Eating garbage: Bacteria for bioremediation

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(Phys.org) -- A 150-foot-high garbage dump in Colombia, South America, may have new life as a public park. Researchers at the University of Illinois have demonstrated that bacteria found in the dump can be used to neutralize the contaminants in the soil.

Jerry Sims, a U of I associate professor of crop sciences and USDA-Agricultural Research Service research leader and Andres Gomez, a graduate student from Medellín, Colombia, have been working on a landfill called "El Morro" in the Moravia Hill neighborhood of Medellín, which served as the city dump from 1972 to 1984. In that period, thousands of people came to the city from the rural areas to escape diverse social problems. There was no housing or employment for them, so they made a living picking up trash from this dump and built their homes upon it.

"There are some frightening pictures of this site on the Internet," said

Sims. "At one point, close to 50,000 people lived there. They grew vegetables on the contaminated soil and hand-pumped drinking water out of the garbage hill."

In recent years, the Colombian government decided to relocate the people to different neighborhoods with better conditions. Then they decided to see if it was possible to clean up the area and turn it into a park. Unfortunately, the most reliable solution -- digging up the garbage and treating it -- is not economically feasible in Colombia.

Another problem was that there were no records of exactly what was in the dump.

"Apparently, hydrocarbon compounds were one of the main sources of contamination," said Gomez. "Phenyls, chlorinated biphenyls, and all kinds of compounds that are sometimes very difficult to clean up."

Three professors from The National University of Colombia in Medellin -- Hernan Martinez, Gloria Cadavid-Restrepo and Claudia Moreno -- considered a microbial ecology approach. They designed an experiment to determine whether bioremediation, which uses biological agents such as bacteria or plants to remove or neutralize contaminants, could be used to clean the site.

Gomez, who was working on his master's thesis at the time, collaborated with them. He was charged with finding out if there were microorganisms living in the soil that could feed on the carbon in the most challenging contaminants.

This was not a trivial task. As Sims explained, "There are maybe 10,000 species of bacteria and a similar number of fungi in a gram of soil."

Gomez's work was further complicated by the fact that the material in the hill was loose and porous with air spaces and voids that resulted from dirt being thrown over layers of garbage. Because of the unusual physical structure and the contaminant levels, it was unclear if the indigenous bacterial community would be as complex, and thus as effective at bioremediation, as those normally found in soils.

Gomez analyzed bacteria at different depths in the hill down to 30 meters. He found microbial communities that appeared to have profiles typical of bacteria involved in bioremediation. The communities seemed to contain a robust set of many organisms that could be expected to weather environmental insults or manipulations.

Gomez then came to Sims's lab at the U of I on a grant from the American Society for Microbiology to perform stable isotope probing, a test to link diversity and function that he was not able to do in Colombia. Contaminants are labeled with a heavy isotope that serves as a tracer that can be detected in the end products of biodegradation.

His results confirmed that the bacterial communities had, in fact, been carrying out bioremediation functions. In collaboration with assistant professor of microbial ecology Tony Yannarell who assisted with the microbial diversity analysis, he determined that the organisms involved changed at every depth.

Based on these results, the Colombian government decided to go ahead with the bioremediation project using the indigenous organisms. One of the professors who worked on the pilot study is looking at ways to provide the microorganisms with extra nutrients to speed up the process. Another project takes a phytoremediation approach, which uses plants to absorb heavy metals.

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