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Project Number
S2211

Project Title
The Effect of Soap Nut Grey Water on the Environment: Vegetables (Year 3)

Abstract

Objectives/Goals
As many parts of the world are facing water scarcity there is a growing interest in reusing greywater. However, many commercial laundry detergents contain chemicals harmful to soil, plants and aquatic life. I tested if the greywater from soap nuts, a natural berry shell, could be used as irrigation water for vegetables without leading to contamination with bacterial pathogens or excessive nutrients.

Methods/Materials
To conduct my experiment I grew three types of plants (tomato, chard, spinach) in two types of soil (sandy & sandy loam) for a total of 6 weeks. I had 3 replicates for each greywater treatment(soapnut(SN), organic detergent(OD), non-organic detergent(ND) and a soapnut-tea -tree-oil(SNO) combination). I measured the abundance of Escherichia coli and Fecal coliforms (FDA produce safety marker) on the outside and inside of the plant as well as in the soil using 3M Petrifilms or Chromagar ECC (1400+ samples). This experiment was repeated twice. Overtime analysis was performed on spinach in sandy soil by inoculating with 10 power 6 E.coli K12 at the beginning of the experiment. Bacterial counts were taken everyday for a week followed by weekly measurements for 4 weeks. In all the above cases, the level of soil and plant nutrients were measured and the data was analyzed with ANOVAs ($p < 0.05$) followed by post-hoc tests.

Results
I found that soapnut greywater was not detrimental with a trend for higher plant growth and biomass than other greywaters. Even with the addition of E.Coli, bacterial counts declined and became undetected after 2-3 weeks, both in the soil and the plant resulting in no E.coli and very low levels of fecal coliforms at the end of the experiment across all grey waters. This indicates that grey water type does not have an effect on the bacterial content of plants tested except soapnut-tea-tree-oil where the levels declined quickly but caused plant death. I also found that plants watered with non-organic detergent died due to high levels of Boron and soluble salts leading to toxicity issues.

Conclusions/Discussion
After the three year study, I now conclude that soapnut greywater does not significantly affect the environment, and can be used for irrigating landscapes and vegetables. In addition, Soap nuts are affordable and cheaper than organic laundry detergents which makes them an ideal solution in drought stricken areas of the world including California and Cape Town.

Summary Statement
Grey water from soapnuts, a berry shell that produces soap, can be used for irrigating lawns and vegetables without leading to bacterial contamination and toxicity issues.

Help Received
I designed and conducted the experiments by myself using equipment from U.C. Berkeley, U.C. Davis and a community lab. Dr. Celine Pallud and Dr. Eric Espinosa helped answer my questions.