Executive Summary

WERF

Using household graywater to irrigate landscape plants

Long-Term Study on Landscape Irrigation Using Household Graywater – Experimental Study (06CTS1CO)

The Central Issue

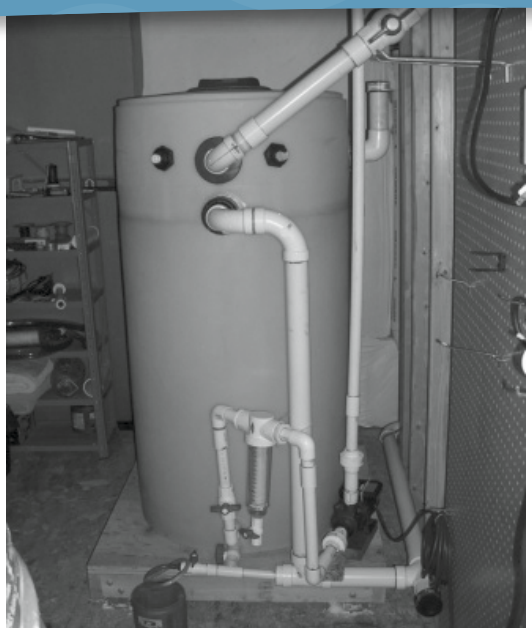
As water supply becomes more limited, there is a growing interest for innovative approaches to water resources sustainability. One approach that is gaining popularity is household graywater reuse for residential landscape irrigation. Graywater irrigation systems offer many benefits, however the use of such systems has not become widespread due to concerns about health and environmental issues. While some states have begun to legalize and regulate the practice of graywater reuse for residential landscape irrigation, little guidance based on scientific data has been provided for the sound operation of graywater irrigation systems. Limited scientific data is available on the fate of graywater chemical and microbiological constituents and the potential effect of these constituents on plant health after graywater is applied. As more households turn to graywater for their irrigation needs, it is important to understand what compounds are in graywater, what happens to them in the environment, and what potential impacts graywater may have on soil quality, groundwater quality, and plant and human health.

Context and Background

The study evaluated both existing and new household graywater irrigation systems in four different states. Experimental studies were conducted in three parts: field studies on existing household systems, field studies on new household systems, and greenhouse studies. For the existing household systems, four households were selected in the southwestern U.S. where graywater was applied for more than five years. For the new household systems, graywater irrigation systems were installed at three households in AZ, CA, and CO. In all household studies, soil samples were taken and plant tissue analysis was conducted. In addition to the field studies, a greenhouse experiment was conducted to evaluate the impact on plants and monitor leachate from graywater irrigated soils.

Findings and Conclusions

Among the results, the research team found that most landscape plants are as healthy under long-term graywater irrigation compared to freshwater irrigation. Only three salt-sensitive tree species (avocado, lemon, and scotch pine) out of 22 plant species investigated showed negative responses to long-term graywater irrigation. Negative responses included reduced growth, leaf burning, or a small reduction in fruit production under long-term graywater irrigation.



Graywater storage tank in an existing system at a household in Fort Collins, CO. (Photo by J. Bergdolt)

While soil irrigated with graywater showed increased levels of surfactants (surface active agents), antimicrobials, and sodium compared to those irrigated with freshwater, the sodium increase after five or more years was not high enough in any of the sampling locations to raise concern about soil quality or plant health. There is potential for salts, including nitrogen and boron, to leach through soil when graywater is applied for irrigation.

No major concerns were identified in this study that would render reuse of graywater following best management practices unfit for growing landscape plants. Results from a greenhouse study showed that nitrogen present in graywater was beneficial for plant growth. It is possible that fertilizer addition can be reduced or eliminated where graywater is applied for irrigation.

Management and Policy Implications

The quantitative data collected during these experiments provides useful information to decision makers, water agencies, regulators, product manufacturers, and consumers considering graywater irrigation systems for household irrigation. For example, although there are no documented instances of disease arising from graywater exposure, graywater contains microbial concentrations far in excess of levels established in standards for recycled irrigation, drinking, and bathing. Human contact with graywater should be avoided. Graywater should be applied through drip irrigation with a protective layer of mulch above emitters. In some states, subsurface irrigation systems are required. Governance and regulation of domestic graywater use for landscape irrigation will continue to evolve and be better informed as research unveils the actual risks and benefits. The information contained in this study helps to inform lawmakers and regulators on how to govern this evolving practice.

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Related WERF Research

Project Title	Research Focus
Long-Term Effects of Landscape Irrigation Using Household Graywater: Literature Review and Synthesis (03CTS18CO)	Provides a comprehensive literature review and synthesis of the current state of the knowledge on graywater reuse for landscape irrigation at the household level. Identifies information gaps for future research on the long-term use of graywater for irrigation of residential landscapes, particularly as it relates to human health, landscape plants, and/or the environment.
Guidance Manual for Separation of Graywater from Blackwater for Graywater Reuse (INFR4SG09a)	Provides guidance on the appropriateness of graywater reuse for home and business owners and discusses the technologies and equipment necessary for graywater reuse systems, known maintenance, and best management practices to ensure safe reuse of graywater. Presents guidance on the steps necessary to determine whether a graywater reuse system is applicable to an individual's situation and discusses reuse goals, including methods for calculating the amount of graywater that is generated from a home or office. Includes information on source separation, plumbing, storage, equipment, irrigation, and toilet reuse applications.
Source Separation and Treatment of Anthropogenic Urine (INFR4SG09b)	Investigates the global status of urine source separation and treatment technologies and presents ideas for further research. Provides a thorough assessment of urine diversion technology, treatment options, and pilot projects to date and proposes further development of the urine diversion concept in industrialized countries. Includes a summary of pilot projects conducted in urine diversion and details of each project (number of users, treatment system employed, etc.), as well as a summary of feedback (social, technical, economic, etc.).
Development of the Integrated Urban Water Management Tool (INFR4SG09c)	The Integrated Urban Water Management Tool (IUWM) is a mass balance model that provides a tool for water managers to forecast water demand, waste, and associated costs for different water management scenarios. Here, integrated urban water management is defined as a holistic approach to urban water management whereby water, wastewater, and stormwater management are considered together rather than optimizing each separately. The practices included in IUWM are indoor conservation, irrigation conservation, graywater reuse for flushing and irrigation, wastewater treatment plant effluent reuse for irrigation, stormwater capture, and reuse for irrigation. A report serves as a user's manual for the IUWM tool.

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