Extracts

Institute of Food and Agricultural Sciences

Bacteria that aid toxic cleanup could boost ag production

Remarkable bacteria that resist arsenic could improve toxic cleanups and boost agricultural production, according to a new UF study.

The bacteria were isolated from arsenic-contaminated soil surrounding the Chinese brake fern, a plant known for its ability to remove arsenic from the environment.

The carcinogen contaminates soils around the world and is deadly to most organisms.

Arsenic levels above state-set minimum standards were reported in residential areas in Miami and Gainesville, according to a 2003 study co-authored by Lena Ma, a UF soil and water science professor.

The findings, published in *Bioresource Technology*, could lead to improved phytoremediation — the process of using plants to remove environmental contaminants.

In the study, the bacteria broke arsenic down into a more easily absorbed form and increased the fern's arsenic uptake ability by more than 900 percent. The bacteria also caused the plant to grow bigger, with a nearly 100-percent increase in root size.

"I really didn't expect that the plant would grow better," said Ma, an author of the study. "But the arsenic-resistant bacteria increased plant biomass."

In 2001, Ma was the first to report the fern's extraordinary arsenic accumulation abilities. Wanting to further increase the plant's arsenic absorption capabilities, Ma, fellow UF Institute of Food and Agricultural Sciences member Bala Rathinasabapathi and soil and water science doctoral candidate Piyasa Ghosh, began examining bacteria living in the soil around the plant. Ghosh is the study's lead author.

"We thought that there could be bacteria associated with the fern that could be useful in one way or another," said Rathinasabapathi, a UF horticultural sciences associate professor.

The researchers collected soil near the fern and the fern's root zone from different places in Florida contaminated with arsenic.

After the scientists isolated bacteria from the soil, they added it to the fern's growing environment in the laboratory where it broke arsenic down into a more available form readily absorbed by the fern. In addition to the increase in arsenic absorption, they also noted a gain in the uptake of the nutrient phosphorus by the fern, which led to better growth.

Rathinasabapathi said more studies are needed to explore whether the bacteria can be widely used in agriculture.

The fern is licensed to and sold by a company based in Manhattan, Kan.

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Copycat caterpillars mimic caustic cousins to survive

The world can be a dangerous place for an insect — especially in the larval stage.

So it's a little surprising to some scientists that caterpillars don't use the same defense tactics that many butterfly species have evolved.

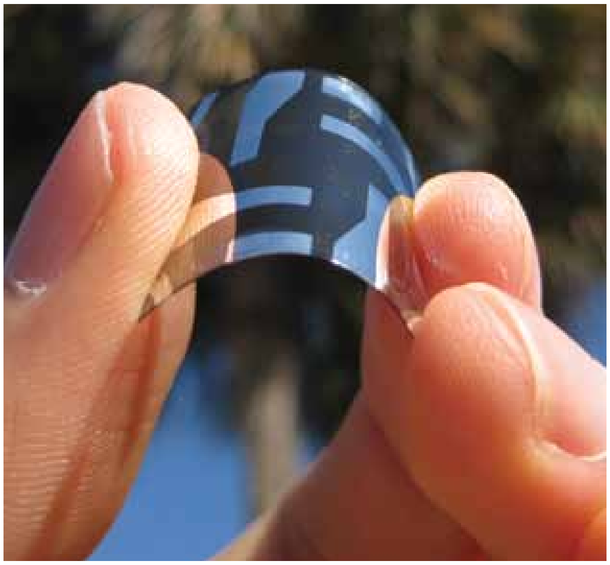
In particular, there are remarkably few documented cases of mimicry in caterpillar species. In mimicry rings, an edible species gains a defensive advantage by evolving to look like a noxious one. In the butterfly world, the most famous case is the viceroy's mimicry of the not-so-edible monarch.

But researchers from UF's Museum of Natural History say that mimicry may be more prevalent in caterpillar species than anyone realizes. In the *Annals of the Entomological Society of America* they report finding two new possible examples of caterpillar mimicry rings: one on the Caribbean island of Hispaniola, and one in the upper Amazon.

The mimics are actually edible prey for birds and other predators, explains Keith Willmott, lead author for the study and associate curator at the museum. But their copycat coloration deceives predators into thinking they aren't. They get the protection without having to invest in the biologically expensive systems required to make them toxic.

Andrei Sourakov, study co-author and collection coordinator at the museum said that caterpillar mimicry

Keith Willmott and Kristen Grace



Piyasa Ghosh (far left) a doctoral student in soil and water science, inspects brake ferns and arsenic-resistant bacteria living near the roots of the fern. Researchers found the bacteria enhanced the arsenic-accumulating abilities of the fern and boosted plant growth.

These four different Neotropical caterpillar species (center) from eastern Ecuador have adapted the same warning color, a mimicry technique, to deter predators. Pictured are, from top to bottom: Pseudoscada florula, Oleria sexmaculata, Ithomia amarilla *and* Forbestra olivencia.

Solar energy cell (right).

examples may have been overlooked in the past because larvae must be raised to adulthood to identify these complexes, and that takes weeks of lab work. Also, relatively few institutions maintain insect collections that feature species at their immature stages, he said.

The researchers said that they hope this finding will inspire others to investigate more closely the ecological processes that influence insects at their immature stages — especially since immature stage insects are the most plentiful on the planet.

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New breakthrough shows promise for solar energy cells

UF RESEARCHERS REPORT THEY HAVE ACHIEVED A NEW RECORD IN EFFICIENCY WITH A PROTOTYPE SOLAR CELL THAT COULD BE MANUFACTURED USING A ROLL-TO-ROLL PROCESS.

"Imagine making solar panels by a process that looks like printing newspaper roll to roll," said Franky So, a UF professor of materials science and engineering.

Industry has eyed the roll-to-roll manufacturing process for years as a means of producing solar cells that can be integrated into the exterior of buildings, automobiles and even personal accessories such as handbags and jackets. But, to date, the photovoltaic sheets cannot muster enough energy per square inch to make them attractive to manufacturers.

The UF team has crossed the critical threshold of 8 percent efficiency in laboratory prototype solar cells, a milestone with implications for future marketability, by using a specially treated zinc oxide polymer blend as the electron charge transporting material. The full report outlining the details of their latest laboratory success in solar cell technology is published in *Nature Photonics*.

The researchers said the innovative process they used to apply the zinc oxide as a film was key to their success. They first mixed it with a polymer so it could be spread thinly across the device, and then removed the polymer by subjecting it to intense ultraviolet light.

John Reynolds, a former UF chemistry professor now at Georgia Tech who continues to collaborate on the project, said the cells are layered with different materials that function like an electron-transporting parfait, with each of the nano-thin layers working together synergistically to harvest the sun's energy with the highest efficiency.

Reynolds' UF chemistry research group developed an additional specialized polymer coating that overlays the zinc oxide polymer blend.

"That's where the real action is," he said. The polymer blend creates the charges, and the zinc oxide layer delivers electrons to the outer circuit more efficiently."

Reynolds was in an ongoing collaboration with So's materials science team, which they call "The SoRey Group." The most recent fruit of their collaboration will now go to Risø National Laboratory in Denmark, where researchers will replicate the materials and processes developed by the SoRey Group and test them in the roll-to-roll manufacturing process.

"This sort of thing can only happen when you have interdisciplinary groups like ours working together," said Reynolds.

Their work is funded by a grant from the Office of Naval Research.

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