2014

Lincoln University Cooperative Extension and Research Annual Report 2013

Lincoln University Cooperative Extension and Research

Lincoln University

Cooperative Extension and Research

Annual Report 2013

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Front cover photograph: Gentians, from the Native Plants Program outdoor laboratory at Allen Hall, Lincoln University campus.

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College of Agricultural and Natural Sciences

Yvonne Matthews
Interim 1890 Administrator
and Dean of the College of
Agricultural and Natural Sciences

Welcome to the College of Agricultural and Natural Sciences.

This is an exciting time within the College. We have just completed a master plan to convert the 280 acre Alan T. Busby Farm to showcase integrated management systems for aquaculture, grazing management, power generation and water conservation. This will occur through outreach and extension programs, university classes and research. This farm is located eight miles southwest of the university campus off Highway 54. Development of the fully functional system will occur in stages with the first stage of construction – a water reservoir.

Other highlights include: 1) The development of an algae research laboratory to study the use of native species of algae in biodiesel production, 2) A new state-of-the-art adaptive optics and nanophotonics laboratory, and 3) purchase of new equipment for science laboratories.

There are a total of seven majors in the two academic departments within the college. Please feel welcome to contact me or one of the department heads if you have any questions regarding our programs.

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PART ONE: Cooperative Extension Programs

Economics

Agricultural Economics and Marketing Program

Dr. Emmanuel Ajuzie, State Extension Specialist – Agricultural Economics

The main goal of the Agricultural Economics and Marketing Program (AEMP) is to help small, limited resource and disadvantaged farmers across Missouri to be economically, socially and ecologically sustainable. This goal is achieved by creating efficient marketing strategies and other entrepreneurial economic incentives.

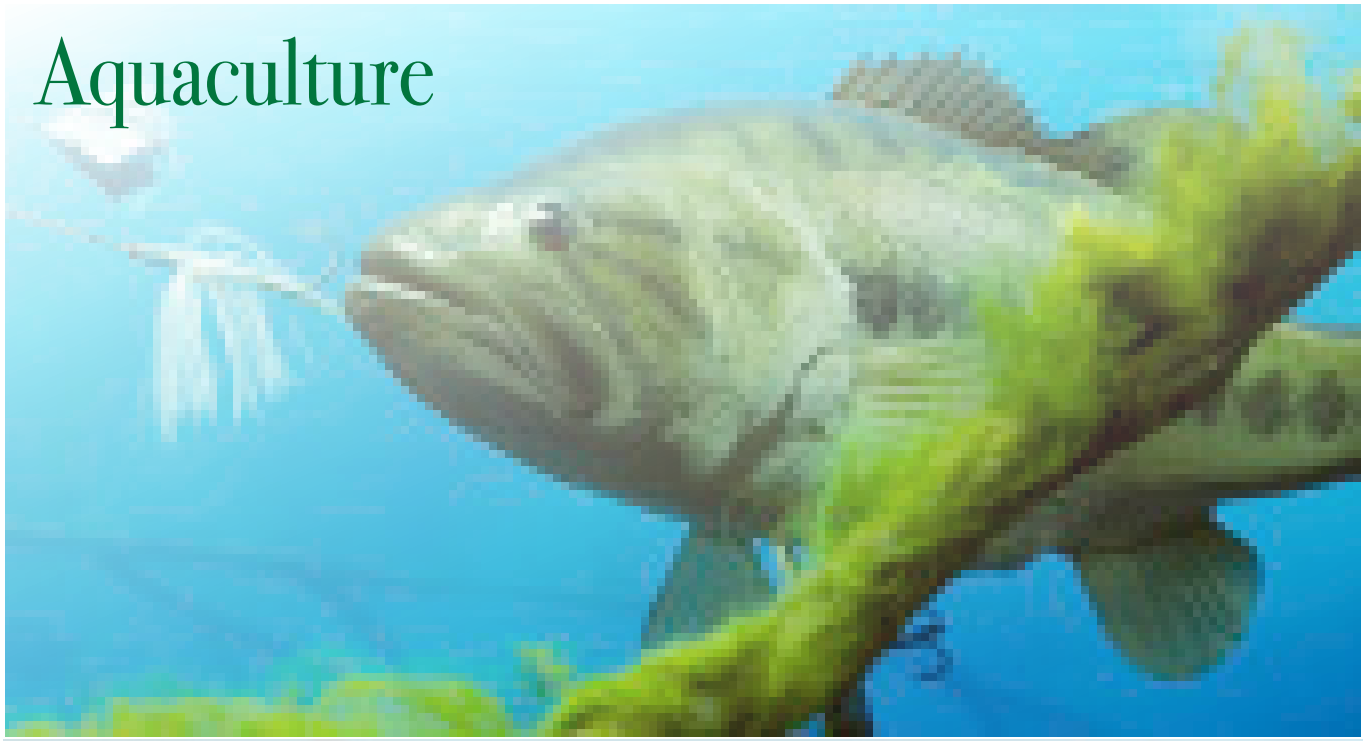
In 2010, the AEMP developed the Missouri Agricultural Products Cooperative (MAPC). Its website is www.moagcoop.com. This year, the AEMP has secured a grant to fund the MAPC. The funds will be used to buy a refrigerated truck. The grant money will also be used to sponsor workshops for producers. With the truck, MACP can transport its produce to wider markets. This should increase profits, as members do not have enough produce to warrant buyers picking it up. Due to slightly better weather this year than in 2012, farmers were able to improve their income by close to five percent. Most sales were made at farmers' markets.

About 15 new farmers have been contacted. They have all agreed to join the cooperative. This means they will start fruit and vegetable production in the spring of 2014. The MAPC has its headquarters in Southeast Missouri. However, it is working to link with producers in the Fulton area, in Central Missouri.

Presentations and articles have been published about AEMP creating awareness that can lead to the rethinking of some economic and marketing policies. In fact, prices of small ruminants have continued to rise because of the innovative marketing provided by the AEMP. ■

Animal and Plant Science

Aquaculture



Charles E. Hicks, State Extension Specialist - Aquaculture

Missouri remains a leader in aquaculture in the North Central states. However, expansion is almost at a standstill. This is due to regulation, little government and other support and limited capital to start aquaculture ventures.

There has been some expansion in selling locally produced fish at high-end farmers' markets. Many Missouri producers have taken part in these markets. And a few startups or expansions occurred in Missouri in 2013. One in Bates County produced sunfish, catfish and largemouth bass for markets in Kansas City. It also grew trophy fish to stock ponds and lakes. A small startup in Osage County got a permit to produce tilapia. This facility was developed along with an active vegetable producer that services many farmers' markets. Some waste will be used when growing the vegetables. Both fish and produce will be sold at farmers' markets.

This office got more than 100 inquiries about aquaponics. An aquaponics talk at the Small Farm Show became a popular YouTube video. It was picked up by Engormix.com, a multilingual media company that shares information about agriculture and aquaculture.

When they published the bluegill sunfish guide sheet, it sparked many questions about sunfish culture. An article on hybrid sunfish was published in the journal of the World Aquaculture Society; this created interest in sunfish and led to more inquiries.

A presentation at Lincoln University Cooperative Extension's (LUCE) Missouri Minority Limited Resource Farmers (MMLRF) Conference 2013 helped develop contacts interested in aquaculture. There are ongoing plans for an urban center for live aquaculture product sales.

With our design help, a Missouri farmer built a raceway; 800 pounds of edible catfish were grown. Missouri has over 300,000 acres of private lakes and ponds. The in-pond raceway system uses few resources to create small aquaculture ventures. ■

Innovative Small Farmers' Outreach Program (ISFOP)

Dr. K. B. Paul, State Extension Specialist - Small Farms

This year, the number of program participants was increased by the eight Innovative Small Farmers' Outreach Program (ISFOP) field staff. During the year, ISFOP staff provided information and/or assistance to a total 456 farmers, ranchers and urban gardeners. However, the staff maintained regular contacts with 288 participants. This included 80 minority, 52 women head of households and 18 community-based organizations (CBOs). A total of 336 small and minority farmers attended ISFOP-organized workshops. The staff wrote eight newsletters. They also published a book of 16 farmers' success stories. The printed materials were made available, either directly or indirectly, to over 1,450 persons.

Farmers in the target counties earned more due to ISFOP's efforts. Of the 288 "core clients", 180 of them, on an average, had an income increase of $2,464 per farm. This included 31 minority and 13 women sole proprietors. As a result of our direct assistance, 28 farmers received grants for on-farm research and infrastructure development or crop insurance payments. The funding breakdown is as follows: Four farmers got Sustainable Agriculture Research and Education (SARE) grants. Ten received Natural Resources Conservation Service (NRCS) High Tunnel Initiative cost-share funds or funds for building fences. Six farmers got Slow Food USA project grants; while two farmers received Farm Service Agency's Non-insured Crop Disaster Assistance Program funds. ISFOP was a key partner in the Kansas City Food Hub Coalition receiving $183,000 in grants, to conduct a multi-agency feasibility study for the Kansas City region. ISFOP continued assisting the Community Action Agency of St. Louis County. Because of this collaborative effort, it obtained a United States Department of Agriculture (USDA) Community Food Project grant of $300,000. This funding will enable it to expand its farm and its Community Supported Agriculture (CSA) program. The total grant funding received by all ISFOP collaborators was $639,130. Beyond the financial impacts, ISFOP has helped many underserved farmers to see for themselves that farming can be a satisfying occupation. ■

Top to bottom: Urban garden

Jeri Villarreal at her farm in St. Louis, Missouri

Hydroponic fodder set-up inside of a semitrailer cargo container.

Linda and Bruce Trammell in their high tunnel on their farm north of Polo, Missouri.

Integrated Pest Management Program

Dr. Jaime Piñero, State Extension Specialist - IPM

During 2013, the Integrated Pest Management (IPM) program increased its ability to reach underserved Missourians.

The IPM program's main goal is to develop simple, effective and low-cost methods so that farmers can manage insect pests. Trap cropping is a method that can be used on small farms. It works by attracting insect pests to border plants that are more attractive to the pest than the cash crop. As a result, little or no insecticide can be applied to the cash crop. Farmers have confirmed the success of this method. José Fonseca is a vegetable farmer from St. Peters, Missouri. In 2012 and 2013, he used trap crops. He harvested high quality cucurbit crops (melons, squash, etc.) without using insecticides. This meant lower production costs. It also preserved beneficial insects.

Training of extension educators in the state continued this year. On June 4-5, 2013, the IPM program held a two-day workshop on "Sustainable Management of Soilborne Diseases and Weeds." Its goal was to instruct agricultural professionals and extension educators in Missouri on research-based IPM information; in that way, they can better assist farmers. Forty-five extension staff took part. They came from the University of Missouri Extension (UME), Lincoln University Cooperative Extension (LUCE), Natural Resources Conservation Service (NRCS) and the Missouri Department of Agriculture (MDA). Attendees made major increases in their knowledge of the IPM topics covered; a nine-month follow-up will be made.

On August 28, 2013, the first Vegetable and IPM Festival was held at LU's George Washington Carver Farm. This free event showcased vegetable production and pest management tools that work; the methods also help to conserve beneficial insects. This event was a joint effort of three LUCE programs: IPM, the Commercial Vegetable Program and the Native Plants Program. Small- and mid-scale farmers and gardeners saw educational displays, demonstrations and heard short talks on aspects of agriculture. Over 120 farmers attended this successful festival. ■

Drs. Charlotte Chifford-Rathert, Jamie Piñero and Nadia Navarrette-Tindall ...Farmers gather at Field Day listen to presentations at the LUCE Vegetable Festival.

Plant Pathology Program

Dr. Zelalem Mersha, State Extension Specialist – Plant Pathology

The goals of the Plant Pathology program are to provide science-based and accurate information about how to diagnose, identify and manage diseases of vegetables and smalls fruits in Missouri. It serves all Missourians; however, its main focus is reaching underserved clients. To this end, it works with small farm experts and regional and state extension specialists. The program hosts events and workshops that inform growers about proactive and sustainable ways to decrease disease. This improves productivity. It also safeguards Missourians by using fewer pesticides.

The North Central Integrated Pest Management Center provided a $10,000 grant. These funds were used to research integrated management of watermelon diseases at Lincoln University's George Washington Carver Farm. The results were demonstrated at a vegetable and integrated pest management (IPM) field day in August 2013.

Lincoln University Cooperative Extension's (LUCE) Plant Pathology program joined a nationwide program, CD-MipmPIPE, that monitors and forecasts about cucurbit (melon, squash or gourds) downy mildew (CDM) disease. At LU, this was done using sentinel plots at Carver Farm. Nine types of cucurbits were grown and downy mildew was monitored weekly.

Integrated pest management Pest Information for Extension and Education

In Service Education (ISE) at Lincoln's George Washington Carver farm.

Over 85 samples were diagnosed based on farm visits, phone, mail or email. More than 80 percent of these consultations occurred in spring and summer. Integrated management approaches were suggested for typical vegetable diseases.

Faculty in the program demonstrated soilborne disease management at an event at Carver Farm. They gave presentations on how to diagnose, identify and manage vegetable diseases at workshops in Desoto and Springfield, Missouri. They spoke at a minority landowners conference in Jefferson City. A tomato field day was held in Springfield and another workshop was organized by Lincoln University Cooperative Extension's (LUCE) Innovative Small Farmers' Outreach Program (ISFOP) at the Growing Growers meeting in Kansas City, Missouri. A Master Gardener class was taught at the Cole County Extension Office. ■

Small Ruminant Program

Dr. Charlotte Clifford-Rathert, State Extension Specialist - Small Ruminants

A four-year old donkey named 'Abi' watches over the herd of goats at Busby Farm and keeps them safe.

The Lincoln University Cooperative Extension (LUCE) Small Ruminant program offered 27 workshops to producers in 12 Missouri counties this year. The topics were herd health, brush control and youth activitie. During 13 farm visits, producers learned about management. Youth activities included value-added products (cheesemaking), 4-H/FFA goat or sheep projects, animal management and how to show a market animal at a youth fair. LUCE attended four national meetings, with Charlotte Clifford-Rathert as a speaker/panelist at two; a booth was also set up at the National Goat Conference. Media wrote articles about the livestock guardian donkeys and the goats.

Value–added products (goat jerky sticks) were well received by the general public at the Missouri State Fair. The meat was also shared at producer meetings to show a marketable value-added product; this also promoted goat meat. The first Browsing Academy was held at Lincoln University's Alan T. Busby Farm. Twenty producers attended the two-day event. Many topics were covered, including drought management, herd health and fencing. Goat meat was served at all field days. Demonstration sites (Busby Farm and Crowder College) that use goats to control invasive brush completed their second year. These were funded by a federal capacity building grant. A joint project with the United States Department of Agriculture (USDA) National Resources Conservation Service (NRCS) Plant Materials Center in Elsberry, Missouri, completed a third year; it shows how goats can get rid of honeysuckle and buckthorn.

There were 1280 direct contacts through program events. Surveys showed that 21.6 percent of those contacted changed their behavior as a result of attending the programs.

About 12,000 indirect contacts were made via phone, email and media (i.e., video, published articles). On the eXtension.org website, Clifford-Rathert answered 66 "Ask an Expert" questions; she also made five content contributions. The Goat Industry Community of Practice (CoP) ranked 37 for the year in all content reviewed on eXtension.org. ■

Southwest Small Ruminant Program

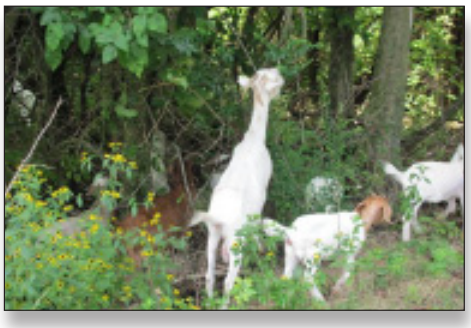
Dr. Jodie Pennington, Regional Educator Small Ruminants

Throughout the Southwest region, meetings about producing and marketing small ruminants were conducted jointly by Lincoln University Cooperative Extension (LUCE) and University of Missouri Extension (UME). The audience was producers and the industry. A trifold display promoted small ruminant educational programs at 17 events; these included field days and goat and sheep sales. At Crowder College, using goats to control browse and undergrowth was displayed. Using hair sheep on small acreage was shown on a Hmong farm and at a field day. A Hispanic producer shared how to use winter annuals to add feed during a shortage. There was also an active small ruminant advisory committee in 2013.

Great effort was made to share programs with minority producers, especially Asian Americans and Hispanics. Good working relationships were maintained with many local businesses and government agencies. Email lists for regional goat and sheep producers were enhanced. They were used to promote educational activities.

Short-term impacts of the program included a more informed public. The office made 6,011 direct contacts. There were an estimated 104,440 indirect contacts; these were made through articles or press releases in local, regional, state and national media. Interviews were given for eight articles in magazines or radio scripts.

Routinely, industry contacted the office for information. Of 279 persons, follow-up surveys showed that 90 percent made management changes based on the help our office gave. As a result of these meetings, 99 percent of producers learned something new; 94 percent planned to change a management practice as a result. Ninety percent who attended the previous year's meetings had made management changes; this was a midterm indication of impact. Many more producers and industry personnel now know of the Small Ruminant Program. This should promote long-term sustainability. ■



Environmental Science

The Renewable Resources Extension Act (RREA) Helps to Reestablish Native Species

Dr. Adrian Andrei, Principal Investigator

The summer of 2012 was one of the hottest and driest on record. After that summer, many livestock owners became interested in drought-resistant grasses. During 2013, Lincoln University (LU) applied funds from the Renewable Resources Extension Act (RREA) to address this issue. The money was used to promote restoring native grasslands and wildlife habitats. This is done by preparing the soil, seeding and applying prescribed fire.

Native Missouri prairies play a vital role. They provide habitats for many species of plants, insects and wildlife. When used properly, native prairies can improve the quality of food for grazing livestock.

Grasses from outside Missouri are grown by most landowners; this means that many species of native plants and animals are on the decline and might vanish. Unlike the now rare Missouri prairie grasses, the introduced grasses grow during the cooler parts of the year.

During the summer of 2013, wildlife habitat management plans were prepared for landowners. This work included conversions to native warm season grasses. A landowner in Wardsville, Missouri stated, "I did not know that those grasses could withstand drought. I will include them in future plans."

In September, LU gave a seminar for Missouri landowners. The seminar presented many aspects of growing native grasses. These included the objectives for using these grasses and their importance. The workshop also discussed advantages and benefits, proper timing and technical issues. Speakers came from the Missouri Department of Conservation (MDC) and the Missouri State Parks. More than 40 landowners attended; they collectively own over 3000 acres in the counties around Jefferson City, Missouri. Many of these landowners now see that prescribed fire is necessary to maintain prairies. ■

Class instruction on RREA.

A controlled burn of Missouri prairie grass.

Composting Program

Dr. Hwei-Yiing Johnson, State Extension Specialist

The Lincoln University Cooperative Extension (LUCE) Composting program served several hundred beneficiaries including youth who attended various training and conference tours. The program continues to expand and advance education and training, serving communities and schools. To bring additional composting choices to participants, Bokashi composting is taught as are aerobic and worm composting. Boksahi is a Japanese word meaning fermented organic matter. In the 1980s, Dr. Teruo Higa, a mycologist in Japan, first reported that a mixture of microbes including yeast, *Lactobacillus* and *Aspergillus* were effective in fermenting and degrading food waste. Bokashi technology has gained worldwide acceptance. It has been implemented in various waste treatment industries. Several trainees receiving Bokashi composting training at LUCE favored this method for these reasons:

(1) easy to prepare;
(2) can operate in limited space and with few required materials;
(3) can be used indoors; and
(4) is effective with no offensive odor.

Compost tea brewing is another new composting by-product that is gaining popularity. The LUCE Composting program makes quality compost tea by brewing compost with molasses for over 48 hours in a highly aerated condition. The resulting tea-like liquid contains soluble fertilizer and abundant aerobic/beneficial microbes, including bacteria, protozoa, some fungi and nematodes. Healthy and vigorous plant growth and abundant flowers and fruits result from using this method. Examples can be observed at LUCE's demonstration gardens and green roof/green wall after compost tea application. To suppress and control disease, compost tea was used in the LU organic orchard as an integrated pest management (IPM) measure. Compost tea brewing and microbe examination are incorporated into the education and outreach program. ■

Native Plants Program

Dr. Nadia Navarrete-Tindall, State Extension Specialist – Native Plants

This year, awareness and interest increased among our participants. They learned more about consuming native edible plants and growing native plants for pollinators. Feedback came from evaluations, personal testimonials and surveys. Seminars, classes, tours and field days increased outreach. Most events entailed indoor and outdoor training. Attendees were of diverse ages, ethnicities and genders.

Families Integrating Nature, Conservation and Agriculture (FINCA) is funded by the National Institute of Food and Agriculture (NIFA). There are two FINCA model farms, one in Southeast Missouri, the other on Lincoln University's campus. Research plots are located on the farms.

Dr. Navarrete-Tindall offered two seminars in El Salvador to seek collaboration with institutions and other groups. Native plant classes resulted in a new garden being planted at Handy Chapel Community Center in Marshall, Missouri.

Author Dave Tylka was the 2013 speaker at the "In Touch with Nature" field day on the LU campus. At this event, Native Plant Outdoor Laboratory (NPOL) tours and native plant appetizers were offered to attendees. This field day attracted new and former participants. Several LU student groups helped at this event.

Two endorsements sum up the impact of this program in Missouri. Mary Glasper, community leader and Lincoln University Cooperative Extension (LUCE) Lay Leader for the Paula J. Carter Center on Minority Health and Aging (PJCCMHA), works with African Americans in Southeast Missouri. Glasper said that because of FINCA, she has been outdoors, lost weight and has enjoyed learning the names of native plants. A Lincoln University Farmers' Market vendor sold jelly made with sumac berries (*Rhus glabra*) after learning that sumac was edible at a display by the Native Plants Program (NPP) staff at the market.

About 3000 direct and 2000 indirect contacts were made this year. This program has shown participants that they can improve their environment and profit from native plants. ■

Photo caption above , far left, left

Youth, Family and Community Development

Community and Leadership Development Program (Sikeston)

Darrell Martin, Research Associate I

The Community and Leadership Development Adult Life and Job Skills Training program is a transition program. It helps people in a number of situations. Persons might be unemployed or severely underemployed. They can be veterans making the transitional to civilian life. The program is also offered to displaced and economically disadvantaged workers. It helps those recovering from substance abuse and who have anger issues. Single mothers and ex-offenders are also assisted.

The program helps people get gainful employment so they can be productive, tax-paying citizens. The program educates the whole person; it develops skills for community living, daily living and employment.

During 2013, the program enrolled a total of 161 students; 81 students dropped out. Eighty students graduated; 61 are now employed.

The town of Clarkton, Missouri wanted to improve community leadership and civic engagement. They chose to enhance their citizens' quality of life. To do this, they worked to increase community pride. They are also developing the community's infrastructure. The town started a Neighbors Assisting Neighbors (NAN) program. There are plans to build a new community meeting place. The city will raise its tax base. This community just made its first 10-year strategic plan. ■

Central Missouri Youth Development

Adrian Hendricks II, Regional Educator - Youth Development

The Central Missouri Youth Development office of Lincoln University Cooperative Extension (LUCE) hosted the Young Medics Summer Camp in 2013. Young Medics is designed to increase the awareness, knowledge and skill level of youth in Central Missouri as they learn about anatomy, nutrition, science and wellness.

There were 25 Young Medics students, aged nine through 18. They partnered with the CALEB (Called to Academic & Leadership Excellence and Building Character and Confidence) Science Club and the University of Missouri (MU) School of Medicine. The goal was a hands-on approach to learning through inquiry and research.

The camp ran for 16 hours over three days. It was a small classroom learning experience. In 2013, 90 percent of attendees were minorities; 60 percent were female.

Students were surveyed after the camp. The results follow:

- All of the students reported at least a 75 percent increase in knowledge after taking part in the Young Medics.
- Students reported a 70 percent knowledge increase in organ and animal dissection and observation. (NOTE: This rate is the result of participants having been tested before instruction and after.)
- Students reported a 75 percent retention rate on anatomy content related to the lower extremities.
- Students reported a 60 percent retention rate on anatomy content related to the upper extremities.
- Overall, the Young Medics program reported a 70 percent effectiveness rate for improving medical science awareness and knowledge. (NOTE: This rate is the result of the participants belief they met the objective of the camp and that their interest in the medical field increased.)

The Young Medics partnered with a number of groups. These included University Hospital (Columbia, Missouri), the MU Emergency Room Trauma Unit, the MU School of Medicine, the CALEB Science Club, the Missouri Department of Health and Senior Services (MDHSS), LUCE Small Ruminant program and LU's biology department. ■

Paula J. Carter Center on Minority Health and Aging

Yvonne Matthews, Coordinator
Deborah Jenkins, Research Assistant I

Lincoln University Cooperative Extension's (LUCE) Paula J. Carter Center on Minority Health and Aging (PJCCMHA) Lunch and Learn series strives to improve the quality of life for minority and underserved older adults. The goal is to reduce disparities in knowledge and to promote healthy behaviors. The Lunch and Learn sessions take a wholistic approach. Health, wellness, nutrition and exercise are covered.

Videoconferencing the Lunch and Learn serises has increased the numbers served. Minority and underserved adults can take part in target areas such as Kansas City, St. Louis and Southeast Missouri.

The following sessions were given in 2013:

How to prevent Seasonal Affective Disorder—Dr. Nadia Navarrete-Tindall, State Extension Specialist – Native Plants, used native plants to engage the seniors in a creative hands-on session. They designed greeting cards for gifts or sale. She stated that if you are tense or depressed, a craft or doing something with your hands can help. Dr. Walter "Cal" Johnson, a psychology professor at LU, stressed the use of an artificial light source. He also discussed diet, exercise and getting enough sleep.

Another session was on how older adults must be aware of HIV and STDs.

"**Just When You Thought It Was Safe**…" was presented by Jannis Evans, Health Representative III from the Missouri Department of Health and Senior Services (MDHSS).

In April, national Minority Health Month, the presentation focused on stroke. The first presenter gave information about senior statewide resources and prevention of stroke. Then two stroke survivors shared very different real life stories. Many seniors could relate to this topic because stroke is common in the minority community. The presenters were asked to record a sixty-second video presentation for the PJCCMHA website "Expert Health Tips" which is geared toward seniors (http://www.lincolnu.edu/web/programs-and-projects/expert-health-tips).

Other talks examined physical, mental and social issues that impact older adults. Seniors were told how important it was to increase their knowledge of health matters. This will help them make informed and healthy decisions.

The number of attendees (including those via satellite) varied from 47 to 70 per session, an increase from the previous year. ■

Above: Lunch and Learn participants get in a little exercise before the lecture. Left, bottom: Seniors make cards from Native Plant materials; Bottom, right, Dr. Alfred Johnson speaks on Diabetes.

Cooperative Extension Satellite Offices

Kansas City Urban Impact Center

Marion Halim, Regional Coordinator

Nina Grimes, Secretary III
Arthur Jackson Jr., Outreach Worker
Will Parker Jr., Outreach Worker
Joanne Smith, EFNEP Program Assistant
Keverick Wilson, Area Educator
Tina Wurth, Regional Educator

Senior Program

The outreach program seeks to improve the health, communication and education of those over 50. This year, about 283 seniors took part in many of the programs run by this office. This program had a number of impacts. Seniors increased their physical activities. They learned about healthy habits. They also socialized more. The total result was an improved quality of life, especially in health and wellness.

Urban Agriculture

In 2013, this office worked with the American Heart Association and Met Life; the joint venture was the result of a grant to create demonstration gardens. The gardens were located in many areas of Kansas City, Missouri. About 175 youth and adults planted three gardens. Programming was aimed at giving low-income individuals, families and communities new ways to deal with food insecurity. The program decreased blight in neighborhoods. It also reduced obesity levels in both kids and adults. And it fostered social, economic, civic and environmental development.

Youth

The 4-H Character Counts Program in Kansas City, Missouri, helps underserved youth. These youth attend afterschool programs at Carver, Whittier, Banneker and Truman elementary schools; students are also served at the Blue Springs Community Center. About 100 youth take part each week. Character Counts has helped to improve students' overall behavior; it has also reduced bullying. The youth learn how to model the six pillars of character; these are responsibility, respect, trustworthiness, fairness, caring and citizenship. This year, the focus in Kansas City was on peer pressure. It was a priority because it can result in bullying. Two hundred and fifty youth attended the Anti-Bullying Summit and rally. They came from eight area high schools. At the summit, there was frank talk about bullying; strategies were taught to address this issue. The youth also devised anti-bullying public service announcements (PSAs) and other messages to share with their peers. ■

St. Louis Urban Impact Center

Patrice Dollar, Regional Coordinator

Jacqueline Anderson, Program Assistant
Ernest Bradley, Program Assistant
Shauneille Connor,
Community Outreach Worker
Jennifer Davis, Nutrition Associate
Karen Davis, Regional Educator - Horticulture
Kandice Goodman, Administrative Assistant
George Little,
Community Outreach Worker
Fran Long, Nutrition Associate
Marla Moore, Regional Educator
Gus Robinson, Area Educator

Lincoln University Cooperative Extension's (LUCE) St. Louis Urban Impact Center (SLUIC) gave computer classes for seniors and youth; this helped to minimize the gap between those who are computer savvy and those who are not. Sixty-five seniors and youth attended these classes. Through hands-on learning, LUCE assisted families and youth to use computers in their daily lives.

The horticulture program maintained active contact with 30 urban farms, nine community gardens, three school gardens and two not-for-profit agricultural training programs. A total of 183 gardeners attended one or more of 12 workshops. Out of the 44 projects, 35 reported an increased income in 2013. Additionally, 10 urban projects were awarded grant funds for foundation and farm research. These totaled $318,900.

Over 80 youth participated in the leadership academy, summer and afterschool programs. Over 1200 community service hours were donated during the summer program by 24 youth and adults. The major outcome of the youth programs was to empower youth to make more informed decisions about their futures.

The Men on Business (MOB) program was conducted in 13 high schools. There was an average of 15 students per school, 195 total. Ninety percent of MOB members were promoted to the next grade level or graduated from high school. The majority now attend college.

The Volunteer Income Tax Assistant (VITA) Grant Program and workshops on financial literacy were conducted. In total, 174 taxpayers took part in the program. They received $149,462 in earned income tax credits; state and federal refunds equaled $475,285. Taxpayers were not charged the tax preparation fee (about $100 - $225 each). The majority of the 82 workshop attendees stated that they would take the needed steps to improve their financial well being. ■

Men on Business students attending a presentation.

Southeast Missouri Outreach Centers

Brenda Robinson Echols, Regional Coordinator

Caruthersville
Patricia Cagle, Program Assistant
Adrienne Hunter, Regional Educator
Dawn Jordan, Program Assistant

Lilbourn
Darvin Green, Program Assistant
Sherry Maxwell, Program Assistant
Tamela Strayhorn, Program Assistant
Ruth Thomas, Program Assistant

Malden Bootheel Youth Museum
Matt Kronz, Regional Educator

Sikeston
Felecia Anderson, Regional Educator
Ciera Andrews, Program Assistant
Rosie Davis, Program Assistant
Brenda Robinson Echols, Regional Coordinator
Kenneth Hollowell,
Community Outreach Worker
Tiara Riggs-Butler, Secretary

Academic Achievement

Afterschool tutoring was offered in Sikeston and Caruthersville for students in grades K-8. Students were helped with homework; they were tutored in math, reading and spelling. Students were also exposed to web-based learning sites. An average of 35 students at each site attended daily. Over 80 percent of students in the Sikeston program and 50 percent in Caruthersville made the honor roll. One attendee won the school spelling bee. Over 30 students got college prep information and help with their Free Application for Federal Student Aid (FAFSA) forms.

Abstinence Education

The Abstinence Education program starts educating students as early as 6th grade. The program hopes to affect the teen pregnancy rates in the area.

The Teen Outreach Program (TOP) trained 50 6th-8th grade students in Charleston, Sikeston and Caruthersville. It taught abstinence education and worked on service learning projects. The students helped a local agency collect 7,000 pairs of shoes for Africa. The agency's director was pleased with the hard work and commitment of the students; she asked them to return for another project. The Teen Talk program also focused on abstinence.

Childhood/Adult Obesity

Summer enrichment programs served over 200 students in grades K-8 in June and July. Students took part in physical fitness, dance, drama, a reading partnership with the library and more. Community gardens were maintained by all sites. Fitness and nutrition classes were also held for adults. A total of 29 inches were lost; overall, the group shed 103 pounds.

STEEAM

(Science, Technology, Engineering/Entrepreneurship, Agriculture and Math) By partnering with the Bootheel Youth Museum, over 1000 students were exposed to STEEAM areas; students learned through hands-on workshops. A Youth Agricultural Conference targeted 50 6th-11th grade students; it taught about opportunities and careers in agriculture.

A grant from the Missouri Department of Mental Health funded many programs. They included substance abuse prevention, black history, an angel tree project, volunteer recognition and Kids of Distinction. ■

Children from the After School program visited the Beggs' Family Farm.

PART TWO: Special Programs

AgDiscovery Program Teaches Youth about Agricultural Careers

David Kiesling, Special Projects Coordinator

Lincoln Univeristy Coopertive Extension's (LUCE) Ag Discovery is an outreach program that was started by the Animal and Plant Health Inspection Service (APHIS) Veterinary Services. It is funded by joint agreements with the universities that host the program. Its goal is to teach students about careers in agriculture. Among these are animal science, veterinary medicine, agribusiness and plant pathology.

July 2013 was the second year that LU offered this program. Students attended from several states. They stayed on campus for two weeks. LU faculty and staff taught them about agricultural science. Student took part in hands-on labs, workshops, field trips and other group and team-building activities.

After the session, a mother sent positive feedback about the "wonderful time" that her son had experienced. On the drive home, he shared the highlights; these included "internal palpation of a pregnant cow, the parking lot gardens in Kansas City, making cheese" and more. He said that the best part of the program was "the people." This parent praised the counselors; she asked that her thanks be passed on to them. Her son plans to attend next year. She also stated, "He is considering applying to Lincoln University when the time comes." ■

Ag Discovery youth get hands-on agriculture experience.

Goat Industry Information on the Web at eXtension.org

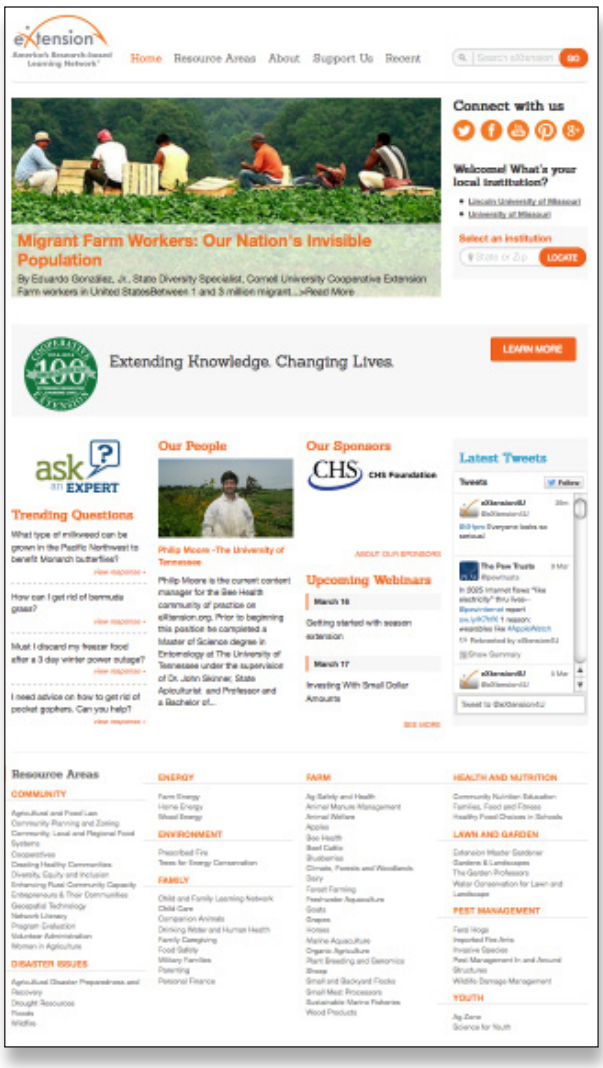
David Kiesling, Special Projects Coordinator

The eXtension.org website offers research-based information on diverse topics. For example, there is material about horses, fire ants and energy conservation.

Lincoln University has taken the administrative lead for the eXtension community of practice (CoP) entitled "Goats." LU, along with other 1890 land grant universities, developed these webpages; they can be found at http://www.extension.org/goat. The leadership team is made up of 17 advisors. They work at 1890 and 1862 universities throughout the US.

The site offers material with a scientific basis for goat producers, extension educators and consumers. The goal is to be a one-stop source for goat information. This site has many features; they include announcements, a glossary, a meat goat management tool and instructional videos. There is information on breeds, the economics of goat production and genetics. There are articles on health, nutrition, marketing, management, organic goat production and reproduction. Users will also find material about pastures, forages, vegetation management and predator control.

Users from the US and beyond visit this part of the eXtension.org website. If the information they seek is not available, they can ask an expert; answers are supplied within 48 hours. Based on a national survey, 93 percent of users would recommend this portion of the eXtension.org website. ■



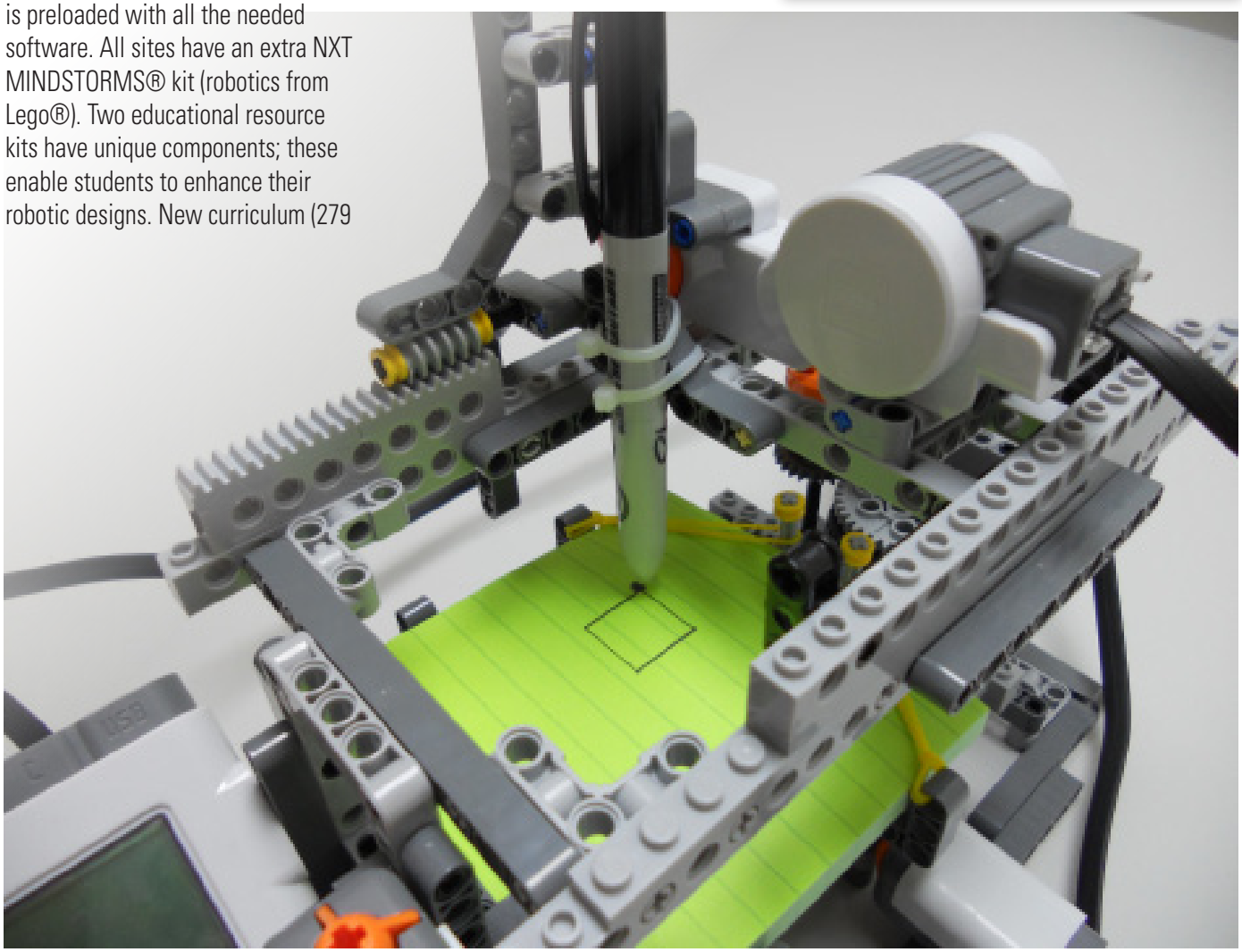
Robotics Program

Gregory Pierson, Research Engineer – Robotics Program Coordinator

The Lincoln University Cooperative Extension (LUCE) Robotics Program has equipped regional educators with curriculum and technology resources. These tools help teachers and youth to further develop science, technology, engineering and mathematics (STEM) skills and interests. This program impacted about 80 students ages 8 to 18. The program occurs at five LUCE sites. These are in Caruthersville, Jefferson City, Kansas City, Sikeston and St. Louis.

Now, each LUCE site is better equipped. A dedicated robotics laptop is preloaded with all the needed software. All sites have an extra NXT MINDSTORMS® kit (robotics from Lego®). Two educational resource kits have unique components; these enable students to enhance their robotic designs. New curriculum (279 pages) has been written. Students will now find example code (C-based programming language), safety lessons and building instructions. They can also consult relevant math examples and exercises and outside references that extend learning. In addition, 386 pages of open-source curriculum have been combined. These include lessons on safety, example code (C-based programming language) and theory of operation. There are also practical exercises, instructor lesson plan development tools, building instructions and quizzes.

In 2014, students will start using a newly acquired 3-D printer to prototype mechanisms. These will be created as part of a design team made up of students. ■



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PART FOUR: Cooperative Research Programs

Animal and Plant Science

Design of a Nanosensor for Detection of Luteinizing Hormone in Small Ruminants

Dr. Zahra Afrasiabi, Principal Investigator

In livestock production, the genetic quality of the animals is a huge factor in economic success. Males represent 50 percent of the genetics of a flock or herd. Therefore, use of high quality males is the most common way to increase the genetic quality of livestock. Buying high quality males is often too costly for small family farms. This limits their ability to compete with larger farms.

One alternative to owning an expensive male is to use artificial insemination. A major problem, especially in sheep, is finding the right time to inseminate. A device that could determine this timing would be very useful. Then, sheep could be bred without a male. Such a device could result in artificial insemination being used more on small farms.

Luteinizing hormone (LH) triggers ovulation (when the egg is ready to be fertilized). A rise in the level of LH is one of the most common changes that can be measured in the blood prior to estrus (the time when conception is possible) and ovulation.

The goal is to create a device to measure real-time changes in LH concentrations. A new peptide sequence (an amino acid sequence; amino acids are the building blocks of proteins), LHP, was produced. LHP was able to detect LH. The polyclonal antibody of the synthetic peptide, anti-LHP, was also created. (An antibody is a protein used by the immune system to counteract an antigen; polyclonal antibodies come from several cell lineages.) A competitive ImmunoStrip® (like ELISA, but easier to use; ELISA means enzyme-linked immunosorbent assay—a lab procedure that can identify a substance by using antibodies and the color reaction they produce) assay was used. AuNP, a gold nanoparticle (a very small particle; a nanometer is one-billionth of a meter), was wedded to LHP. This research showed that AuNP-LHP was able to distinguish LH from related samples. More studies are needed to develop a lateral flow device (similar to a home pregnancy test) that uses AuNP-LHP to detect LH. Initial field trial experiments were conducted to confirm the proof of concept. ■

Performance and Behavior by Katahdin Lambs Weaned Using Either Fenceline or Traditional Weaning Methods in the Morning or Afternoon

Dr. James Caldwell, Principal Investigator

Weaning is stressful for livestock. However, alternatives to traditional weaning methods and times might improve performance and reduce its negative effects. This project determined the effects of weaning method and time of day on lamb performance and behavior. Katahdin ewe and ram lambs (n = 93) were grouped by litter, body weight (BW), sex and age of their dam (female parent). Two weeks before weaning, they were randomly put into one of eight groups. Groups were then randomly assigned to one of four treatments. These were "Fenceline a.m.," "Fenceline p.m.," "Traditional a.m." and "Traditional p.m." In fenceline weaning, there is often less stress, as lambs and their dams maintain nose-to-nose contact through a fence. In traditional weaning, the separation is abrupt.

Morning weaning occurred at 7:30 a.m.; evening weaning, at 5:50 p.m. Fenceline-weaned lambs were placed into quarter-acre paddocks across from their dams, consisting mainly of endophyte-infected tall fescue. (An endophyte is a fungus or bacteria that lives in a plant without causing harm.) Traditionally weaned lambs were housed in a drylot (without vegetation) away from their dams, with access to endophyte-infected tall fescue hay. All lambs could access water and trace minerals. They were offered a grain-based supplement at 2 percent BW (as fed) for the 14-day weaning period. Afterward, lambs were weighed and revaccinated. Behavior measurements were observed and recorded at intervals after weaning. Over a 10-minute period, trained observers determined if each lamb vocalized, walked rapidly, ran quickly within its pen, stood or lay down. If seen, these behaviors were only recorded once per behavior per lamb.

Weaning weight, 14-day post-weaning weight, average daily gain (ADG) and total gain did not differ across treatments. The percentage of lambs vocalizing (a negative) was greater from fenceline. A weaning method by weaning time tendency was observed for the percentage of lambs standing. Afternoon weaning increased the percentage of lambs standing by 14 percent (87% vs. 73%) from "Fenceline p.m." compared with "Fenceline a.m." However, the percentage of lambs standing decreased by 14 percent (96% vs. 82%) when comparing "Traditional a.m." with "Traditional p.m." The percentage of lambs walking rapidly or running did not change across treatments. Therefore, the time of day lambs are weaned or the method of weaning may not affect performance. However, weaning method and time of day might have a slight effect on lamb behavior. ■

Black and White Crappie Rearing Methods Project

Charles E. Hicks, Principal Investigator

Crappies have great potential as a commercial food species in the North Central Region. They can also be grown in states with moderate water temperature. This research has shown that crappies can be cultured in recirculating aquaculture systems (RAS). They can also be raised in ponds using commercial diets.

Lincoln University is working with Auburn University to develop genetic markers for crappies. This research will show how the best brood fish can be genetically selected. It will also identify genetic traits that are commercially important. One goal is to link these traits to phenotypic (physically observed) qualities; these can then be used in LU's crappie selection program.

A recent study looked at juvenile black and white crappies that were harvested from pond-spawned fish. They were brought inside for feed training, using several methods. They were later stocked in tanks. Silver Cup® 2.0 (feed type 1) and Purina® AquaMax® 200 (feed type 2) were the commercial feeds used. Both were fed to four replicates of each species. Amounts were increased weekly and recorded. Weight gain, feed conversion ratio (FCR) and specific growth rate (SGR) were calculated. Significant performance differences occurred between fish fed different feeds; however, there were no differences among the species. The survival rate was similar for all categories. Fish fed type 2 outperformed fish fed type 1; they had a larger final biomass, percent gain and SGR. The only significant difference in FCR was between black crappie fed type 1 and white crappie fed type 2.

Crappies from the indoor RAS study were later stocked in six ponds; there were three replicates of each species. After harvesting, 300 males and females of each species were selected by size and body type. These fish were moved inside as the founder population for the selection study. Although there were not significant differences in the harvest size between the two species, the white crappies weighed more on average. ■

Numerous water tanks hold aquatic life inside Lincoln's Aquaculture Building.

Divergent Selection for Parasite Resistance in a Closed Line of Kiko × Boer Goats

Dr. Bruce Shanks, Principal Investigator

Goats have become more and more popular with small landowners. They fit well into forage-based production systems in the Central U.S., including Missouri. However, goats are highly prone to infection by internal parasites. Parasites have mainly been controlled by using commercial dewormers. Recently, there have been increasing concerns about parasite resistance to these chemicals. Thus, this research studies a selection program; whereby the host animal's natural or acquired immunity might be used to increase parasite resistance.

At Lincoln University's George Washington Carver Farm, a base population of doe were evaluated for resistance to internal parasites. Next, they were placed in one of two selection lines. The first group (high) had a high resistance to internal parasites; the second group (low) had a low resistance. Those does have now been mated for three breeding seasons, including this season; their mates were from corresponding high- or low-line bucks. Bucks were bought from private breeders based on their parasite resistance. The resulting kids from each line are being selected based on parasite resistance. They will be further crossed with high-line and low-line bucks, respectively, to produce the next generation. Then the lines will be closed. After that, the most parasite-resistant animals from the high line and the least parasite-resistant animals from the low line will be mated within line; this will continue for several more generations. Typical production traits will be recorded to reveal the response to selection for parasite resistance.

Genetically selecting goats for improved parasite resistance may give producers a novel option for dealing with parasites. It may also reduce the dependence on commercial chemicals. Overall, this process fits with modern trends toward sustainable agriculture. This research is part of a long-term selection project; it is ongoing. ■

Establishing a Footrot-resistant Katahdin Sheep by Genetic Marker-assisted Selection

Dr. Tumen Wuliji, Principal Investigator

Food animal diseases affect production economics, animal welfare and human food safety. Footrot is a very contagious disease that mainly infects goats, sheep, cattle and some wild ungulates (mammals with hooves). However, the genes of some sheep allow them to tolerate footrot infection. Therefore, this study focuses on genetic screening, identification and selection of a footrot-resistant genotype (genetic makeup) within hair sheep breeds or flocks. The goal is to create a line of sheep that can resist footrot.

At George Washington Carver Farm, there were Katahdin ewes (n=120), and 30 rams (Katahdin, K = 16; Dorper, D = 7; and Texel, T = 7). Ewes were divided into two groups. One was a footrot-resistant selection flock (SF = 60). The second group was a crossbreed genotype flock (CF = 60). The SF animals were bred once a year within breed (K) mating group as a footrot-resistant selection flock. The CF ewes (K) were crossbred with Dorper and Texel rams (1st and 2nd years); their F1 progeny was backcrossed to one of the two sire breeds (3rd and 4th years), respectively. Selective breeding generated crossbreed F1 progeny groups of ½K½D and ½K½T. The crossbreed F1 ewes will be backcrossed to Texel (n = 4) and Dorper (n = 4) sires in the third and fourth years of the project to generate F2 three-breed crosses of ¼K¼D½T and ¼K¼ T½D. After four breeding seasons, there will be one selected breed (Katahdin) and four crossbreed genotypes (½K½D; ½K½T; ¼K¼D½T and ¼K¼ T½D) available for footrot-resistant challenge, genotype marker typing, selective breeding and genetic linkage analysis.

From 2011 through 2013, the project carried out its breeding plan and gene marker screening tests. Results show that a large ratio of the SF possesses genetic resistance to footrot disease (Figure 1). Also, 38 farmers' flocks in Missouri and six flocks in other states were inspected for footrot. An on-farm biosecurity protocol was developed for use during footrot outbreak seasons. ■

Environmental Science

Enhancing Biodegradation of Herbicides Using Biofilter Systems

Dr. Frieda Eivazi, Principal Investigator

Common design for a biobed. (photo courtesy of: http://www.fwi.co.uk/articles/15/01/2009/113811/integrated-crop-management-cuts-costs-and-benefits-wildlife.htm)

Laboratory testing determine herbicide concentration.

Pesticides can cause pollution when they are used in agriculture; pollution also occurs from spills and improper storage, handling and disposal of pesticides. Another source is the incorrect disposal of wastes when cleaning the pesticide application equipment and storage containers; leaks at pesticide dumpsites and wastes discharged from production facilities also pose problems. Such problems can occur on any sized farm. Instead, biofilters can be used to contain and biodegrade pesticides; this may be a cost-effective alternative. A biofilter is an in-ground treatment unit; it contains and degrades pesticide spills through microbial activity. Varying the conditions that aid in degradation can enhance microbial activity.

This year, the study will develop a biofilter system that adapts to the soil and environmental conditions of Missouri. It will be used to treat and dispose of selected pesticide wastes on-farm. Another goal is to learn more about biofilter technology. This is needed because after pesticides and other pollutants enter the environment, they can be transformed by biological and nonbiological processes. A variety of biological, chemical and physical methods have been used to degrade and detoxify pesticides. However, these methods are costly. They also are not always effective.

Four biofilter mixtures with different ratios of top soil, straw and peat were tested in the laboratory. Glyphosate (herbicide) was added to the biofilter mixtures in glass jars. The herbicide-degrading potential of the biofilter mixtures was found by measuring the remaining herbicide concentration. Degradation kinetics (changes in chemical or physical systems) were analyzed. Initial results showed that after three months, the glyphosate concentration and degradation half-life (time for half of the material to degrade) (DT50) was lowest in the biomix containing 12.5 percent straw, 62.5 percent soil and 25 percent peat. Future studies include more degradation and sorption (attaching) experiments; these will use different herbicides in biofilter materials and identification of microbes in the biofilter. Eventually, an on-farm biofilter will be created. ■

Energy and Environmental Economics

Dr. Haluk Gedikoglu, Principal Investigator

This research focuses on energy and environmental economics. The research program analyzes the socioeconomic (social plus economic) factors that impact whether farmers will set up sustainable bioenergy (renewable energy made from a biological source) production systems. The economic analysis is done at the farm level. The research looks at the creation of cellulosic (from the material that forms the major part of cell walls in plants: cellulose) ethanol; this ethanol is made from sustainable biomass (living or recently living material, meaning plants in this context). This feedstock development is needed so that energy crops can be grown. Three dedicated energy crops are analyzed by this research program. They are switchgrass (a native grass), miscanthus (a genus of perennial grasses) and sweet sorghum. Large and small farmers are surveyed. The results explore farmers' willingness to grow these dedicated energy crops. The ongoing analysis shows that farmers' willingness to grow dedicated energy crops is much lower than the levels predicted. This implies that the target dates for cellulosic ethanol production will not be met. These targets were set by the Energy Independence and Security Act of 2007. Another major result is that small farms, rather than large farms, will likely grow these crops. This will mean an increased cost to gather biomass feedstock, as small farms produce lower yields and are spread out. This will make it less profitable to produce cellulosic ethanol. Based on this research, alternative production systems should be designed.

This research program received interest from external funding groups. The program was funded by the United States Department of Agriculture (USDA)-Agriculture and Food Research Initiative (AFRI)-Sustainable Bioenergy Competitive Grants Program. It also received funds from the USDA-AFRI-Agriculture Economics and Rural Communities (AERC) Program, USDA-Capacity Building Grant (CBG) program and USDA-Higher Education Challenge (HEC) Grants Program. ■

Evaluation of Surface Water Quality Impacted by Sewage Overflows from Animal and Residential Lagoon Systems using Principal Component Analysis

Dr. Abua Ikem, Associate Professor

The Evaluation of Surface Water Quality Impacted by Sewage Overflows from Animal and Residential Lagoon Systems using Principal Component Analysis study assessed the water quality of Gans Creek in Missouri. It looked at the domestic and confined animal lot (CAL) sewage lagoon overflows that were discharged into this creek. The overflows were examined to find out about their physical and chemical properties. This study used principal component analysis (PCA) to find the major factors that affect Gans Creek water quality. Samples were collected monthly (May 2009 - February 2010). This was done along Gans Creek and at both lagoon overflow points. The ammonia-nitrogen (NH3-N) in Gans Creek and the overflows was monitored the next year (March 2010 - July 2011). This was necessary because Ammonia Nitrogen can be toxic to stream health. Thirty-one variables were measured in the samples. These included pH, electrical conductivity (EC), total nitrogen (TN) and total organic carbon (TOC).

The samples from the domestic overflow had the highest level of NH3-N, total phosphorus (TP), TN, TOC and boron (B); these were in comparison to the CAL and the Gans Creek samples. Dissolved materials and ammonia were the major stressors for this stream. PCA showed that four components accounted for about 60 percent of the total variability of the data. The study found that there were four major controlling processes. These

were mineralization (20%), sewage overflows (19%), diffuse pollution (12%), and runoffs from cattle grazing areas (9%). Also, over 20 water quality aspects showed significant levels of these four components. Lagoon system overflows need regular treatment and management to protect the Gans Creek ecosystem. This project taught and trained students, technicians, beef facility operators and the treatment plant operator. It also informed persons at the University of Missouri (MU), Columbia city officials and the scientific community. ■

Controlling Stream Water Quality in a Missouri Claypan Watershed

Dr. Fengjing Liu, Principal Investigator

Knowing about hydrologic (water-related) processes will help to understand the controls on contaminants in stream water in agricultural watersheds. Since October 2011, intensive field sampling has been performed in a small claypan watershed in Central Missouri. (Claypan is a continuous, thick layer of soil consisting of clays about 20-50 cm below the land surface.) More than 300 samples have been collected by 2013 from streams, seep flows (shallow subsurface water that returns), rainwater and groundwater.

This study reveals that stream water was mainly controlled by flows from three sources. These sources were rainwater, shallow subsurface water above the claypan and groundwater below the claypan. This information is vital in order to develop a conceptual understanding of watershed management and land use planning. In the long run, this work can benefit farmers. It will also help direct management practices to the areas that are most at risk of stream water quality and eventually help decrease contaminant transport.

This project trains a graduate student and a postdoctoral researcher in the field of water quality. It also adds to outreach that can improve the management of fertilizers and herbicides commonly used by Missouri farmers. This research was funded by two sources: the United States Department of Agriculture (USDA) National Institute of Food and Agriculture (NIFA) Capacity Building Grants and Evans-Allen projects. ■

Accounting for Barriers to Gas Emissions from Soil in a Central Missouri Forest

Dr. Nsalambi Nkongolo, Principal Investigator

Emissions of greenhouse gases (GHGs) from soil can be restricted by obstacles; these might be soil rocks or dead, fallen or live trees. In fact, soil surface rocks and deeper rocks occupy soil areas that emit little gas. Also, in forests, roots contribute to GHG emissions from soil through biological processes; however, each standing tree (basal area) occupies an area that prevents GHGs emissions from soil. These barriers to emissions are not always considered when deciding GHGs emissions from point measurements to the entire plot. Therefore, researchers should factor in the presence of rocks and tree trunks. Otherwise, the large-scale flux estimate could be too high.

The objectives of this study are twofold. The first is to quantify GHGs emissions and carbon (C)-stocks. The second is to develop correction factors for improving the quantification of GHGs fluxes and C-stocks in the rocky forest soil of Central Missouri.

Twenty cylindrical polyvinyl chloride (PVC) chambers 0.30 m long and 0.20 m in diameter have been installed permanently in the forest since 2003. They monitor soil carbon dioxide (CO2), methane (CH4) and nitrous oxide (N2O) fluxes regularly and during rainfall events. Surface rocks and trees were mapped. The areas they occupied were calculated using geospatial technologies. Tree diameter (dbh, diameter at breast height) was measured; aboveground carbon biomass was assessed using allometric (measuring a part in relation to the whole or to a standard) equations. Soil samples and measured soil carbon pools and other soil and environmental parameters (soil moisture, temperature, bulk density, etc.) were collected. Geospatial analysis was done using ArcGIS and Multispec© software. Regression analysis and modeling was performed using R statistical software. ■

Evolution of the Afar Triple Junction, Central Afar, East Africa

Dr. Samson Tesfaye, Principal Investigator

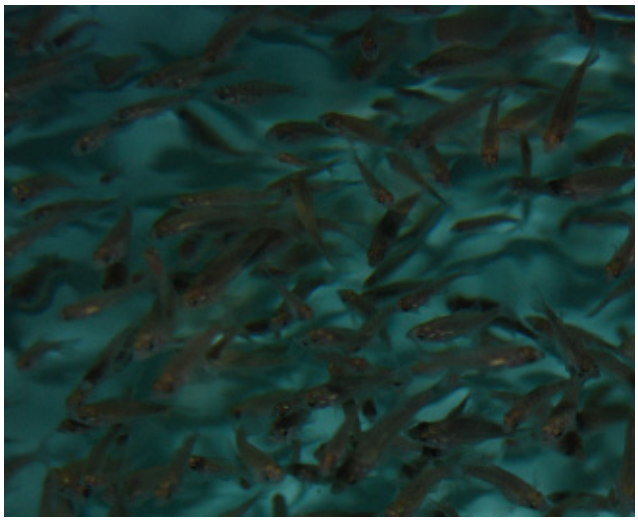
New oceans form when continents break apart. A classic example of such a phenomenon is currently occurring in the Afar Rift in Ethiopia and Djibouti. A Lincoln University team made up of the project leader and an undergraduate student, Stephan Bradley, spent a little over three weeks conducting fieldwork in the Afar rift. The trip was funded by the National Science Foundation (NSF).

The climate in Afar is very dry. The soil horizons (layers) are poorly developed and the terrain has no vegetation cover except in localized spots in the basins. These conditions provide ideal situations for remote sensing studies. Satellite images, which were analyzed prior to field work, were utilized to maximize the field investigation effort. The team conducted field geologic investigations and collected rock samples. It also took topographic profiles along fault scarps (vertical rock formations). The team was able to verify information gathered from the satellite images. The data collected are now being analyzed. Hopefully, it will shade light on the evolution of the Afar Rift and its march to become the newest ocean. ■

Top photo: Dobe Graben, Ethiopia
Above: Student Stephan Bradley at the shores of Lake Asal, Djibouti

Aquaculture Nutrition Research Initiative in Missouri: Developing a Least-cost Diet to Produce Bluegill Fingerlings

Dr. Thomas R. Omara-Alwala, Principal Investigator



The demand for seafood is increasing at the same time the supply of wild fish is decreasing. Catfish, salmon, trout and tilapia are the most common food fish produced in the US. However, it is not economically feasible to grow these fish in Missouri and other North Central states.

Sunfishes are considered potential food fishes in the Central US because of their popularity. They have little or no effect on native habitat if they should escape from their captivity into the public water systems. Bluegill is the most popular member of the sunfish family.

Many institutions are studying sunfish production. The current research at Lincoln University Cooperative Research (LUCR) focuses on the nutrient requirements for sunfishes. It looks at creating readily available least-cost feeds for bluegill fingerlings (young fish).

An alternative is needed because fishmeal, while it is easy to digest, is one of the most costly protein sources. Previous research at LUCR found a minimal energy level requirement for bluegill. It also found 38 percent fishmeal protein was needed for the culture of juvenile bluegill. ■

Lincoln's aquaculture facility.

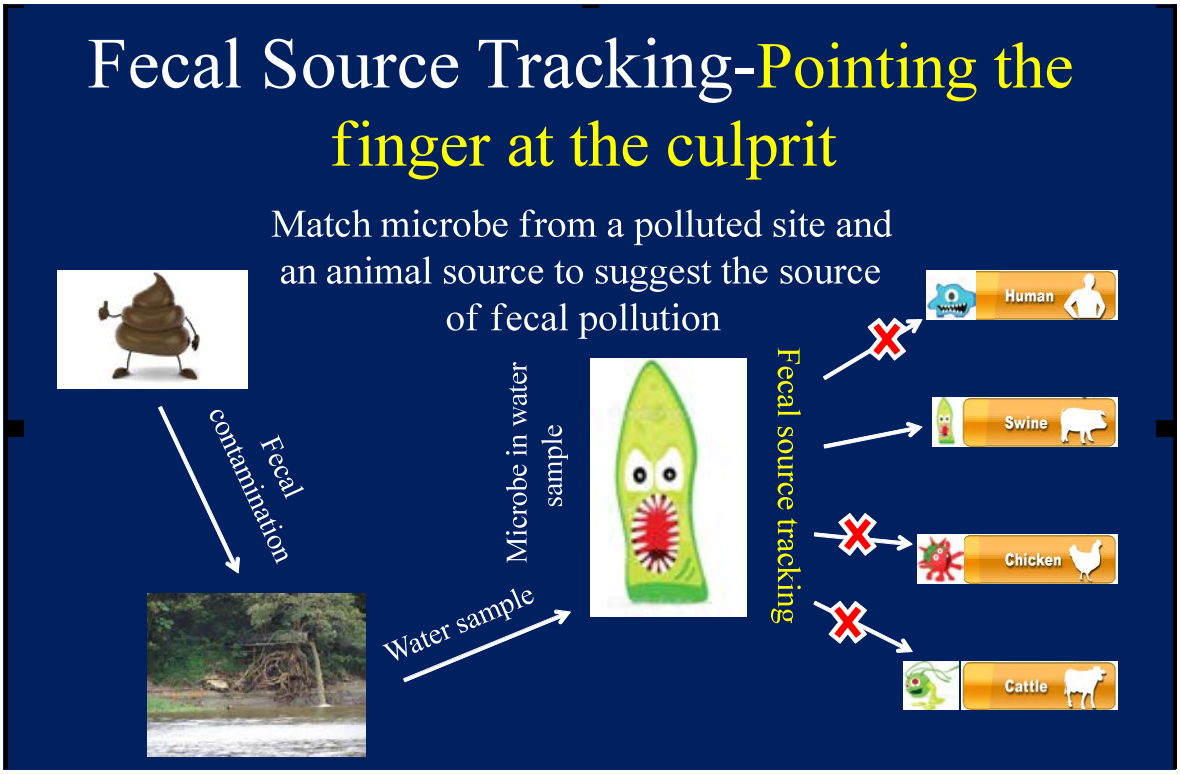
New Methods for Tracking Fecal Pollution in Water

Dr. Guolu Zheng, Principal Investigator

Fecal pollution of water is a risk to human health. Waterborne pathogens (agents capable of causing disease) may come from human and animal feces. Yearly, fecal pollution from point (specific places, such as a factory) or nonpoint (nonspecific, such as snow melt) causes many waterborne-disease outbreaks. The U.S. Environmental Protection Agency (EPA) measures the fecal pollution of fresh and marine water bacteria using *E. coli* (*Escherichia coli)* and enterococci as indicators. (Enterococci are members of a genus of bacteria, some of which live in the human gut.) The source of the *E. coli* or enterococci might be humans or animals; and that information is needed so that the sources can be removed or remediated. This research is to create new DNA-based techniques to detect these sources. Water systems can be better managed using these tools. These methods will also assess the health risk more precisely.

This research was funded by Evans-Allen grants and an 1890 Capacity Building Grant from the United States Department of Agriculture (USDA). It is a joint project of scientists from a few universities, the state environmental agency and a local environmental group. New DNA-based methods have been created that rely on the association of certain DNA traits of intestinal bacteria with specific animal species. This will aid in the accurate detection of human, poultry and swine fecal pollution. Studies using these technologies have been presented in a peer-reviewed paper; they have also been shared at a dozen professional meetings and conferences.

By improving upon current methods, the new methods are likely to be more effective in monitoring and managing water quality. Applying these methods can better protect those in the state and the nation from waterborne diseases that result from feces-polluted water. ■



Human Nutrition

Effects of Dietary Omega-3 Fatty Acids on Biomarkers of Cardiovascular Disease in Obese Individuals

Dr. Suman Ahuja, Principal Investigator

Obesity has become a major health concern worldwide. The increasing incidence of obesity brings with it growing evidence of diet-related health issues. These include hypertension, type 2 diabetes, cardiovascular diseases and some cancers. Research has shown that obese individuals have a higher incidence of premature mortality compared to their lean peers. This is mainly due to obesity-related health issues, such as diabetes and cardiovascular diseases. Hence, the goal of this project is to produce scientific information that will assist healthcare professionals to increase possible treatment avenues for their patients. This project will primarily support health improvement efforts that relate to underserved Missouri residents and the US general public. Treatment of cardiovascular health problems might require upwards of billions of dollars in the US alone. Therefore, the proposed study attempts to find beneficial effects of dietary omega-3 fatty acids to prevent cardiovascular diseases and maintain optimal health, counteracting obesity.

At this time, the following activities of this project have been successfully implemented:

- designation and setup of a human obesity lab/ exercise facility (infrastructure, equipment, staff, etc.)
- equipment purchase and training
- application and approval of Institutional Review Board (IRB) procedures and flyers to promote recruitment
- active recruitment of obese individuals as study participants
- formulation of special omega-3 fatty acids in various strengths
- creation of educational handouts, videos, etc., along with nutrition training sessions for possible subjects of the study.

Further objectives have been added to explore the genetic parameters of obesity using saliva in addition to human blood. Saliva samples were collected in collaboration with the University of Houston. The results will help determine choices governing eating habits, and therefore, risk for chronic diseases. ■

Center for Nanotechnology and Biosensors

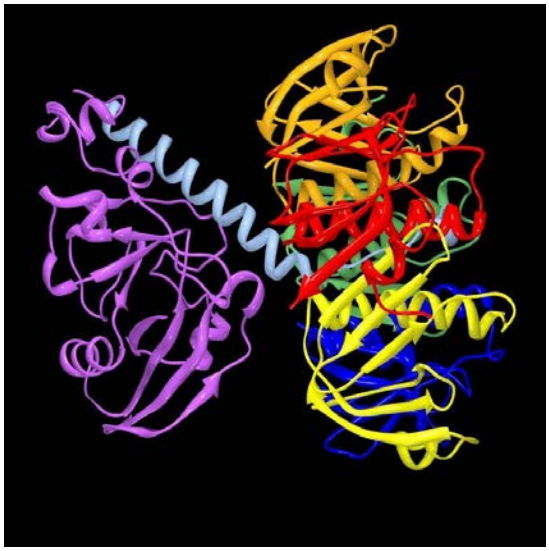
Dr. Majed Dweik, Principal Investigator

Studies by Lincoln University Cooperative Research's (LUCR) Center for Nanotechnology and Biosensors advanced the quick (about two-hour) detection of foodborne pathogens; this compares with current systems that take days. Faster results were made possible by using impedance (a complex process related to opposition in an electrical circuit) sensing with micro-fabricated sensors. Quicker detection can prevent or contain disease outbreaks from foodborne bacteria. Lives can be saved; the economic impact can also be minimized. To make this technology mobile, research is underway to develop a handheld system. It could find wide use in agriculture, food-processing, pathological labs, etc. Both private (food growers and processors, grocers, etc.) and government agencies, such as the United States Department of Agriculture (USDA), could use this device for inspection.

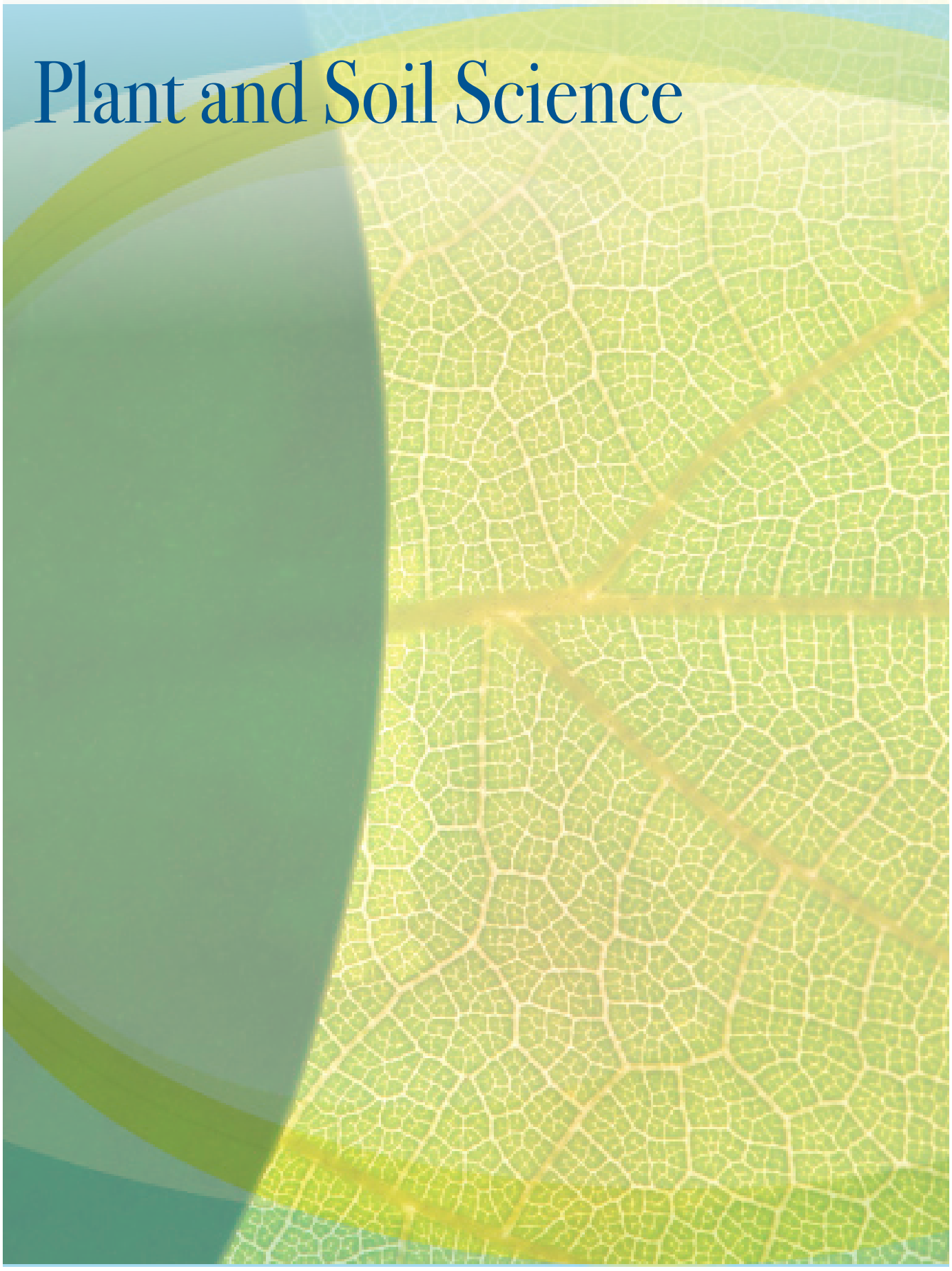
More research on this topic was done using optical sensing. Optical platforms compare the difference in wavelengths of light to distinguish between samples. The goal is to detect specific bacteria among a group of bacteria in a sample. This is being done using antibody-antigen binding. (An antibody is a protein used by the immune system to counteract an antigen. An antigen is a substance that the body responds to by producing antibodies—for example, bacteria.) This research is ongoing. More substantive results are expected within the year.

The laboratory also works on renewable energy. This includes creating various types of photovoltaic cells. These are cells that use the voltage produced by light at the meeting of two unlike substances. These cells may use photosensitive dyes in dye-sensitized solar cells. They also use nanoparticles (a billionth of a meter or less in size) in solar cells or organic dyes (raspberry, blueberry, tea, etc.). The aim is to design and create cost effective, high efficiency and environmentally friendly solar cells.

The lab could not have achieved these results without the tireless efforts of Syed Barizuddin (LUCR) and Mahmoud Almasri and Shibajyoti Ghosh Dastider (University of Missouri). ■



Plant and Soil Science



Effect of Biochar on Soybean Growth and Nodulation

Dr. M. Raimund Bayan, Principal Investigator

Worldwide, innovative approaches are needed to maintain soil and environmental quality while producing the food, feed and fiber needed by a burgeoning world population. Recently, biochar has received attention as a soil amendment because it can enhance soil quality and plant growth while sequestering (containing) atmospheric carbon dioxide (CO2). Biochar is a charcoal created by the pyrolysis (using high temperature to decompose organic material) of biomass (living or recently living material, meaning plants in the case of fuel production). Biochar can also be used in the organic farming of grains, fruits and vegetables.

This greenhouse study investigated the effects of biochar produced from *Miscanthus giganteus* (a tall grass) and *Pinus alba* (pine) feedstocks on soybean growth and nodulation. Nodulation is the forming of root nodules, which are swellings on the root that contain a bacteria that can fix nitrogen (N).

The test plant was the soybean (*Glycine max L.*) cultivar 'Elgin 87'. Soil samples were taken from each pot at the beginning and end of the experiment.

Biochars generated from giant miscanthus and pine feedstocks significantly affected soybean growth and

increased its yield. However, the soybean nodulation was reduced mainly due to the nitrogen content of the biochar. The biochar also increased the soil pH and lowered its bulk density. The addition of biochar to soil provides more aeration, better water holding capacity and reduced compaction. As a result, the roots were longer in the biochar-treated pots. The root dry matter was significantly higher in pots treated with miscanthus biochar; the pine biochar also increased the root dry weight. The number of nodules on the soybean roots increased with the addition of 2 percent pine biochar, but there was no change in the number of nodules with the 5 percent biochar treatment.

Applying biochar increased the leaf surface area. The biochar treatment significantly increased the number of developed pods, indicating that biochar application to soybeans can potentially increase yield. The two rates of biochar, however, resulted in statistically comparable increases in soybean yield.

A field experiment is planned to verify these findings. ■

Plant Nutrient Management in Sustainable Small-scale Hydroponic Production and Field Blueberry Trials

Dr. Jonathan N. Egilla, Principal Investigator

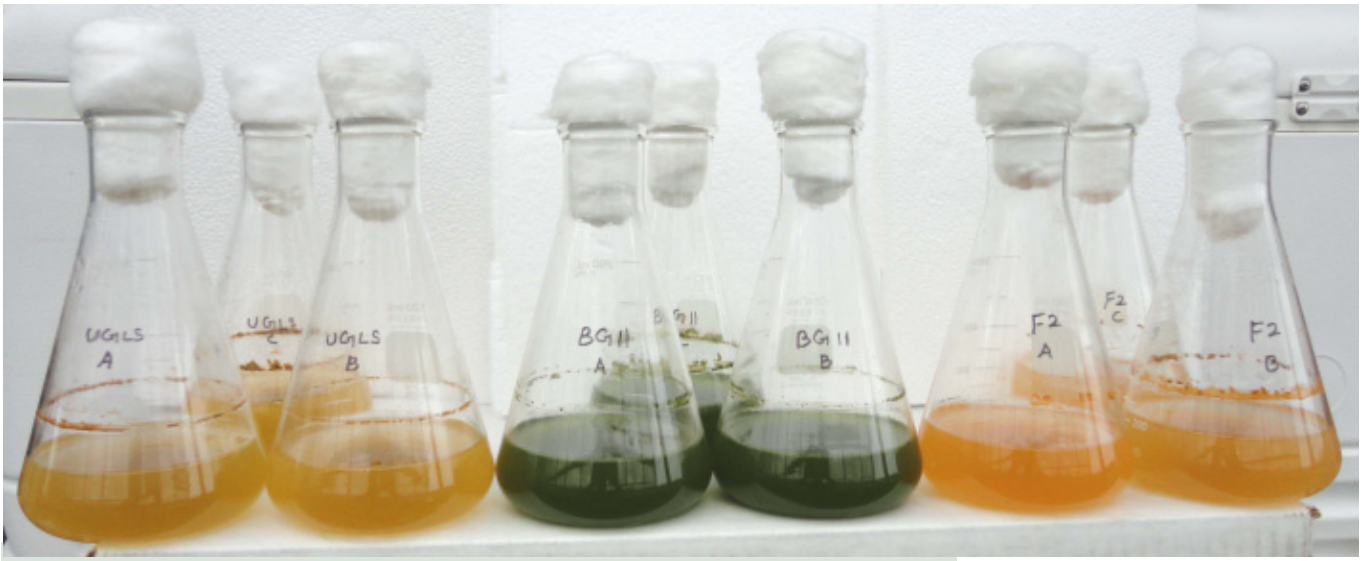
The agronomic and horticultural industries are rethinking how to fertilize and irrigate crops. This is due to the high degree of environmental pollution. The small-scale hydroponic industry in Missouri and the Midwest needs to adopt best management practices (BMPs). When fertilizer leaks from hydroponic systems, over time it can overwhelm the capacity of the surrounding environment to take up plant nutrients.

Nine experiments were run using a commercial Nutrient Film Technique system (NFT) (figs. 1-2). Seven were conducted in a portable flood and drain hydroponic system (fig. 3). Two nutrient solution management (SMGMT) techniques were tested. The two were nutrient renewal and nutrient replenishment. The goal of the experiment was to reduce nutrient losses, increase market quality and yield of hydroponically grown crops.

Cultivars of four leafy green vegetables were used as test crops. These were arugula 'Astro', collards 'Champion', lettuce 'Paris Island Cos' 'Black Seeded Simpson', 'Concept', 'Nevada', respectively, and Swiss chard 'Acelga'. A fourth-year crop was also harvested from our blueberry variety trial; located at Lincoln University's George Washington Carver Farm from June to August 2013 (fig. 4). Presentations were made at meetings and conferences. These included the Missouri Aquaculture Association, American Society of Horticultural Science and Association of 1890 Research Directors (ARD) Conference.

As a result of this research, small-scale limited resource hydroponic growers in the Midwest will know more about on site-specific SMGMT methods. These can improve productivity, and environmentally friendly hydroponic production. This means less nutrient loss. And market quality yield is increased. Growers save money by using less inorganic fertilizer. Research technicians and students at Lincoln acquired research skills in hydroponic production, plant biology and how to take care of the environment. The hydroponic program showcased environmentally sustainable methods of food production. They were shared with K-12 and community college students. ■

Figure 1. Two lettuce cultivars ('Concept' and 'Nevada') in NFT hydroponic system at LU's Carver Farm. Figure 2. Swiss chard 'Lucullus' used as a test crop at LU's Carver Farm. Figure 3. Collards 'Champion' in a flood-and-drain hydroponic system at Carver Farm. Figure 4. 'Elliott,' a later-ripening blueberry cultivar in Central Missouri, compared with the other four cultivars in the trial plot.



The Center for Bioenergy

Dr. Keesoo Lee, Principal Investigator

The Center for Bioenergy researches microalgae (microscopic algae) to find local species that can produce bioenergy and valuable bioproducts (energy and products made from living things). It also maintains a microalgal collection that provides algae for research and supports other institutes needing algae.

The center is working with the Department of Chemistry at the Missouri University of Science and Technology (Missouri S&T in Rolla, Missouri). This research is to develop methods to extract bioproducts from algae. The bioproducts made from algae are many and varied.

They include biomass (living or recently living material; in this case, plants) feedstock, (renewable and biological material that can be used or converted for use as fuel). Another product is biodiesel (diesel derived from plants or animals). Antioxidants (substances that protect cells from unstable molecules, such as from oxidation) and sunscreen pigments can be produced. Polysaccharides (types of carbohydrates) and antimicrobial compounds (that kill microorganisms or reduce their growth) also can be made from algae.

The research group collected microalgae from Midwestern water bodies (Missouri and nearby regions). If a species from the algal collection can naturally produce certain bioproducts, its production is stimulated. This is done without modifying genes. Instead, the yield is improved using alternate techniques. These methods aim to minimize cost. They also simplify the manufacturing process. Microalgae require less input/energy than other microbial cultivation/products and are eco-friendly.

As plants, microalgae need light. Therefore, summer is the best time for outdoor growth. When light is weaker, small-scale tests are done in the laboratory and greenhouse. When results are positive, tests are next performed outdoors in 1,000-gallon circular ponds.

To reduce costs, agricultural fertilizers were used as a nutrient for algae. On a pilot scale, the net chemical cost for producing a pound of dry biomass was $0.54; it was $1.16 using f/2 medium, typically used to grow algae. ■

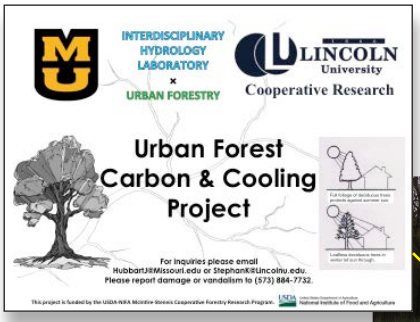
Carbon Storage and Cooling Effects of Urban Forests

Dr. Kirsten Stephan, Urban Forester

Urban areas are a source of the carbon dioxide (CO2) that is released into the atmosphere. However, a great deal of carbon can be sequestered (held) by urban vegetation and soils. By providing shade and shelter from wind, soil and vegetation can also reduce the energy needed to cool and heat buildings; thus, they reduce CO2 emissions. The purpose of this project is twofold. First, it seeks to identify urban forest types that maximize carbon uptake and storage. Second, it strives to find which forest features optimize urban climate. This will reduce energy use.

This research involves six study sites in Columbia, Missouri. The sites span the entire range of forest stand (tree groups), canopy density and soil conditions based on the level of urbanization. The highest level is downtown. A moderate to high level is at a new strip mall. A residential area is a moderate to low-level site. An urban biomass (willow tree) production site is a low-level area. A bottomland hardwood forest represents a minimal level and a non-urban hardwood forest site is used for reference. At each site, carbon storage in plant biomass and soils, and carbon exchange with the environment will be measured. Automated climate instruments will assess such parameters as air and soil temperature; this will be done by partnering with Jason Hubbart, from the University of Missouri (MU), Department of Forestry, and Department of Soil, Environmental and Atmospheric Sciences.

Data collection began in spring 2013; however, there were some setbacks due to flooding. There are several expected impacts of the project. First, significant new fundamental or applied knowledge will come to light. Second, science-based information will be available to guide urban planners and land managers. Then, they can better use the potential of urban trees and forests for climate protection. Third, undergraduate and graduate students who work on this project will gain knowledge and skills. ■



Reducing Arsenic Content in Rice Grains

Dr. John Yang, Principal Investigator

Rice is one of the most important crops in the United States. A recent survey showed that rice grains grown in the South Central U.S. had higher arsenic (As) concentrations. This is due to the use of As-containing pesticides over time. This situation is a threat to public health, food safety and the rice-based regional economy.

This research aims to improve the quality and safety of US-produced rice. It also works to safeguard human health from soil that is contaminated by As. This will be done by creating a low-cost management strategy that minimizes arsenic uptake; it also lessens the arsenic content of rice grains in soil with excess As. Lincoln Univeristy Cooperative Research (LUCR) will engage in multi-institution joint research. An integrated approach will use laboratory, greenhouse and field studies.

Initial results showed that rice grain yield was dependent on the cultivar (variety). It was also influenced by the amount of As in the soil. Water management practices were a third factor. As-resistant cultivars yielded more; they had lower grain As contents than the nonresistant strains. Wet-dry water management would greatly reduce As uptake by rice plants. It would also reduce As buildup in rice grains.

This research will add a great deal to the body of knowledge about the fate, transport, transformation and uptake behavior of As in the rice-soil ecosystem. It will also provide the best management practices to reduce the arsenic accumulation in rice grains that are grown in As-elevated soils. Results could help rice growers produce high quality, safe, marketable rice. This protects American rice consumers from the potential health risk of eating As-elevated rice products. At the same time, it promotes the rice-based economy of the region. ■

Surface-coating Technology for Preventing the Weathering of Lead-bearing Solids in Soils

Dr. John Yang, Principal Investigator

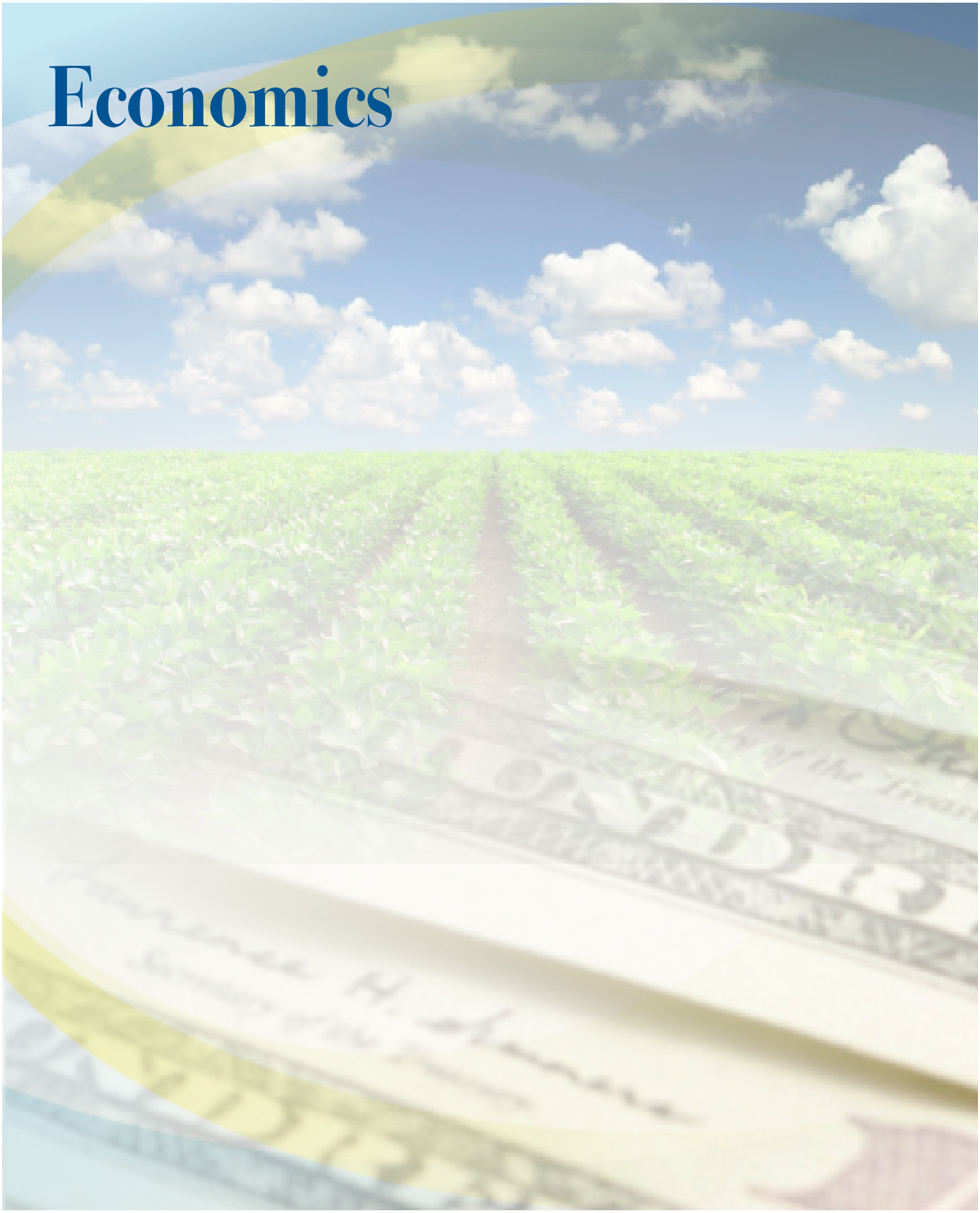
Lead (Pb) is listed as the most common, highly toxic heavy metal in the natural environment. The Pb contamination in a shooting range is a threat to human health and ecosystems. It is difficult to use conventional technology to remediate such sites. This is because Pb solids are large and their dissolution in the soil ecosystem is limited.

This research is to develop a new surface-coating technology that would work in three ways. It would immobilize soil Pb and inhibit the weathering process of the Pb solids. It would reduce the health and ecological risks linked with soil Pb through an integrated approach of laboratory and field studies.

Early results have shown that chemically stable iron (Fe) or aluminum phosphate ($AlPO_4$) have been successfully coated on the surface of lead pellets. This has been revealed by using X-ray diffraction (XRD), which studies the behavior of X-rays beamed at an object to provide information about its makeup, and X-ray photoelectron spectroscopy (XPS), which analyzes the surface chemistry of a material in the parts per thousand. The surface-coating would greatly reduce the amount of lead released into the aquatic ecosystem from lead pellets in the soil. This was confirmed by using the U.S. Environmental Protection Agency (EPA) standard method: Toxicity Characteristics Leaching Procedure (TCLP). Data suggested that using the surface-coating technology caused a major reduction in the health and ecological risk of soil lead.

This research will provide more data about what makes lead corrode and how this corrosion is inhibited in soil. It will also present a cost-effective and environmentally safe way to deal with contaminated soils. The goal is to safeguard humans and the ecosystem from the risks linked to Pb. The new technology has the potential to support national efforts to restore or remediate hazardous sites. It will ultimately help Missouri and U.S. residents living in the contaminated areas; they will benefit from this project by gaining increased environmental safety, sustainability and quality of life. ■

Economics



A Study of Rural Entrepreneurship for Economic Development in Southeast Missouri Counties

Dr. Wesseh J. Wollo, Principal Investigator

Dr. Felix M. Edoho, Professor of Business Administration

Kevin Anderson, Collaborator, Business Development Specialist, University of Missouri Extension

Rural America lacks economic diversification. It needs more small businesses and microenterprises to expand opportunities. Therefore, attention has centered on the role of small businesses and entrepreneurship to increase the economic development of rural areas. Entrepreneurship can boost employment. It also improves incomes and enhances the quality of life.

This project focuses on rural entrepreneurship in the Bootheel area of Southeast Missouri. The Bootheel is part of the lower Mississippi Delta, the most economically depressed area in the state and the nation. Great disparities in economic performance exist among the counties of the Bootheel. The western half appears to be performing well economically; however, the eastern half appears to be performing poorly. This project seeks to discover the reasons for these disparities between regions. Possible strategies will be proposed to stimulate entrepreneurial activities to foster economic development.

Out of 444 seniors at three high schools in the Bootheel, 238 (54%) took part in a survey. One high school was in the western half and two were in the eastern half. A total of 205 (86%) of the surveys were usable. Respondents were asked about if they prefer to own a business and where they prefer to work. They were also asked to assess both entrepreneurial qualities and the key knowledge and skills needed by a successful entrepreneur.

The results show a significant difference between the eastern and western halves of the region in students' preference about business ownership. There is also a significant difference in views about whether an entrepreneur motivates others. A significant difference also exists in the assessment of apprenticeship and in seeing formal education as the key knowledge and skill required to become a successful entrepreneur.

The results imply that high schools should teach about entrepreneurship. Also, policymakers and economic development professionals should encourage programs that develop entrepreneurial skills; they should provide apprenticeship opportunities for students. ■

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