

## FIELD EVALUATION OF CONTROLLED RELEASE PELLET FORMULATION OF METHOPRENE AGAINST CHIRONOMID MIDGES IN MAN-MADE LAKES

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**ABSTRACT.** The duration of the efficacy of 4% methoprene pellets against emergence of chironomid midges, *Chironomus stigmaterrus* Say, *Goeldichironomus amazonicus* (Fittkau) and *Tanytus imperialis* Sublette, in man-made lakes supplied with tertiary effluent water in Palm Desert, California, was dose dependent. For *C. stigmaterrus* and *T. imperialis*, the rate of 4.5 kg/ha of the controlled release pellet formulation of 4% methoprene yielded >90% control for 3 wk and 75% control in the 4th week, the rate of 3.4 kg/ha provided >90% control for 2 wk, and the rate of 2.25 kg/ha provided control for 1 wk. *Goeldichironomus amazonicus* was under 90% control for 2 wk at the rate of 4.5 kg/ha and 1 wk at the rates of 3.4 kg/ha and 2.25 kg/ha.

**KEY WORDS** Control, chironomid midge larvae, methoprene, man-made lakes

### INTRODUCTION

Nonbiting midge larvae (Diptera: Chironomidae) have a wide range of tolerance to environmental conditions and are dominant by biomass and numbers of species in many freshwater ecosystems. They break down organic material and are one of the major food sources for fish, birds, and terrestrial and aquatic invertebrates. The midge community is an important indicator of the health of an aquatic system (Oliver et al. 1990). At the same time, midge larvae may become so numerous as to overpopulate recreational residential lakes or flood control channels. High numbers of emerging adults pose a variety of nuisance and economic problems to residential, commercial, and recreational establishments surrounding chironomid breeding sites. This aspect has been reported by many authors (Mulla 1974, Ali and Mulla 1979, Rodcharoen et al. 1991, Lothrop and Mulla 1995). Chironomid midges also may cause allergies (Cranston et al. 1981, Cranston 1988).

In situations where chironomid midges pose a nuisance or public health problem, control measures must be implemented. To date, only temephos (organophosphate) is registered, and diflubenzuron (insect growth regulator) in California, as a chironomid larvicide. Encouraging results were obtained with insect growth regulators (IGRs) that interrupt metamorphosis, causing mortality in the pupal stage (Mulla et al. 1974, 1976; Ali and Mulla 1977; Ali et al. 1978; Ali 1991). Other compounds were either highly toxic to nontarget organisms, too expensive, or ineffective in some habitats with organic pollution (Mulla et al. 1990, Rodcharoen et al. 1991, Mulla 1992).

The purpose of the present study was to determine the effective dose of 4% methoprene (an IGR)

in pellet formulation against chironomid midge larvae in shallow ( $\leq 1$  m) man-made lakes filled with tertiary sewage effluent water. We selected sustained released pellet formulation over liquid and briquettes because pellets provide an even distribution of the active ingredient. Testing was also conducted to encourage a possible registration of methoprene for chironomid midge larvae in shallow man-made lakes. The importance of this product for midge control in man-made lakes is that most lakes are stocked with fish.

### MATERIALS AND METHODS

The controlled release 4% methoprene pellets (Altosid<sup>®</sup>, Sandoz Agro Inc., Des Plaines, IL) were evaluated in 3 lakes at Portola Country Club in Palm Desert, California. The lakes were  $\leq 1$  m deep, edged with concrete, and supplied with tertiary sewage effluent water. A more detailed description of the study area was presented in Lothrop and Mulla (1995). The lake at hole 10 on the golf course was used as a control and had a surface area of 0.2 ha. The lakes at holes 2 (0.24 ha) and 5 (0.2 ha) were used for treatments.

Each rate was evaluated 3 times with 2 replicates. The 1st treatment on September 3, 1993, in lake 2 and the 2nd treatment on September 24, 1993, in lake 5 tested the rate of 4.5 kg/ha. The 3rd treatment on May 3, 1994, in lake 2 and the 4th treatment on May 27, 1994, in lake 5 tested the rate of 2.25 kg/ha. The 5th treatment on August 2, 1995, in lake 2 and the 6th treatment on August 22, 1995, in lake 5 tested the rate of 3.4 kg/ha. During testing, water temperature was monitored by min./max. thermometer and pH with color pH indicator strips. The required amounts of 4% Altosid pellets were distributed with a U.S. Borax P.C.B. spreader (Model B, Earthway, Bristol, IN).

For assessment of methoprene efficacy, adult emergence was monitored by placing 5 metal cone emergence traps in each lake. Each trap covered 0.3

<sup>1</sup> Present address: Coachella Valley Mosquito and Vector Control District, 83-733 Avenue 55, Thermal, CA 92274.

Table 1. Prevalence of chironomid midge larvae in treated and untreated lakes in Palm Desert, California.

| Genus                   | Lake <sup>2</sup> | Rate <sup>1</sup> |         |           |         |            |         |
|-------------------------|-------------------|-------------------|---------|-----------|---------|------------|---------|
|                         |                   | 4.5 kg/ha         |         | 3.4 kg/ha |         | 2.25 kg/ha |         |
|                         |                   | 9/3/93            | 9/24/93 | 5/3/94    | 5/27/94 | 8/2/95     | 8/22/95 |
| <i>Chironomus</i>       | 2 (treated)       | 198               | —       | 261       | —       | 81         | —       |
|                         | 5 (treated)       | —                 | 184     | —         | 97      | —          | 99      |
|                         | 10 (control)      | 43                | 69      | 57        | 47      | 33         | 9       |
| <i>Tanytus</i>          | 2 (treated)       | 53                | —       | 91        | —       | 23         | —       |
|                         | 5 (treated)       | —                 | 37      | —         | 28      | —          | 34      |
|                         | 10 (control)      | 19                | 9       | 14        | 10      | 12         | 8       |
| <i>Goeldichironomus</i> | 2 (treated)       | 0                 | —       | 101       | —       | 89         | —       |
|                         | 5 (treated)       | —                 | 59      | —         | 71      | —          | 247     |
|                         | 10 (control)      | 0                 | 23      | 6         | 12      | 31         | 67      |

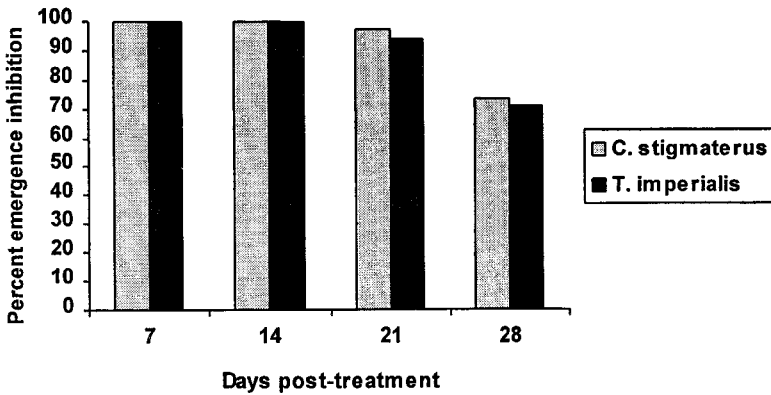
<sup>1</sup> Average number of midge larvae per scoop.

<sup>2</sup> Lake number corresponds to golf course hole on which lake is located.

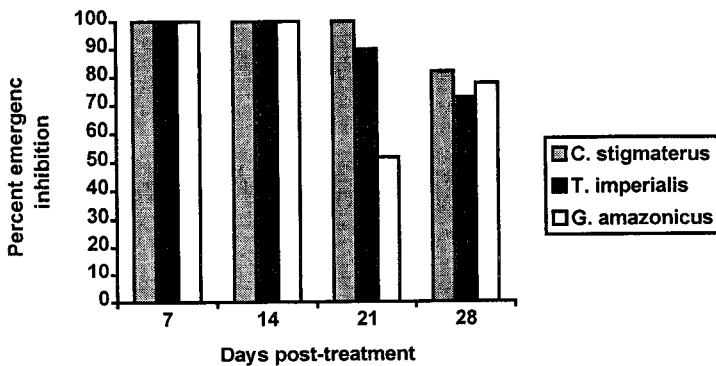
m<sup>2</sup> of the lake bottom and was placed before sunset and recovered the following morning (Mulla 1974). Adult midges were trapped 7 days posttreatment and then weekly for 3 wk. Adults were removed from the collection jars, counted, and stored in al-

cohol. Later, slide preparations were made in Euparal mounting medium (Pinder 1983) and specimens were identified to species.

Larvae were sampled randomly with 15-cm × 15-cm scoop (0.02 m<sup>2</sup>) to estimate the potential

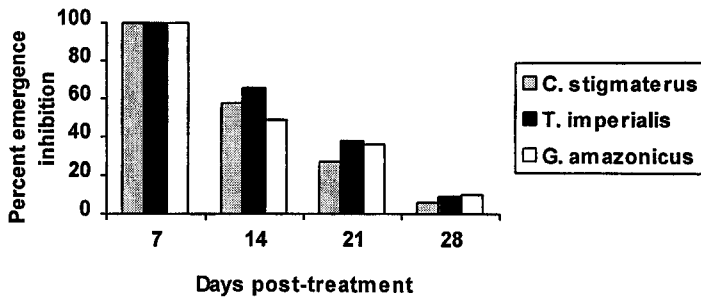


September 3, 1993, lake 3

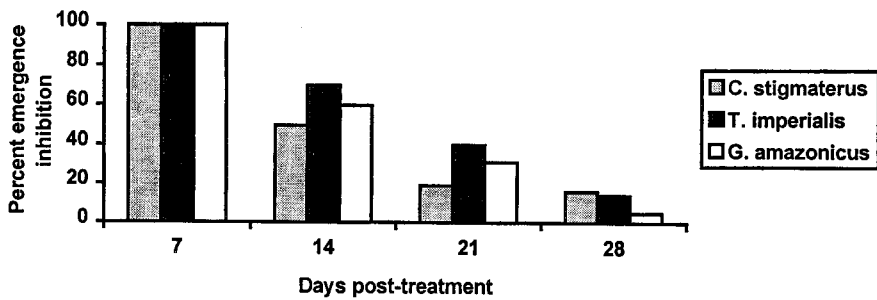


September 24, 1993, lake 5

Fig. 1. Effectiveness of 4% methoprene pellets at the rate of 4.5 kg/ha against chironomid midges in man-made lakes in Palm Desert, California.



May 3, 1994, lake 2



May 25, 1994, lake 5

Fig. 2. Effectiveness of 4% methoprene pellets at the rate of 2.25 kg/ha against chironomid midges in man-made lakes at Palm Desert, California.

adult population. Five samples of bottom mud were taken from each lake concurrently with adult sampling. Each sample was washed through a 40 mesh screen (pore size 50 × 65 mm). The residues, which included larvae, were transferred to white enameled pans for counting and identification to genus.

The adult emergence data are presented as average number of adults per trap per night from treated and control lakes. Percentage of control was calculated by Mulla's formula (Mulla et al. 1971):

$$\%EC = 100 - \frac{(C_1 \times T_2)}{T_1 \times C_2} \times 100,$$

where  $C_1$  = average number of adults pretreatment in control lake,  $T_1$  = average number of adults pretreatment in treated lakes,  $C_2$  = average number of adults posttreatment in control lake, and  $T_2$  = average number of adults posttreatment in treated lakes.

**RESULTS**

*Chironomus stigmaterus* and *Tanypus imperialis* were present during each test. *Goeldichironomus*

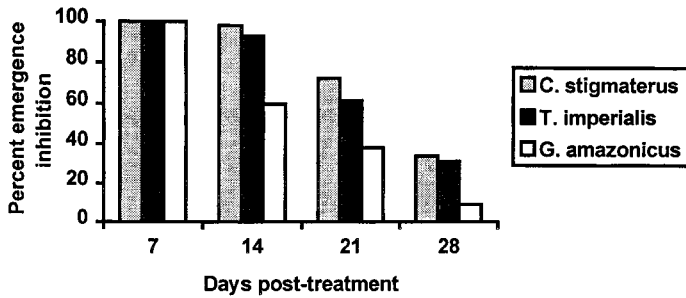
*amazonicus* was present in all tests except on September 3, 1993, in lake 2.

During the test periods, these lakes had uniform water temperature ranging between 26°C and 29°C and pH ranged between 8.5 and 9.5.

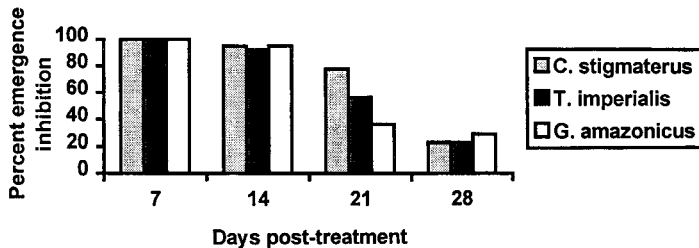
Larval densities averaged 50–270 per mud sample in all lakes prior to each treatment. During the course of each test, the larval population in the control lake averaged 60–80 per mud sample. The larval densities by genera during the test periods are presented in Table 1.

The rate of 4.5 kg/ha of 4% methoprene pellets inhibited adult emergence of 3 midge species for 21 days by more than 90%. An exception was on the 21st day after treatment on September 24, 1993, in lake 5, when control of *G. amazonicus* was only 52%. The range of control on the 28th day for all species was 71–82% (Fig. 1).

The rate of 3.4 kg/ha inhibited adult emergence at the level of 100% on the 7th day after treatment for all tested species. Fourteen days after treatment, adult emergence inhibition was 92–97% except for *G. amazonicus* in lake 2 on August 2, 1995, when emergence inhibition was 60%. Twenty-one days



August 2, 1995, lake 2



August 22, 1995, lake 5

Fig. 3. Effectiveness of 4% methoprene pellets at the rate of 3.4 kg/ha against chironomid midges in man-made lakes at Palm Desert, California.

posttreatment, *G. amazonicus* was controlled between 36% and 38%, whereas the control range of the other two species was 56–77%. The effective control of all species subsided 28 days after treatment (9–34%; Fig. 2).

The rate of 2.25 kg/ha inhibited adult emergence for tested species completely (100%) 7 days after treatment. Fourteen days after treatment, the control level of 49% (*G. amazonicus*) to 70% (*T. imperialis*) was obtained. The control level for all species was lower (19–40%) on the 21st day posttreatment, and on the 28th day posttreatment, it went down to 5–16% (Fig. 3).

## DISCUSSION

Various formulations of methoprene, such as wettable powder and emulsifiable concentrate, were reported to be effective against midge larvae at the dose of 0.5 kg/ha for 1–2 wk. A number of tests of other IGRs performed against different midge genera/species showed different levels of control, depending on the species and material (Mulla and

Darwazeh 1975, Mulla et al. 1976, Ali and Mulla 1977, Johnson and Mulla 1982, Ali 1991).

Our field trial showed that 4% methoprene pellets at the rate of 4.5 kg/ha yielded excellent control of *C. stigmaterus* and *T. imperialis* for 21 days and good control for 28 days. The rate of 3.4 kg/ha provided excellent control for 14 days and good control for 21 days. The rate of 2.25 kg/ha provided excellent control only within 1 wk after treatment.

*Goeldichironomus amazonicus* was under excellent control for 14 days at the rate of 4.5 kg/ha and for 7 days at the rates of 3.4 kg/ha and 2.25 kg/ha. The results also indicated that *G. amazonicus* was under variable control after 7 days posttreatment. Differences in control of *G. amazonicus* from 60% to 97% at the rate of 3.4 kg/ha and 49% to 60% at the rate of 2.25 kg/ha indicated that more tests are needed.

Chironomid midges are a short living nuisance, with no serious medical importance. They breed in many lakes at a tolerable level. However, their number can increase to high population levels and

pose a serious nuisance problem to the public. In that case, control should be applied.

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