Investigating Environmental and Health Risks of Greywater use in New Zealand

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Abstract

Many countries, including New Zealand, are investigating alternative water management practices to address increasing demands on freshwater supply. One such practice is the diversion and reuse of household greywater for irrigation. Greywater is a complex mixture containing contaminants such as microbes and household chemicals. These contaminants may present an environmental and public health risk, but this has never been characterised in a New Zealand context.

This thesis aims to reduce this knowledge gap by characterising the fate and effects of a representative chemical contaminant, the antimicrobial triclosan (TCS); and the microbial indicator, *E. coli*, in three soils. It also investigated public attitude towards the fate of household products in the environment.

In Chapter 4, microbial biomass was used to determine an EC_{50} for TCS in one soil type (silty clay loam: EC_{50} = 803 ppm). This determined the loading rate of TCS for the lysimeter study in Chapter 5, where triplicate cores of 3 soil types were irrigated with greywater treatments (good/bad quality) or a freshwater control. Leachate samples throughout the study and soil samples from three horizons at the end of three months irrigation were analysed for TCS and *E. coli.* The results indicate that regardless of soil type, *E. coli* and TCS leached from the lysimeters posing a risk for groundwater contamination. *Escherichia coli* levels in the leachate were as high as 4.71 x 10^6 CFU/100ml for the GQGW treatments (Lincoln soil) and 6.97 x 10^7CFU/100ml in the BQGW treatment (Gisborne soil). Triclosan concentrations between 0.03ppb and 3.17ppb were measured in the leachate from the GQGW treatment and 0.03ppb - 42.3ppb for the 10ppm TCS treatments. Soils with high clay content had even larger potential for leaching through preferential flow as the average levels of *E. coli* found in the leachate from the BQGWD were at least on log_{10} lower than the average found in the BQGW leachate (Gisborne & Katikati). In contrast the levels of *E. coli* detected in the Lincoln soil were similar for both treatments. The effects of TCS on soil health parameters in the top horizon were also investigated, but were not found to be significant at concentrations used in this study.

To address the source of greywater contamination, i.e. use of household products, I engaged with school children to investigate if awareness of household-contaminants will support behaviour change with respect to what products are used (Chapter 6). With my scientific guidance, the children successfully designed and implemented a greywater experiment and presented their results at a local hui.

The results from this study provide New Zealand specific, scientifically-robust information on potential environmental and public health risks associated with domestic greywater reuse for soil irrigation.

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