



Nevada Water News

Wastewater Reuse and Uptake of Emerging Contaminants by Plants

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As one of the driest states in the United States, finding ways to preserve and extend Nevada's limited water resources is vitally important for sustaining the region's growing population. Solley (1993) showed that agricultural irrigation accounts for up to 81 percent of daily freshwater usage. Because water used for agricultural irrigation

isn't required to comply with drinking water standards, using reclaimed water to irrigate crops could help conserve valuable drinking water resources.

However, there are concerns about using reclaimed water for irrigation, particularly for food crops because their uptake of contaminants isn't completely understood. "Municipal

RFPs

If you have questions about submitting a NWRRI proposal, e-mail Amy Russell (Amy.Russell@dri.edu).

For current RFP information, visit the NWRRI website (www.dri.edu/nwrri).



Spinach plants are being grown in greenhouses at UNLV and irrigated with reclaimed water to assess CEC uptake in leafy plants.

(Project Spotlight continued)

wastewater combined with storm water runoff can be a source of emerging pollutants such as pharmaceuticals and personal care products (PPCPs), especially in urban areas,” explains Dr. Kumud Acharya, the co-PI of this research project that also includes Dr. Daniel Gerrity of the University of Nevada, Las Vegas (UNLV). “It is common for sewage waste to have residues of prescription pharmaceuticals, antimicrobial products, and hormones and many existing wastewater treatment plants are not designed to remove trace concentrations of these chemicals.”

“Through this research, we hope to determine if plants have different capacities to uptake and accumulate CECs, and if accumulation varies within the different structures of the plants. We also hope to determine if the uptake of CECs by plants is a compound- and concentration-dependent process.”

– Kumud Acharya

In a study funded by the United States Department of Agriculture (USDA) National Institute of Food and Agriculture (NIFA), Wu et al. (2014) reported detection frequencies for 19 target contaminants of emerging concern (CECs) of 64 percent for vegetables irrigated with treated wastewater and 91 percent for vegetables irrigated with fortified water. “Because this is an emerging research field, more studies are needed to understand the uptake rates and pathways of CECs in food crops irrigated with reclaimed water,” Acharya says.

In order to fill this knowledge gap, the goal of this project is to evaluate the uptake and bioaccumulation of CECs in food crops. The researchers are growing both tomatoes and spinach in a climate-controlled greenhouse located on the UNLV campus, and the plants are being irrigated with both tap water and reclaimed water at different stages of treatment, which was obtained from the Clark County Water Reclamation District (CCWRD) in Las Vegas, Nevada. “We chose tomatoes and spinach as the food crops for the study because they



Tomato plants are also being grown to assess the uptake of CECs in fruit plants. The results will be compared with those obtained for the spinach plants.

encompass both leafy and fruit varieties of crops,” Acharya explains. “Tomatoes and spinach are also often consumed raw, which would increase potential human exposure to CECs.”

The data from this project will be combined with the data collected for the associated project “Plant Uptake of Contaminants of Emerging Concern in

(Project Spotlight continued)

Agroecosystems Irrigated with Reclaimed Water” being conducted for the USDA Agriculture and Food Research Initiative (AFRI), and then used to characterize the potential human exposure to chemical and microbiological contaminants through food crops irrigated with reclaimed water. Currently, the researchers are still in the process of collecting samples. Harshad Oswal, a PhD student at UNLV, is in charge of the project experiments, such as collecting wastewater, planting and harvesting the plants, and taking samples and analyzing the samples for CECs. Providing opportunities for students to expand their research skills is also an important aspect of the

projects supported by the NWRRI program. “Harshad is being trained and developing many new skills in researching emerging contaminants, which is a rapidly growing new research field,” Acharya says.

Once the plants are ready to be harvested, samples of the plants and soils will be collected and analyzed for the target CECs to evaluate potential human exposure. “Through this research, we hope to determine if plants have different capacities to uptake and accumulate CECs, and if accumulation varies within the different structures of the plants,” Acharya explains. “We also hope to determine if the uptake of CECs by plants is a compound- and concentration-

dependent process. For example, if uptake is a function of the CEC, the water source, or the pretreatment processes.” ■

References

- Wu, X.Q., J.L. Conkle, F. Ernst, and J. Gan, 2014. Treated Wastewater Irrigation: Uptake of Pharmaceutical and Personal Care Products by Common Vegetables under Field Conditions. *Environmental Science & Technology* 48, 11,286-11,293.
- Solley, W.B., 1993. Water-use Trends and Distribution in the United States, 1950-85. *HortScience* 28, 283-285.

Postdoc Interview: Zhufeng Fang

We asked postdoctoral fellow Dr. Zhufeng Fang about his current research and his continuing research plans. Here’s what he had to say:

1) What sparked your interest in water resources research?

I was born in northeast China, so growing up near the overwhelming beauty of the Changbai Mountains and the Amur River cultivated my obsession with nature. Over time, this obsession developed into an

impulse to understand the natural environment. And when I learned that many Chinese river and groundwater systems were contaminated, this impulse further prompted me to choose water science as my specialty.

2) What do you find most interesting about water resources research, particularly working in an arid/semiarid environment such as Nevada?

Working in an arid/semiarid region is amazing because

sources of water will appear seemingly from nowhere. I currently live near the Truckee River and walk by it every day on my way to and from work. Looking out at the river, I often think about how my work at DRI can contribute to making the river cleaner and healthier, which will allow more people to enjoy it as well.

3) What kinds of research are you currently working on and what have you learned

(Postdoc Interview continued)

so far from this research?

I'm currently working on modeling the transit time distribution of precipitation and snowmelt. The goal of this work is to understand the significance of seasonal snowmelt, as well as the precipitation types and intensities of a snow-dominated, alpine watershed. My previous research was on subsurface flow and groundwater research, so this ongoing surface hydrologic study is a new area of research for me.

So far, I have learned a lot about surface hydrology, such as how rain and snow are formed and how they enter the surface water system, how hydrochemicals with different ages partition and travel from the precipitation to the outflow, and how the different snowmelt rates before and during the spring snowmelt season control the dynamics of catchment storage, stream flow transit time distribution, and young water percentage in the outflow.

4) What do you hope to learn more about from the research you are doing?

I hope to learn more about snow hydrology, which it is very important for my current and future research projects at DRI. Although this area of research is still pretty new to me, I already find it very interesting and it's definitely worth learning so



that I can incorporate it into my expertise and research background.

5) Do you have a preference for lab work or fieldwork, and if so, why?

I started doing scientific research in the lab at Nanjing University back in 2005. I built a big glass box, filled it with fine sand, planted soybeans, designed a mini irrigating system, and set up high-density electrical resistivity tomography (ERT) monitoring system to simulate rainfall infiltration processes and investigate the effect of vegetation on the spatial and temporal distribution of soil water content. This early work taught me so

many things about hydrology and inspired me to pursue higher-level water research, so my answer at this point is definitely lab work. However, I will welcome any opportunity to work in the field because it is something new for me to explore.

6) What are some of your other research interests? Do you have any goals for incorporating those interests into your work as you continue in your career?

Mathematics is my top research interest besides hydrology and I have already incorporated a lot mathematics into my research, such as principal component analysis, wavelet coherence analysis, Bayesian updating, and

(Postdoc Interview continued)

the stochastic process. Because hydrologic research—especially the modeling work I am doing now—has a fairly close relationship with mathematics, there are plenty of opportunities for me explore this interest.

Another one of my research interests is botany, and I'm sure that I will be able to combine hydrology and botany in future research, such as exploring variations in root water uptake in desert and forest plants. I am also very interested in astronomy, so hopefully one day I can incorporate the Big Bang into my hydrologic research (just kidding!).

7) If you could go on vacation anywhere in the world, where would you want to go, why

would you want to go there, and what would you want to do there?

I have travelled to 41 countries and regions over the past twelve years, but there are still places I dream of visiting. Given this vacation, I would want to go to Greenland. I've wanted to explore the Arctic since childhood. Imagine being surrounded by giant icebergs, traveling or fishing by canoe, and watching polar bears and whales (as long as they don't make me their dinner) with a cup of hot coffee in your hand—what a wonderful vacation!

8) Coke or Pepsi?

Coke! ■

"I currently live near the Truckee River and walk by it every day on my way to and from work. Looking out at the river, I often think about how my work at DRI can contribute to making the river cleaner and healthier, which will allow more people to enjoy it as well."

— Zhufeng Fang

Upcoming Events

2018 Ocean Sciences Meeting
February 11-16, 2018
Portland, OR
osm.agu.org/2018/

2018 UNR/NWRA Dinner Forum
February 15, 2018
Reno, NV
www.nvwa.org/2018unr-nwradinnerforum

Groundwater Issues and Science Affecting Policy and Management in the Southwest
February 26-27, 2018
Albuquerque, New Mexico
www.ngwa.org/Events-Education/conferences/Pages/5034feb18.aspx

NWRA 2018 Annual Conference
February 26-March 1, 2018
www.nvwa.org/2018-annual-conference-week

2018 NGWA Groundwater Fly-in and Water Resources Congressional Summit
March 6-7, 2018
Washington, D.C.
www.ngwa.org/Events-Education/conferences/Pages/5090mar18.aspx

2018 Lower Colorado River Science Symposium
March 8, 2018,
Southern Nevada Water Authority, Molasky Building
100 N. City Parkway, Las Vegas, NV 89106
Contact: todd.tietjen@snwa.com

2018 AWRA Spring Specialty Conference: GIS & Water Resources X
April 22-25, 2018
Orlando, FL
www.awra.org/meetings/Orlando2018/index.html

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Events Continued

2018 GSA Combined Cordilleran
& Rocky Mountain Meeting
May 14-17, 2018
Flagstaff, AZ
[www.geosociety.org/GSA/Events/
Section_Meetings/GSA/Sections/
rm/2018mtg/home.aspx](http://www.geosociety.org/GSA/Events/Section_Meetings/GSA/Sections/rm/2018mtg/home.aspx)

North American Forest Soils
Conference: International Symposium
on Forest Soils
June 10-16, 2018
Quebec City, Quebec, Canada
[www.cef-cfr.ca/index.php?
n=Colloque.NAFSC-ISFS2018](http://www.cef-cfr.ca/index.php?n=Colloque.NAFSC-ISFS2018)

Water Rights in Nevada Class
June 11, 2018
Reno, NV
www.nvwra.org/2018-june-water-rights

Aquifer Testing Workshop
June 11, 2018
Reno, NV
www.nvwra.org/2018-june-aquifer-testing-workshop

Advanced Water Rights in Nevada Class
June 12, 2018
Reno, NV
www.nvwra.org/2018-june-advanced-water-rights

Nevada Well Drilling Regulations & Forms Class and
Water Well Drilling Exam Tutorial
June 12, 2018
Reno, NV
www.nvwra.org/2018june-wellregs

The New MODFLOW Course: Theory and Hands-on
Applications
June 19-22, 2018
Las Vegas, Nevada
[www.ngwa.org/Events-Education/shortcourses/
Pages/258jun18.aspx](http://www.ngwa.org/Events-Education/shortcourses/Pages/258jun18.aspx)

AWRA Summer Conference: The Science,
Management, and Governance of Transboundary
Groundwater
July 9-11, 2018
Fort Worth, TX
www.awra.org/meetings/FortWorth2018/index.html

AGU Chapman Conference: Hydrologic Research in the
Congo Basin
September 25-27, 2018
Washington, D.C.
chapman.agu.org/congo-hydrologic-research/



2018 ASA and CSSA Meeting: Enhancing Productivity in
a Changing Climate
November 4-7, 2018
Baltimore, MD
www.acsmeetings.org/

2018 GSA Annual Meeting
November 4-7, 2018
Indianapolis, Indiana
[www.geosociety.org/GSA/Events/Annual_Meeting/
GSA/Events/rsa2018.aspx](http://www.geosociety.org/GSA/Events/Annual_Meeting/GSA/Events/rsa2018.aspx)

2018 AWRA Annual Conference
November 4-8, 2018
Baltimore, MD
www.awra.org/meetings/Baltimore2018/index.html

2018 Fall Meeting
December 10-14, 2018
Washington, D.C.
fallmeeting.agu.org/2017/

2018-2019 SSSA International Soils Meeting: Soils
Across Latitudes
January 6-9, 2019
San Diego, CA
www.sacmeetings.org/

NWRRI - Desert Research Institute

Success and the dedication to quality research have established the Division of Hydrologic Sciences (DHS) as the Nevada Water Resources Research Institute (NWRRI) under the Water Resources Research Act of 1984 (as amended). As the NWRRI, the continuing goals of DHS are to develop the water sciences knowledge and expertise that support Nevada's water needs, encourage our nation to manage water more responsibly, and train students to become productive professionals.

Desert Research Institute, the nonprofit research campus of the Nevada System of Higher Education, strives to be the world leader in environmental sciences through the application of knowledge and technologies to improve people's lives throughout Nevada and the world.



www.dri.edu/nwrri

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Banner photo: Winter scene with snow in Red Rock Canyon National Conservation Area by Caleb Steele <https://unsplash.com/photos/PTsDbfXgpxc>, CC0, <https://commons.wikimedia.org/w/index.php?curid=61894887>

Events list, page 6: Lake Tahoe winter scene by Samir Mahendra from San Francisco, USA - Flickr, CC BY 2.0, <https://commons.wikimedia.org/w/index.php?curid=1084962>

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