* Sumin Guo, Veronique Levesque T., Dierdra Daniels, Lena Müller, Maria Harrison

HOW PLANTS PUT DOWN ROOTS IN ROCKY SOIL

A collaboration between students in the labs of Cornell physicists Itai Cohen and Chris Henley and former postdoctoral researcher Daniela Floss in the Harrison Lab resulted in a project to observe and extrapolate how roots navigate around rocks and other barriers in the soil. The group found that roots grow in a "run-and-tumble" pattern, which gives them 90 percent accuracy in avoiding obstructions.

NOVEL PROTEINS FOR PLANT-FUNGAL SYMBIOSIS

Plants use a protein called EXO70I to build a membrane around the fungus in AM symbiosis. EXO70I is part of a large protein complex that serves as a docking station on the root membrane and guides the development of new membranes around the fungal branches. Her lab also identified an ammonium transporter that plants use to take up nitrogen from soil fungi when soil phosphate levels run low.



THE DENNIS R. HOAGLAND AWARD

Harrison was the 2015 winner of the Dennis R. Hoagland Award, given by the American Society of Plant Biologists every three years for outstanding work on plant mineral nutrition. The award recognizes her monumental body of research on plant-fungal interactions, her leadership within the plant science community and the progress she has made toward increasing the transport of soil nutrients into crop plants.

RESEARCH *highlights*

ADVANCES *in* MEDICINE *and* AGRICULTURE HAVE SAVED VASTLY MORE LIVES THAN HAVE BEEN LOST *in* ALL THE WARS *in* HISTORY.

Carl Sagan

INSIGHTS INTO APHIDS

Professor Jander and his lab made discoveries into the inner workings of aphids, a highly destructive plant pest. They showed that aphids survive off their unbalanced diet of sugary sap by breaking down the few amino acids they consume and rebuilding a complete portfolio of amino acids with the help of bacterial partners living inside them. The group also discovered that aphid numbers get a boost on certain maize varieties when a caterpillar feeds on the plant first. The maize defensive compounds produced against the two insects share a metabolic pathway and some varieties cannot defend against both pests at the same time.

TOMATO RESEARCH, ACCORDING TO "SPECK"

This year, Greg Martin, the Boyce Schulze Downey Professor at BTI, made great advances in his career-long study of the tomato's defense against *Pseudomonas syringae* pv. *tomato*, or bacterial speck disease. He reports the discovery of a segment of DNA from a wild relative of the tomato that gives the plants resistance to a group of *P. syringae* bacteria called race 1. Currently, no cultivated tomatoes can resist race 1 infection and these bacteria are becoming increasingly problematic for tomato growers. He plans to use a local tomato field that was struck down with speck disease in 2015 as a natural test site to study speck resistance in future years.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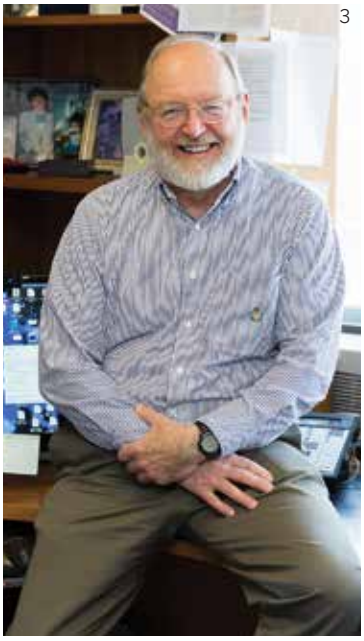
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1. Aphids feeding on corn leaves that have been previously nibbled by caterpillars. *Photo Courtesy: Meena Haribal*
2. A tomato in the BTI experimental field showing signs of bacterial speck disease. *Photo Courtesy: Greg Martin*
3. BTI's Professor Daniel Klessig.
4. The GOBII project room. In 2015 the BTI building maintenance staff created a state-of-the art bioinformatics facility in a former laboratory space.


4

ASPIRIN RESEARCH REVEALS THAT AN OLD MEDICINE HAS NEW TRICKS

Professor Daniel Klessig's team published several exciting investigations into the actions of salicylic acid in human cells in 2015. Klessig discovered that salicylic acid is an immune system regulator in plants in 1990, but the compound, which is better known as the breakdown product of aspirin, can interact with the human immune system as well. A recent study by his group showed that salicylic acid binds to an enzyme called GAPDH in cell cultures. This enzyme is known to cause cell death associated with Alzheimer's, Parkinson's and Huntington's diseases. Another study showed that salicylic acid blocks the pro-inflammatory activities of HMGB1, a protein associated with rheumatoid arthritis, heart disease, sepsis and inflammation-associated cancers, such as colorectal cancer and mesothelioma. These discoveries, combined with the recent identification of more potent forms of salicylic acid, suggest that aspirin-like drugs may be developed to treat these devastating diseases.

GRANT FOR BIG DATA MAY YIELD MORE DISEASE-RESISTANT CUCURBIT CROPS

Associate Professor Zhangjun Fei received part of a $6.5 million USDA grant to use applied genomics to speed up the development of cucurbit crops that can resist common diseases. The initiative is a collaboration among 21 researchers and is headed up by Professor Rebecca Grumet of Michigan State University. As the genomics and bioinformatics lead on the project, Fei plans to sequence 10,000 varieties of squash, melon, cucumber and watermelon, and to identify genetic markers linked to disease resistance. The information will be publicly available through the Cucurbit Genomics Database, so that breeders can access the data and use genomic tools to accelerate the breeding of improved crops.

BTI, *moving* NEW TECHNOLOGY *from the* LAB *to the* PUBLIC

BTI'S TECHNOLOGY TRANSFER OFFICE *is the* CATALYST *that* ADVANCES BASIC RESEARCH *from the* LABORATORY *to the* PRIVATE SECTOR *and* NONPROFITS *so that* BTI DISCOVERIES CAN FUEL SOLUTIONS *to* REAL-WORLD ISSUES.

2015 HIGHLIGHTS

58 MATERIAL TRANSFER AGREEMENTS
and other sharing agreements with industry labs, research institutes and academic laboratories.

7 INVENTION DISCLOSURES

12 PATENT APPLICATIONS
6 U.S. and 6 international applications

1 NEW PATENT ISSUED

Director of Technology Transfer Paul Debbie bridges the gaps between scientists, industry and foundations to ensure that BTI research achieves its potential in societal impact. The office has broad participation across the institute, with a majority of researchers working with Technology Transfer to increase the reach of their discoveries.

BTI TECHNOLOGY TRANSFER HOSTS PARK FELLOWS FROM THE CORNELL JOHNSON SCHOOL OF BUSINESS

In 2015, four-second year MBA students from the Johnson Graduate School of Management at Cornell University *(picture upper left: Paul Debbie, Julia Chan and Kelly Surdoval)* began working on several marketing-related projects with the BTI Technology Transfer Office. The students come from the prestigious Roy H. Park Leadership Fellows Program funded by the Triad Foundation, which provides two-year tuition fellowships. In teams of two, one group is working on a project to market BTI insect cell line technology for human health-related applications. The other team is working on marketing technology derived from plant disease resistance research at BTI, which is geared towards improving protein production in plants for pharmaceutical or other uses.

NEW PATENT FOR VITAMIN A-PRODUCING POTATOES

BTI, along with inventor and Assistant Professor Joyce Van Eck *(picture bottom left)* secured a new patent on a method to boost beta-carotene—a precursor of vitamin A—in potatoes. Her group collaborated with researchers at the Donald Danforth Plant Science Center with the ultimate goal of applying this method in cassava. Hundreds of thousands of children suffer from vitamin A deficiency, which can cause blindness and death. Beta carotene-rich cassava would provide a reliable source of this vital nutrient in developing countries in Africa and South Asia.

EDUCATION & OUTREACH

GROWING *the* NEXT GENERATION *of* SCIENTISTS *to* ADDRESS FOOD *and* ENERGY CHALLENGES

CURRICULA DEVELOPMENT PROGRAM TEACHER INSTITUTES

BIOENERGY FROM ALGAE & SWITCHGRASS

In 2015, the Education and Outreach group wrapped up their 5-year USDA-supported Bioenergy and Bioproducts Education Program (BBEP). The project aimed to demonstrate how plant science can be used to address global issues, such as sustainable production of energy, fuels and bioproducts for a growing global population. The BBEP integrated STEM fields (science, technology, engineering and math) into a single curriculum to expose students to the power of interdisciplinary thinking and problem-solving.

The BBEP came to a close with a national conference at the Wings of Eagles Discovery Center in Horseheads, NY. In that time, more than 600 science teachers participated in BBEP programs at BTI and seven other partner sites. More than 50 STEM teachers and 20 scientists attended the conference, where 21 outstanding alumni—including five from BTI—presented on the benefits of the program in their classrooms at an Alumni Impact Poster Session. Alumni introduced new teachers to curricula using switchgrass and algae to demonstrate the relevance and importance of STEM training to young people across the country.

Alumni teachers Karen Horikawa and Pushpa Ramakrishna also presented their curricula at the 2015 Emerging Researchers National Conference in STEM in Washington, D.C., and Gary Silverman and Peter Hentchke had posters at the 2015 National Science Teachers Conference in Chicago, IL.

ALL *of the* HANDS-ON LABS WERE FUN, EDUCATIONAL *and* RELEVANT. THEY PROVIDE MANY OPPORTUNITIES *for* INQUIRY *and* FURTHER INVESTIGATION,

Julie Wilson, Espanola Valley High School, Espanola, New Mexico


1

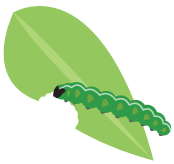
BEET ARMYWORM INVASION

Director of Education and Outreach Tiffany Fleming launched the Beet Armyworm Invasion in the annual summer teacher institute in 2015. Postdoctoral scientist Vered Tzin helped to develop methods for the classroom research experiments. In this citizen science project, students grow different varieties of corn that are more or less susceptible to the beet armyworm, a major agricultural pest. The program teaches students about genetic diversity in crop species and plant research aimed at improving the sustainability of agriculture, while also providing the Jander lab with classroom results as part of an ongoing research project.


2


3

DURING THE INVASION *of* 2015:



2,025 maize plants were grown in classrooms across 10 states: AZ, CA, DE, IL, IN, OH, OR, PA, NY and VT

6,075 caterpillars nibbled on these plants to test caterpillar-resistance

727 citizen science students learned about natural corn defenses against agricultural pests

85 teachers attended Invasion workshops and 21 followed up as citizen scientists to lead the project with their students

4.85 bushels of corn would be produced if all of those maize plants had grown to maturity—enough to feed 10.6 people for a year.

1. Teachers Alecia Redway (Pearls Hawthorne School, Yonkers, NY) and Sue Verbeck (Pine Grove Middle School, Syracuse, NY) construct systems for algal growth during the 2015 Summer Institute.
2. The Beet Armyworm Invasion of 2015 debuts as part of the BTI teacher institute.
3. Students imaging caterpillars as part of a BTI citizen science program.
4. Students in Bhawna Chowdhary's Niagara Falls High School classroom collect switchgrass germination data for the Biofuel Bumper Crop lab.
5. The winners of the 14th Annual PGRP Symposium: Luis Cruz, Judges' Choice—Kochian Lab; Michelle Laterrade, 1st place—Rose Lab; Cedric Clark, 2nd place—Richards Lab.
6. The people behind the PGRP: Professor Jian Hua of Cornell University, Director of Education and Outreach Tiffany Fleming, BTI Professor Georg Jander, Director of the USDA Holley Center Leon Kochian, Education and Outreach Assistant Nicole Waters Fisher.
7. Teacher alumna Karen Horikawa presents her poster on algal biofuel at the 2015 BBEP National Conference.

PLANT GENOME RESEARCH PROGRAM LEADERSHIP

The internship program began in 2001, instituted by former BTI faculty member Tom Brutnell, and has been led by BTI Professor Georg Jander since 2005. Jander and Jian Hua, a faculty member in the Cornell School of Integrative Plant Sciences, are the recipients of an National Science Foundation grant titled "REU Site: Plant Genome Research," the fourth in a series of NSF grants that have funded undergraduate summer research at BTI for the last 11 years. Tiffany Fleming, BTI's Director of Education and Outreach, has acted as program coordinator since 2008.

PLANT GENOME RESEARCH PROGRAM SUMMER INTERNSHIPS

In 2015, seven high school and 19 undergraduate interns attended the summer internship program. Students learned first-hand the joys and challenges of life sciences research, while receiving training in bioinformatics and data presentation.
Of the 2015 class:

44% come from racial and ethnic groups that are underrepresented in science

22% are first-generation college students

92% reported that the research experience has prepared them for advanced course work in their field of interest

78% reported good to great gains in their confidence to conduct research

87% reported that their research experience confirmed their interest in their field of study

The impact lasts long after the internship, as *80%* of former REU students attend graduate school.

Attendees and speakers at PGS Symposium 2015

PGS: ADVANCING CAREERS *in* ACADEMIA *and* INDUSTRY

CAREER DEVELOPMENT

Alumni of BTI go on to a wide spectrum of jobs that address challenges in research, agriculture and sustainability. To better prepare the next generation of STEM leaders, the Postgraduate Society (PGS) supports postdoctoral scientists, graduate students and technicians in deepening their level of experience and broadening their skill sets. Last year, a group of PGS researchers, with inspiration and support from Professor Emeritus Robert Kohut, organized the FLASH SCIENCE! competition, a speaking contest where 16 BTI researchers described their projects in three minutes or less without jargon, resulting in 48 minutes of crystal clear science communication. PGS members also organized professional development luncheons with an intellectual property attorney and a science writer. Additionally, postdoctoral researcher Sarah Hind and former graduate student Natalie Henkhaus organized a workshop to help PGS members increase their online presence.

NETWORKING IN ACADEMIA

To increase networking and training opportunities for researchers, PGS organized five "PGS Fests" with invited speakers, including a talk from BTI alum Xuemei Chen, now of the University of California Riverside. They also hosted two Distinguished Lecturer presentations, one from Wolf Frommer, former director of the Carnegie Institution for Science, and the other from Paul Schulze-Lefert of the Max Planck Institute. PGS also organized the Annual BTI Science Symposium, where 20 of its members presented posters on their work, and more than 100 attendees heard seminars from Cornell and BTI professors.

AN ENTRANCE TO INDUSTRY

Many graduate students and postdocs pursue careers in industry after leaving BTI, leading PGS to hold an industry mock-interview event in 2015. Seven "applicants" participated in 15-minute interviews with Karen Kindle, former BTI VP for Research; Christine Holmes, Director for Postdoctoral Studies at Cornell University; Paul Debbie, Director of Technology Transfer; and Eric Eisenhut, Managing Director of KensaGroup, a technology commercialization company. The event ended with a debriefing from the panel, which included advice on applying and interviewing for industry careers. Christine Krause, a graduate student in the Martin laboratory used feedback from her "interviewers" to secure an industry internship, while Daniela Floss, a postdoc in the Harrison group found the experience helpful in attaining a research scientist position at Valent BioSciences Corporation.

The mission of the BTI POSTGRADUATE SOCIETY *is to* PROMOTE PROFESSIONAL DEVELOPMENT, FOSTER A SENSE *of* COMMUNITY, FACILITATE COMMUNICATION *and* ENSURE THE REPRESENTATION *of* POSTDOCTORAL ASSOCIATES, GRADUATE STUDENTS, *and* TECHNICIANS *at* BTI.

Natalie Henkhaus, Executive Coordinator for the PSRN
David Stern, BTI President and CEO, Principal Investigator for the PSRN
Photo: Philip Rosenberg Photography

Grace Yu, 2011-12 BTI Summer Intern

BOYCE THOMPSON INSTITUTE *alumni*

NATALIE HENKHAUS

Former PGS member Natalie Henkhaus put her career development into action after completing her doctoral degree in the lab of Professor Eric Richards in 2015. She joined the BTI Communications team for a six-month internship where she moderated a panel discussion on genetically modified crops, increased graduate student representation on the website, and presented on science communication at a national plant science conference. She is now working with the American Society of Plant Biologists as the executive coordinator of the Plant Science Research Network (PSRN). In her new career, she works with the group to promote research collaboration, interdisciplinary projects and training opportunities for graduate students and postdoctoral researchers.

For me, being a part of PGS was being a part of something bigger than just BTI. Each year, we led efforts to improve the professional development of our fellow researchers, from organizing a panel on "modernizing graduate training" at the annual BTI symposium, to visiting an industry research site. PGS wouldn't have been so helpful to me without dedicated volunteers, including BTI Board members and alumni working in various plant science careers. PGS was a big part of my research experience at BTI and I'm eager to give back to the next generation of BTI students!

GRACE YU

As an intern in the Plant Genome Research Program, Yu worked with Cornell University's Jeff Doyle in 2011 and Susan McCouch in 2012 while studying at Fullerton College. She now works as a laboratory research assistant at the Arnold Arboretum at Harvard University in Boston and has plans to attend graduate school.

Upon first stepping onto the Cornell campus, I hardly knew what I was in for. As it turned out, it was 10 intense weeks of work hard, play hard. I was pushed out of my comfort zone... I had written a project proposal, given a 15-minute presentation on stage with a room full of people listening intently and had found the courage to make friends and fall in love with the little town of Ithaca I now consider a second home of sorts...With mentor Sam Crowell and Dr. McCouch, I really felt like I belonged in the world of plant biology. Working on Sam's graduate student project with him, I discovered a whole new way of looking at plants that suited my personality and interests, solidifying my love for botany.

This summer, BTI IS PROUD TO WELCOME ITS 15TH CLASS *of* SUMMER INTERNS. SINCE ITS INCEPTION *more than* 400 STUDENTS HAVE CROSSED BTI'S THRESHOLD

COMMUNICATING BTI SCIENCE *to the public*

MEDIA OUTREACH

The Communications Office is actively engaging with the media to share stories on discoveries made by BTI researchers. Through these media outlets, millions of viewers and readers can learn about the institute's work. In 2015, there were 214 media placements in more than 170 outlets ranging from Huffington Post and WedMD to Newsweek and CNN.

BRANDING & POSITIONING

In the fall of 2015, staff, faculty and board members of BTI met for a day-long, facilitated exercise. A wide range of discussions around BTI's scientific portfolio, collaborations and future directions coalesced in a consensus recommendation that has been reviewed and endorsed by the Board of Directors and descendants of BTI's founder, William B. Thompson. Results of these efforts are encapsulated in the following statement:

To provide a MORE ACCURATE REPRESENTATION *of its* SCIENCE, TO BUILD A STRONG FOUNDATION *for* INCREASING AWARENESS *of its* RESEARCH PROGRAMS, *and to* BRING SIGNIFICANT FOCUS *to the* ORGANIZATION, BTI WILL NOW BE PROUDLY KNOWN AS

BOYCE THOMPSON INSTITUTE
DISCOVERY AND INNOVATION
IN THE LIFE SCIENCES.

BTI Discovery & Innovation in the Life Sciences
BOYCE THOMPSON INSTITUTE

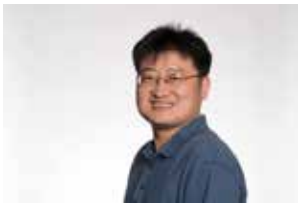
BTI FACULTY *and projects*

KLAUS APEL
How do plants sense and respond to environmental stress?
bti.cornell.edu/staff/apel-klaus

GARY BLISSARD
How do viruses interact with insects?
bti.cornell.edu/staff/blissard-gary

CARMEN CATALÁ
The making of a fruit: What are the processes involved in fruit formation?
bti.cornell.edu/staff/carmen-catala

MICHELLE CILIA
How do pathogens commandeer plants and insects to promote their own transmission?
bti.cornell.edu/staff/cilia-michelle



ZHANGJUN FEI
How can scientists access and use massive amounts of plant genomics data?
bti.cornell.edu/staff/fei-zhangjun

JIM GIOVANNONI
What is the genetic basis of fruit ripening and nutritional quality?
bti.cornell.edu/staff/dr-jim

MARIA HARRISON
How do plants form symbiotic associations with fungi to access phosphate from the soil?
bti.cornell.edu/staff/dr-maria-harrison

GEORG JANDER
How do plants defend themselves against insect herbivory?
bti.cornell.edu/staff/jander-georg

DANIEL F. KLESSIG
Uncovering salicylic acid's roles at the crossroads of plant and human health
bti.cornell.edu/staff/dr-dan-klessig

GREGORY MARTIN
How do bacteria infect plants and how do plants defend themselves from attack?
bti.cornell.edu/staff/martin-gregory

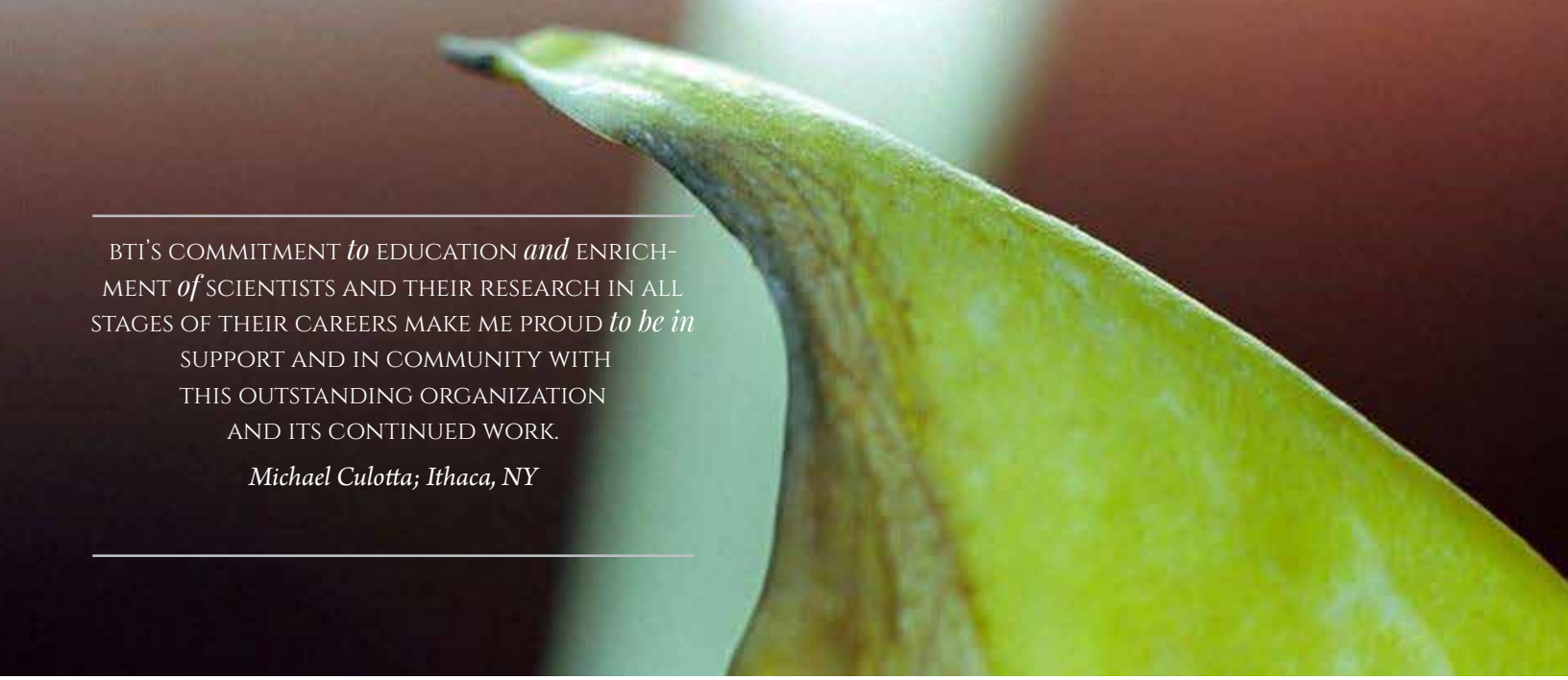
LUKAS MUELLER
How can genomics contribute to improved crop breeding?
bti.cornell.edu/staff/dr-lukas-mueller

ERIC J. RICHARDS
How does the three-dimensional organization of the genome within the cell affect gene activity?
bti.cornell.edu/staff/dr-eric-richards

FRANK SCHROEDER
Missing pieces in the chemistry of life:biogenic small molecules control development and aging
bti.cornell.edu/staff/dr-frank-c-schroeder

DAVID STERN
How can combining genetics and Big Data help us understand and improve photosynthesis?
bti.cornell.edu/staff/david-stern

JOYCE VAN ECK
How can biotechnology create better crops?
bti.cornell.edu/staff/dr-joyce-van-eck



BTI'S COMMITMENT *to* EDUCATION *and* ENRICHMENT *of* SCIENTISTS AND THEIR RESEARCH IN ALL STAGES OF THEIR CAREERS MAKE ME PROUD *to be in* SUPPORT AND IN COMMUNITY WITH THIS OUTSTANDING ORGANIZATION AND ITS CONTINUED WORK.

Michael Culotta; Ithaca, NY

fellows

CHAIRPERSON'S CIRCLE FELLOWS $5000+

Anonymous
Christian C. & Nora R. Hohenlohe
Laura Philips & John Elliott
William B. Thompson Fund

PRESIDENT'S CIRCLE FELLOWS $2500-$4999

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Peter Cornelius
Greg & Betsy Galvin
Carolyn W. Sampson
David & Karen Stern
John & Kate Townsend
Tompkins Charitable Gift Fund
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Philip & Anette Goelet
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Ithaca Garden Club
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Peter Ten Eyck
Kathryn W. Torgeson
Sylvia Weinstein

partners

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Xuemei Chen
Drs. Paul Chomet & Brenda Lowe
Ron & Shelley Cooper
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Donald & Marcia Slocum

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Bob & Johanna Granados
Stephen & Elizabeth Howell
Andre & Jean Jagendorf
Robert & Roberta Kohut
Alan & Anne Renwick
Richard & Mildred Staples

friends

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James & Terry Byrnes
Luke & Greta Colavito
Vanessa & John Wyatt Greenlee
Greg & Beverly Hartz
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Georg & Lucia Jander
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Grace Yu
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Jean Fincher
Bart Holland
Dr. Douglas Spencer
Crispin Taylor

FRIENDS $1-$59

Warren Allmon & Jennifer Tegan
Anonymous
Judith A. Bishop
Sharon Clark
Michael & Sara Culotta
Sophia & Nick Darling
Paul & Dorothy Debbie
Chris DiRienzo
Tiffany Fleming
Kathleen Gifford
Ryan Gutierrez
Natalie Henkhaus
Kelly Mackey
Gene Mattison & Nancy Ray
Daniel & Jean McPheeters
Paxton & Cherie Payton
Keith Perry & Magdalen Lindeberg
Bridget Rigas
Derek Salvato
Johanna & Russell Sample
Sanjeev Shukla

matching gifts

Anonymous
Altman Foundation
Monsanto

THANK *you*

We wish to extend our heartfelt appreciation to all who supported BTI's work in 2015. Your generosity enables us to practice our passion and supports the crucial role that basic research plays in addressing societal challenges, including improving human health, increasing the sustainability of agriculture, and protecting the environment.

For supporting this pursuit of scientific discovery and all the promise it holds, and for enabling the next generation of scientists to continue in that pursuit, we thank you.

Sincerely,
The Scientists of the Boyce Thompson Institute

designations

IN SUPPORT OF EDUCATION & OUTREACH
Georg & Lucia Jander

IN SUPPORT OF ANNUAL STUDENT SYMPOSIUM
Greg & Betsy Galvin

IN SUPPORT OF THE HIGH SCHOOL INTERNSHIP PROGRAM
Warren Allmon & Jennifer Tegan
Anonymous (2)
Sharon Clark
Michael & Sara Culotta
Sophia & Nick Darling
Tiffany Fleming
Vanessa & John Wyatt Greenlee
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Grace Yu

IN SUPPORT OF FLASH SCIENCE
Robert & Roberta Kohut
Susan & Gregory Martin

IN SUPPORT OF THE POSTGRADUATE SOCIETY
Paul & Dorothy Debbie
Natalie Henkhaus
Kelli Monce

IN MEMORY OF A. CARL LEOPOLD
Lynn B. Leopold

IN MEMORY OF LEONARD WEINSTEIN
Robert & Roberta Kohut
Sylvia Weinstein

IN HONOR OF BOB AMUNDSON
Jean Fincher

I KNOW MY DONATION *is* MAKING A DIFFERENCE *in* GROUNDBREAKING RESEARCH, IMPACTING PROBLEMS OF GLOBAL IMPORTANCE *and* CREATING THE SCIENTIFIC LEADERS *of* TOMORROW THROUGH INSPIRING EDUCATIONAL PROGRAMS.

Dr. Laura Philips; New York, NY

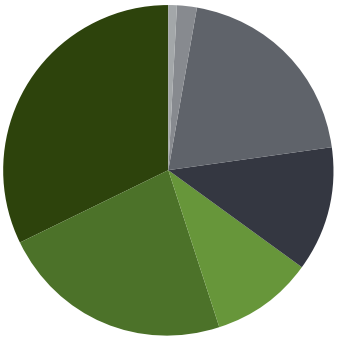
ONE *of the* KEYS TO UPLIFTING AN EMERGING OR DEVELOPING SOCIETY *has to do with* FOOD SECURITY. THIS IS WHERE OUR FINANCIAL EFFORTS SHOULD BE DIRECTED BECAUSE *there are* REAL TANGIBLE DOWNSTREAM RESULTS...I FEEL VERY GOOD ABOUT GIVING *to* ORGANIZATIONS LIKE BTI BECAUSE THEY'RE RIGHT THERE ON THE FRONT LINE, IMPROVING LIVES FOR PEOPLE WHO NEED IT.

Dr. Ronald Cooper; Ithaca, NY

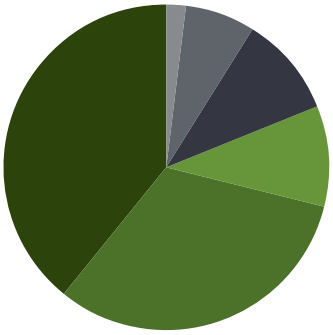
SELECTED *financials*

2015 NEW GRANTS (TOTAL AWARD LESS SUBCONTRACTS)*

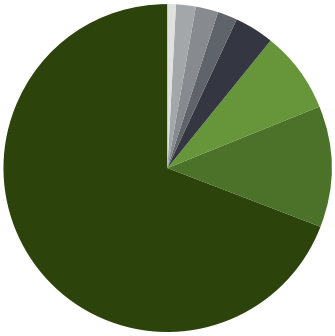
GOVERNMENT		
National Science Foundation	$3,817,733	32%
United States Dept. of Agriculture	$2,787,364	23%
Dept. of Energy	$1,170,828	10%
National Institutes of Health	$1,436,697	12%
CORPORATE, FOUNDATIONAL & OTHER		
Foundation funding	$2,431,865	20%
Corporate funding	$199,613	2%
Other collaborations	$153,853	1%
TOTAL	$11,997,953	



SOURCES OF FUNDS (INCOME)		
US Government	$6,728,000	39%
Institute endowment	$5,413,000	32%
New York State	$1,632,000	10%
Foundations	$1,661,000	10%
Other private sources	$1,270,000	7%
Unrestricted revenues	$385,000	2%
TOTAL	$17,089,000	



USE OF FUNDS (EXPENSES)		
Research	$11,870,000	69%
Administration	$2,161,000	12%
Research support	$1,316,000	8%
Equipment & facility	$701,000	4%
Communications	$343,000	2%
Development	$309,000	2%
Non-research	$280,000	2%
Education & Outreach	$109,000	1%
TOTAL	$17,089,000	



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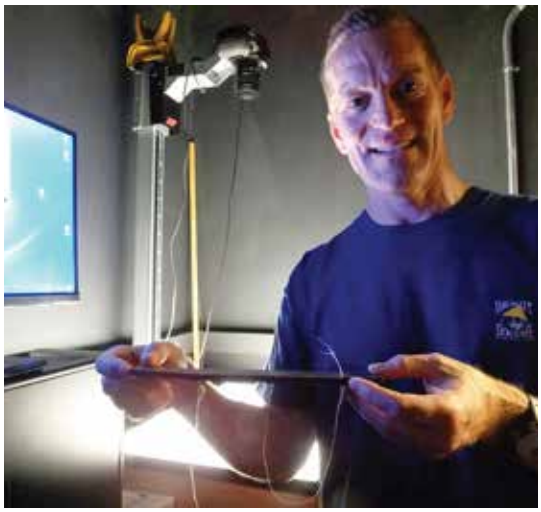


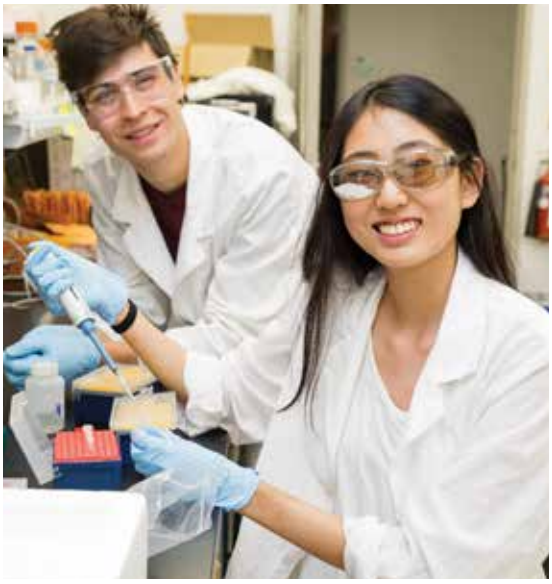
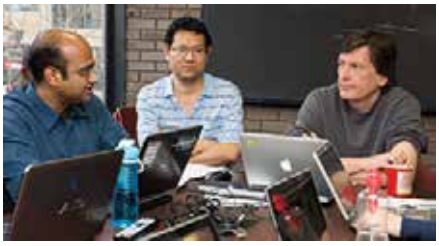

VERY FEW RECOGNIZE SCIENCE *as the* HIGH ADVENTURE IT REALLY IS,
THE WILDEST *of all* EXPLORATIONS EVER TAKEN BY HUMAN BEINGS,
THE CHANCE *to* GLIMPSE THINGS NEVER SEEN BEFORE,
THE SHREWDEST MANEUVER *for* DISCOVERING HOW *the* WORLD WORKS.

Lewis Thomas, M.D.

2015 BTI *publications*

1. Bao, Z.L., Meng, F.H., Strickler, S.R., Dunham, D.M., Munkvold, K.R. and Martin, G.B. (2015) Identification of a candidate gene in ***Solanum habrochaites*** for resistance to a Race 1 strain of ***Pseudomonas syringae*** pv. tomato. ***Plant Genome***, **8**, 3.

2. Betsiashvili, M., Ahern, K.R. and Jander, G. (2015) Additive effects of two quantitative trait loci that confer ***Rhopalosiphum maidis*** (corn leaf aphid) resistance in maize inbred line Mo17. ***J Exp Bot***, **66**, 571-578.

3. Boyle, P.C. and Martin, G.B. (2015) Greasy tactics in the plant-pathogen molecular arms race. ***J Exp Bot***, **66**, 1607-1616.

4. Breuillin-Sessoms, F., Floss, D.S., Gomez, S.K., Pumplin, N., Ding, Y., Levesque-Tremblay, V., Noar, R.D., Daniels, D.A., Bravo, A., Eaglesham, J.B., Benedito, V.A., Udvardi, M.K. and Harrison, M.J. (2015) Suppression of arbuscule degeneration in ***Medicago truncatula phosphate transporter4*** mutants is dependent on the ammonium transporter 2 family protein AMT2;3. ***Plant Cell***, **27**, 1352-1366.

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11. Chen, W., Hasegawa, D.K., Arumuganathan, K., Simmons, A.M., Wintermantel, W.M., Fei, Z. and Ling, K.S. (2015b) Estimation of the whitefly ***Bemisia tabaci*** genome size based on k-mer and flow cytometric analyses. ***Insects***, **6**, 704-715.

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14. Choi, H.W., Tian, M., Manohar, M., Harraz, M.M., Park, S.W., Schroeder, F.C., Snyder, S.H. and Klessig, D.F. (2015a) Human GAPDH is a target of aspirin's primary metabolite salicylic acid and its derivatives. ***PLoS One,*** **10**, e0143447.

2015 BTI *publications cont.*

15. Choi, H.W., Tian, M., Song, F., Venereau, E., Preti, A., Park, S.W., Hamilton, K., Swapna, G.V., Manohar, M., Moreau, M., Agresti, A., Gorzanelli, A., De Marchis, F., Wang, H., Antonyak, M., Micikas, R.J., Gentile, D.R., Cerione, R.A., Schroeder, F.C., Montelione, G.T., Bianchi, M.E. and Klessig, D.F. (2015b) Aspirin's active metabolite salicylic acid targets High Mobility Group Box 1 to modulate inflammatory responses. *Mol Med*, **21**, 526-535.

16. Christensen, S.A., Huffaker, A., Kaplan, F., Sims, J., Ziemann, S., Doehlemann, G., Ji, L., Schmitz, R.J., Kolomiets, M.V., Alborn, H.T., Mori, N., Jander, G., Ni, X., Sartor, R.C., Byers, S., Abdo, Z. and Schmelz, E.A. (2015) Maize death acids, 9-lipoxygenase-derived cyclopente(a)nones, display activity as cytotoxic phytoalexins and transcriptional mediators. *Proc Natl Acad Sci USA*, **112**, 11407-11412.

17. DeBlasio, S.L., Chavez, J.D., Alexander, M.M., Ramsey, J., Eng, J.K., Mahoney, J., Gray, S.M., Bruce, J.E. and Cilia, M. (2015a) Visualization of host-polerovirus interaction topologies using protein interaction reporter technology. *J Virol*, **90**, 1973-1987.

18. DeBlasio, S.L., Johnson, R., Mahoney, J., Karasev, A., Gray, S.M., MacCoss, M.J. and Cilia, M. (2015b) Insights into the polerovirus-plant interactome revealed by coimmunoprecipitation and mass spectrometry. *Mol Plant Microbe Interact*, **28**, 467-481.

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20. Elrouby, N. (2015) Analysis of Small Ubiquitin-Like Modifier (SUMO) targets reflects the essential nature of protein SUMOylation and provides insight to elucidate the role of SUMO in plant development. *Plant Physiology*, **169,** 1006-1017.

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22. Fernandez-Pozo, N., Menda, N., Edwards, J.D., Saha, S., Tecle, I.Y., Strickler, S.R., Bombarely, A., Fisher-York, T., Pujar, A., Foerster, H., Yan, A. and Mueller, L.A. (2015a) The Sol Genomics Network (SGN)--from genotype to phenotype to breeding. *Nucleic Acids Res*, **43**, D1036-1041.

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25. Freilich, S., Lev, S., Gonda, I., Reuveni, E., Portnoy, V., Oren, E., Lohse, M., Galpaz, N., Bar, E., Tzuri, G., Wissotsky, G., Meir, A., Burger, J., Tadmor, Y., Schaffer, A., Fei, Z., Giovannoni, J., Lewinsohn, E. and Katzir, N. (2015) Systems approach for exploring the intricate associations between sweetness, color and aroma in melon fruits. *BMC Plant Biol*, **15**, 71.

26. Fuhr, L., Rousseau, M., Plauth, A., Schroeder, F.C. and Sauer, S. (2015) Amorfrutins are natural PPAR gamma agonists with potent anti-inflammatory properties. *Journal of Natural Products*, **78**, 1160-1164.

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2015 BTI *publications cont.*

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CONTACT US

Boyce Thompson Institute
533 Tower Road, Ithaca, New York 14853-1801
T: 607-254-2923 F: 607-254-1242
bti_comm@cornell.edu / www.bti.cornell.edu

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