# EVALUATION OF MOSQUITO LARVICIDES IN CATCH BASIN SYSTEMS (2022 UPDATE)

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## ABSTRACT

The inspection and treatment of storm drains is a significant function of the Central Massachusetts Mosquito Control Project during the spring and summer months. 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 two, Altosid® WSP and FourStar® 45 being evaluated by CMMCP in 2022. Both of these products 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 can also transmit WNV (Anderson 2011; Butler 2006). Fortunately for public health officials, there are several mosquito control options for these species while they develop in catch basins. Current products available to CMMCP field staff specifically for storm drains, include 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). Although it was not specifically evaluated in 2022, Natular™ G30 WSP (EPA Reg. No. 8329-91) are water soluble pouches, containing the active ingredient spinosad. This specific ingredient is produced from the fermentation of the soil bacteria *Saccharopolyspora spinosa*, and has

been shown to control developing mosquito larvae. Natular™ G30 WSP is engineered to provide approximately 30 days of control (CMMCP 2021).

CMMCP has used larvicide bioassay protocols from the Northeast Regional Center for Excellence in Vector-Borne Diseases (NEVBD) network (Cornell University) in both the 2021 and 2022 seasons. In prior years, CMMCP had evaluated catch basin larvicide treatments by conducting direct inspections of treated and untreated storm drains. The NEVBD procedure uses water samples from various catch basin systems that are used against reared *Culex* larvae in the laboratory setting. Compared to the field inspection option, the NEVBD lab-based process should allow for more consistency and uniformity in testing compared to exclusively field observations.

## MATERIALS & METHODS

As in past seasons, 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, and 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 3$^{rd}$ and 4$^{th}$ instar stage, and be ready for use in the bioassays.

With Altosid® WSP and FourStar® 45 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 FourStar® 45, 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

Looking back at the prior season, the 2021 results were generally inconsistent and did not show significant control. At the time it was hypothesized, and conveyed to NEVBD, that the tremendous amount of precipitation

during that season resulted in the storm drains habitually being flushed with fresh, clean rainwater. This action could have negatively impacted the concentration of active ingredient present, resulting in the inconsistent results. Interestingly, the 2022 season experienced similar results, despite the lack of rain. With drought conditions present in the region, catch basin flushing should not have been an issue, and the variable results must have been due to other unknown factors.

In response to these questions, NEVBD will be consulted again to discuss how CMMCP can adapt the larvicide assay protocols to the local service area. Field inspections will also be reinstated as a concurrent evaluation for the catch basin larvicide program. These direct assessments have indicated successful larval control in the past with products including Altosid® WSP, FourStar® 45, and FourStar® 90. Additionally, larvae collected from the CMMCP service area will be sent directly to NEVBD for independent evaluation in 2023. This was attempted in 2022, but the sensitive timing related to the specific larval instar for shipping could not be achieved. In 2023, more attention will be given to spinosad as an option for catch basin larviciding, with an emphasis on its potential against mosquitoes in the pupal stage.

This season of larvae rearing at CMMCP was again quite successful. *Culex* egg rafts were relatively easily to obtain, with the only real issue was the timing of larvae hatching and development. Although larvae were not reared to adulthood and used specifically for adulticide resistance testing, this is still a future goal. These lab reared mosquito adults would be more beneficial to the bottle bioassays than field collected adult mosquitoes, as the population can be a single species, and also more consistent in age and metabolic stage.

With *Culex* mosquitoes having the capacity to amplify and transmit West Nile virus among other diseases, the ability to successfully control the larvae while in catch basins systems is of tremendous public health importance. This importance is further advanced when one considers the urban nature of this species, and the human population densities that accompanies those areas. The success of these larvicide treatments is also significant when the financial resources used in these programs are taken into consideration. Through the NEVBD larvicide assays, reinstated field inspections, and larval specimens being sent directly to NEVBD, the evaluation of catch basin products used by CMMCP will continue in 2023.

## REFERENCES


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