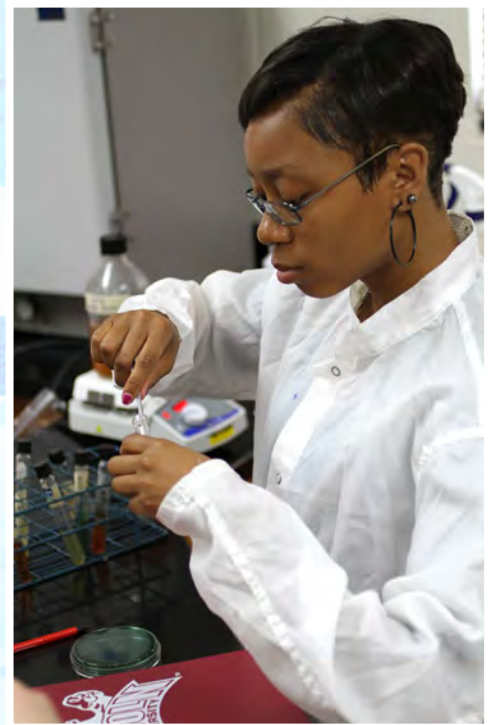


Programs and Impacts 2016-2017



Lincoln University Cooperative Extension and Research (LUCER)



LUCER-MC Report #03-2017



Dr. Albert E. Essel,
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Sciences (LUCAEHS)

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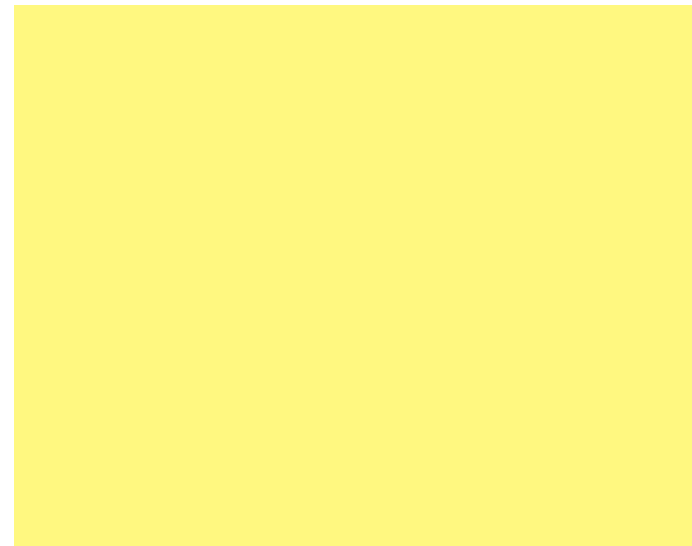
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Cooperative Extension

Renewable Resources

Dr. Adrian Andrei, Professor of Wildlife Management



Vine honeysuckle, *Sericea lespedeza*.

Farmers, Extension specialists and state and federal agency personnel report that added challenges face small Missouri farms. Many of these problems are due to aggressive, non-native weeds. These include bush or vine honeysuckle, *Sericea lespedeza* (a perennial, herbaceous plant that is widely planted as a forage and hay crop, especially on poor soils), Russian olive and many others, which are becoming more common and widespread. Non-native weeds, if not managed and controlled, can cause economic losses to forest and grassland owners. This is especially true for economically disadvantaged small farmers.

The goal of this program is to increase the options for disadvantaged and minority small

farmers in Central and Southeast Missouri. They are offered the knowledge and training needed to enhance the resource management of forests and rangelands, including wildlife management. Lincoln University Cooperative Extension (LUCE) promotes the conservation of bio-

logical diversity. LUCE also increases growers' knowledge about the control and prevention of emerging non-native, invasive plants and vertebrate pests. To this end, LUCE offers annual workshops for Central Missouri farmers on many subjects. Topics include rotational grazing, prescribed fire and timber stand improvements. Native plants for pastures and forests, and the control and prevention of weeds and vertebrate pests are also covered.

In March 2016, LUCE organized and conducted a prescribed fire seminar at Lincoln University. After the seminar, participants went to a demonstration burn on a privately owned farm in Cole County. Working with the Missouri Department of Conservation (MDC), LUCE demonstrated to landowners the use of

prescribed fire to improve forage quality and wildlife habitats. Thirty landowners, who own a total of over 2,000 acres of rangeland and forest, reported increased awareness and knowledge about the importance of prescribed fire and its potential benefits. As a direct result of the workshop, more than 150 acres of rangeland were improved. ■

Dr. Andrei giving a prescribed fire workshop.



Horticulture

Dr. Touria E. Eaton, State Extension Specialist

During fiscal year 2016, the Horticulture Program at Lincoln University Cooperative Extension (LUCE) had six major goals. First, it sought to secure funds through grants. Second, it aimed to build the capacity of the program. Third, the program shared knowledge on the production of horticultural crops to farmers and farmer educators. Fourth, it sought to educate farmers on the resources available to them through the United States Department of Agriculture (USDA). Fifth, the program offered professional services. And lastly, it contributed to Lincoln University's global initiative.

Between October 1, 2015, and September 30, 2016, the program procured \$379,383 through the USDA, Food and Drug Administration (FDA) and Cochran Fellowship Program. Funds were used for program capacity building and to start four programs in Missouri and the Midwest. The equivalent of 3.5 fulltime personnel were hired. The staff, on average, attended four professional development events during the year. Staff worked one-on-one with 181 small farmers throughout Missouri. During the year, the five team members, including the program leader, conducted 362 farm visits. Areas addressed included soil fertility, crop production in open fields and high



LUCE Horticulture Program plant grafting workshop.

tunnels, irrigation, soil stewardship and postharvest handling.

To share knowledge on the production of horticultural crops, three articles were published through the *Agronomy Journal* and the *Journal of Plant Nutrition*, reaching at least 500 farmer educators. The program conducted the Missouri Minority and Limited Resource Farmers' Conference (MMLRF) and six workshops, directly reaching 182 farmers.

Additionally, the Horticulture Program submitted four fact sheets to the Lincoln University Cooperative Extension and Research (LU-CER) Media Center and two manuscripts to the *Journal of Plant Nutrition* and *Agronomy Journal* for publication. Farm tours were conducted for middle school students. To extend the program's involvement with the USDA and other institutions and

organizations, the program leader volunteered to review 18 grant proposals for the USDA and six manuscripts for the *Journal of Plant Nutrition*. She also assumed a leadership role as a committee member for the 2016 Great Plains Growers Conference, Missouri Grown, 2016 National Small Farm Conference and Missouri Blueberry school. The program leader gave four lectures on organic farming in Jamaica, organized by Lincoln University.

Below: Carver Farm field day tour.



Paula J. Carter Center on Minority Health and Aging

Yvonne Matthews, Coordinator
Deborah Jenkins, Research Assistant I



Yvonne Matthews, PJCCMHA Coordinator, with MIMA Queen Maxine Gregory and King Joseph Turner. Below, Joseph Turner speaks about his time as MIMA King at the Missouri Institute on Minority Aging.



The Senior Lay Leaders program at the Paula J. Carter Center on Minority Health and Aging (PJCCMHA) was created to help Lincoln University Cooperative Extension (LUCE) develop and maintain relevant programs that meet the needs of senior citizens in Missouri. All lay leaders are volunteers. Staff at the regional LUCE satellite offices identify them as leaders in their communities. They meet quarterly and when necessary.

The primary duties of PJCCMHA lay leaders are to

- Attend the annual Missouri Institute on Minority Aging (MIMA) for training.
- Encourage and recruit other senior citizens to take part in PJCCMHA activities.
- Give advice about the programming needs of senior citizens to the PJCCMHA.
- Represent and promote LUCE and the PJCCMHA programs that benefit senior citizens in their communities.
- Provide leadership for the programming efforts for senior citizens in their communities.
- Attend Lunch and Learn sessions and Senior Summer School sessions provided by the PJCCMHA.

Lay leaders are assets in community outreach, so they are a vital part of PJCCMHA grant proposals. For example, the PJCCMHA received a grant award from Community Leaders Assisting the Insured of Missouri (CLAIM) for a Medicare Improvements for Patients and Providers Act (MIPPA) proposal to conduct outreach in rural and urban communities. The target population was underserved, minority, older adults with limited resources who are residents of Missouri. This grant provided the funding for lay leaders to receive training from a medical doctor from New York on cardiovascular and brain health. After training, the lay leaders conducted 25 community presentations to 309 senior citizens in their respective communities: Kansas City, St. Louis and Central and Southeast Missouri. ■



Above and left: Seniors participate in a Lunch and Learn session on finances at the Paula J. Carter Center on Minority Aging.



Central Missouri Youth Development

*Yvonne Matthews, State Extension Specialist
Adrian Hendricks II, Regional Coordinator*

The Central Missouri Youth Development program at Lincoln University Cooperative Extension (LUCE) initiated the Young Medics Club in 2012. The club collaborates with the University of Missouri School of Medicine – Called to Academic & Leadership Excellence and Building Character and Confidence (CALEB) science club.

The Young Medics Club educates youth aged nine through 18 who are interested in the fields of science, anatomy and medicine. The program is designed to expand the pool of African-American students in Science, Technology, Engineering, Agriculture and Math (STEAM). The program gives underserved and underrepresented Central Missouri students an opportunity to interact with educators and health professionals who are uniquely qualified to help youth understand the health field. Students develop the knowledge it takes to explore viable options for careers in the health professions. The Young Medics Club is designed intentionally to remove barriers to involvement and parental support by providing

transportation and being offered at no cost. Young Medics is limited to 30 students so that all participants can benefit.

During fiscal year 2016, 12 students, ranging from 9-14 years old, participated in the club. The group was very diverse: 70 percent African-American, 20 percent Caucasian and 10 percent Other. The students spent three days at partner locations, such as Community Health Center of Central Missouri; University of Missouri; University of

Missouri School of Medicine and University Hospital; Pathways; The Joshua House Church; Central Missouri (CeMO) WeCan!™ Coalition; Missouri Department of Health; Phi Beta Sigma Fraternity, Inc.; and Women’s and Children’s Hospital. This year’s Young Medics students gained knowledge about bones, blood, muscles and sickle cell anemia. They also learned about and were able to participate in teamwork, character and leadership development. ■



Young Medics participants learn how to perform intubation.



*Top, left: Young Medics learning intubation;
Bottom, left: Learning how to use a microscope.
Right: Learning how to use an evacuation chair.*



Plant Pathology Program

Dr. Zelalem Mersha, State Extension Specialist

The Lincoln University Cooperative Extension (LUCE) – Plant Pathology Program (PPP) reaches out to Missouri and midwestern minority and underserved gardeners and specialty crop growers. During fiscal year 2016, the program helped more than 1,565 people to improve their productivity and livelihood.

The program provides plant health-related services and educational programs. In fiscal year 2016, the LUCE – PPP offered two workshops that focused on the organic management of vegetable and fruit disease at Lincoln University's (LU) Alan T. Busby Farm, an organically certified farm, and at the Mid-America Organic Association's annual conference in Springfield, Missouri. Deliverables at these workshops included presentations and hands-on trainings for a total of 40 attendees. The LUCE – PPP was part of an educators' team on a high tunnel workshop for intermediate and advanced growers held March 12, 2016, in Hillsboro, Missouri. Seventy-eight visitors of the sweet corn plots at Busby Farm attended field days, and 15 growers attended the Farming for Sustainability field day at LU's George



Preserved sample of the *Sclerotinia fungus*.

Washington Carver Farm (tomato and cucurbit—squash, melon, etc.) plots. The program took part in the annual Missouri Minority and Limited Resource Farmers' (MMLRF) conference. Presentations were made on plant disease management at Master Gardener™ events and growers' meetings (e.g., Great Plains Growers Confer-

ence, St. Joseph, Missouri). Farm visits, teleconferences and consultations helped growers with disease management in open fields, gardens and/or high tunnels.

In 2016, the program worked with Purdue University to provide four MELCAST (MELon disease for-

CASTer) sites in Missouri. Using this program, growers saved two to three fungicide sprays annually. Grant funding was secured from the Missouri Department of Agriculture (MDA) to study integrated approaches for managing *Sclerotinia* (fungal) diseases in high tunnels in Missouri. A peanut project was started at Carver Farm, working with the student club, Minorities in Agriculture, Natural Resources and Related Sciences (MANRRS). The program contributed articles to LUCE's *Down to Earth* newsletter and to the University of Missouri's integrated pest management (IPM) newsletter.

With Jomo Kenyatta University of Agriculture and Technology (JKUAT) and RealIPM Kenya, the program secured funding from the United States Department of Agriculture (USDA) – Foreign Agricultural Service (FAS) to conduct research and outreach on integrated approaches to tomato diseases. In July 2016, a tomato field day was organized in Kiambu, Kenya, to show biologically based ways to manage tomato diseases. ■



Above: Plant Pathology display. Left: Dr. Mersha at Jomo Kenyatta University.



Innovative Small Farmers' Outreach Program

Dr. K. B. Paul, State Extension Specialist and ISFOP Director

Fiscal year 2016 marked the eighth year that the Lincoln University Cooperative Extension (LUCE) – Innovative Small Farmers' Outreach Program (ISFOP) offered on-farm technical help and educational programs to Missouri's small farmers. Ten field staff served 20 Missouri counties. The ISFOP promotes three facets of farm sustainability: environmentally friendly farming practices, profitability and positive social engagement. The target audience is limited-resource, underserved and minority farmers and ranchers making \$50,000 or less annually.

This year, 256 Missouri farm families had direct contact with the ISFOP staff at least once in three months. Of these families, 56 were racial minorities, 75 were female sole proprietors, 15 were U.S. military veterans, nine were physically disabled, and six were Amish/Mennonite.

ISFOP staff were technical advisors to nine farmers' markets. These markets provided outlets for many of the ISFOP's growers. Working with the markets' boards of directors, ISFOP staff trained the market managers and their vendors (43 people) on topics such as good production



ISFOP staff visiting the state Capitol.

practices, and disease and insect management. Another 23 people were trained in food safety. ISFOP staff informed clients about United States Department of Agriculture (USDA) programs for underserved farmers.

Staff also supported nine community-based organizations (CBOs). These included community gardens, training farms for socially disadvantaged people, gardens linked to houses of worship and schools, and one refugee resettlement agency. For fiscal year 2016, the 256 clients' aggregate gross annual income increased by \$488,600, averaging \$1,909 per family. Also, 18 farm families received a total of \$107,465 (an average of

\$5,970) in grants or government payments due to ISFOP efforts. Over 110 farmers reported adopting one or more new farming practices, such as season extension techniques (33 farmers), rotational grazing systems (24 farmers) or cover cropping (12 farmers).

Farming and gardening projects, rural or urban, often lead to positive social impacts, improving the quality of life for community members. ISFOP field staff found that one or more of the following had positive social impacts: educational programs for youth and/or adults, leadership of local farmers' market committees, development of vacant lots in

poor metropolitan areas into gardens or urban farms, food donation to food pantries/food access for low-income families and collaborative marketing/networking.

The ISFOP worked with the Missouri Sustainable Agriculture Research and Education (MoSARE) project and Missouri AgrAbility Project (MAP) to bring more resources to clients. The ISFOP published four quarterly, eight-page newsletters distributed statewide, sharing useful and timely information. For the past three years, with the Webb City Farmers Market, University of Missouri Extension (MUE) and Missouri Department of Agriculture (MDA), the ISFOP played a key role in organizing the Midwest Winter Production Conference in Joplin, Missouri. This year, the ISFOP received two feral swine awareness and management grants from the USDA – Animal and Plant Health Inspection Service (APHIS) and Tuskegee University. ISFOP – Southwest Region staff offered three workshops with the Missouri Department of Conservation (MDC) and APHIS. Sixty farmers and ranchers attended. ■



Top: ISFOP quarterly newsletter, Down to Earth. Bottom: Dr. Paul, a 42-year employee at Lincoln, presenting an ISFOP workshop.

Integrated Pest Management Program

Dr. Jaime Piñero, State Extension Specialist

From May to August 2016, the Lincoln University Cooperative Extension (LUCE) – Integrated Pest Management (IPM) Program provided demonstrations on grower cooperators’ lands near Kansas City, Springfield and Hillsboro, Missouri. Participants selected IPM strategies that seemed to best address their pest problems. One strategy was the mass trapping of Japanese and cucumber beetles. Another was trap cropping targeting cucurbit (squash, melons, cucumbers, etc.) pests. A third method used insectary plants (those



Left: Japanese beetle trap. Top: Two Japanese beetles. Bottom: Cucumber beetles.



that attract insects) to support beneficial arthropods (predatory insects, spiders, etc.), including releasing these arthropods in high tunnels.

Jose Fonseca, a vegetable grower in St. Peters, Missouri, uses trap cropping as a simple, effective and affordable way to control multiple pest species in his cucurbit crops. Trap cropping saved him \$400 per acre per year by reducing inputs (e.g., fuel, time, cost of insecticide). By not spraying his cash crops since 2011, he now sells pesticide-free produce. In a September 2016 interview, Fonseca stated that spending less time, effort and money managing cucurbit pests gives him more time with family. He also faces fewer risks from insecticide application. Because he lives near a daycare center and a hospital, he believes IPM has improved his image among customers.

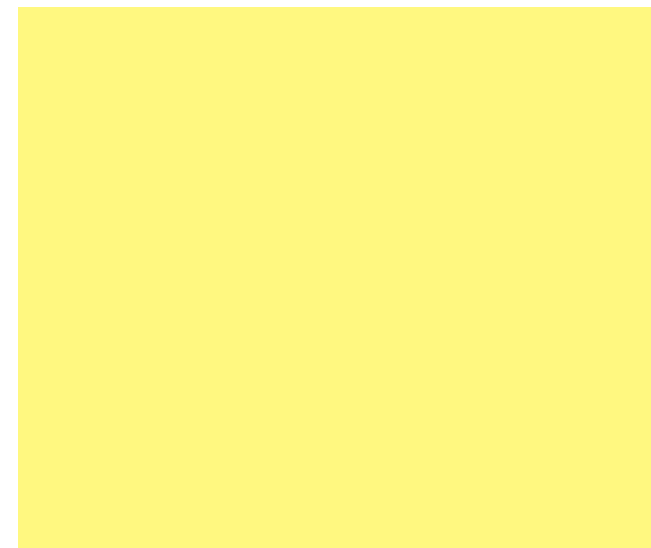
On June 9, 2016, the annual sustainable/organic field day showcased organic pest management at Lincoln University’s Alan T. Busby Farm. This innovative workshop had seven

breakout sessions held in the morning and hands-on events in the afternoon. Over 145 producers learned about many topics. These included multispecies grazing, organic blueberry production and organic vertical gardens. Other topics discussed were silvopasture (combining livestock with forestry), plant disease management with products allowed in organic production, and small ruminant (goats, sheep, etc.) parasite management. Composting, cucurbit pollination, trap cropping, insectary plants, invasive insects and biochar (a

soil amendment) were covered. While organic production was stressed, the concepts and methods offered sustainable, alternative practices for conventional growers. ■

Below: Dr. Piñero presenting information to field day participants at Alan T. Busby Farm.





Cooperative Extension Satellite Offices

St. Louis Urban Impact Center

Patrice Dollar, Regional Coordinator

During fiscal year 2016, the Lincoln University Cooperative Extension (LUCE) – St. Louis Urban Impact Center (SLUIC) conducted the following programs:

Students participating in Jr. Minorities in Agriculture, Natural Resources and Related Sciences (MANRRS) – Men on Business held an event in October 2015 at Jennings Senior High School, in collaboration with Ferguson 1000, a local group working to bring jobs to the area in the wake of issues in Ferguson, Missouri. At this event, community members were able to interact with Dr. Marvin D. Carr, the Obama administration's Policy Advisor for STEM Education, Innovation and Diversity from the Office of Science and Technology. Part of his job involved working at local events to enhance the Science, Technology, Engineering and Mathematics (STEM) and innovation aspects of the White House's My Brother's Keeper initiative. This program promoted opportunities for young males of color and other youth.

The VITA (Volunteer Income Tax Assistance) program is a free tax preparation program. It targets low-to-moderate-income (adjusted gross income of \$21,632)



Senior citizens participate in computer training classes at the SLUIC.

residents of St. Louis City and County. The volunteers are IRS (Internal Revenue Service)-trained and certified. The program was held from January 28-April 18, 2016. Volunteers filed 275 federal returns, 369 state returns, and taxpayers saved a total of \$55,000 on the preparation cost of federal and state returns. Federal and state refunds totaled \$367,599, including earned income credits totaling \$167,281 and child tax credits totaling \$66,002.

The Horticulture Program helped to create five new, urban farming projects. This brought the total to 13 urban farms getting aid (e.g., hiring staff; clearing lots; teaching classes on preservation, seed starting and plant production; and setting up

a farmers' market). In its first year, Seeds of Hope Farm, a project of the Community Action Agency of St. Louis County, created a community supported agriculture (CSA) program that served 20 limited-resource families. The sliding scale sponsorship program is based on income, with a range of aid, including full sponsorships for low-income families. Each week, the CSA program provided fresh produce to low-income families valued between \$25 and \$40, depending on the week. The average was \$28 over a 20-week distribution period. The farmers estimated the income from this program at \$5,000 for the first year, which was reinvested in the program.

St. Louis City residents visiting the SLUIC were assessed regarding their need for technical assistance and for computer lab hours, if they did not have personal computers. The following reasons were found for needing a computer: 66.7 percent, to conduct personal business; 16.7 percent, to conduct a job search; 8.3 percent, to apply for work; and 8.3 percent, to send/print a résumé. Of the people who visited the computer lab, 98 percent were African-American, one percent were Latino/a, and one percent were Caucasian.

The SLUIC partners with organizations, such as Christian Hospital's Just Lose It program and ExerStart. This promotes education, wellness and healthy lifestyle and behavior changes for those taking part in the SLUIC's Wellness and Healthy Lifestyle Program. The 260 participants of the Just Lose It program lost a total of 1,500 pounds. The ExerStart program lasts up to 20 weeks. Attendees were able to take charge of their health by making healthy lifestyle changes, such as attending regular exercise classes, shopping for nutritious foods, cooking healthy recipes, attending workshops on weight control and getting weekly weigh-ins through the programs offered at the SLUIC.



Below: Intergenerational programs put youth together with senior citizens in health-promoting activities.



Kansas City Urban Impact Center

Marion Halim, Regional Coordinator

The Lincoln University Cooperative Extension (LUCE) – Kansas City Urban Impact Center (KCUIC) is located within the urban core of Kansas City, Missouri, where its programs serve a diverse clientele.

Youth programs teach life skills. They also improve the academic achievement of 300 underserved youth aged 8-16. School children take part in hands-on learning, with the help of caring adults. The programs impart leadership skills and stress the importance of academics. Students take college tours or enroll in vocational training to keep them on the right path. Students' positive behaviors increase as do their reading and math scores. The program focuses on the Josephson Institute's Six Pillars of Character®: trustworthiness, respect, responsibility, fairness, caring and citizenship.

In fiscal year 2016, the KCUIC provided a caring program to 492 senior citizens. The goals were to keep them feeling youthful; to motivate them to exercise and increase their endurance and stamina; and to eat healthy foods. Ongoing participation in group projects results in positive



Youth learn agricultural techniques by growing food in the KCUIC community garden.

interactions among peers, more socializing, and less isolation and depression. Participation also fosters better health and wellness, improved lifestyles and creativity. Group projects, activities and field trips encourage mobility. Memory Matters is a program that presents activities and games that are memory boosters for senior citizens. Exercises are conducted, and educational information about health and fitness is also taught.

The KCUIC's Healthy Living Series partnered with local houses of worship to provide another outlet for senior citizens and other adults to learn, socialize and interact. The topics for the series are chosen by

senior citizens from the community to address issues that they face. These included Alzheimer's disease, diabetes, estate planning, heart health, men's health, chair exercise and yoga, and financial planning.

The KCUIC's pantry and toiletry program partners with the Community Action Agency of Greater Kansas City. A food desert (location without access to healthy foods) surrounds the KCUIC, so hunger is being addressed. Donations are made by community partners and private donors and funded by a small grant to buy food baskets for those in need. Because of the small amount do-

nated, the pantry is open one day per week. The food is distributed within an hour of opening. This program serves about 50 families with food for one weekend each month.

The Total Man project was an instant success, with men gathering at local schools to tackle issues of their choosing. It was made possible by a partnership with the United Community Action Agency and St. Luke Memorial Church. There were formal topics, including information about the Missouri Department of Social Services, education, relationships, employment, nutrition and financial planning. The men participated in eight-week group sessions. A graduation was held at



Youth participate in computer classes.

Paradise Park, a location where the men could have fun interacting with their children, with food and games.

The Urban Agriculture program helped 46 adults and 11 youth who set up and took part in garden projects. The program also informed participants of potential entrepreneurial activities. A demonstration garden grew vegetables and native plants. It allowed attendees to create value-added products, such as canned goods, preserves and natural dyes. With the American Heart Association and MetLife®, demonstration gardens were planted throughout Kansas City. Plots of land were also donated to individuals to plant, grow and harvest their own vegetables. ■



The Urban Agriculture program allows youth an opportunity to harvest for themselves, their families and the community.



Southeast Missouri Outreach Offices

Brenda Robinson Echols, Regional Coordinator

Lincoln University Cooperative Extension (LUCE) has three outreach offices in Missouri. They are located in Caruthersville, Charleston and Sikeston. The Sikeston office held a program called Aiming Higher once a week. It helped forty 5th and 6th grade students to increase the time they spent reading and improving their self-confidence. The Sikeston Public Library provided books. Before reading, students received a nutritional snack. After reading, students completed an activity related to the story. When the program began, most of the youth were afraid to read aloud and did not read fluently. By the end of the year, they were excited and competing to read aloud first.

A tutoring program was offered in Caruthersville for K-6th grade students from Monday-Thursday after school. Students got help with homework and personal tutoring in math, reading and spelling, plus exposure to web-based learning sites. An average of 25 students at each site attended daily. Sixty percent reported improved grades. Step by Step, LUCE's college preparation program, taught the necessary steps to enter postsecondary education. Over 33 students

completed Free Application for Federal Student Aid (FAFSA) applications.

Teen Talk targeted 6th-8th grade students in Caruthersville, Charleston and Sikeston. It taught abstinence education along with engaging students in service learning projects.

Summer enrichment programs served over 200 K-8th grade students daily during June and July. Students engaged in physical fitness for at least two hours daily. This included dance and stepping (percussive dance). Life skills were also taught. There were drama lessons and a reading partnership with the local library. All three sites had community gardens. Several parents reported that if their child had not attended this program, they would have lain on the couch all day. The summer enrichment program saved families \$640 per child (the cost of a similar YMCA program), for a total savings of \$128,000. Fitness and nutrition classes were also held for adults.

By partnering with the Bootheel Youth Museum, LUCE was able to teach and expose over 1,000 students to Science, Technology, Engineering, Entrepreneurship, Agriculture, Art and Math (STEEAAM) areas through hands-on workshops. In addition, a Youth Agricultural Conference targeted 50 students in grades 6-11. They

were told about opportunities and careers in agriculture. Several students chose STEEAAM areas as their major in college.

A grant from the Missouri Department of Mental Health provided a variety of activities for the Kids' Beat youth development program. Topics included substance abuse prevention, the Angel Tree Project, breast cancer awareness, black history, Real Fathers/Real Men, Fitness Affair and Kids of Distinction/Kiddie's Kidz Garden.

The Seniors Moving On program allowed senior citizens to teach classes to youth on local history; sewing; gardening; and canning and preserving fresh fruits and vegetables. This intergenerational program collaborated with many agencies, including the University of Missouri (MU) and United Migrant Opportunity Services (UMOS). One of the goals was to decrease the amount of social isolation, so older adults read to children at the local Head Start. Likewise, computer literacy was taught to senior citizens by youth. After taking Spanish classes, senior citizens taught Spanish to summer camp youth. The program also focused on healthy eating and physical activity.

Ten job readiness and counseling workshops were offered, five of which were geared towards inmates. Attendees were taught interview skills and résumé preparation. They also learned how to retain employment, which increased their confidence. The prison required inmates to attend the job readiness program before their release. Each eight-week session had 12 inmates. Fifty-seven of 60 inmates received certificates of completion. All inmates were given a list of employers who hire ex-offenders and character references to give to employers based on inmates' attendance and conduct during their eight-week training. Follow-up on inmates was difficult; however, 23 inmates confirmed their employment status. At the LUCE Sikeston office, from five to 10 students attended each session. Of the 45 enrolled, 15 dropped out, and 20 found jobs. ■



Participants in the job readiness program display their certificates.



Youth participating in the afterschool reading program in Sikeston.





Cooperative Research

Behavior of Silver Nanoparticles in Soil: Interactions with Physicochemical and Microbiological Properties

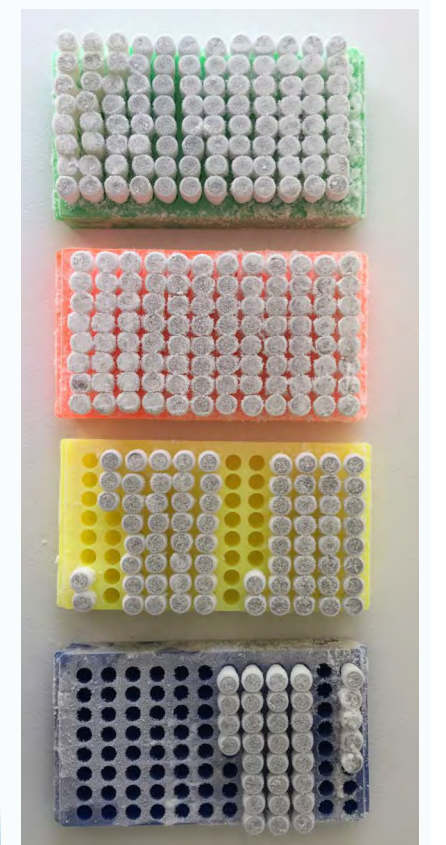
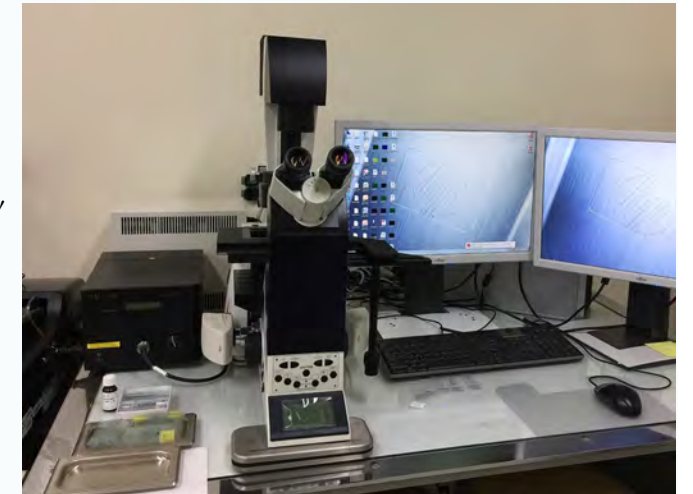
Dr. Frieda Eivazi, Project Director

Within 10 years, each product sold in the marketplace will likely contain at least one nanomaterial (sized about a billionth of a meter) to enhance its efficiency or durability. Soils are constantly exposed to large amounts of engineered nanoparticles (ENPs), especially silver (Ag) nanoparticles (NPs), known as AgNPs. Studies are needed to find out the influence nanomaterials have in altering the ecological balance as well as the environmental risks of this exposure.

Measuring specific enzyme activity can indicate major changes in the soil environment. This project studied the effect of AgNPs on soil enzymes that play a key role in the mineralization (conversion to mineral form) of carbon (C), nitrogen (N), phosphorus (P) and sulfur (S). Soil samples were collected from the surface layer (0-10 cm) of a Wrengart silt loam series (a United States Department of Agriculture-Natural Resources Conservation Services classification of Missouri soils). Two sizes (10 and 50 nm), two rates (1.6 and 3.2 mg Ag/kg of dry soil) of silver nanoparticles and a control with no AgNP were used in a randomized complete design, with three replications of each treatment. The AgNP solution

was applied to the soil and well distributed. Acid phosphatase, β -glucosaminidase, β -glucosidase and arylsulfatase activities were measured after incubating one hour, one week and one month. Measurements indicated that all four enzymes decreased in activity after treatment with silver nanoparticles at one-hour and one-week intervals compared to the control. There was no difference in the effect on enzyme activity between the two sizes. The effect of AgNPs after one month showed mixed results, suggesting that their effect on soil enzymes may be detectable shortly after application to soil.

The study is ongoing. Complete results will be presented in the future. The results will provide a holistic view of the effects of nanoparticles on the soil and plant environment. This study can have a major impact on the design of novel nanomaterials for product development by using AgNPs that are less harmful to soil and plant production. ■



Sustainable Small-scale Hydroponics Production Research

Dr. Jonathan N. Egilla, Project Director

This study "Nitrate Management in Non-recirculating Hydroponic Culture Systems" evaluated the capacity of 100% perlite and rockwool (soiless root-support substrates) to reduce the nitrate content of flow-through fertilizer solution (leachate) in drainage systems during the life cycle of Swiss chard in an environment-controlled, hydroponic greenhouse. Leachate was collected from each substrate weekly over a 49-day period and analyzed for nitrate content using an ion chromatograph (IC). Results indicated that both perlite and rockwool greatly reduced the nitrate concentration of the leachate by ~73% and 81%, respectively. The leaf count, leaf fresh weight, leaf dry weight and leaf water content grown in perlite when compared to rockwool were 12.1%, 39.2%, 23.5 and 1.8% higher, respectively. Collards and Swiss chard, vegetable crops, were successfully grown in the aquaponic system using effluent from a bluegill fish culture tank.

This research could develop crop and substrate-specific, environmentally friendly production systems, which would help small-scale, limited-resource hydroponic growers to improve crop productivity and fertilizer-use efficiency, leading to higher profits and income.



Close-up view of Swiss chard seedlings in a flow-through hydroponic system, with rockwool and perlite root support substrates.

During fiscal year 2016, there were over 35 small farmers from Missouri and other states who visited the systems. In July 2016, a workshop was conducted for 25 Mandela Fellows from 19 countries who participated in a Business and Entrepreneurship Leadership Development training program on campus. In addition, hydroponic training was given to middle and high school students from various Missouri counties during a two-week Summer Institute on campus. ■



May 2016 crop in the Blueberry Field Trial at Carver Farm.



Above: Aquaponic system with collards and Swiss chard at Lincoln University's George Washington Carver Farm.

Left: Middle and high school students at the 2016 Summer Institute.



Swiss chard seedlings in a flow-through hydroponic system, with rockwool and perlite root support substrates.



Water Quality and Toxicological Significance of Heavy Metals in Biota Near Mining Areas in Southeastern Missouri

Dr. Abua Ikem, Project Director



A crayfish.

Intense lead/zinc ore mining occurred for many decades in the Old Lead Belt, Mine La Motte-Fredericktown, Viburnum Trend and minor sub-districts in Southeast Missouri. Previous research in the area suggested ecological changes and elevated metal concentrations in water, sediment and the food chain. Consequently, some sites were designated as Superfund sites (polluted locations requiring a long-term response to clean up hazardous material contaminations) by the U.S. Environmental Protection Agency (EPA). The present work will study the water quality, sediment fine fractions and metal/metalloid body burdens of sev-

eral crayfish species from moderately mining-impacted Ozark streams. Crayfish metal toxicities were compared as a function of site, season and gender. Furthermore, crayfish from metal-impacted and metal non-impacted sites were compared as a function of the molt cycle. Water and crayfish samples were collected from a reference site (Mill Creek) and moderately mining-impacted streams (West Fork Black River and Brushy Creek). Crayfish samples collected were sorted according to species and sex. The tissues (abdominal muscle, hepatopancreas, exoskeleton, gills and eggs) were carefully removed by dissection and acid-digested in a microwave digestion system. Elemental determinations were performed by

either inductively coupled plasma - optical emission spectrometry (ICP - OES) or inductively coupled plasma - mass spectrometry (ICP - MS). The spothand (*Orconectes punctimanus*) and woodland (*Orconectes hylas*) crayfish species were found to be abundant in the streams. In these waters, trace elements were generally below 10 µg/L. Bioaccumulation factors of metals in tissues of two abundant crayfish species ranged from (1 - 5) x 10⁶. No major differences were found in the concentrations of iron (Fe), copper (Cu) and zinc (Zn) in the tissues (hepatopancreas, gill, muscle and exoskeleton). This project would add knowledge about the effects of mining on stream quality and crayfish health. This information will assist policy makers and stakeholders to mitigate ecological problems in this mining area. ■



Development of High-yielding and Value-added Soybean Germplasm and Varieties

Dr. Safiullah Pathan, Project Director

The goal of this research is to increase the profitability of small farmers by cultivating identity-preserved (IP), new, specialty soybean varieties. IP is a specialty type of grain guaranteed not to be comingled with any other grain type. The project has two goals. One is to develop conventional, non-genetically modified (non-GM), food-grade soybean varieties for tofu production, with stable, higher yields across environments. The second is to identify a gene or genes related to food-grade traits in soybeans.

During fiscal year 2016, the following progress was made on the project. To develop conventional tofu-type soybean varieties, four crossbred varieties were made in July 2015. Then, F1 (first-generation) seeds were sent to Don Heil Farms, Upala, Costa Rica, in November 2015 and grown in a winter nursery so that future generations could be produced more quickly. In the U.S., only one generation can be grown per year; however, three generations can be produced in Costa Rica, due to the presence of perfect weather to grow soybeans year-round. Using a winter nursery greatly reduces the time for varieties to develop. Five more new



Soybean seedlings.

crosses were made in July 2016. Two high-yielding and high-oleic acid (a monosaturated omega-9 fatty acid)-content prospective soybean lines were crossed with three other tofu-type soybean lines. Later, these F1 seeds were also sent to Costa Rica, to grow in a winter nursery to advance the generations. Generation advancement (from F1 to F3, first to third generations) of four populations was made during the summer of 2015 in Costa Rica. Also, eight tofu-type soybean varieties and

advanced lines were evaluated at Lincoln University's George Washington Carver Farm during the summer of 2016. Based on yield and other phenotypic (physical) data, a number of the best soybean lines were selected to further evaluate for yield and other food-grade traits, such as protein, oil, sugar, seed size, seed color, etc. ■



Disinfection By-product Control of Drinking Water by Advanced Chemical Oxidation Technology for Small Rural Communities

Dr. John Yang, Project Director

Elevated, natural, dissolved organic matter (DOM) or dissolved organic carbon (DOC) in surface water is a threat to drinking water quality in small, rural communities because of the potential formation of cancer-causing disinfection by-products (DBPs) during water treatment. The presence of DBPs in drinking water is an environmental and public health concern. To safeguard human health in rural areas, this research seeks to develop a water treatment technology using advanced chemical oxidation as a cost-effective treatment strategy that would control toxic DBP formation in small drinking water systems. In fiscal year 2016, one goal was to assess the impacts of ferrous iron (Fe^{2+}) and hydrogen peroxide concentration (H_2O_2) on trihalomethane formation potential (THMFP), haloacetic acid formation potential (HAAFP), chemical oxygen demand (COD) and DOC removal. A second goal was to investigate the optimal conditions or effective treatment to maximally degrade DOC, THM precursors, through the Fenton (chemical) reactions.

Batch experiments have been conducted to assess the effects of dosages of Fe^{2+} , Fe^{3+} and H_2O_2 on the total organic carbon

(TOC), COD, THMPF and HAA removal efficiencies. By increasing the Fe^{2+} dosage to 0.25 mM, THMs and HAAs after chlorination were greatly reduced. Using the Fenton treatment, 94% THMFP and 76% HAAFP reductions were reached. TOC decreased by 30%; COD decreased by 36%. Raising Fe^{2+} to 0.5 mM did not affect the results. However, the degradation of resorcinol was significantly improved with 0.25 mM hydrogen peroxide. This might result from the accelerated and increased generation of hydrogen oxide radicals ($\bullet\text{OH}$) along with the raised dosage of H_2O_2 . Results showed that the concentrations of 0.5 mM Fe^{2+} and 0.25 mM H_2O_2 could achieve a maximum treatment efficacy to reduce the THMFP and HAAFP and remove the TOC and COD in treated water.

This research is to address water quality concerns of rural communities and to help small water systems comply with recent U.S. Environmental Protection Agency (EPA) drinking water regulations. The project also provides training for undergraduate and graduate students,



Dr. Yang evaluating samples in his lab.

strengthens the university's education and research capacity, and facilitates multidisciplinary collaboration on environmental research. During fiscal year 2016, one visiting scholar, one master's degree student and one undergraduate in the Environmental Science Program were mentored. ■

Differentiation of Common and Cryptic *Escherichia coli*

Dr. Guolu Zheng, Project Director

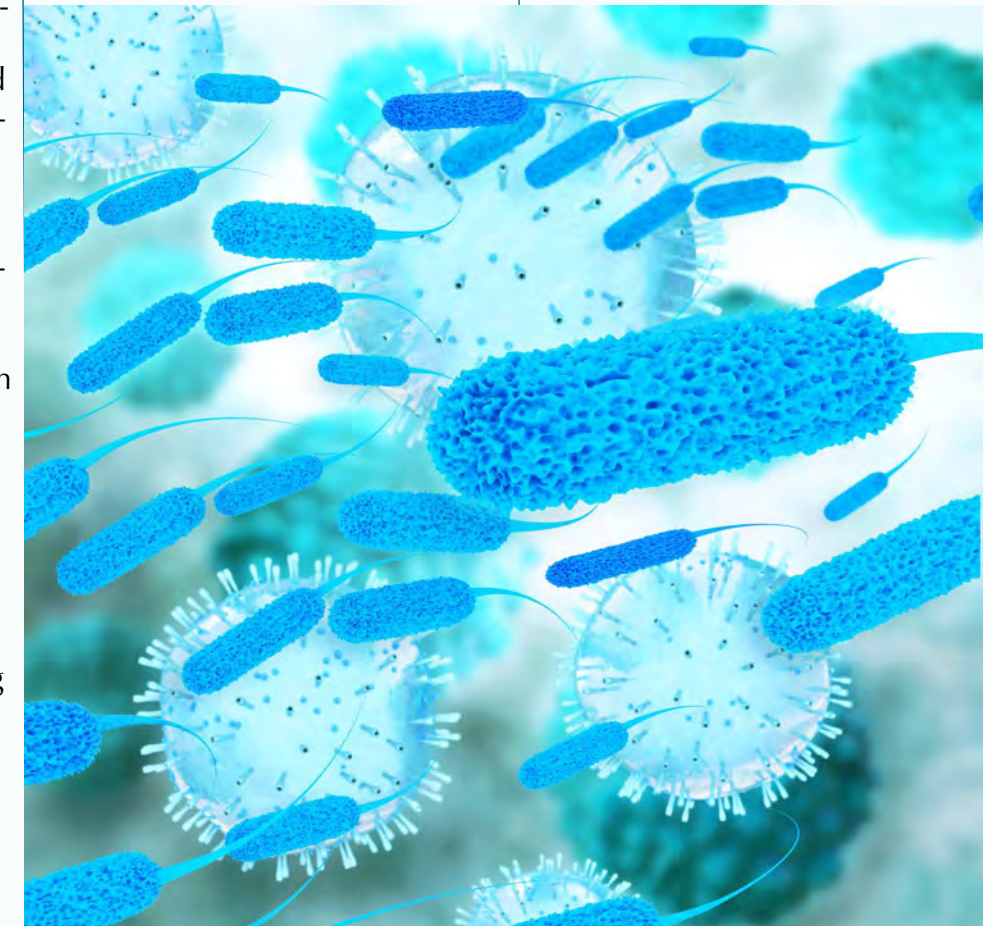
Escherichia coli (*E. coli*) is a fecal indicator used to test water quality and manage water safety. Cryptic *E. coli* are bacteria that are harmless to humans but that cannot be distinguished from common, harmful *E. coli* using standard *E. coli* tests. Cryptic *E. coli* mainly live outside the human or animal body. However, these environmental bacteria can add to the high number of *E. coli* found in water. This can cause false alarms of fecal pollution, leading to needless management procedures, such as public beach closures and health concerns. Thus, user-friendly methods must be developed to tell the difference between harmful *E. coli* and cryptic *E. coli*. This project seeks to find genetic differences between these two groups of bacteria and develop DNA-based rapid methods to distinguish the bacteria.

During fiscal year 2016, this research continued to use bioinformatics methods to search for genes that were highly associated with cryptic *E. coli*. (Bioinformatics deals with designing and using computer software to analyze a large amount of biological data, such as DNA sequencing data.)

A group of more than 20 genes was found by this study. A panel of over 300 common and 20 cryptic *E. coli* strains is being used to verify the usefulness of the 20 genes in differentiating the two groups of *E. coli*. In this study, common *E. coli* were isolated from the feces of several animal species. Cryptic *E. coli* for this research came from Michigan State University.

During this project, one graduate student was trained and supported by this research. The student graduated in August 2016. Two conference presentations and one thesis were made based on the results of the research. ■

3-D illustration of *E. coli*.



Small Ruminant Research: An Out-of-season Breeding System for Organic Fall Lamb Production

Dr. Tumen Wuliji, Project Director

Organic production is one of the fastest-growing food and agriculture industries. Compared to mainstream animal industries, there are fewer goats and sheep operations, but these are widely distributed. For example, sheep farming occurs on more than 2,200 ranches in Missouri. The seasonality of lamb production affects markets and prices.

This does not help producers or consumers. Instead, it creates a pattern of peaks and troughs in the market supply. Traditional lamb production times do not match the periods of high consumption of lamb for ethnic, religious and festive holidays (from December to May). A natural cycle of breeding, lambing and marketing in sheep slows the market supply and misses out on the high market demand period.

Today, many consumers are conscious about selecting organic foods. However, there are no organic lamb production systems. Hence, an out-of-season breeding program was launched. It will



show producers how to increase the profitability of sheep farming operations by increasing the supply of lambs to the marketplace year-round. An out-of-season breeding and organic fall lamb production regimen will enhance lamb product competitiveness.

The out-of-season breeding for organic lamb production was scheduled in April and May. So, lambing will occur in September and October. This will provide lambs to sell in winter-to-spring markets. It will fill the trough

periods and meet the increasing demand for lamb. Initially, 100 Katahdin ewes were selected for an out-of-season breeding flock. They were bred for two estrus (time when the female can conceive) cycles, mated in mixed sire groups. Weaned lambs will be separated from dams at 70 days of age and monitored for post-weaning growth rate. In addition, the organic fall lamb production program coincides with the growth of preferred forage.



Cool season pasture nutrients will be available during gestation, lactation and weaning onto grass feeding. This will lower the number of gastrointestinal parasites and reduce the use of anthelmintics (dewormers). Organic production flock performance will be analyzed for reproductive efficiency, lambing rate, growth rate and market values. The results will be presented at local organic growers' field days, regional and national animal science meetings. ■





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