# Dimilin®: A New Larvicide for use in Dirty Water Areas

KEITH GRIFFITH

Uniroyal Chemical Co., Inc.
Orlando, Florida 32819

ABSTRACT

This paper presents a brief summary of the use of DIMILIN® (diflubenzuron) insect growth regulator for larvicidal control of dirty water mosquitoes. An overview of the mode of activity of Dimilin, labelled use sites and rates, and efficacy data summaries are included. Also discussed are LD 90's for various mosquito species and environmental factors affecting control.

## INTRODUCTION

The state of California granted a state label for Dimilin® use for mosquito larval control in dirty water areas in 1985. Another label for midges was granted in 1987. In 1990, a label for the control of anchor worm in commercial rearing ponds of goldfish, golden shiners, and fathead minnows was also granted in California.

The State of Florida granted a state label (24C) for Dimilin 25WP for use in the control of dirty water mosquitoes in September, 1991. This label was amended with slight changes in November, 1991. This report covers the mode of action, labelled uses, and efficacy results on various mosquito species.

Dimilin (diflubenzuron) is a benzoylphenyl urea compound that inhibits the synthesis of chitin and cuticle deposition in the larvae during the molting process (Mulder and Gijswijt 1973, Post et al. 1974). Chitin is the chemical that enables the insect larvae to develop the exoskeleton necessary for the various stages of growth. Without

® - DIMILIN is a registered trademark of Duphar B.V. of Holland.

| State Label | Pest | Sites |
|---|---|---|
| Florida<br>Fl-910014 | Mosquitoes | • Street gutters<br>• Rubber tires stockpiled for processing or frost protection<br>• Storm water drains<br>• Ditches<br>• Retention/detention/seepage ponds<br>• Sewage effluent<br>• Sewage spray fields<br>• Oxidation ponds<br>• Grassy swales<br>• Phosphate pits and tailing canals<br>• Slime ponds<br>• Wastewater biological filter beds<br>• Industrial waste tertiary ponds<br>• Industrial waste irrigation disposal fields<br>• Livestock, swine and poultry waste lagoons<br>• Man-made ponds developed for decorative or landscape purposes<br>• Man-made channels developed for decorative or landscape purposes<br>• Man-made percolation basins for decorative or landscape purposes<br>• Intermittently flooded pastures |

Mosquito Acute Toxicity

| Species | Instar | LC 95 (ppm) |
|---|---|---|
| Culex nigripalpus | 3rd | 0.00016 |
| | 4th | 0.00080 |

C. B. Rathburn, Jr. and Boike, A.H., Morquito News. 35, 1975

chitin, internal pressure from larval growth causes the weakened exoskeleton to rupture resulting in the insect's death before it reaches the next stage of growth. Activity from Dimilin can occur in egg, larvae, pupae, and early adult development of susceptible species.

The IGR (insect growth regulator) qualities of Dimilin make it an extremely safe and environmentally sound product for mosquito control. Half life in soil ranges from .5 - 1 week and in water from 1 - 7 days. Dimilin does not leach, therefore no risk of groundwater contamination. Dimilin is non-toxic to birds, fish, bees, mammals (including humans) etc. The safety of Dimilin for applicators and homeowners makes it a very desirable product to use in today's environmentally conscious society.

Dimlin is effective against *all* larval stages of mosquitoes. Some pupicidal activity and inhibition of adult eclosion also occurs. An example of acute toxicity on *Culex nigripalpus* shows that 3 rd instar LC 95 (ppm) with Dimilin is 0.00016 and 4 th instar is 0.00080 (C. B. Rathburn, Jr. et al. 1975). Dosage effects of Dimilin and Altosid on twelve species of mosquitoes including the genera, *Aedes, Anopheles, Culex, Culiseta*, and *Psorophora* show the relative susceptibility of different species to the growth regulators (Hsieh and Steelman, La. State Univ. 1974).

In 37 field trials conducted in Florida and Georgia with Dimilin, results were considered good - excellent in 36 trials and unsatisfactory in 1 trial. Acreage treated ranged from .75 - 156 acres with water depths of 2 inches to 10 feet. Rates of Dimilin applied ranged from 0.014 - .07 lbs. ai per acre. Mosquito larvae ranged from 1 st instar to pupae with pre-treatment counts ranging from 7 - 250 per dip. Species controlled in these trials were *Ae.*

Dosage Effects At LC90 for Dimilin & Altosid

| Species | Dimilin LC90 ppm | Altosid LC 90 ppm | Relative Susceptibility |
|---|---|---|---|
| *Ae. aegypti* | 0.000706 | 0.7799 | 1105 |
| *Ae. sollicitans* | 0.000036 | 0.0013 | 36 |
| *Ae. triseriatus* | 0.000718 | 0.6472 | 901 |
| *An. quadrimaculatus* | 0.000086 | 0.4964 | 5772 |
| *Cx. p. quinquefasciatus* | 0.000064 | 0.1936 | 3025 |
| *Cx. salinarius* | 0.000121 | 1.238 | 10238 |
| *Cx. tarslais* | 0.001049 | 0.0325 | 31 |
| *Cx. inornata* | 0.003833 | 0.1007 | 26 |
| *Ps. ferox* | 0.000072 | 0.0007 | 10 |
| *Ps. varipes* | 0.000069 | 0.0020 | 29 |

(Hsieh and Steelman, La. State Univ.)

Dimilin Mosquito Control
Summary of Results

| Location | Acres | Water Depth | lbs A.I. Acre | Species | Instar | Pre-Treatment Dip Counts |
|---|---|---|---|---|---|---|
| Florida 32<br>Georgia 5<br>Total 37 | .75-156 | 2 inches-10 feet | .014-.07 | A.t<br>A.s<br>C.n<br>P.c<br>C.s<br>A.a | 1st to Pupae | 7 - 250 |

Results
Good - Excellent - 36
Unsatisfactory - 1

*taeniorynchus, Ae. sollicitans, Cx. nigripalpus, Ps. columbiae, Cx. salinarius,* and *Ae. atlanticus.*

A Dimilin trial for control of *Aedes albopictus* in septic tanks in Malaysia showed effective control of larvae for up to 8 weeks at high use rates of 1, 2, and 4 ppm. The 4 ppm dose prevented any pupation for the entire 8 week study period. These exaggerated doses would not be used in Florida, but the trial does show Dimilin activity on this species.

Dimilin 25W use rate in Florida is 3.25 oz. formulated (0.05 lbs. ai.) per acre. Applications can be made by either ground or aerial application equipment and repeated as necessary for control. Under practical use conditions, a Dimilin treatment in surface water will control or suppress adult emergence for 7 - 14 days.

The Dimilin 25W formulation is suited for use on open water surfaces. In heavy vegetation, the use of a sand granule to penetrate thru the vegetation is best for delivering Dimilin to the target. For pastures a use rate of 5 - 8 lbs. of the 0.5% granule (0.025 - 0.04 lbs. ai/A is recommended. Providing the chemical has reached the water, efficacy for the wettable powder and granular formulations is comparable.

Many different factors can affect control of mosquitoes with any larvicide product. Temperature, pH, organic matter, and shelf life are some of these factors. Dimilin is effective over a wide range of temperatures. Under warm water conditions, activity is rapid with control generally in 1 - 3 days. However when water temperatures cool, activity is slowed but control will still be obtained.

Dimilin is effective over a wide range of pH's and resitual control is not affected. Dimilin is effective in high OM waters but

Dimilin Efficacy on *Aedes albopictus*

| Location | Site | Rate | Results |
|---|---|---|---|
| Malaysia | Septic tanks | 1 ppm<br>2 ppm<br>4 ppm | Effective control of up to 8 weeks at all rates on larvae.<br><br>The 4 ppm dose prevented any pupation for the entire 8 week study period. |

higher rates may be needed to overcome absorption to matter. If the system is closed, such as sewage pits or lagoons. Dimilin may give control for up to a month. Shelf life of Dimilin is excellent (> 6 years) as long as the material remains dry.

Dimilin has shown no resistance under field use. Organo-phosphate resistant mosquitoes are sensitive to Dimilin.

In summary, Dimilin 25W is an excellent product to use for mosquito larval control with minimal effect on the aquatic or terrestrial environments.

## LITERATURE CITED

Hsieh, M. Y. H., Steelman, C. D. 1974. Mosquito News 33, 278.

Mulder, R. and M. J. Gijswijt. 1973. The laboratory evaluation of 2 promising new insecticides which interfere with cuticle deposition. Pestic. Sci. 4:737-745.

Post, L. C., B. J. deJong and W. R. Vincent. 1974. 1-(2,6-Distributed benzoyl)-3-pbenylurea insecticides: Inhibitors of chitin synthesis. Pestic. Biochem. Physiol. 4:473-483.

Rathburn, C. B. Jr. and A. H. Bioke, Jr. 1975. Laboratory and small plot field test of Altosid and Dimilin for the control of *Aedes taeniorhynchus* and *Culex nigripalpus* larvae. Mosq. News 35:540-546.