EVALUATION OF METHOPRENE (ALTOSID® XR) SUSTAINED-RELEASE BRIQUETS FOR CONTROL OF *CULEX* MOSQUITOES IN URBAN CATCH BASINS

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ABSTRACT. A sustained-release, briquet formulation of methoprene (Altosid® XR), applied at a rate of one briquet per catch basin in Saginaw, Michigan, provided ca. 70% reduction in emergence of *Culex pipiens* and *Cx. restuans* adults, compared with nontreated catch basins, during a period of 15 wk in the summer of 1990. In a parallel study using one briquet per 10.5 liter bucket, there was 99% reduction in adult emergence of these species for a period of 12 weeks. The difference between catch basins and buckets may be attributable to water movement through the catch basins with each rainfall, causing a dilution of methoprene through time. However, both studies indicated that the briquets released methoprene for 12–15 wk, suggesting that this formulation may offer season-long control of *Culex* mosquitoes from urban catch basins in Michigan, with a single treatment of insecticide.

INTRODUCTION

Culex pipiens Linn. and *Culex restuans* Theobald mosquitoes are abundant in Michigan, and comprise an important group of vectors of St. Louis encephalitis virus (Monath 1988, Mitchell et al. 1980). The Saginaw County Mosquito Abatement Commission (SCMAC) concentrates a large effort toward the control of these species. One of the major larval habitats of this mosquito group in urban areas is catch basins (Munstermann and Craig 1977). These structures are designed to collect and channel run-off water from city streets into the public sewerage system. The catch basin provides a sump that holds standing water and allows for oviposition by mosquitoes and subsequent larval development. During rains, a spate occurs in the sump that replaces old water and adds new. Currently, SCMAC utilizes a granular formulation of 1% Dursban® for control of *Culex* larvae in catch basins, with approximately 44,705 applications made to over 20,000 catch basins each year. Many must be treated 2 or 3 times in one season, so an alternative material that requires one treatment for season-long control (i.e., June to September) would offer clear advantages. A sustained-release formulation of methoprene, such as Altosid® XR briquets, has this potential, but efficacy against *Culex* mosquitoes in catch basins has not been evaluated.

In this study, the effectiveness of Altosid XR briquets was tested against *Culex* mosquitoes in urban catch basins in Saginaw, Michigan. Additionally, these briquets were evaluated against *Culex* mosquitoes in experimental, plastic buckets to determine the length of release of methoprene from the briquets, and to measure their efficacy under highly organic, yet controlled conditions. Because buckets are not susceptible to large volumes of run-off water moving through them, buckets provided a further comparison with catch basins for static versus nonstatic water conditions.

MATERIALS AND METHODS

The study consisted of 2 parts. In the first part, briquets were tested utilizing buckets as habitats. Thirty plastic buckets (10 liter capacity, 26 cm diam × 26 cm height) were provided with an alfalfa hay-yeast infusion as ovipositional stimulant (Reiter 1986) and filled completely. The buckets were placed in a concrete window well of a multistory building on the campus of Michigan State University, East Lansing, in mid-June, 1990. The window well was below ground level, with dimensions of 2.5 m deep × 2 m wide × 8 m long, and was surrounded by a hedge. *Culex* mosquitoes oviposited into the buckets *ad lib.*, and consisted of 96% *Cx. pipiens* and 4% *Cx. restuans* during the course of the study. Fifteen buckets were treated with Altosid XR briquets, and 15 others served as controls. Briquets weighed 36 g, and contained 1.8% methoprene (0.65 g per briquet). Rainwater replenished water loss owing to evaporation from the buckets, and no additional infusion was added. Overflow from buckets was rare. Pupae were collected from each bucket weekly, from June 27 until September 24 (12 wk total), held in the laboratory in covered dishes with water, and adult emergence recorded.

In the second part of the study, the efficacy of Altosid XR briquets in preventing development of *Culex* mosquitoes to the adult stage was studied through a summer season in catch basins in Saginaw, MI. Thirty-six catch basins (Fig. 1) were selected based upon their capacity to retain water and to be colonized by *Culex* mosquitoes. Twenty basins were treated each with a single briquet on June 13, while 16 were left nontreated as controls. To ensure that known numbers of mosquito larvae were exposed to methoprene in

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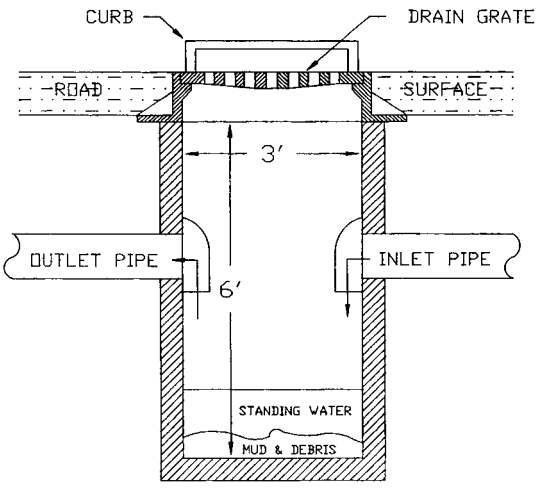

Fig. 1. A typical catch basin in Saginaw, Michigan.

treated catch basins, 20 second, third and fourth instar *Culex* larvae were collected from catch basins and placed in the lower chamber of an emergence device (Fig. 2). The mosquitoes consisted of approximately 60% *Cx. pipiens* and 40% *Cx. restuans*. The device was a 14 inch (35.5 cm) length of 3 inch (7.6 cm) inside diam, thin-walled polyvinyl chloride pipe with a lower and upper section. The lower section had a sealed end, screened ports, and was used to hold larvae and pupae. The upper end was a chamber to receive adults that had emerged from the lower chamber. A plastic funnel separated the chambers, with the narrow end pointing toward the upper section. Only those adult mosquitoes capable of emerging from the lower chamber would fly through the funnel into the upper chamber. These mosquitoes would not be able to fly back into the lower chamber because of the funnel. The entire apparatus was attached to a 3 ft (0.9 m) long wooden dowel, with the lower end of the dowel placed in mud and debris at the bottom of the catch basin sump. The emergence chamber was always positioned so that the water level was just below the level of the inverted funnel.

At weekly intervals from June 14 to September 24, 1990, larvae were introduced into the emergence device along with any larvae from the previous weeks, and then reimmersed in the water of the catch basins. At this time, adults were also collected out of the upper chamber and counted. During the study, water temperature in the catch basins ranged from 16 to 26°C, while water depth ranged from 15 to 63 cm (mean 38 cm). The last date that adults were collected was October 18 (15 wk total).

Data analysis of cumulative emergence curves of *Culex* adults from the bucket or catch basin studies were constructed from mean data. Percentage reduction of emerged adult mosquitoes from treated compared with controls was calculated as $[1 - (x_T/x_c)] \times 100$, where x_T is the mean of the number of adults cumulatively emerged from treated conditions, and x_c is the mean of the number of adults cumulatively emerged from the controls. Mann-Whitney *U*-tests were used to compare responses between treated and control groups for each study (Sokal and Rohlf 1969).

RESULTS

Bucket study: Weekly cumulative emergence of adult *Culex* showed that few emerged successfully from buckets treated with briquets, whereas emergence was steady and continuous throughout the study in nontreated buckets (Fig. 3). Significantly more adult *Culex* emerged from control buckets than treated buckets for all 12 wk combined ($U = 218$, $P < 0.001$). Reduction of adult emergence in treated buckets when compared with controls over all sampling weeks was 99%.

Catch basin study: Weekly cumulative emergence of *Culex* adults showed that significantly more mosquitoes emerged from control than treated catch basins for all weeks combined (Fig. 4) ($U = 279.5$, $P < 0.001$). Reduction of adult emergence in treated catch basins when compared with controls over all sampling dates was 69%.

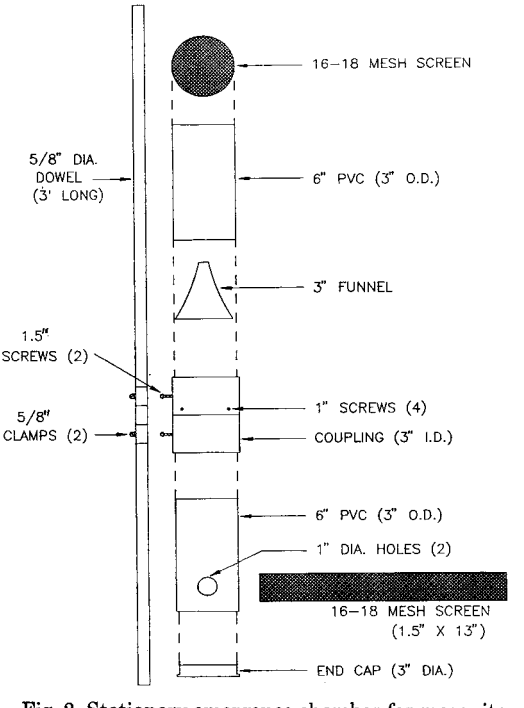

Fig. 2. Stationary emergence chamber for mosquito larvae and adults.

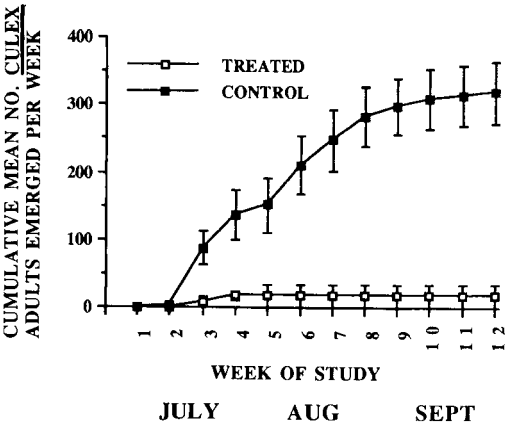

Fig. 3. Mean cumulative emergence of *Culex* adults from experimental buckets treated or not treated with sustained-release, Altosid XR briquets.

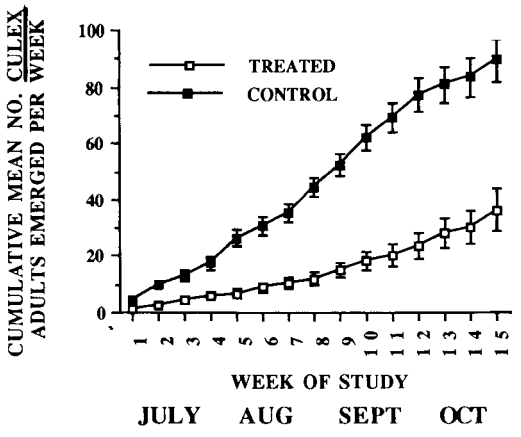

Fig. 4. Mean cumulative emergence of *Culex* adults from catch basins in Saginaw, Michigan, treated or not treated with sustained-release, Altosid XR briquets.

DISCUSSION

In this study, Altosid XR sustained-release briquets reduced emergence of adult *Culex* mosquitoes in urban catch basins and in experimental buckets. In Michigan, the "*Culex* season" is typically mid-June to late September or early October (R. G. Knepper, unpublished data). This study provided firm evidence that the briquets retained their activity in catch basins, throughout the study period corresponding to this season.

The effectiveness of methoprene in experimental buckets was very high (99%), as indicated by both percentage reduction in emergence of adult mosquitoes in treated compared with nontreated conditions, and by cumulative emergence curves. Thus, the briquets showed sustained-release activity in highly organic water conditions, such as those in which *Cx. pipiens* and *Cx. restuans* larvae are usually found. In catch basins, the briquets were less effective: approximately 70% reduction for the 15 wk study period. The difference between buckets and catch basins in percentage reduction probably reflects the fact that experimental conditions were more controlled in buckets. Catch basins experienced regular, high volume flushes at each rainfall owing to their position and design, whereas buckets did not exhibit flushes. Indeed, the function of catch basins is to channel run-off water for hundreds of square feet of city streets and environs, and consequently catch basins were not static habitats. However, the data clearly show that mosquitoes in treated catch basins were exposed to methoprene over a long period of time, so that methoprene remained in these systems and did not rapidly dissipate from the briquets.

Two additional problems occurred which may affect the operational use of the briquets in urban catch basins. One problem was the size of the briquet. Catch basins were covered by a heavy metal grate, and the briquets were too large to fit through the grate. It would be impractical to lift the grate each time a treatment is made. A second problem was that the effectiveness of the briquets was lower than that currently given by 1% granular dursban, which is highly effective but of shorter duration (R. G. Knepper, unpublished data). Thus, whether the control offered by briquets can adequately reduce the biting nuisance or vector potential of *Culex* mosquitoes remains unknown.

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