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Source: Journal of the American Mosquito Control Association, 30(1):68-70.
Published By: The American Mosquito Control Association
DOI: http://dx.doi.org/10.2987/13-6355.1
URL: http://www.bioone.org/doi/full/10.2987/13-6355.1

Journal of the American Mosquito Control Association, 30(1):68–70, 2014

OPERATIONAL NOTE

A COMPARISON OF FOURSTAR™ BRIQUETS AND NATULAR™ XRT TABLETS IN A NORTH SHORE SUBURB OF CHICAGO, IL

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ABSTRACT. Stormwater catch basins are the primary source of mosquitoes targeted by the North Shore Mosquito Abatement District, in the northern suburbs of Chicago. Over a 17-wk period (June to September 2011), 3 clusters of catch basins located within a 0.7-km^2 area were monitored weekly with dipper samples of immature mosquitoes. During the 2nd week of monitoring, Natular™ XRT tablets (6.25% spinosad) were applied to northernmost cluster and FourStar™ Briquets (6% *Bacillus sphaericus*, 1% *Bacillus thuringiensis israelensis*) were applied to the southernmost cluster; the remaining middle cluster was kept untreated. Following 15 wk of monitoring in 20 basins in each cluster, both Natular and FourStar reduced immature numbers in treated catch basins for 8 consecutive weeks. These results suggest, if effectively timed, a single application of either larvicide may last an entire season.

KEY WORDS Spinosad, *Bacillus*, larvicide, catch basin, mosquitoes

For over a century, stormwater structures, including storm drains and catch basins, have been targeted by mosquito control agencies to minimize the spread of mosquitoes and their associated diseases (Munstermann and Craig 1977, Harbison et al. 2010, Harbison and Metzger 2010). Today, larviciding stormwater catch basins contributes the bulk of mosquito control and West Nile virus (WNV) prevention programs (Harbison et al. 2013). As such, there is a need to find larvicides that are both effective and economical for these programs. In 2012, the North Shore Mosquito Abatement District (NSMAD) treated the majority of the catch basins within its service area with Natular™ XRT (Clarke Mosquito Control Products, Inc., Roselle, IL), a tablet formulation of 6.25% spinosad. Based on previous efficacy studies, results suggest that the larvicide may reduce immature mosquitoes from 5 to 14 wk (Anderson et al. 2011, Harbison et al. 2013). To expand the number of effective catch basin larvicides that could be utilized by NSMAD, FourStar™ Briquets (FourStar Microbial Products LLC, Sag Harbor, NY), a 180-day briquet formulation (6% *Bacillus sphaericus* Neide and 1% *Bacillus thuringiensis israelensis* de Barjac) were evaluated as an alternative to Natular XRT tablets.

For the purpose of this study, 3 clusters of 20 catch basins were selected for 17-wk monitoring, using the standard mosquito dipper for immature sampling. The 3 equally sized contiguous treatment zones (approximately 0.21 km^2 [0.08 mi^2] each), were located within an experimental study area (approximately 0.7 km^2) near the center of the NSMAD service area. This is similar in design and location to Harbison et al. (2013). During the 2nd week of monitoring all catch basins and belowground vaults in the northernmost (n = 106) and southernmost zones (n = 119) received a single application at label rate of Natular XRT and FourStar, respectively. All catch basins and belowground vaults in the middle zone (n = 92) were left untreated. During 12 of the weekly monitoring events, between 1 and 15 larvae from at least 1 to 3 basins in each zone were collected and identified to species. Additionally, average weekly dipper samples from clusters were compared to average weekly catches from a nearby gravid trap (Model 1712; John W. Hock Company, Gainesville, FL) located approximately 500 m away from the study area to more rigorously compare adult counts to dipper samples. This gravid trap was one of 16 placed permanently throughout the NSMAD for the adult mosquito and WNV surveillance season. Precipitation data were collected from a nearby weather station of the National Weather Service Forecast Office located at the Chicago O'Hare Airport (http://www.nws.noaa.gov/climate/index.php?wfo=lot). Statistical analyses were conducted using Stata 12.1 (StataCorp LP, College Station, TX). Kruskal–Wallis rank tests were used to test for differences in the weekly mean ranks of immatures collected per dip between untreated catch basins, and Natular- and FourStar-treated catch basins for up to 15 wk after larvicide applications. Using a Spearman's rank correlation average, weekly adult trap counts collected from the nearby gravid trap were compared to the average weekly immatures observed

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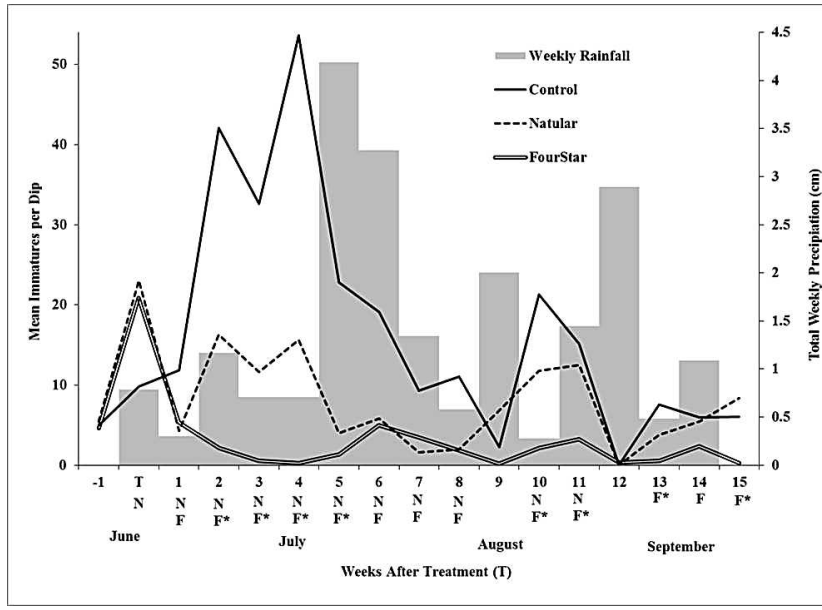

Fig. 1. Average immature mosquitoes per dip from weekly monitoring of 3 clusters of 20 catch basins each (Natular™ XRT-treated, FourStar™ Briquets 180-treated, and untreated) within a 0.25-km^2 suburban area in northeastern Illinois from June 4 to September 24, 2012, with total weekly rainfall. Larvicides were applied once, on June 13, 2012. T, treatment; N, Natular significantly different from untreated but not FourStar; F, FourStar significantly different from untreated but not Natular; F*, FourStar basins significantly different from both untreated and Natular basins based on the results of Kruskal–Wallis comparisons, $P < 0.05$.

from each zone. An alpha P-level of $P < 0.05$ was used for statistical significance.

For the duration of the study, larvae were observed from 58 of the 60 catch basins, following the application of the treatments. In comparison to the untreated control basins, significantly fewer immature mosquitoes were collected for a total of 10 and 13 wk in the Natular- and FourStar-treated catch basins, respectively (Fig. 1). A total of 359 4th instars were identified from 56 samples from 29 catch basins. Three hundred thirty-eight (94%) were *Culex pipiens* L. and 21 (6%) were *Cx. restuans* Theobald. The percentage of observed 4th instars and pupae was 32.1 (360/1,121) for FourStar basins, 46.9 for Natular basins (2,064/4,393), and 48.2 for untreated basins (5,019/10,420). No significant association was found between mean weekly adult counts and mean weekly immatures observed in experimental zone ($rs = 0.09$, $P = 0.51$, $n = 51$).

The NSMAD larvicide operations focus primarily on catch basins to prevent the spread of mosquitoes and the associated pathogens they tranmit. Therefore finding larvicides that can be effective for the entire mosquito season is important. That nearly all the basins held immatures for multiple weeks in the study supports the need for targeting these structures for mosquito control. Further, both Natular and FourStar appeared to reduce immature numbers in catch basins for at least 10 wk, suggesting a single application of either larvicide may indeed last an entire season for catch basins in the area. The results of this study also support previous work (Harbison et al. 2013), suggesting adult counts from aboveground gravid traps collected during the same week of immature monitoring may not effectively reflect immature populations in catch basins. Many mosquito abatement districts rely on aboveground gravid traps for adult mosquito and WNV surveillance, yet focus much of their larviciding operations on catch basins and other belowground sources. However, when relying principally on gravid trap counts, estimations of mosquito populations may be less accurate without consideration of routine and widespread immature surveillance data. For mosquito control programs that target catch basins, such as those in the Chicago region and other more urbanized areas, it may be beneficial to incorporate routine catch basin sampling in mosquito monitoring efforts. Finally, with so many of these structures located in or along major roadways (the city of Chicago has upwards of 200,000 catch basins), ensuring safe access of mosquito control staff is another important consideration (Harbison and Bhattacharya 2013).

The authors thank the NDMAD Board of Trustees for their continued support of scientific assessments of mosquito surveillance and control.

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