Action in Agroforestry

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IN-BETWEEN CROPS: Integrated cover crops study wins Conservation Innovation Grant

Photo courtesy of CAFNRnews

Ranjith Udawatta, research associate professor in soil, environmental and atmospheric sciences, discusses riparian buffers at CAFNR's Horticulture and Agroforestry Research Center.

By Mike Burden
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They have intriguing names such as hairy vetch, pearl millet and bird's-foot trefoil. Collectively known as cover crops or green manure, they've been used for years to increase soil productivity by fixing atmospheric nitrogen into soil, making it available for cash crops, such as corn, and saving farmers money on input costs.

But fixing nitrogen is just one benefit of cover crops. They improve soil health because they add diversity to the microbial community, foster natural biological processes, boost organic matter, and increase soil porosity, which improves soil's water holding capacity. What they capture is just as critical as what they add. Cover crops reduce soil erosion, sequester carbon and significantly mitigate nitrogen, phosphorous, and herbicide and pesticide losses to surface water.

Despite their myriad benefits, how to integrate them successfully into a production system still raises lots of questions for Missouri producers. Ranjith Udawatta, associate research professor in CAFNR's soil, environmental and atmospheric sciences department and Center for Agroforestry, and his collaborators, aim to answer those questions and demonstrate cover crops' benefits to soil health, water quality, ecosystem services and farm profitability.

Udawatta's team was recently awarded a $500,000 Conservation Innovation Grant from the USDA-NRCS to examine cover crop management practices in 12 watersheds in central and north central Missouri. Several partners are contributing to the project, bringing the total budget to $1.1 million. Associated Electric Cooperative Inc. provided the principal research site in Chariton County.

According to EPA water quality studies, 44 percent of rivers, 30 percent of estuaries and 64 percent of lakes in the Mississippi River Basin are impacted by agricultural pollution and contribute to hypoxia in the Gulf of Mexico. Udawatta's previous watershed research at Greenley Memorial Research Center has shown that the bulk of the loss of nitrogen and phosphorus occurs during the fallow period, when the ground is bare.

Udwatta's project will demonstrate the environmental benefits of adopting a production system focused

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on soil health and conservation practices. Researchers will measure reductions in soil erosion, and nitrogen, phosphorous, and herbicide and pesticide losses to surface water. They'll measure improvements in soil and water quality and biomass production, and aim to enhance wildlife diversity as a result of planting field edge buffers and cover crops, which provide potential habitat.

What's the bottom line? They'll calculate that as well, measuring changes in productivity and decreased input costs from adopting an integrated cover cropping system. Finally, the project will develop and implement a user-friendly tool to recommend best management for cover crop selection, nitrogen application and economic return.

Not much cover crop data exists for Missouri, and this study, along with several cover crop projects at CAFNR's out-state research centers, will bridge those knowledge gaps, providing technical information for farmers about which cover crops perform best for their area and cropping system and what machinery is needed to get the job done. Through the data they collect, they'll be able to add Missouri to the Midwest Cover Crop Council's database–a decision tool that helps farmers choose the right cover crops for their production needs. They'll share their results at field days across the state.

The project involves several collaborators including Associated Electric Cooperative Inc., Syngenta, Pioneer, Cover Crop Solutions, Chariton County Soil and Water Conservation District, Missouri Department of Natural Resources, Missouri Department of Conservation, USDA-ARS, Natural Resources Conservation Service and several participating farmers.

Photo courtesy of CAFNRnews

Researchers measure soil water movement in the field.

Remains of munitions past

By Randy Mertens

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Excerpts of story originally printed in Illumination research magazine

A joint research project by the Center for Agroforestry and Department of Veterinary Pathobiology at the University of Missouri has finished preliminary testing on a novel and cheap method to apply pollution-eating enzymes to munitions contaminants.

Initial studies show that the process works in groundwater. Lab testing has just begun to determine how well the delivery system works in soil. The project is headed by Chung-Ho Lin, a research assistant professor of bioremediation and phytoremediation in the School of Natural Resources' Center for Agroforestry, and George Stewart, the McKee Professor of Microbial Pathogenesis and chair of the Department of Veterinary Pathobiology.

Lin and Stewart are building on known qualities of these enzymes to degrade the nitrogen-rich explosive compounds left over from TNT, HMX and RDX manufacture. Lin says the challenge in using enzymes effectively is that they are fragile and don't stay put in the environment. The enzymes are easily inactivated or washed away by rain before they can finish degrading the pollutants.

Lin and Stewart's trick is to use bacterial endospores as a vehicle to deliver the enzymes to the pollution, thus allowing these "tethered" enzymes to persist there over time. The soil bacterium Bacillus thuringiensis, a spore-forming organism that has been widely utilized as a safe biocontrol agent against insect pests, forms the basis of this bioremediation system.

"Nature has designed these spores to be relatively immobile in soil, to allow the bacteria to persist in these environments," Stewart says. "We have engineered B. thuringiensis to express enzymes tethered to the surface of the spores. The spore normally has a protein called BclA on its surface. Using the BclA attachment signals, we developed a method to trick the bacterium into attaching a foreign protein instead of BclA."

Stewart says the expressed enzyme is engineered to be present in substantial quantities over the entire spore surface. Tethering an enzyme to the spore surface extends the time the enzyme is active. "Thus, high levels of stabilized enymes are present on these spore particles," he says.

In this system, the spores function as particles with attached enzymes. Because the spores need to remain

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as spores, rather than germinate to their bacterial cell form, the spores are killed prior to use. This effectively turns the spores into inert particles with enzymes attached. Because the spores are engineered to display the enzymes, no expensive protein purification steps are involved, greatly reducing costs. "The spore platforms do not break down easily, as they are naturally resistant to harmful environments, such as acidic soil, heat and desiccation." says Stewart.

And there are other benefits. "In addition to their potential use in soil environments, the spores can be immobilized on filters in a bioreactor, which can then be used to remove pollutants from groundwater environments," Stewart says.

The compounds Lin and Stewart are targeting are mostly remnants of munitions manufactured decades ago, including the nitrogen-rich explosive compounds left over from TNT, HMX and RDX. All are potentially detrimental to human health.

The Department of Defense has identified 2,307 sites that are potentially contaminated with military munitions. Of these, 25 were located in Missouri, 62 in Kansas, 29 in Nebraska, and 35 in Illinois. In all, according to the Government Accounting Office, more than 15 million acres in the United States are contaminated with unexploded ordnance, discarded military munitions and munitions constituents such as propellants and other chemicals.

Much of this land has been or will be converted to non-military uses such as farming, recreational or residential and commercial development. The Weldon Springs Ordnance Works, located about 30 miles west of St. Louis, is typical of these sites.

Lin and Stewart are encouraged by the initial research findings. The spore-enzyme system will degrade the pollution 20 to 50 times more effectively than applying the enzymes to the pollution alone. In an early test, TNT compounds began to be significantly degraded within 10 minutes.

"Our results," Lin says, "suggested that more than 30 percent of TNT in water was degraded by the constructed spore-enzyme system within the first two hours" — an outcome that, if sustained, could go a long way toward finally bringing to a close a toxic legacy leftover from a heroic struggle.

Read the full story at http://illumination.missouri.edu/f12/remains_of_munitions_past

Kudos

SEC Symposium Poster Exhibition Awards Announced Tuesday

Six deserving Southeastern Conference students, selected from more than 80 entries, garnered Excellence in Poster Presentation honors on Tuesday to cap off the inaugural SEC Symposium at the Hyatt Regency Atlanta, Feb. 10-12, 2013.

The posters, submitted and displayed by students and faculty from each of the SEC's 14 universities, represented a wide variety of research areas related to the Symposium's topic: "Impact of the Southeast by the World's Renewable Energy Future."

"The poster exhibition is an important part of the SEC Symposium," said Torie Johnson, Executive Director of SECU. "We had more than 80 entries in a number of different areas. The research of these six students was a truly exemplary and our judges had a difficult task choosing the winners, which is a testament to the quality of work of the students in the Southeastern Conference."

Undergraduate students, graduate students and post-doctoral scholars were eligible to receive poster awards, and SEC Commissioner Mike Slive was on hand to present the certificates of achievement.

Graduate Students

T-1st Place: Christopher Bobryk, Department of Forestry/Center for Agroforestry, University of Missouri, "Modeling the Dynamics Of Aboveground Forest Biomass Within the Missouri River Corridor"

Post-Doctoral Scholars

2nd Place: Dr. Sougata Bardhan, University of Missouri, Center for Agroforestry, "Screening of Common Herbaceous and Woody Biomass Feedstock Species for Flood Tolerance"`

Welcome!

Dr. Pradip Adhikari, originally from Nepal, recently joined the MU Center for Agroforestry and SEAS Department as a Post-doc working with Dr. Ranjith Udawatta. Dr. Adhikari will focus on changes in soil properties as influenced by cover crops. He will work on cash crop management with various cover crop combinations on several locations in northern Missouri. These include the Cover Crop Soil Health farm in Chariton County and several other farms in Knox, Linn, and Cole counties. Dr. Adhikari received his Ph.D. degree in soil science (and applied statistics) from New Mexico State University in the fall of 2012. His Ph.D research centered on the effects of treated wastewater application on soil physical, chemical and thermal properties in semi-arid ecosystems.

Dr. Nataliya Kutsokon arrived in February 2013 as a Visiting Fulbright Scholar. She is working with Dr. Shibu Jose to advance the methods for planting and creating new clones of poplars for short-rotation biomass plantings. Her work with UMCA will focus on identifying poplar clones tolerant to flooding as well as searching for molecular methods to increase the yield of plant biomass in forest plantations. Dr. Kutsokon is a Ukrainian researcher working at the Institute of Cell Biology and Genetic Engineering of National Academy of Sciences of Ukraine. Dr. Kutsokon will complete her Fulbright Scholar program in November 2013.

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Upcoming events

May 4

MNGA Grafting and Scionwood Exchange Meeting
Dr. Bill Reid will demonstrate various grafts on nut trees at Phil Moore's orchard in Pleasant Hill, Mo.
Visit missourinutgrowers.org for more information.

May 17 to 19

Chestnut Growers of America Annual Meeting
Gainesville, Fla.
Visit chestnutgrowers.com for more information.

Casey Purcella, Designer