Effectiveness of Treatments to Reduce Mosquito Larvae in Rain Barrels

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Objective

Stormwater management practices that involve the collection of rainwater, such as rain barrels, have the potential to provide habitats for mosquito breeding (Kwan et al. 2008, Metzger et al. 2008, Taguchi et al. 2020, Brown et al. 2022). To deter mosquito breeding in rain barrels, several recommendations are made available through Rutgers Cooperative Extension publications (Rector et al. 2014). These recommendations include screening all openings, use of *Bacillus thuringiensis israelensis* (BTI) larvicides (a.k.a., Mosquito Dunks®), and creating a surface barrier of oil or soap. However, the relative success of these practices for rain barrels at the homeowner scale is currently unknown. This study was developed to close this knowledge gap. Since many homeowners may be reluctant to use rain barrels because of the potential for increasing mosquito populations, having science-based information on how to effectively reduce mosquito breeding habitats would allow for wider adoption of rain barrels as a practice and more water being conserved for the future.

Methods

- Sampling was conducted using 19.1 L buckets as simulated rain barrels filled with 3.8 L of water.
- Four mosquito reduction treatment options were examined to determine their effectiveness in preventing mosquito breeding populations in rain barrels: 1) screening; 2) addition of a Mosquito Dunk®; 3) surface barrier of oil; and 4) surface barrier with soap. A 45 cm by 45 cm square of window screen was attached to bucket 1, one half of a Mosquito Dunk® was placed in bucket 2, 250 mL of vegetable oil was added to bucket 3, and 250 mL of liquid hand soap was added to bucket 4. A fifth bucket was filled with water and received no treatment to be used as a control.
- Each treatment was repeated three times during each round of sampling for a total of 15 samples per trial.
- The buckets were placed in a lightly wooded area adjacent to a building and/or other structures, such as sheds (Figure 1). Each set of buckets was left out for approximately 20 days to ensure that sufficient time was allowed for egg deposition, development, and hatching. During each round of sampling, the containers were visually inspected daily for larvae development.
- After the sample period, water from each bucket was screened through a 150 µm sieve. These were then transferred from the sieve to a 1 L container, with tap water, for transport to the Ocean County Mosquito Commission laboratory in Barnegat, NJ for identification and enumeration of larvae.

Figure 1: View of the experimental setup showing one set of the buckets after sample initiation.

Results

Table 1: Summary of results from 2021 – 2023 sampling period.

YEAR	NUMBER OF SAMPLING ROUNDS	NUMBER OF SAMPLES	NUMBER OF LARVAE COLLECTED BY TREATMENT TYPE				
			CONTROL	MOSQUITO DUNK®	OIL	SCREEN	SOAP
2021	4	23	374	2	0	1	2
2022	6	90	959	0	0	0	2
2023	4	60	587	0	0	0	0
TOTAL	14	173	1,920	2	0	1	4

Table 2: Percent (%) reduction in larvae (in relation to the control) for each treatment method.

SAMPLE	TOTAL NUMBER OF LARVAE	% REDUCTION IN LARVAE
Control	1,920	--
Mosquito Dunk®	2	99.9%
Oil	0	100.0%
Screen	1	99.9%
Soap	4	99.8%

Conclusions

- The results indicate all the methods examined (Mosquito Dunks®, screening, or a barrier of soap or oil) are effective at reducing the likelihood of mosquito larvae growing in rain barrels that use them by at least 99% (Table 2). A one-way ANOVA found that there were significant differences between the different treatments and the control (no treatment) during this study ($F(4, 69) = 11.76$, $p = <0.001$), but no statistical difference between each of the treatments.
- While the reduction in mosquito larvae was quantified for each practice, there are some practical outcomes that need to be noted that would affect homeowners' choice of practice for their rain barrel. For example, the buckets with the oil added to them began to smell due to the summer heat causing the oil to go rancid, the Mosquito Dunks® broke apart leaving debris in the bucket from the filler/media used to contain the BTI bacteria, and the screened bucket not only kept mosquito breeding to a minimum but also prevented debris such as leaves and twigs from entering the simulated barrels. When recommending these options, these noted effects should be mentioned to homeowners.
- The American Mosquito Control Association (AMCA) recommends the use of screening and larvicides, such as Mosquito Dunks®, only (AMCA, 2021).

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