EVALUATION OF MOSQUITO LARVICIDES IN CATCH BASIN SYSTEMS (2021 UPDATE)

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ABSTRACT

Throughout the spring and summer months, Central Massachusetts Mosquito Control Project staff members inspect and treat storm drains with various larvicides. The primary goal of this program is to reduce the number of *Culex* mosquitoes, which are documented vectors of several mosquito-borne diseases including West Nile virus. A significant portion of this activity is conducted in urban areas with high densities of catch basins. There are several different products available for use in storm drains with four, Altosid® WSP, FourStar® 45, FourStar® 90, and Natular™ G30 WSP, being evaluated by CMMCP in 2021. All four of these are currently utilized by CMMCP in the catch basin larvicide program.

BACKGROUND

Culex mosquitoes, long known to develop in storm water systems, are of significant public health importance because of their role in the transmission of West Nile virus (WNV) in the United States. More specifically, *Cx. pipiens* and *Cx. restuans* have been identified as abundant species in the Northeast United States that WNV has been detected in (Anderson 2011; Butler 2006). Fortunately for public health officials, there are several mosquito control options for these species while they develop in catch basins. CMMCP field staff currently use four of these storm drain specific larvicides including Altosid® WSP, FourStar® 45, FourStar® 90, and Natular™ G30 WSP.

Altosid® WSP (EPA Reg. No. 2724-448) are water soluble pouches that contain the active ingredient methoprene. A juvenile hormone mimic, growth regulator, methoprene acts by preventing the adult mosquitoes from successfully emerging. Studies have been conducted using this formulation in the laboratory setting as well as observations from the field (Butler 2006; Harbison 2018). FourStar® 45 and FourStar® 90 (EPA Reg. No. 83362-3) briquets are slow release combinations of *Bacillus thuringiensis israelensis* (*Bti*) and *Bacillus sphaericus* (*Bs*). These two bacteria produce crystalline toxins that kill mosquito larvae when ingested. Various formulations of these two bacteria have been developed and their success against mosquitoes, including *Culex*, is well documented (Anderson 2011). Natular™ G30 WSP (EPA Reg. No. 8329-91) are also water-soluble pouches, but contain the active ingredient spinosad. Created from the fermentation of the soil bacteria *Saccharopolyspora spinosa*, spinosad has been shown to control developing mosquito larvae. This particular

formulation is engineered to provide approximately 30 days of control (CMMCP 2021).

Previous catch basin evaluations by CMMCP involved direct field observations of the treated catch basins, but in 2021 water samples from these treated storms systems were obtained and used against reared *Culex* larvae in the laboratory setting. The protocols for this were based on those established by Northeast Regional Center for Excellence in Vector-Borne Diseases (NEVBD) network at Cornell University. This process should allow for more consistency and uniformity in testing compared to exclusively field observations.

MATERIALS & METHODS

Pans of hay-infused water were used as oviposition sites for local *Culex* mosquitoes and monitored daily for the presence of egg rafts. Once detected, these eggs rafts were collected and transferred to the CMMCP laboratory, into shallows trays of fresh water. Within a day or two hatching typically was observed, and ground fish food would added daily for the developing larvae. Approximately a week later the *Culex* larvae should have grown to 3rd and 4th instar stage, and be ready for use in the bioassays.

With Altosid® WSP, FourStar® 45, FourStar® 90, and Natular™ G30 WSP being evaluated, separate storm drain systems in the CMMCP service area were treated entirely with one of the products. Although only a few storm drains would be sampled from in each system, all basins were treated within a network to ensure the same conditions were present in that particular neighborhood. All treatments were conducted according to the current product labels. Glass mason jars (32oz.) were used to collect water from these treated storm drains, with others used to collect water from untreated basins for use in bioassay controls.

Fourteen small wax-lined paper cups used to house 15 of the *Culex* larvae each, along with a proportional amount of food. Ten of these cups contained the water from a particular treatment area/product, two with the untreated field collected water, and the last two contained bottled water as an additional control. These small wax-lined paper cups were then each placed into their own larger soup cups, and covered with fine mesh fabric to prevent potential emerged adults from escaping. If the water was from an Altosid® WSP (methoprene) treated area or control, the containers were documented every 24 hours for 6-9 days, noting the number of emerged adults. If the water was from an area treated with any other product, larval mortality was noted after 24 hours. At the conclusion of the particular trial, the small wax-lined paper cups were replaced, and other materials thoroughly washed with soap and water, followed by an acetone rinse (NEVBD 2021).

RESULTS & DISCUSSION

Following early season success with FourStar® 45 treatment samples, bioassays results became inconsistent and generally did not show significant control. Previous evaluations by CMMCP have indicated strong larval control with Altosid® WSP, FourStar® 45, and FourStar® 90 through catch basin field inspections. Recognizing

these past assessments, it is proposed that the highly elevated levels of precipitation during the 2021 season resulted in the storm drains routinely being flushed with fresh, clean rainwater. This action dampened the concentration of active ingredient present when sampled by CMMCP staff, resulting in the inconsistent results, counter to previous studies. Regardless, protocols used will be reviewed to see if this scenario can be avoided, or artificially replicated. A more typical season of precipitation should provide additional insight into the results from these particular bioassays.

Despite the inconclusive results of these bioassays, this initial year was very successful on many fronts. *Culex* egg raft collection and larvae rearing was very fruitful. This was the first attempt by CMMCP to establish a reliable supply of mosquito larvae for testing. It was unknown how well this process would unfold, but throughout the catch basin larvicide evaluations, *Culex* larvae supply was never an issue. This bodes well moving forward, and it also creates the potential for raising *Culex* larvae to adulthood for use in adulticide resistance testing, which currently uses field collected adult mosquitoes. A more uniform collection of mosquitoes for the adulticide bottle bioassays in both age, species, and metabolic stage, would be very beneficial.

The public health significance of *Culex* mosquito larvae in catch basin systems leads mosquito control professionals to dedicate significant time and effort on larvicide treatments there. This is especially important in densely populated urban areas, where storm drain networks can be extensive. Considering this focus, the evaluation of these storm drain treatments is vital. With the inconclusive results from this first year of larval bioassays, the evaluation of these product types should continue, possibly through both laboratory larval bioassays and field storm drain inspections.

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