WASTEWATER REUSE AND UPTAKE OF EMERGING CONTAMINANTS BY PLANTS

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Statement of Regional or State Water Problem
Municipal wastewater and storm water runoff are major sources of emerging contaminants, including steroidal hormones and pharmaceutical and personal care products (PPCPs). However, conventional wastewater treatment plants are not designed to remove these organic compounds completely. Therefore, they are frequently detected at low levels (parts per billion to parts per trillion) in wastewater effluents. In the United States, agricultural irrigation accounts for up to 81 percent of daily freshwater usage (Solley, 1993). Because agricultural and landscape irrigation do not require compliance with drinking water standards, using treated wastewater (i.e., reclaimed water) for these purposes has become an attractive option for conserving and extending available water supplies. However, the uptake and bioaccumulation of emerging contaminants from reusing wastewater effluents in agriculture are relatively unknown. This project will address this knowledge gap by characterizing the potential human exposure to chemical and microbiological contaminants of emerging concern (CECs) through food crops irrigated with reclaimed water.

The scope of the proposed work will focus on understanding the uptake rates and pathways of trace organic chemicals by various plants irrigated using wastewater effluents. The study will include conducting laboratory experiments in greenhouse chambers combined with trace-level analytical methods. The objective of this research is to evaluate the transport, persistence, and accumulation of CECs in edible plants irrigated with reclaimed water.

Research Questions:
1. Do plants have different capacities to uptake and accumulate CECs, and does this accumulation vary within different structures of the plants?
2. Is plant uptake of CECs a compound- and concentration-dependent process (e.g., as a function of the CEC and water source/pretreatment)?

Methods, Procedures, and Facilities
Preliminary plant uptake experiments will be conducted in a climate-controlled greenhouse located on the UNLV campus. Experiments will be performed with two food crops: tomatoes and spinach. These species were selected because they are similar to those currently grown in the western United States using reclaimed water (e.g., Sea Mist Farms in California). These plants also encompass leafy and fruit varieties that may behave differently in terms of chemical uptake. The plants will be irrigated with tap water and reclaimed water obtained from the Clark County Water Reclamation District (CCWRD) in Las Vegas, Nevada, at several treatment stages. After harvesting the plants, soil samples will be collected from pots irrigated with each of the experimental water matrices. The soil samples will be extracted and analyzed for the target CECs. Soil retention will be quantified and compared as a function of plant species, irrigation
strategy, and water matrix. This information is critical to understanding fate and transport of CECs in agricultural fields irrigated with reclaimed water.

The project will train and partially support one PhD student and serve as the primary topic of the student’s thesis. The nature of this project will ensure that the student is thoroughly trained in state-of-the-art laboratory and field sampling techniques related to environmental chemistry and ecological toxicity studies, which will provide the student with valuable skills for a rapidly emerging field. The results of this study will be presented at the quarterly meetings of Lake Mead Ecosystem Monitoring Workgroup, which will be attended by all the local and state agencies in southern Nevada.