Journal of the American Mosquito Control Association, 12(1):144–146, 1996

EFFICACY AND PERSISTENCE OF ALTOSID® PELLETS AGAINST *CULEX* SPECIES IN CATCH BASINS IN MICHIGAN

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ABSTRACT. Larvae of *Culex pipiens* and *Cx. restuans* in catch basins were exposed to Altosid® pellets (4% active ingredient, [S]-methoprene) applied at a rate of 11.3 kg/ha (7 g of pellets per catch basin). Under field conditions, the pellets yielded an average 82% emergence inhibition of adult mosquitoes over the 15-wk trial period.

Methoprene products have been evaluated and used successfully in mosquito abatement programs for many years. Floore et al. (1991) found Altosid® pellets (4% active ingredient, [S]-methoprene) inhibited emergence (92%) of *Culex quinquefasciatus* Say for 29 days posttreatment in freshwater plots. Knepper et al. (1992) showed that Altosid XR briquets placed in city catch basins containing *Culex* spp. reduced adult emergence by 69% when compared with controls over all sampling dates during a 15-wk study period. Schoeppner (1978) concluded that Altosid briquets proved successful in controlling *Culex pipiens* Linn. in catch basins from 5 to 13 wk posttreatment during 3 individual trials.

Catch basins are dynamic systems that provide excellent breeding refuge for *Cx. pipiens* and *Culex restuans* Theobald mosquitoes in Bay County, Michigan. Catch basins are designed to collect and channel runoff water from city streets into the public sewer system (Knepper et al. 1992). There are nearly 10,000 catch basins within Bay County, and Bay County Mosquito Control has averaged 28,214[1] catch basin treatments annually. In the past, with use of conventional products such as Abate® 5% PG, approximately 3 treatments to Bay County's catch basins were needed to control *Culex* spp. mosquitoes each summer. It was hoped that surveillance and treatment time could be substantially decreased by utilizing Altosid pellets, which are designed to provide approximately 30-day control.

The objective of this study was to evaluate the emergence inhibition of *Culex* mosquitoes and residual effectiveness of Altosid pellets introduced to catch basins.

Catch basin surveys from early June 1994 indicated the presence of all instars of *Culex* spp., which led to the hand-treatment with Altosid pellets of 600 basins in Bay County on June 8. A comparable 13-square-block zone containing about 700 catch basins was maintained as a control. Each basin comprised roughly 6 m^2 of exposed surface area, including water in lateral inlet and outlet pipes; average water depth treated with the pellets was 0.38 m. The dosage rate was 7 g of pellets per catch basin (11.3 kg/ha).

A standard 350-ml mosquito dipper was used to collect mosquitoes from the catch basins on a weekly basis from day 2 through day 104 (15 wk) posttreatment. The samples were placed in enamel pans (31.7 × 20.3 cm) for viewing, and mosquito pupae from treated and untreated areas were transferred with large-mouth pipets to mosquito breeders (BioQuip®) that were lined with Ziploc® bags. Pupae were transported to the laboratory for rearing in water from each respective site. Water temperature and water depth were recorded with each site visit, and rainfall was recorded daily.

Once pupal activity ceased, containers were opened and counts made of dead pupae, dead adults on the water surface, and live, healthy adults. Mortality was computed in the form of emergence inhibition (% EI), which was calculated for each plot using the following equation:

$$\% \text{ EI} = \frac{\text{dead pupae} + \text{dead adults}}{\text{total mosquitoes collected}} \times 100.$$

Adult mosquito emergence inhibition percentages from treated catch basins were then corrected for control mortality (Abbott 1925). Emergence inhibitions between treatment and control areas were compared with the *z*-test for proportions (Dixon and Massey 1969).

Many pupae did not complete ecdysis in the initial stages of the study; however, as time went on, fewer dead pupae were seen whereas more partially emerged adults with tarsi still attached to the pupal cuticle were noted. Although the residual activity of Altosid pellets against the *Culex* mosquitoes varied with time, emergence

[1] Data compiled as an average from Bay County Mosquito Control annual reports (1990–94).

Table 1. Mean percentage of emergence inhibition (% EI) of *Culex pipiens* and *Cx. restuans* collected from Altosid-treated catch basins and from control catch basins in Bay County, MI, June–September 1994.

			Altosid-treated			Control		
Day post-treatment	Collection date	Rain-fall (cm)	Catch basins sampled	No. pupae collected	% EI	Catch basins sampled	No. pupae collected	% EI
2	June 10	0	2	5	100	3	63	6
9	June 17	0.8	2	60	70	1	65	18
13	June 21	0	14	16	100	5	45	29
20	June 28	9.6	6	0	—	6	3	0
23	July 1	4.4	3	4	100	6	0	—
28	July 6	1.2	5	0	—	21	34	9
33	July 11	11.5	2	14	86	4	18	22
40	July 18	0.4	3	4	100	16	12	0
47	July 25[1]	1.4	13	17	50	—	—	—
54	August 1	0	12	126	99	6	92	18
58	August 5	5.0	16	9	44	5	7	0
65	August 12	0.2	21	36	78	7	66	14
75	Augsut 22	6.3	4	0	—	17	0	—
82	August 29	1.5	28	51	57	4	78	12
91	September 7	0	9	59	97	4	54	13
104	September 20	0.8	7	232	87	7	106	10

[1] No samples collected from control.

inhibition was significantly greater for mosquitoes from treated areas compared with controls throughout the study ($z = 26.2$; $P < 0.01$). Although emergence inhibition varied throughout the trial, an adjusted 15-wk cumulative inhibition (82%) of mosquito emergence was achieved (Table 1). Control data are also presented in Table 1. One explanation for the variation in mortality may be the small sample sizes collected. Attempts were made to gather at least 20 pupae with each collection, but lower pupal counts were common. Small sample sizes were attributed to the consistent heavy rainfall, which caused flushing of catch basins (as evidenced during depth analysis) resulting in low mosquito activity. A 2nd reason for variation in mortality may be that on 2 occasions, low pupal mortality was exhibited from one particular catch basin; therefore, the average mortality in 2 instances (day 47 and day 58, Table 1) was affected. It is possible that the catch basin was not hand-treated with the pellets because mortality was not significantly different from that of the controls. The effect of this lower mortality on our average is amplified because of the small number of pupae collected.

Record levels of rainfall occurred in Bay County from June to August 1994; nearly 44 cm of rainfall was recorded during the evaluation period (Table 1). Rainfall runoff from the streets into the catch basin system created water flushing and replacement. Many studies have evaluated the fate of methoprene under various environmental situations, including persistence in water. Schaeffer and Dupras (1973) found that methoprene had a half-life of approximately 2 h in water. Further, in evaluating methoprene concentrations in static systems, Ross et al. (1994) found that Altosid pellets produced (S)-methoprene residues that peaked at 2.0 μg/liter on day 7 and declined steadily through day 14, when they leveled off at 0.2 μg/liter through the duration of the 35-day study. There is evidence, therefore, that methoprene degrades quite rapidly in water, yet mortality remained high throughout our study despite rainfall. Water temperature ranged from 14 to 29°C (mean = 21°C). According to Schaeffer and Dupras (1973), temperature has a definite effect on the persistence of methoprene in aqueous solutions (an increase in water temperature decreases the percentage of initial Altosid concentration); however, sunlight appeared to be a much more important factor accounting for the rapid decline in methoprene concentration. Catch basins are shaded systems that receive little sunlight, thereby contributing to the length of residual control achieved in our study.

At the rate used in this study, Altosid pellets can provide season-long control of *Culex* mosquitoes in catch basin habitats. Satisfactory control has been achieved with Abate 5% PG, but we sought to evaluate a product that promised a longer residual. One treatment with Altosid pellets per season is a cost-effective control strategy compared with 2–3 treatments using Abate. We have the potential to realize a 50% savings in material cost alone. The effectiveness of the pellets will be monitored in an operational setting. *Culex* mosquito activity is also common in other habitats in Bay County, such as roadside ditches, sewage lagoons, wooden vats at pickle stations, and numerous artificial containers. Treatment of any such habitat would be feasible.

I thank Dr. Thomas R. Wilmot, Midland County Mosquito Control, for his critical review of the manuscript. I am grateful for the field assistance of Suzanne Kohnert, Domonique Martin, and Holly Roth. The guidance of Jeffrey O'Neill of Sandoz Agro, Inc. is gratefully acknowledged.

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