BOOM SPRAY APPLICATION OF INSECTICIDE FOR CONTROL OF ESTUARY BREEDING BITING MIDGE
(CULICOIDES, CERATOPOGONIDAE)

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ABSTRACT. Temephos or Abate® insecticide emulsifiable concentrate formulation applied at the rate of 10% with a salt water carrier and discharged through a telescopic boom from apparatus fitted to a small boat has been 98% effective against Culicoides molestus larvae in canal banks. Equipment described enables the application of Abate® E.C. at 0.78 Kg per ha, and 20 Km per day are readily achieved in all weathers.

INTRODUCTION

Culicoides molestus (Skuse) has assumed major pest status on the Gold Coast of Queensland, since former wetlands were converted for residential development with artificial canals and white sand beaches. This biting midge species breeds in relatively clean flocculated sand and has effectively colonized man-made breeding places. The larval habitat extends from the 1.5m tideline to the 2m tideline, usually a distance of about 4m on the average slope of canal beaches, and adults emerge at spring tides (new and full moon).

Fox et al. (1968) and Wall and Margarian (1971) showed Abate® insecticide to be effective against Culicoides larvae in Puerto Rico and Cape Cod respectively. Abate® insecticide (0,0,0"0"- tetramethyl 0,0' thiiodi-p-phenylene phosphorothioate) has been used extensively for mosquito control in this area since 1968, with minimal effects to other organisms (Kay et al. 1973), and preliminary trials indicated that it would be effective against Culicoides in Queensland.

A rapid practical method was required for the treatment of the 140 Km of canal banks, when the breeding zones were exposed. A boom spray was designed to fit into a small boat and has proved to be highly effective in both distribution of the chemical and reduction in labor costs.

MATERIALS AND METHODS

Spraying Equipment. A 3.6m aluminium boat, driven by 15 horsepower outboard motor, was fitted with a V.D.O.® sunlog and speedometer which accurately measures distance travelled and speed in knots, even at slow speeds.

A 4 horsepower air-cooled 4 stroke petrol engine fitted with a pulley and a vee belt drives a 25mm (1 in) positive displacement gear pump to produce 60 lb pressure, and a pressure relief valve protects the system. A discharge line allows salt water to be circulated through the pump and discharged back to the sea when the insecticide flow is interrupted.

A pulley and belt fitted on the pump
shaft drives a 6.33mm (¼ in) positive displacement gear pump used to pump insecticide from a bulk container to a liter capacity header tank. From this tank the insecticide flows through a needle valve and flow meter to a venturi fitted to a 25mm (1 in) suction hose connected to the intake of the 25mm pump which draws salt water from the canal through a filter.

The Abate®/saltwater mixture is pumped through the 25mm pump and is thoroughly mixed by recirculating, then discharged through a 12.5mm (½ in) pressure hose to the boom. The boom consists of 3 aluminum tubes each 3m (10 ft) long, which telescope together. The 3 tubes 25mm, 32mm, and 38mm (1”, 1¼” and 1½”) in diameter, are fitted to a mast 145 cm (4’9”) high, by means of a device which allows the boom to be raised, lowered and moved horizontally. (Figure 1).

The 12.5mm hose passes through the boom to 2 nozzles fitted to “Rega” hand valves individually controlled by the boatman. The nozzles are made from 25mm x 10mm stainless steel clevis pins, bored through the head with a 6mm (¼”) drill. The first nozzle has a slot 1.4mm wide and cut so as to give a 4m swath width. The second nozzle has 5 x 1.5mm holes drilled into the 6mm cavity and spaced so as to extend the swath width another 4m. Both nozzles have slots cut in the ends so that the swath widths can be varied by turning the nozzles with a screwdriver. The first nozzle covers the normal 4m swath, and the second extends the coverage for treating breeding areas with longer and more gentle slopes. The pump delivers 8 liters per min. through each nozzle. A 1 liter container fitted next to the header tank holds insecticide used when calibrating the equipment.

The equipment is calibrated by turning the 2-way cock to the metering position, and spraying the liter of insecticide on to the canal beach at the usual speed of 5 knots. The distance covered is measured in meters by a “Measure master” peptometer and the area sprayed is calculated on a 4m swath width. The insec-

Fig. 1. Diagram showing arrangements for mixing insecticides.
Larval sampling. Sand samples are taken at the 1.7 cm tide level, using a hinged sand grab (Figure 2) which takes a 5 cm x 5 cm x 7.5 cm deep sample. Five of these samples are taken at intervals of 5 paces and combined in a 1 liter bucket to form 1 sample for processing. Twelve 1 liter samples are collected from each canal system and sampling is repeated at approximately 30-day intervals.

The larval extraction technique is a development from Bidlingmayer (1957) and modified by E. J. Reye of Queensland University.

The sand from each 1 liter bucket is transferred to a 9 liter bucket and mixed with a cane sugar syrup which has been diluted with water to produce a specific gravity of 1.3. Raw sugar is added to the sample to compensate for the water content of the sample. The sand and syrup are thoroughly mixed then transferred to 8 cm diameter by 40 cm high settling tubes and left to settle for 20 mins. This settling time is satisfactory for relatively clean sand, but needs to be extended for sand containing more organic matter. The surface of the tube is then skimmed with an inverted cone, and the skimings passed through sieves of 7 and 48 meshes per cm. and washed with water. The larvae are trapped on the finer sieve and are washed into a dish from which they are extracted by pipette and counted.

RESULTS

Preliminary trials in 1972 had shown that Abate insecticide was effective against Culicoides larvae at 0.78 kg active ingredient per ha. In vitro tests have also proved that Abate was as effective when mixed with clean sea water as with clean fresh water. Mean pre-spraying and post-spraying larval counts for the period December 1977 to January 1978 are shown in Table 1. Regular monthly sampling between January and April 1978 has shown the larval density has been reduced by 98% in every canal system treated. Prior to larviciding canal systems, residents were being so seriously affected by biting midge infestation that some people were hospitalized, and some were forced to sell their properties and move.
Table 1. Effects of Abate® insecticide on Culicoides molestus larvae at 0.78 kg per ha. December, 1977–January, 1978. (Mean larval count per canal system (12 × 125 sq. cm. samples) calculated according to Williams.)

<table>
<thead>
<tr>
<th></th>
<th>Pre-treatment</th>
<th>38 days post-treatment</th>
<th>65 days post-treatment</th>
<th>108 days post-treatment</th>
</tr>
</thead>
<tbody>
<tr>
<td>Swordfish Canal</td>
<td>0.73</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
</tr>
<tr>
<td>Mackerel Canal</td>
<td>2.22</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
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<tr>
<td>Dolphin Canal</td>
<td>1.60</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
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<tr>
<td>Barracuda Canal</td>
<td>5.70</td>
<td>0.41</td>
<td>0.41</td>
<td>0.73</td>
</tr>
<tr>
<td>Marlin Canal</td>
<td>10.18</td>
<td>0.00</td>
<td>0.25</td>
<td>8.16</td>
</tr>
<tr>
<td>Control Endless</td>
<td>35.96</td>
<td>17.95</td>
<td>12.43</td>
<td>21.77</td>
</tr>
</tbody>
</table>

In all treated canals no pupae were found after 108 days. In the Control pupae were present at the rate of 6.67 per sample.

To satisfy the tidal requirements, the duration of the larval stage must be greater than 1 lunar cycle. The breeding of Culicoides molestus in canal banks reached such proportions that some form of control became necessary. The breeding areas are more readily accessible by boat than by land. The mixing of Abate® with sea water has obviated the necessity to carry fresh water and has permitted a small boat to be used, which can easily navigate restricted waters. Four men were previously required to spray the area with a hose, and spraying was restricted to the walking pace of a man in heavy sand.

The equipment described enables the application of Abate® E.C. at 0.78 Kg. per ha. and treatment rates of 20 Km per day are readily achieved in all weathers. The equipment is operated by 2 men, with resultant saving in labor costs, and the area covered is 5 times greater than previously achieved thus allowing the total 140 Km of canal banks to be treated over a 7 day period. Larval control has been

Thus far the use of Abate® has proven satisfactory in the control of Culicoides molestus and this is being continued at all of the above locations. The toxicological evaluation of Abate® is scheduled for completion by April, 1978.

Fig. 3. Diagram to show relation of insecticide application and biting midge life cycle.
proved in biting midge producing areas in artificial canal banks with this equipment, and the equipment is suitable for distribution of any insecticide which can be mixed with sea water.

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References Cited


GENETIC FITNESS OF THE MUTANT, CARMINE EYE, IN CULEX TARSALIS IN THE LABORATORY

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ABSTRACT. Experiments designed to test the effect of the eye-color mutant, car, on mating competitiveness indicated car does not significantly influence mating ability. Estimates of survivorship to pupae indicate that car might be an overdominant gene. However, the genetic history of the stocks used indicated that a general hybrid vigor was expected and might have produced the overdominance detected.

INTRODUCTION

The development of chromosomal translocations for the genetic control of the mosquito, Culex tarsalis, has progressed in our laboratory to a point where assessment of the relative genetic fitness of the translocation lines is necessary. Recently visible genetic markers were incorporated into translocations generated in this species (McDonald et al. 1978). This allowed the development of selection experiments which depend upon genetic markers to assess the results. Before assessing the fitness of translocations, the fitness of populations that carry genetic markers should be determined.

Carmine-eye color (car) (Asman 1975b) was chosen for the first round of selection experiments because car can be detected in the larval, pupal, and young adult stages. This report is an assessment of the mating competitiveness of car-bearing adult males against wildtypes and the survivorship of car to the pupal stage.

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