Heavy Metals — How Plants can Help Make Stormwater Cleaner

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Margie Rycewicz-Borecki and Andrew Lewis prepare a soil sample at the bio-retention site constructed for stormwater quality research. The team is working to determine if plants can play a more active role in remediating heavy metal buildup in stormwater retention areas.

Professor Ryan Dupont, Ph.D., clips vegetation from a test bay at a stormwater research site. Dupont is overseeing a research study that could unveil new information about low-cost phytoremediation.

Student Darianne Willey, front, clips vegetation with Ph.D. candidate Margie Rycewicz-Borecki. The team is working to determine if plants can play a more active role in remediating heavy metal buildup in stormwater retention areas.

Thomas Nyanda records plant height at a stormwater test cell in Logan. He and his team are working to determine if plants can play a more active role in remediating heavy metal buildup in stormwater retention areas.

Ever wondered what happens to the surge of stormwater you see racing down your street or driveway?

In municipalities across the Western United States, precipitation is collected in urban centers by a network of roadside gutters and drains, channeled outside city boundaries and, in some cases, piped into irrigation canals or natural waterways. This system of collecting and piping surplus surface water from city streets has been standard practice for more than 100 years, but the method is under increasing scrutiny in light of emerging research that shows stormwater in urban areas carries with it various harmful pollutants into our downstream rivers and lakes.

Water quality experts have shown, for example, that stormwater conveys heavy metals and hazardous organics from roadways, parking lots and asphalt rooftops. It also carries suspended solids and nutrients, including phosphorous and nitrogen that accumulate downstream and negatively impact receiving waterways.

In recent years, researchers and environmental engineering experts at Utah State University have looked closely at the level of pollutants carried by stormwater and how simple changes in stormwater management in cities and towns across Utah could help alleviate the problem.

Margie Rycewicz-Borecki, a doctoral candidate in the Department of Civil and Environmental Engineering at USU, is approaching the issue with a unique perspective thanks to her green thumb and background in landscape architecture.

She and her adviser, Ryan Dupont, are wrapping up a long-term research study that could unveil valuable information about how vegetation can be used to more effectively remove heavy metals and other unwanted pollutants in stormwater.

“More and more, we’re realizing that stormwater pollution is a big deal,” she said. “This study looks at the importance of vegetation in improving stormwater quality. The questions we originally asked were ‘how does stormwater quality change with the presence of vegetation?’ and ‘how much does it change?’ We’ve seen that vegetation does positively improve stormwater quality. We now ask ‘does the species of plant make a difference and if so, how much?’”

To test their theory, she and her colleagues constructed a test site on the outskirts of Logan City. Storm runoff from a nearby subdivision is collected and channeled into a retention site that is divided into 24 cells. The treatment cells were planted with one of three species commonly found in stormwater bio-retention systems — cattail, sedge and sunflower.

It’s widely known the three plants do a good job at removing nutrients from soil. Some urban planners already use phytoremediation to reduce contamination in soil and ground water in areas where stormwater accumulates. What Rycewicz-Borecki wants to know is if the application of citric acid to the treatment cells stimulates the plants to take up more metal, thereby decreasing the buildup of metals in the soil.

Citric acid acts as a chelating agent, meaning it increases metal solubility and allows for more metal uptake in the plants. Unlike many widely studied synthetic chelators, such as EDTA, citric acid biodegrades quickly and does not persist in the environment, diminishing the potential for the chelated metals to leach into the groundwater.

After the treatment cells were planted, researchers went back twice a year to harvest the plant material and analyze it at the Utah Water Research Lab. Rycewicz-Borecki is concerned with the quantity of heavy metals the plants extract from the soil. If adding citric acid to the stormwater treatment areas increases metal uptake, and if she and her team can identify which plant species does the best job of removing particular constituents, bio-retention systems could function much more efficiently and at a lower cost than chemical or biological water treatment facilities.

Prior to the citric acid study, sunflower was found to be good at taking up zinc and copper; while sedges were found to be effective at taking up phosphorus and nitrogen.

Dupont says the results will demonstrate that using this enhanced method of phytoextraction can significantly increase heavy metal uptake into the plants, which can then be harvested and removed from the site.

“With the application of this low-tech, plant-based stormwater treatment approach,” he explained, “the surge of stormwater generated from storms in our urban environments can safely be released back to the environment free of hazardous metals and polluting nutrients, in a low-cost, environmentally