

# THE Leaflet

Volume 13, Issue 3

Summer 2011

## PROGRESS

**Two Cassava Research Grants Renewed  
by the Gates Foundation, and How They Have  
the Potential to Impact Africa**

| **Fighting Corn Fungus | Center in Top 10 Places to Work |**  
**| The Mechanics of Morphine Production |**



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## Center Researchers Use Virus as Inspiration to Fight Fungal Infection

Corn suffering from severe smut infection



Retrieved from [http://commons.wikimedia.org/wiki/File:Ustilago\\_maydis\\_001.JPG](http://commons.wikimedia.org/wiki/File:Ustilago_maydis_001.JPG)

**Corn smut infection is responsible for \$1 billion in crop losses yearly in the U.S. alone**

Corn smut, despite its unusual name, is no laughing matter. This pathogenic disease, caused by the plant fungus *Ustilago maydis*, is responsible for \$1 billion in crop losses annually in the U.S. alone, according to the National Corn Growers Association. With the U.S. being one of the largest corn exporters in the world, these losses have a global impact. The disease itself is common internationally, reducing yields wherever corn is grown.

Danforth Center Principal Investigator Dr. Tom Smith and Research Associate Member Dr. Dilip Shah collaborated on a project to develop a variety of corn that is highly resistant to the corn smut fungus. The results of their research were published in *Plant Biotechnology Journal*.

Corn smut is an airborne fungus found most frequently on ears, tassels and nodes. Sweet corn is most susceptible to infection, with losses as high as 20 percent. The disease causes misshapen grey/black tumors, also known as galls, to form in place of the normal kernels.

Strategies to prevent corn smut currently involve crop rotation, sanitation, seed treatments, applications of fungicides and the modification of fertility and biological controls. Unfortunately these tactics only work to minimize the rates of infection. Before the Center's discovery there were no corn varieties that were naturally immune to *Ustilago maydis*, and no single gene that could confer resistance.

Drs. Smith and Shah explored an alternative approach using a naturally found killer protein, KP4, made by a virus that lives in one specific strain of corn smut.

"This is the only symbiosis I know of in the virus world," said Smith. "Viruses like the common cold and the flu infect the host cell and destroy it after they have reproduced. In contrast, these corn smut viruses cannot leave the cell and the viruses 'know' that the host has to live if they hope to survive. To make sure its captive host lives, this virus, UMV4, makes a protein that is exported from the host cell and will kill off the other strains of corn smut trying to infect the same ear of corn. It's an infection of an infection; the corn smut infects the corn, the virus infects the smut, and the virus produces the KP4 protein to kill competing fungi, and thus ensuring the host will outcompete other corn smut strains. With our genetically modified corn, the plants are producing so much KP4 protein, that the corn smut strains commonly found in the field are killed by the plant before they get a chance to establish an infection."

Toxicity studies have shown that the KP4 proteins are safe for humans and animals to consume. Smith and Shah will continue to explore KP4 and other antifungal proteins' ability to control different types of pathogenic fungi.

"Applying our control method could significantly reduce annual losses caused by corn smut and other fungi," said Smith. "Plants often require a number of genes to only partially protect the plant from a particular fungal infection, making it difficult to use traditional breeding methods to develop resistant lines. Here we have shown that a single gene that can lend extremely robust protection, giving us hope that there are other similar and effective solutions to be found in nature."

Other antifungal work at the Center by Drs. Shah and Smith includes research into proteins to fight *Fusarium* head blight and *Fusarium* ear rot, which affect wheat/barley and corn, respectively. ■



Faculty and interns celebrate in the Lower Atrium

## Center Continues Climb into the Top 10 list of "Best Places to Work in Academia"



In the past three years the Danforth Center has risen in *The Scientist* magazine's survey of "Best Places to Work in Academia" from #66 in 2009, #18 in 2010, all the way to #8 this year!

The survey is completed by respondents identified as life scientists with a permanent position in an academic, hospital, government or research organization. This year the survey received more than 2,200 qualified responses, ranking a total of 111 organizations – 90 from the United States and 19 international organizations.

Respondents were asked to evaluate their working environment according to 37 criteria in eight different categories. Survey questions were posed as positive statements, with the respondent acknowledging the degree of either their agreement or disagreement on a one to five scale. Like last year's survey, the Danforth Center received strong marks in the "Management and Policies" and "Infrastructure and Environment" categories. Other categories in the 2011 survey included "Teaching and Mentoring," "Research Resources," and "Pay."

"Collaboration was a recurring theme among this year's top-ranked institutions," said *The Scientist* editor Jef Akst. "It's clear that scientists value the accessibility of fruitful partnerships to enhance their research." The Danforth Center was built with collaboration in mind, with large, overlapping lab spaces and daily teatimes to encourage communication.

"We are proud to be voted among the top 10 Best Places to Work in Academia," said Sam Fiorello, COO of the Center. "We strive to foster an atmosphere of collaboration and support to enable our employees to do their very best work in pursuit of our mission, to improve the human condition through plant science."

The full results are published in the July 2011 edition of *The Scientist* and are available online at <http://www.the-scientist.com> ■

**"We strive to foster an atmosphere of collaboration and support to enable our employees to do their very best work in pursuit of our mission, to improve the human condition through plant science."**

**- Sam Fiorello, COO, Danforth Plant Science Center**



## World Food Day at the Center Returns - Looking Back & Looking Ahead!

**“I was just so overcome with emotion at being able to see the end result of months of planning and hard work serving its purpose – and the fact that I was able to feed the children the meals that thousands of St. Louisans had graciously helped purchase and package just took me away.”**



Preparations for the Center’s 2011 World Food Day Commemoration are in full swing! Last year’s two-day food packaging event saw 1,900 volunteers from the community come together and package 355,000 meals for the malnourished in Tanga, Tanzania. After a long boat trip the food has reached its destination and photos of the children’s appreciative faces have made it back to us!

This summer has our Junior Board, made up of local civic-minded high school students, hard at work promoting the event at various events around the city. They’ve been spreading the word about the October Commemoration at Forest Park’s Earth Day event, the Volunteer Fair at the Magic House and will soon even be at Busch Stadium for Bioscience Day at the Ballpark. Junior Board members

have also split up into groups focusing on fundraising, outreach, social media, video production and more.

Hannah Hightower, returning for a second year as a Junior Board member, was so moved after her first World Food Day experience that she raised her own funds and travelled to Tanzania to experience the struggle against malnutrition first-hand. “I introduced myself to officials with Outreach International, an organization that partners with the Danforth Center on World Food, initially to thank them, but I also asked if they needed me to help continue their work. I expected to stuff envelopes. But they said ‘we’re going to Africa in February, and you can tag along, if you want.’” Hannah jumped at the opportunity, raising \$3,500 for the trip. She spent much of her time working at patient-intake at an open clinic called the Singida Children’s Community Center and interacting with the 400 children who are fed there.

Hannah described her reaction to seeing the food that the Center packaged at its destination: “I was just so overcome with emotion at being able to see the end result of months of planning and hard work serving its purpose – and the fact that I was able to feed the children the meals that thousands of St. Louisans had graciously helped purchase and package just took me away.”

For the Center’s May 17 *Conversations* event, Hannah joined Danforth Center researcher Dr. Mark Manary, where the two discussed their experiences on *The Frontlines of the Battle Against Malnutrition*.

Manary, often referred to as the “Peanut Butter Doctor” for the therapeutic food mixture that he developed to pull

Last year’s two-day food packaging event saw 1,900 volunteers from the community come together and package 355,000 meals for the malnourished in Tanga, Tanzania.

children back from the brink of starvation, spends much of his time in Malawi. He is also involved with the cassava nutritional fortification work ongoing at the Center. Both he and Hannah agreed that food aid from overseas was only a short-term answer. “We need to provide long-term solutions like what the Danforth Science Center is working toward,” said Hannah. Solving malnutrition worldwide “is going to need fifty or a hundred solutions,” said Manary.

Our 2011 World Food Day Commemoration on October 14-15 is shaping up to be even bigger and better. Like last year, volunteers will be packaging rice/soy meals, complete with a vitamin packet and a scoop of dried vegetables. Each package feeds four adults or six children, and costs only \$1.50.

This year’s goal is to package 500,000 meals in the same two-day span, so we’re going to need even more help! We are looking for 3,000 members of the St. Louis community to join us in this worthy cause. Students from a variety of area schools will also help package while on a “Field Trip for Food.”

Additionally, the “Science Highlight” portion of the visit has been expanded this year and renamed “Bringing Science to Life.” Participants will tour our facilities and engage in interactive learning stations run by Center scientists from around the world and Junior Board members, giving volunteers the opportunity to learn about the Center’s year-round long-term research focus. Some of these areas will include an “Algae Research Lab” (courtesy of the Magic House), a “Technology Center” where visitors can learn about the tools Center scientists use to conduct their research, and much more.

Even though the actual cost of one hour of food packaging is estimated at \$35 per person, the price for students (reduced from last year) is only \$10, while adults are \$20. Learn more about World Food Day, relive last year’s event and reserve your spot today by visiting <http://www.danforthcenter.org/wfd>



Hannah Hightower with new friends in Tanzania



Children in Tanga, Tanzania with food from our World Food Day event



## Center Oversees Sorghum Improvement Grant with Buffett Foundation & DuPont

Sahel, an area of Africa just south of the Sahara desert



**We're demonstrating that the Center can administer a project and oversee its development for a separate organization, which opens up the possibility that we might do this for other humanitarian funding organizations."**

**-Dr. Paul Anderson, Executive Director, Office of International Programs**

In May the Howard G. Buffett Foundation announced that it would be giving a \$4 million grant to the Danforth Center and DuPont to bring healthier sorghum to underserved communities in Africa.

The grant will help fund the completion of the development of biofortified sorghum, a more nutritious and digestible version for Africans who depend upon it as a staple in their diet. DuPont business Pioneer Hi-Bred began working on the project in 2005 in conjunction with the African Biofortified Sorghum (ABS) Consortium, an Africa-led public-private partnership. The ABS Consortium is a key partner in the project and will work to secure regulatory approvals and pursue production and deployment plans as Pioneer and the Danforth Center complete product development.

Sorghum and corn share a common ancestor, but unlike corn, sorghum evolved for the harsh, dry climate of Northeast Africa. "People estimate that it's been cultivated in Africa for almost eight thousand years," said the head of the Danforth Center's Office of International Programs, Dr. Paul Anderson. While it has many characteristics similar to corn, this cereal grain is far more naturally drought tolerant. It is an especially important crop in what is called the Sahel, an area of Africa just south of the Sahara desert. Even cassava, another staple crop in drought-prone parts of Africa, is not tolerant enough to survive in this harsh part of the continent.

While sorghum provides adequate calories, it is severely lacking nutritionally when consumed as a main source of food. The project has three goals for the grain- to elevate the plant's production of beta-carotene (the precursor to vitamin A), to make the iron and zinc already in the grain more bioavailable (absorbable by humans during digestion), and to make



Sorghum growing in Africa

the protein content more digestible. "There's been good progress on these three traits, and the feasibility looks good," said Anderson. Once these desirable traits have been created, work will begin to combine them into one plant. Nigeria, Burkina Faso and Kenya are set to be the initial targets for deployment once the work is complete.

Pioneer is one of the largest genetic agriculture companies in the world, and one of their main crops in corn. Since corn and sorghum are so closely related, a lot of their corn research is transferable for humanitarian causes. "Pioneer is not pursuing transgenic sorghum for commercial purposes, so it did not present a conflict of interest," explained Anderson.

The sorghum project has the Center in a more supervisory role than most of its normal research. "What we're doing is the monitoring and evaluation. We will work with Pioneer to assess progress on the project and provide advice and inputs as they're needed," said Anderson. The grant is to last four years, with the Center providing Pioneer funds every six months, through a sub-grant, dependent on the progress that is reached. Anderson described the Center as the "Interfacing organization... This is a new role for us," he continued. "It's demonstrating that we can not only carry out projects and develop products with technology developed at the Center, or work with other organizations to help them with their product development, like we're doing with Golden Rice, this is a third category now. We're demonstrating that the Center can administer a project and oversee its development for a separate organization, which opens up the possibility that we might do this for other humanitarian funding organizations."

Like the cassava work at the Center, the enhanced sorghum varieties will be released and distributed in Africa without any restrictions, free of charge. ■

Retrieved from: [http://commons.wikimedia.org/wiki/File:Sorgo\\_Avila\\_Spain.JPG](http://commons.wikimedia.org/wiki/File:Sorgo_Avila_Spain.JPG)



## Solving the Puzzle of How Poppies Make Opium



Dr. Toni Kutchan



Dr. Thomas Smith

A portion of the Danforth Center's research involves, on a fundamental level, deciphering how exactly plants create different useful compounds. From how oil is created in soy to the how opiates are made by poppies, decoding this fundamental information is an important step toward developing plants tailor-made to create large quantities of compounds of our choosing.

Center Principal Investigators Dr. Toni Kutchan and Dr. Thomas Smith have collaborated to discover new information about the atomic structure of the poppy, one of humankind's oldest medicinal plants and the commercial source for the painkiller morphine. The results of this research were published in *The Journal of Biological Chemistry*.

Kutchan and her team investigate opium's biosynthetic pathway to learn more about how this plant is able to produce the basis of some of the most frequently used medicines worldwide. Kutchan's research team was able to produce, purify, and crystallize one of the plant's enzymes involved in the production of morphine to better understand, in atomic detail, how these compounds are produced.

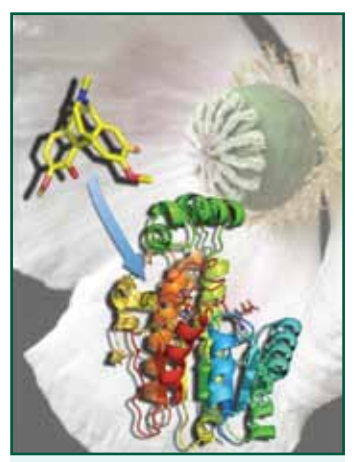
"This may be the first time an enzyme from the opium synthetic pathway has been able to be crystallized for these kinds of structural studies," said Kutchan. "Opium

may be one of the oldest medicinal plants but we are now discovering more about its pathway to enable the development of alternate sources of known pharmaceuticals and of novel drugs."

Next, Smith and his colleagues used a technique called X-ray crystallography to find the locations of all of the atoms in this enzyme. This information was used to create a model for the enzyme that showed a large flap covering the active site. From this structure and additional evidence, it seems likely that the enzyme acts in a 'pacman' fashion; its mouth opening and closing as the enzyme catalyzes its reaction.

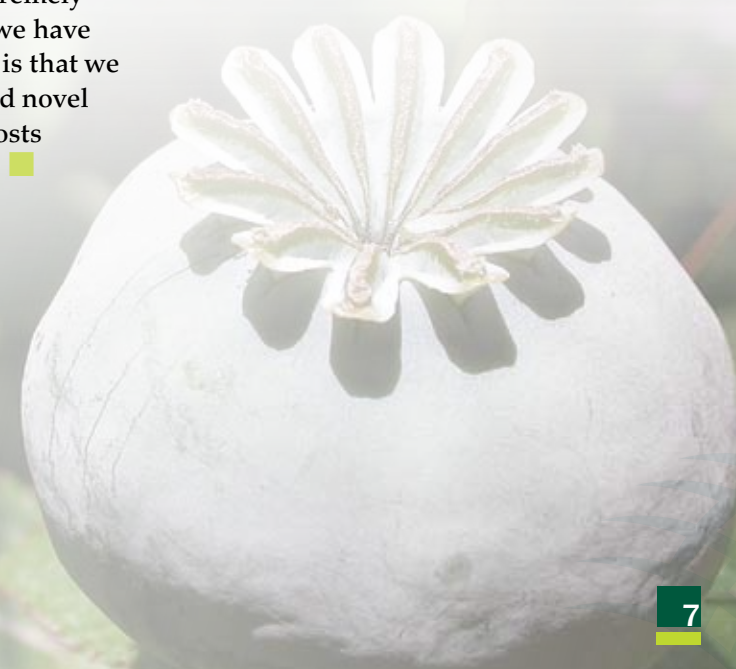
"Understanding how the enzyme works at an atomic level can further our understanding of the complex reactions that the poppy uses to produce opium," said Smith.

The production of opium in poppy is just one example of the extremely complex chemistry that is common in plants. The more details we have as to how plants make such complex products, the more likely it is that we will someday be able to manipulate enzymes to produce new and novel therapeutics. Additionally, this research could lead to reduced costs for a variety of medicines, from painkillers to anti-cancer drugs. ■



**"Opium may be one of the oldest medicinal plants but we are now discovering more about its pathway to enable the development of alternate sources of known pharmaceuticals and of novel drugs."**

**-Dr. Toni Kutchan**



# Gates Foundation Renews Two Major Grants to Fight Hunger

In a move showing great confidence in the progress and potential of the cassava work currently underway at the Center, the Bill & Melinda Gates Foundation recently granted additional funding for two long-term projects focused on the crop.

## WHAT IS CASSAVA?

Sometimes called manioc or yucca, cassava is a starchy root crop that grows productively in low-nutrient soils with little rainfall. Roots are consumed freshly, boiled, or fermented and processed into a wide variety of food products. Despite the fact that more than 250 million sub-Saharan Africans and nearly 700 million people worldwide consume cassava roots, it is relatively unknown in the U.S.

In addition to its natural drought resistance, cassava is very important to smallholder farmers because the tubers can be left in the ground for up to three years. This allows it to serve as a food security supply if a farmer's other crops are ruined by disease or drought.

Cassava, for all of its positive traits, is severely lacking in other ways. The tubers consist mostly of starch, offering calories but very poor nutrition. Those who depend on cassava for the majority of their diet often suffer from chronic malnutrition, or insufficient intake of essential nutrients and vitamins, including pro-vitamin A, iron and protein.

Cassava is often highly susceptible to a number of viruses such as cassava mosaic disease and cassava brown streak disease. These viruses can limit yield or destroy a harvest entirely.

Despite its shortcomings, according to the Global Cassava Partnership for the 21st Century, co-chaired by Center scientist Dr. Claude Fauquet, the land dedicated to growing cassava is expanding, as it is far more adaptable to the effects of climate change than other crops, such as maize, grown in sub-Saharan Africa.

## BIOCASSAVA PLUS (BC PLUS)



In April the Danforth Center announced that Phase II of the BC Plus project was funded with an additional \$8.3 million grant from the Bill & Melinda Gates Foundation. BC Plus aims to reduce malnutrition by

increasing cassava's nutritional value, including pro-vitamin A, iron and protein. According to the World Health Organization, deficiencies in these areas lead to blindness and other illnesses, disability and death for an estimated 250,000 to 500,000 children each year. Children who do survive are often stunted mentally and physically for life.

"Beta-carotene, the precursor to vitamin A, and iron are contained in various foods today, but those foods are scarce, unavailable, or too expensive for many people in certain parts of Africa," said Dr. Martin Fregene of the Danforth Center, director of the project. "Increasing nutrients in local cassava varieties will make it both accessible and affordable for communities to improve their health."

In Nigeria and Kenya, millions of people eat cassava two times a day, so researchers are focused on increasing the levels of pro-vitamin A, iron and protein in this familiar food to enhance their diet and improve livelihoods. To encourage their adoption, two cultivars of cassava are being improved in order to match the style and taste of varieties that farmers are already familiar with.

Partners in the project include the Kenya Agricultural Research Institute and the Nigerian National Root Crop Research Institute. The scientists of these institutions are well trained in genetics and biosafety and are intimately familiar with farmer and community needs.

In Phase I of the project the research team met or exceeded all of its biofortification targets. These new cassava plants have 30 times as much beta-carotene and four times as much iron and protein compared to traditional cassava. The increased levels reflect what is needed to provide the minimum daily dietary requirements for a child under five years old.

"BioCassava Plus is an opportunity to help people, especially in rural areas throughout Africa. It will give people the vitamins and other important nutrients they need through a food they already grow and eat," said Chiedozi Egesi, product development manager, BC Plus Nigeria.

## VIRUS RESISTANT CASSAVA FOR AFRICA (VIRCA)



The Bill & Melinda Gates Foundation also recently awarded \$5.6 million to support Phase II of the VIRCA program, which is a

humanitarian effort to develop and deliver farmer-preferred cassava cultivars resistant to serious viral diseases that are greatly reducing crop yields and increasing the threat of famine. In addition, the Monsanto Fund has allocated \$5.4 million, the Howard Buffett Foundation \$860,000, and USAID: From the American People another \$2.5 million.

In sub-Saharan Africa farmers lose at least 30 percent of their yield to cassava mosaic disease (CMD) each year. Cassava brown streak disease (CBSD), which has been spreading at an alarming rate in East Africa, can be responsible for a complete loss of the harvest.

The first VIRCA product will incorporate resistance to CBSD in the popular cultivar TME204, which has natural resistance to CMD and is favored by farmers in Uganda and the Lake Victoria region. A second product will be developed with a highly popular, traditional variety known as Ebwanateraka. Virus sequences will be stacked to impart resistance to both CBSD and CMD in this cultivar. Known as the "Queen" of cassava for its many positive traits, including its taste and texture, Ebwanateraka has been virtually wiped out in Uganda due to the two viruses.

VIRCA is a collaboration between researchers at the Danforth Center, the National Crop Resources Research Institute in Uganda, and the Kenya Agricultural Research Institute.

## BETTER CASSAVA FOR A BETTER FUTURE

Confined field trials and further testing for effectiveness and safety are underway for both projects. Ultimately researchers hope to combine VIRCA and BC Plus' improved traits in order to allow smallholder farmers to grow more nutritious, virus resistant cassava, which would not only fight malnutrition, but improve economic opportunities as farmers move beyond subsistence agriculture to selling their surpluses at market.

Both the nutritionally fortified and virus resistant cultivars of cassava will be available to farmers in the same way it is being offered today and will have no royalty fees. This means farmers will be able to freely multiply, save and share their planting materials.

"While the consequences of malnutrition are dire, especially for children, there is enormous potential for nutritionally enhanced foods to make substantial improvements to people's health," said Sylvia Mathews Burwell, president of the Global Development Program at the Bill & Melinda Gates Foundation. "If small farmers chose to grow these new improved crops, we expect to see not only their health improve, but also a ripple effect that means more prosperous lives."

The grant continues the foundation's support of the project and will fund further research and safety testing. ■



**"In Nigeria, for example, we may be able to save nearly 39,000 children from dying every year from vitamin A deficiency with this improved variety of cassava"**

**-Dr. Martin Fregene, director, Biocassava Plus**



Fortified cassava, orange due to enhanced beta-carotene content



**“If I was a little rough on St. Louis [in my book], I think I made up for it with a good deal of praise for the Danforth Center, which I called one of St. Louis’ ‘enviable assets.’”**

## Author Richard Longworth Describes the Center as What’s Right About St. Louis

On June 8, some of St. Louis’ most engaged and committed citizens convened at the Danforth Center to hear about the troubles facing our region. Richard Longworth, author of the book *Caught in the Middle: America’s Heartland in the Age of Globalism*, was set to give a sobering view of the Midwest’s problems. In addition to his most recent novel, Longworth is a Senior Fellow at the Chicago Council on Global Affairs and a two-time Pulitzer Prize finalist.



(left to right) Derek Rapp, Denny Coleman, John McDonnell, Jack Oliver III and Richard Longworth

This was the Center’s second annual *Seeds of Change* event, which each year features a different speaker and focuses on St. Louis’ potential and challenges, along with other topics designed to provoke thought and conversation.

And indeed, Longworth did have a few choice words for both St. Louis and the Midwest in general, describing it as “a region that does two big things for a living, which are heavy industry and intensive agriculture, and globalization has come along and tossed both of them right up in the air.”

Longworth lamented the region’s decline from the economic powerhouse of the country it once was, and decried the infighting between groups, when the region is truly competing with other countries, not other cities and states.

And yet the talk wasn’t all negative, as Longworth explained, “If I was a little rough on St. Louis [in my book], I think I made up for it with a good deal of praise for the Danforth Center, which I called one of St. Louis’ ‘enviable assets.’” He also referred to the Danforth Center as “one of the most impressive institutions, scientific or civic, in the Midwest.”

“The industrial era is pretty much over and the age of globalization is here. The old ways really won’t work anymore, and we’ve got to recover and retool and reinvent,” said Longworth. While he suggested no quick fix for the region’s troubles, he cited the need for better cooperation, a stronger emphasis on educating the workforce, a more robust public transit system, and institutions like the Danforth Center.

The BioResearch and Development Growth (BRDG) Park on the Center’s campus is a great example of what Longworth says the region is doing right. Not only does it work to attract businesses from other parts of the country and world, but it also serves as an incubator to foster new startups. Its tech-training program, done in conjunction with St. Louis Community College, ensures that the region has the trained and educated workforce needed for companies to succeed. The Center’s own programs for graduate and undergraduate students serve as further examples of what the Center is doing for the region.

After his talk, local business leaders John F. McDonnell, retired chairman of McDonnell Douglas; Denny G. Coleman, CEO of the St. Louis Economic Council; Derek K. Rapp, CEO of Divergence, Inc.; and Jack L. Oliver III, chairman of Bryan Cave Strategies, joined Longworth on stage. With Oliver serving as moderator, the five continued to discuss what St. Louis needs and how to achieve it. The whole group saw St. Louis as full of enviable assets that need to be properly leveraged and fostered.

Ultimately Longworth made it clear that the future of St. Louis is in our hands, stating that the city needs to “choose its own future without waiting for Jefferson City or [...] Washington.”

Thanks go out to the Danforth Leadership Council, who coordinated the event.

To view the event in its entirety, visit <http://danforthcenter.org/seedsofchange>

## Dr. Toni Kutchan Honored with Fellows Award

Dr. Toni Kutchan, the Oliver M. Langenberg Distinguished Investigator and Principal Investigator at the Danforth Center has been awarded the Fellows Award by the Academy of Science-St. Louis. The award recognizes a distinguished individual for outstanding achievement in science. The St. Louis scientific community and the Academy’s Board of Trustees presented her award on April 13 during the 17th annual Academy of Science-St. Louis Awards dinner.

“Since its inception, the Academy has promoted the recognition of impressive scientists of St. Louis,” said the Academy’s website. “This tradition continues with the annual Outstanding St. Louis Scientist Awards. Each award-winner represents both an extraordinary caliber of expertise and a dedication to fostering science literacy.”

“Toni is a world class scientist who has explored the biochemical pathways that

plants use to produce pharmaceutical products,” said William H. Danforth, chairman of the Center. “St. Louis is fortunate that she decided to come here to work at the Danforth Center.”

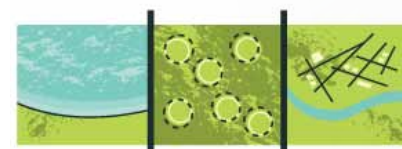
Kutchan was recently elected to the prestigious German National Academy of Science, the Leopoldina. In March the Girl Scouts of Eastern Missouri also named her a 2011 Woman of Distinction in the Sciences category.

Prior to joining the Danforth Center in 2006, Kutchan spent 20 years researching biochemistry at the University of Munich and the Leibniz Institute of Plant Biochemistry in Germany. She is currently investigating how plants produce medicinal compounds at the enzyme and gene level, which could lead to new sources of medications for use against conditions such as chronic pain and cancer. ■



Dr. Kutchan with the 2011 Girl of Distinction in the Sciences, JaLynn Gieseke

## Backyard Biofuels Returns to Engage Citizen Scientists



### Backyard Biofuels

It is a rare project that manages to get the community involved while actually achieving genuine, usable research, but this is exactly what is occurring with Backyard Biofuels, which has returned for its second year this summer.

Backyard Biofuels is a collaborative project between the Danforth Center and the Saint Louis Science Center, which aims to find more productive oil-producing algae strains by looking for them in the wild. Using kits provided by the Science Center, community members of all ages are encouraged to collect algae samples from local lakes, ponds and streams. After returning their sample kits to the Science Center, participants can track their algae’s progress on the project’s website as it is cultured and tested for lipid production.

Research is ongoing at the Center to develop algae as a potential source of biodiesel, which could fuel everything from cars to jet engines while using our currently fuel infrastructure. However, the algal varieties that are used in many of the studies are the same strains that have been growing in the lab for decades.

In its first year approximately 1,000 collection kits were given to the public, 150 samples were cultured in the lab and 100 were tested for biofuel production viability. Out of those, ten tested high for oil production, with three samples showing greater lipid numbers than currently used species.

Funding for the program is generously provided by the National Science Foundation and the Danforth Center’s own Center for Advanced Biofuel Systems.

Pick up your sample kit today at the Science Center, or visit <http://www.backyardbiofuels.com> to learn more! ■



A screenshot from Backyard Biofuels’ comical and informative instructional video



## Bono Meets with Center Leadership

Danforth Leadership Council Member Jack Oliver brought the Center together with U2's Bono, a longtime friend with whom Jack has worked on a variety of humanitarian initiatives. In addition to his rock star status, Bono is co-founder and spokesperson for the ONE Campaign, an international aid advocacy group.

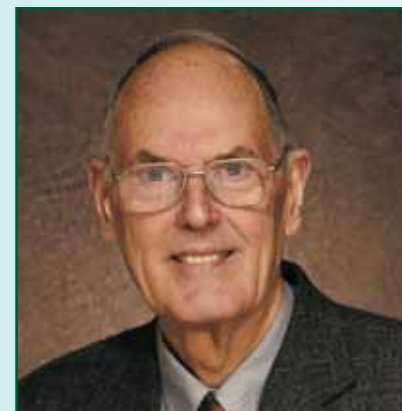
On July 17, during the St. Louis stop of the U2 360 tour, Jack made it possible for Center leadership to meet with the world's most charitable rocker. Danforth Center Chairman William Danforth, Center President Jim Carrington, and Director of our BioCassava Plus program Dr. Martin Fregene, joined Bono and Oliver backstage for an exchange of ideas about Africa.

Dr. Fregene, a native of Nigeria, shared details about the Center's work to combat hunger by improving the nutritional value and disease resistance of crops such as cassava (see pages 8-9). Bono, obviously taken by the dialogue, asked multiple questions about the Center's research as it relates to the developing world.

The conversation ended with Fregene's astute observation: "Africa needs both technology and social action - we are the technology - you are the social action. We have to work together." The next day a substantive conversation began with the ONE Campaign, and a key agriculture policy member from the group visited the Center and met with our scientific and leadership teams. ■



## Dr. Meinhart Zenk, In Memoriam



**"Meinhart was a great scientist, making countless seminal discoveries about the chemistry and biochemistry of plants. Even more so, Meinhart was a great human being who touched countless lives around the world."**

**-Dr. James Carrington,  
Danforth Center President**

It is with sadness that we announce the passing of Dr. Meinhart Zenk, member, principal investigator and colleague at the Danforth Center. Dr. Zenk passed away at his home in Creve Coeur on July 5.

Dr. Zenk's distinguished career covered more than 50 years, spanned multiple countries and resulted in the publication of 400+ plant biochemistry articles. Originally from Germany, he held positions such as Professor and Department Head of Plant Physiology at Ruhr-University of Bochum (1968-1980), Department Head of Pharmaceutical Biology at the University of Munich (1980-2000) and Honorary Professor at the University of Halle-Wittenberg (2000-2006). He moved to St. Louis to join the Center in 2006 along with his wife, fellow Principal Investigator Dr. Toni Kutchan.

His research resulted in understanding of biosynthesis and enzymology of plant natural products, including pigments, flavor components, and medicinal compounds. He made significant discoveries about the mechanism of detoxification of heavy metals within plants. More recently, he studied the formation and function of morphine in human cells and tissue. In 2010 he garnered attention after publishing an article in the *Proceedings of the National Academy of Sciences* that theorized that mammals naturally produce morphine in a similar way to how poppies create the compound.

Zenk received numerous awards, including the Liebig-Medaille of the

Society of German Chemists and the Carl-Mannich-Medaille of the German Pharmaceutical Society. He was recognized with the "Research Achievement Award" from the American Society of Pharmacognosy and the "Phytochemical Pioneer Award" given by the Phytochemical Society of North America.

After receiving a Master of Science from Purdue University and a doctorate from the University of Munich, Germany, he went on to receive honorary PhDs from Purdue University, Braunschweig University, and Shanghai University. He was also a member or foreign associate of eight scientific academies. He was elected to the German Academy "Leopoldina" and the National Academy of Sciences in Washington, D.C.

"Meinhart was a great scientist, making countless seminal discoveries about the chemistry and biochemistry of plants. Even more so, Meinhart was a great human being who touched countless lives around the world. Each of us who were fortunate to know Meinhart has a set of experiences in which he showed rare wisdom and insight, strength of character and conviction, piercing humor, generosity, and uncompromising support," said Center President Dr. Jim Carrington.

Zenk is survived by his wife and scientific collaborator Dr. Toni Kutchan, along with his two daughters, Isabelle and Annabelle, and four grandchildren. ■

### POSITIONS HELD

**1968 - 1980**

**Professor & Department Head of Plant Physiology at Ruhr-University of Bochum**

**1980 - 2000**

**Department Head of Pharmaceutical Biology at the University of Munich**

**2000 - 2006**

**Honorary Professor at the University of Halle-Wittenberg**

**2006 - 2011**

**Principal investigator at the Danforth Center**

**400+ plant biochemistry articles published**

## Third Annual Ag-Showcase Grows in Prominence and Attendance



### Ag Innovation Showcase

On May 23 and 24 the Center opened its doors for the third annual *Ag Innovation Showcase*, an annual global event for agriculture's industry leaders, entrepreneurs, venture capitalists and investors. The event promotes emerging technologies in ag-bio, food and nutrition, biofuels, sustainable materials, clean-tech, information technology and animal health.

More than 270 attendees came from around the country and world, including places such as Brazil, India and Malaysia. The event included panel discussions, keynote speakers, and a competition among emerging companies in the ag and plant science industries. Following a very competitive application process, 16 entrepreneurial companies were selected to present and exhibit their technologies at the Showcase.

Speakers spoke candidly about what is necessary to stave off an impending agricultural crisis. "You're going to see a fairly bleak picture in business-as-usual scenarios," Mark Rosegrant, director of environment and production technology at the International Food Policy Research Institute, said during the Ag Economic Forum's keynote address.

In the Economic Forum, private industry, governments and social welfare groups agreed that they must move quickly and work together to invest in rural farming and infrastructure, particularly in Africa, to mitigate the bleak situation that is developing.

The Ag-Showcase is a joint partnership of BRDG Park, located on the Danforth Center's campus, the Larta Institute, and several other sponsors. While not technically a Center event, BRDG Park and the Showcase both fit into the Center's mission of fostering the St. Louis region as a world center for plant science, as well as promoting technologies with the potential to improve the human condition.

For more about the event, a list of winners, as well as information about next year's Showcase, visit [www.agshowcase.com](http://www.agshowcase.com) ■

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