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**Cellulosic nanomaterial may help solve problem of herbicide drift**

By Fred Miller

U of A System Division of Agriculture

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**Fast facts**

* Grad students develop nanotechnology adjuvant for ag chemicals
* Formed new company, CelluDot, to bring product to market
* Business plan earns Governor’s Cup, NSF technology transfer grant

(971 words)

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FAYETTEVILLE, Ark. — Joseph Batta-Mpouma and Gurshagan Kandhola found a tiny solution to a big problem.

Batta-Mpouma says up to 70 million pounds of herbicides are lost to the environment each year in the United States, according to Environmental Protection Agency estimates.

“Global crop production suffers immensely from the off-target drift of herbicides,” Batta-Mpouma said. “Herbicides that miss their target, or that volatize and drift after application, damage sensitive crops. It can lead to over-spraying and environmental pollution.”

To keep those herbicides on target and on the ground, Batta-Mpouma and Kandhola developed a unique formulation of biodegradable nanomaterials derived from cellulosic waste, like sawdust. The formulation is designed to be added as an adjuvant to herbicide spray mixtures to reduce drift.

The Arkansas Agricultural Experiment Station research was initially supported by the Center for Advanced Surface Engineering under the National Science Foundation’s Established Program to Stimulate Competitive Research (EPSCoR) grant. The grant was awarded through the Arkansas EPSCoR program, ASSET III, administered through the Arkansas Economic Development Commission.

Later the project earned a $50,000 University of Arkansas Chancellor’s Fund grant to continue advancing the technology.

Batta-Mpouma is a Ph.D. candidate in the Materials Science and Engineering program at the University of Arkansas. He is a senior research assistant to Jin-Woo Kim, professor of biological and agricultural engineering for the Agricultural Experiment Station, the research arm of the University of Arkansas System Division of Agriculture, and the U of A’s College of Engineering.

Kandhola has completed her doctoral degree in biological engineering and is a post-doctoral fellow in Kim’s research group. She is partnering with Batta-Mpouma in a commercial venture to bring the nanocellulosic technology for herbicide drift control to market.

**Research**

Nanoparticles are between 1 and 100 nanometers long, a nanometer being equal to one billionth of a meter. Kim has spent years developing methods for turning nanoparticles into practical tools for medical, agricultural and manufacturing uses.

Kim’s research, funded by grants from the National Science Foundation and the National Institute of Health, combines multiple nanoscale materials into single, multifunctional structures with defined physical, chemical or biological characteristics that hold promise for advanced materials and devices.

“The potential applications of these technologies are wide open,” Kim said.

To produce these materials, Kim has been developing nano-building-block technology to guide self-assembly of nanoparticles into specific shapes for specific purposes. He calls it nBLOCK technology, and it induces nanoparticles to arrange themselves into designed structures.

Kim has been expanding nBLOCK technology into a “nano-toolbox” of assembly methods that can be used to produce an unlimited number of different materials.

Batta-Mpouma said he was reading news stories about problems with volatilization and drift of dicamba-based herbicides in Arkansas farm fields.

“I thought, our technology can do something about this,” he said.

Working with Kim’s nano-toolbox, Batta-Mpouma and Kandhola developed a cellulosic crystal nanoparticle, dubbed BioGrip™, designed to bind to herbicides. Added to farm chemicals as an adjuvant, the particles add weight to the herbicide droplets, causing them to fall faster and more directly on target during field applications. It also prevents volatilization of the active ingredient, so it stays put on the weeds.

The nano-toolbox gave them the control they needed to precisely construct the agrochemical encapsulating carrier that became BioGrip™.

“We did the research,” Batta-Mpouma said. “This is the first application of this technology.”

**Road to market**

Batta-Mpouma and Kandhola realized they had a potentially marketable technology.

Batta-Mpouma knew he had to learn more about how to go commercial. After attending a Research and Commercialization class offered by the MSEN program, he enrolled in courses in the U of A’s Walton College of Business to study business management and entrepreneurship. He and Kandhola first participated in the local NSF I-Corps program to conduct initial customer discovery and followed it up with the college’s New Venture Development (NVD) courses.

The program required the formation of a new company and so CelluDot, LLC was formed. Batta-Mpouma and Kandhola serve as chief executive officer and chief technology officer, respectively, and develop technology, business and marketing plans.

The team won first place in the Arkansas Governor’s Cup and third place in U of A’s Heartland Challenge. CelluDot was recently awarded a National Science Foundation Small Business Technology Transfer (STTR) Phase I grant, totaling $256,000.

The Agricultural Experiment Station will receive $80,000 of that grant money for product research. Kandhola said, “The grant will be instrumental in helping us optimize the formulation and conduct some key tests that are essential to validate its performance and commercialize the technology.”

Nilda Burgos, professor of weed physiology and molecular biology in the division’s department of crop, soil and environmental sciences, will conduct research as a consultant to CelluDot to determine BioGrip’s™ efficacy in controlling herbicide application, volatilization and drift.

Batta-Mpouma said the research will also investigate the best methods for adhering the chemicals to the nanoparticle and how well they bind together.

The Division of Agriculture filed for a patent on the nanotechnology and optioned intellectual property rights to CelluDot, said Bryan Renk, director of technology commercialization for the division. His office also helped Batta-Mpouma and Kandhola get all the paperwork and contracts in order to make their grant applications.

**Next up**

Kim said the technology that created BioGrip™ can be applied to many uses.

“The nano-toolbox technologies and methods offer precise control over size, shape and function of nanoparticles,” he said. “There are limitless uses for precision nanoparticles in agricultural, biomedical, manufacturing and other technologies.”

Biomedical uses, for example, can employ nanoparticles for cancer treatments, general medical diagnostics and therapies, and to stabilize medical compounds, Kim said.

His focus on cellulosic nanoparticles builds important uses for sawdust, rice hulls and other grain husks, and straw from crop stems. “They have the added advantage of being biodegradable,” he said.

“We are adapting the technology to many potential products and issues,” Kim said.

To learn more about Division of Agriculture research, visit the Arkansas Agricultural Experiment Station website: <https://aaes.uark.edu>. Follow us on Twitter at [@ArkAgResearch](https://twitter.com/ArkAgResearch).

**About the Materials Science and Engineering Program**

Materials Science and Engineering (MSEN) at the University of Arkansas is an interdisciplinary graduate program under the supervision of the Graduate School and International Education. The program focuses on the study of materials, processes, and devices for applications, commonly acknowledged as a program where science and engineering converge.

Students participate in cross-departmental research, take applications-intensive classes from multiple engineering and science departments, and develop workplace productivity skills in a simulated industrial environment. The MSEN graduate program started in Fall 2020 and is a reconfiguration of the Microelectronics-Photonics interdisciplinary graduate program which was started in 1998. As the resident graduate program of the Nanoscale Materials Science and Engineering building, students have access to world-class materials faculty, research labs, and materials characterization equipment.

**About the Division of Agriculture**

The University of Arkansas System Division of Agriculture’s mission is to strengthen agriculture, communities, and families by connecting trusted research to the adoption of best practices. Through the Agricultural Experiment Station and the Cooperative Extension Service, the Division of Agriculture conducts research and extension work within the nation’s historic land grant education system.

The Division of Agriculture is one of 20 entities within the University of Arkansas System. It has offices in all 75 counties in Arkansas and faculty on five system campuses.

The University of Arkansas System Division of Agriculture offers all its Extension and Research programs and services without regard to race, color, sex, gender identity, sexual orientation, national origin, religion, age, disability, marital or veteran status, genetic information, or any other legally protected status, and is an Affirmative Action/Equal Opportunity Employer.

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