Rain Barrels Part IV: Testing and Applying Harvested Water to Irrigate a Vegetable Garden

Fact Sheet FS1218



Cooperative Extension

Michele Bakacs, Environmental and Resource Management Agent
Mike Haberland, Environmental and Resource Management Agent
Steve Yergeau, Senior Program Coordinator, Rutgers Cooperative Extension Water Resources Program

Summer months are the time of year when having a rain barrel can really be useful. Heavy thunderstorms fill up rain barrels quickly, storing water for hot, dry days when there is no rain in sight. Rain barrel water is usually soft, meaning free of dissolved minerals and slightly acidic which is excellent for nutrient uptake by plants.

One of the most common questions asked about rain barrels is whether water harvested from a rooftop is safe to use on a vegetable/herb garden. Limited studies have been conducted focusing on the safety of roof runoff for vegetable garden irrigation. Gardeners often collect water in a rain barrel with little to no protection from the roof's "first flush" of runoff. The first flush water is the initial rainwater that drains off an impervious surface, such as a driveway, parking lot, or roof and has been shown to have the highest levels of contaminants. Larger rain water collection systems (cisterns) that collect hundreds or thousands of gallons of water are normally installed with a first flush diverter which reroutes the first few gallons of rainwater away from the storage container. Rain barrels are often not installed with this feature.

Research has shown that roof runoff can have high levels of pathogens, zinc (Zn), lead (Pb), and polycyclic aromatic hydrocarbons (PAHs) (Bannerman et al., 1993; Clark et al., 2008; DeBusk, 2009; Van Metre and Mahler, 2003; Gikas et al., 2012). These metals and compounds may be hazardous to human health if ingested in specific concentrations. The question is whether these levels are high enough to be of concern for a backyard or community gardener who uses a rain barrel to water a garden grown for consumption.

This fact sheet summarizes the findings of one New Jersey study investigating the water quality of rain barrel water (Haberland, Bakacs & Yergeau, 2013). In addition, recommendations are made for testing rain barrel water and how to safely utilize rain barrel water to irrigate a home, community, or school garden.

Water Quality Study

Twelve rain barrels were installed during the summer of 2011 on homes that have asphalt shingled roofs, the dominant roof surface on New Jersey houses. Six barrels were located in a suburban community and six in an urban community to help determine the effect of surrounding land use on rain barrel water quality. Samples were collected six times from each barrel over a four month period from July-October. Water samples were collected 3–7 days after a rain event in order to mimic the amount of time a homeowner or community gardener would wait before using the collected runoff. Samples were analyzed for PAHs, Pb, Zn, and total coliform and *Escherichia coli* (*E. coli*) bacteria. *E. coli* is a species of bacteria that is specific to fecal matter from warm-blooded animals such as squirrels and birds. The presence of *E. coli* indicates the potential presence of human pathogens, i.e. bacteria, and is important

RUTGERS
New Jersey Agricultural Experiment Station

Rutgers, The State University of New Jersey
88 Lipman Drive, New Brunswick, NJ 08901-8525
Phone: 848.932.5000

information if rain barrel water is used to water a vegetable garden.

Having a standard against which to compare the level of contaminants in the roof runoff is important for determining the safety of the water for irrigation. Table 1 shows the water quality standards against which the data were compared. Both Pb and Zn were compared to the United States Environmental Protection Agency (USEPA) reclaimed water (treated waste water) guidelines (USEPA, 2012) for agriculture irrigation because no other irrigation standards exist for these parameters. No irrigation standards exist for total coliform. *E. coli* results were compared to the US Food and Drug Administration's (USFDA) proposed standards for "Growing, Harvesting, Packing and Holding of Produce for Human Consumption" (USFDA, 2011).

Results were also compared to the New Jersey Drinking Water Standards although in New Jersey harvested rainwater can not normally be used as a source of drinking water per the Safe Drinking Water Act (NJDEP, 2011).

Table 1: Water quality standards for comparing test results

Parameter	Federal Irrigation Standards	NJDEP Drinking Water Standards[1]
Lead	5.0 mg/L[2]	0.015 mg/L
Zinc	2.0 mg/L[2]	5.0 mg/L
Total coliform (counts/100 mL)	n/a	based on presence/ absence
E.coli (counts/100 mL)	geometric mean= 126/100 mL[3] single sample limit= 235/100 mL[3]	based on presence/ absence

[1]USEPA, 2012
[2]USFDA, 2011. The standard calls for maximum E. coli levels in agriculture irrigation water of <126 counts/100 ml for the geometric mean (must have 5 samples) and <235 counts/100ml for one sample.
[3]NJDEP, 2011. Coliform bacteria standards are based on the presence or absence of coliforms in a sample. When collecting less then 40/samples per month, no more than one coliform sample can be positive.
mg= milligrams, L= liters, mL= milliliters

Results

Results of this study showed that overall the water quality of the rain barrel water was very good. Heavy metals were well below federal irrigation standards for reclaimed water and posed minimal risk for irrigating a vegetable garden. PAHs were not detected in any samples. Results also showed the majority of water samples to be below recommended irrigation guidelines for *E. coli*. Table 2 shows the percent of samples that violated the federal irrigation standard and the New Jersey drinking water standards.

Table 2: Percent of samples above the standard

Contaminant (total # of samples)	Federal Irrigation Standards	NJ Drinking Water Standards[1]
Lead (72)	0%[2]	4%
Zinc (72)	0%[2]	0%
Total coliform (71)	n/a	Present in 100% of samples
E.coli (47)	9% (single sample limit only)[3]	Present in 66% of samples

[1]USEPA, 2012
[2]USFDA, 2011
[3]NJDEP, 2011

- Zn values did not violate any of the water quality standards although Zn levels were higher in samples taken from urban barrels than the suburban barrels. Atmospheric Zn can come from tire dust and industrial processes (Councell, 2004). Both increased traffic and industrial processes involving metals may be the reason Zn was higher in urban samples.
- Pb values did not violate the irrigation standards at any site. Three of the samples violated the drinking water standard for Pb. The main source of Pb is most likely from atmospheric deposition due to industrial processes, manufacturing industries, waste incineration, and airborne soil dust (USEPA, 2006a). Pb results showed no difference between urban and suburban land uses.
- Total coliform violated the drinking water quality standards at all sites for all samples. This is not necessarily a concern for irrigating vegetable gardens though because total coliform is found in rainwater and is a poor indicator of human pathogens.
- *E. coli* violated the irrigation standards in 9% of the samples collected. *E. coli* violated state drinking water standards in 66% of the samples collected.

In this study, potential sources of pathogens were wildlife (i.e. birds, squirrels) that had access to the roofs that were monitored or living in trees adjacent to the homes.

Best Practices and Recommendations

Even though a low percentage of samples exceeded the irrigation limits, caution is still warranted when using harvested water to water a vegetable/herb garden to reduce the risk of exposure to a harmful contaminant like *E. coli*. Below is a list of recommendations for pathogen treatment and best practices for utilizing collected rain water to irrigate vegetable/herb gardens.

- Rain barrel users should make sure to clean the barrel with a 3% bleach solution before collecting water to irrigate a vegetable/herb garden. Household, unscented bleach with a 5–6% chlorine solution can be added at the rate of 1/8 teaspoon (8 drops) of bleach per gallon of water. A typical 55 gallon rain barrel would need approximately one ounce of bleach added on a monthly basis. During periods of frequent rainfall, bimonthly treatment may be necessary. Wait approximately 24 hours after the addition of bleach to allow the chlorine to dissipate before using the water. Note that household bleach is not labeled for use in water treatment by the Food and Drug Administration although it is frequently recommended for emergency disinfection of drinking water (USEPA, 2006b).
- When using harvested water to irrigate a vegetable garden, care should be taken to avoid getting water on the plant itself. Harvested rainwater should only be applied to the soil, possibly through drip irrigation. A watering can may be used, as long as the water does not get directly on the plant.
- Water should be applied in the morning only. Produce harvesting should not take place right after watering in order to benefit from leaf drying and ultraviolet light disinfection.

Testing Harvested Rainwater

Guidelines on using harvested water often recommend having the water tested by a commercial lab to determine the safety of using the water on an edible garden. The results of this study show that testing harvested water at the necessary frequency needed to draw meaningful conclusions about the water quality is impractical and too expensive for the average homeowner, community, or school garden. Rather, it is recommended that the rain barrel user automatically treat the water, and take appropriate best practices, if it will be used to irrigate a vegetable/herb garden.

However, testing may be necessary to comply with state or federal guidelines. For example, school or community gardens may have to test water sources used for irrigation to show that the produce is safe for student consumption. The National Food Service Management Institute recommends testing non-municipal water sources for a school garden annually (NFSMI, 2011). The following steps should be followed for having the water tested.

- At a minimum, *E. coli* testing should be conducted. Local county health departments may perform this type of service for residents or may have a list of water quality laboratories that test for *E. coli*. The NJDEP lists water quality labs on their website by county at nj.gov/dep/oqa/certlabs.htm. In addition, it may be possible to have the water tested through a local well water testing program. It should be made clear to the laboratory that the water is utilized for irrigation purposes and not for drinking water.
- Most laboratories provide sampling bottles. The water sample should be taken from the rain barrel's faucet or hose and not dipped into the top of the barrel.
- Pathogen samples must be kept in a cooler in ice and returned to the laboratory within six hours of taking the sample.
- Results can be compared to the irrigation standards for *E. coli* listed in Table 1. For individual samples, if *E. coli* values are under 235 counts/100ml then the water would be safe to use for irrigation.

Conclusions

Based on study results, rain barrel water can be safely utilized to irrigate a vegetable/herb garden. Pathogen treatment should be conducted and best practices utilized when applying the water. Testing rain barrel water is not a practical method for the average homeowner or community/school garden for determining water quality but may be necessary based on state guidelines. Additional information on water quality considerations for harvested rain water can be found in Mangiafico and Obropta (2011).

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Rutgers, The State University of New Jersey
88 Lipman Drive, New Brunswick, NJ 08901-8525
Phone: 848.932.5000