FURTHER EVALUATION OF THE EFFECTIVENESS OF MOSQUITO BEATER,® A GRANULAR REPELLENT, AGAINST MOSQUITOES[1, 2]

ROBERT G. MEANS[3]

New York State Science Service, N. Y. State Museum, Albany, NY 12234

ABSTRACT. Mosquito Beater®, vermiculite granules containing naphthalenes and polymethylated naphthalenes, performed satisfactorily as a repellent against mosquitoes for up to 24 hr in a limited area of 5,625 ft² when applied either over an entire area or on a 15 ft border within the perimeter of the area.

A granular area repellent, Mosquito Beater® [4], was evaluated in 1972 and found to be effective in driving mosquitoes from a 50 ft square area and preventing re-entry for up to 24 hr when applied at the manufacturer's recommended rate of ½ cup per 100 ft² (approximately 4.5 lb per acre AI) (Means 1973). Mosquito Beater contains 20.5% naphthalenes and polymethylated naphthalenes impregnated in 30–50 mesh exfoliated vermiculite granules and is marketed in 1 lb, 10 oz cellophane bags. Naphthalene has an oral LD_{50} of 2,000–3,000, making it only slightly toxic as compared to other insecticides (Dewey et al. 1976). No threshold limit value has been established for atmospheric concentrations of naphthalene (Monsanto, Pers. Comm., Nov. 16, 1977).

From June 23 to July 4, 1975, Mosquito Beater was evaluated further to determine its effectiveness against mosquitoes when applied as a barrier, i.e. in a 15 ft wide strip within the perimeter of the test site, as compared with complete coverage, i.e. evenly distributed over the entire test site.

TEST SITES.

Tests were conducted at Limekiln Lake Public Camping area and Moose River Plains Recreation Area in the Adirondack Mountains. Both sites were located between the towns of Indian Lake and Inlet, New York and were maintained and operated by the New York State Department of Environmental Conservation. Moose River Recreation Area was a wilderness region of about 50,000 acres containing several dozen ponds, lakes, marshes and streams with access only by dirt roads and trails. Limekiln Lake Camping area was a camping area containing about 200 campsites. Neither area received any chemical treatment for biting insects which were extremely abundant during late June and early July.

METHODS.

The methods used to apply the test material and evaluate its effectiveness were similar to those described earlier (Means 1973). Test sites were 75 × 75 feet (5,625 ft²). Three observation stations were selected at each site: Station I (untreated control) was 25 ft outside the treated plot: Station II was 7.5 ft inside the edge of the plot; Station III was in the center of the plot (figs, 1a, b).

Tests were begun at 7:00 p.m. each day for 9 successive days, each at a different test site. Landing rate counts of mosquitoes were made after waiting 5 minutes at each station, beginning with Station I, counting the mosquitoes which landed on the observer during the next 5

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[2] This paper reflects the results of research only. Use of the trade name, Mosquito Beater, does not constitute a recommendation or endorsement by the New York State Science Service.

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[4] Bonide Chemical Company, Utica, New York.

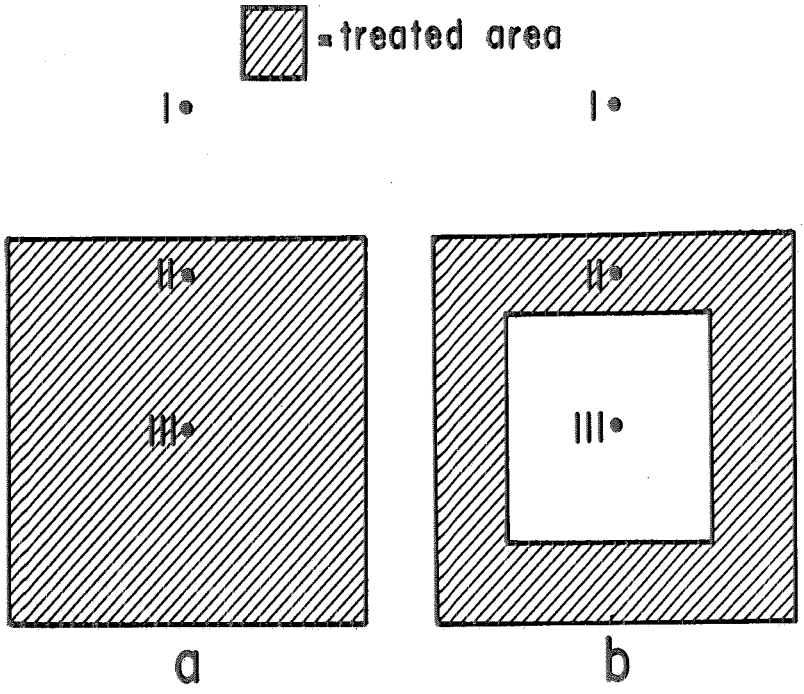


Fig. I. Treated area of test plots; a. Complete coverage treatment. b. Perimeter treatment. Observation stations: I—control, II—edge of plot, III—center of plot.

minute period, then moving quickly to the next station (II then III). At the conclusion of counting at each station any mosquitoes which remained on the observer were brushed off with hands or a net before proceeding to the next station. Counts were made just prior to application of the test material and approximately 0.5, 1, 3, 24, 36 and 48 hr following application. Thirty specimens from each of 9 test sites in the 2 general test areas were collected at random and saved for future identification. The species composition is shown in table 1.

Three replicates each of 3 tests were conducted; a complete coverage treatment, i.e. evenly distributed over the entire test site at the rate of 4.5 lb per acre AI (fig. 1-a); and as a perimeter barrier treatment, i.e. applied as a 15 ft strip within the perimeter of the test site (fig. 1-b) at the rates of 4.5 and 9.0 lb per acre AI. A cylindrical cardboard ice cream container with 3–6 holes punched in the bottom was used as a shaker to spread the material evenly over the test site. In perimeter barrier treatments, the dosages of 4.5 or 9.0 lb per acre were figured only for the area to which the material was actually applied. Therefore less material was used to treat a site than the same size site treated with full coverage at the same rate.

RESULTS

COMPLETE COVERAGE TREATMENTS. Beginning approximately 1 hr after application at the rate of 4.5 lb per acre AI (naphthalenes), the mean mosquito landing rate for a 5 min period was reduced from 23 to zero at station III (center of test plot). The landing rate at station I

Table 1. Composition of mosquito species collected at random from nine locations in the Adirondacks, New York before and after treatment with Mosquito Beater® granular repellent.

Mosquito species	Pretreatment[1]		Three hours post-treatment[2]	
	Number	Percent	Number	Percent
Aedes canadensis	16	6	0	0
Aedes cinereus	10	<5	2	<5
Aedes stimulans gp.	103	38	56	47
Aedes triseriatus	13	5	8	7
Aedes communis	13	5	5	<5
Aedes trichurus	9	<5	0	0
Aedes vexans	97	36	46	38
Coquillettidia perturbans	2	<5	1	<5
Anopheles punctipennis	7	<5	2	<5

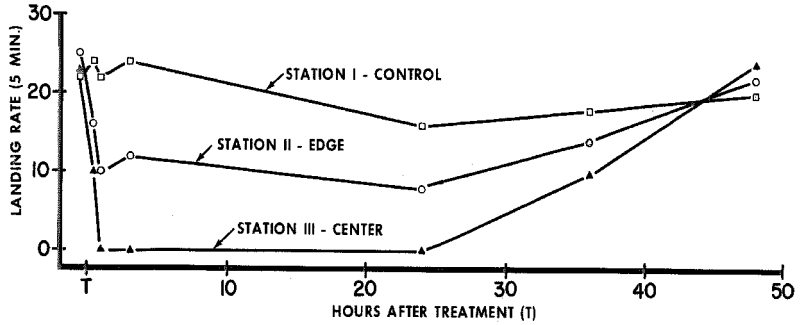
[1] Thirty specimens collected from station III at each location immediately prior to treatment.
[2] Total of 120 specimens collected from near station III at each location over a nominal 30 minute period three hours after treatment.

(control, outside of test plot) was 22, unchanged from the pretreatment rate; at station II (near edge of plot), the rate was 10, reduced from a pretreatment rate of 25. The landing rates at each of these stations remained about the same for 24 hr, then progressively returned to the pretreatment levels after 48 hr (graph I).

PERIMETER TREATMENTS. In treatments of a 15 ft wide perimeter barrier, the landing rate was reduced at the center of the test plot to less than 5 from about 70 beginning 1 hr after treatment at the rate of 4.5 lb per acre. At 9.0 lb per acre, the landing rate increased slightly from 20 to 26 one-half hr after treatment, then decreased to zero after 3 hr. At both dosages the landing rates remained low for 24 hr; then increased to approximately the pretreatment level after 48 hr. At both dosages the landing rate at station II was also greatly decreased while the rate at Station I remained the same or increased (graph II).

SUMMARY AND DISCUSSION

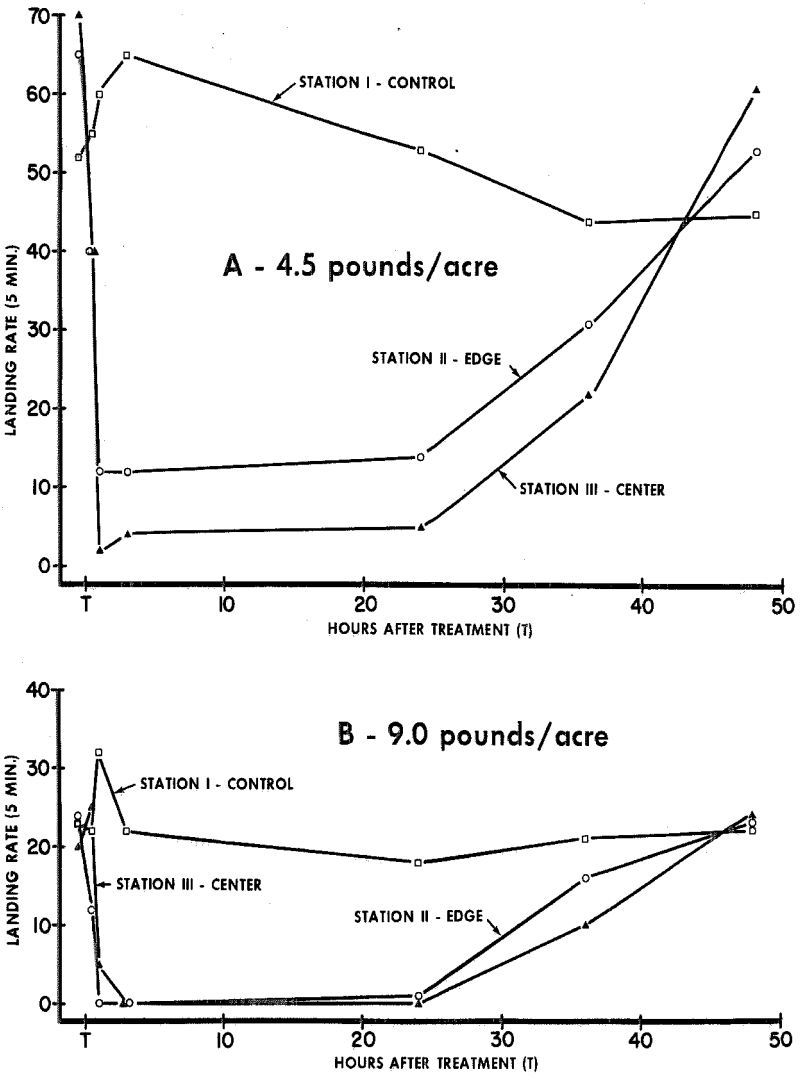
Treatment of a limited area (75 × 75 feet) with Mosquito Beater® at the rate of 4.5 lb per acre AI (naphthalenes) reduced the landing rate of mosquitoes by 100% beginning about 1 hr after treatment and



Graph I. Mean landing rates of mosquitoes at three observation stations in plots treated completely with Mosquito Beater® granular repellent at the rate of 4.5 pounds per acre.

lasting for up to 24 hours. Treatment of just a 15 ft border within the perimeter of a 75 × 75 ft area produced similar results (90 to 97% reduction at the rate of 4.5 lb per acre for up to 24 hr).

The test material was nearly as effective in driving mosquitoes from the center of a 5,625 square foot area when applied as a perimeter barrier on only 3,600 square feet of the area as when it was applied at



Graph II. Mean landing rates of mosquitoes at three observation stations in plots treated with a fifteen foot perimeter barrier of Mosquito Beater® granular repellent: A. 4.5 pounds per acre, B. 9.0 pounds per acre.

the same rate over the entire test area. Since less material was used for this type of treatment it may be a more desirable method, especially since this would provide for even less chance for contact or inhalation of the material. A repellent barrier may have several uses, for example, repelling mosquitoes and other insects from a campsite, a picnic area, or various outdoor events.

References Cited

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TOXICITY OF THE IGR, DIFLUBENZURON, TO FRESHWATER INVERTEBRATES AND FISHES

ARNOLD M. JULIN AND HERMAN O. SANDERS

U.S. Fish and Wildlife Service, Columbia National Fisheries Research Laboratory, Columbia, Missouri 65201

ABSTRACT. Technical grade material and wettable powder formulations of the insect growth regulator diflubenzuron and 3 of its degradation products were tested for toxicity to 3 species of aquatic invertebrates and 4 fishes: daphnids (*Daphnia magna*), scuds (*Gammarus pseudolimnaeus*), midges (*Chironomus plumosus*), rainbow trout (*Salmo gairdneri*), fathead minnows (*Pimephales promelas*), channel catfish (*Ictalurus punctatus*), and bluegills (*Lepomis macrochirus*). The acute toxicities of the wettable powder formulation of diflubenzuron ranged from a 48-hr EC_{50} (estimated concentration immobilizing 50% of test organisms) of 0.015 mg/liter for daphnids to a 96-hr LC_{50} (estimated concentration producing 50% mortality) of 660 mg/liter for bluegills. The 96-hr LC_{50} of the technical grade material exceeded 100 mg/liter for all 4 fishes. The most toxic degradation product, 4-chloroaniline, had a 96-hr LC_{50} of 2.4 mg/liter to bluegills and a 48-hr EC_{50} of 43 mg/liter to early fourth-instar midge larvae. The 48-hr $EC_{50's}$ (midge larvae) and 96-hr $LC_{50's}$ for 3 of 4 species of fish for 4-chlorophenyl urea and 2,6-difluorobenzoic acid were greater than 100 mg/liter.

INTRODUCTION

The insect growth regulator, (IGR) diflubenzuron (Dimilin®)[1] is a substituted phenylurea compound that inhibits chitin synthesis during metamorphosis of immature insects (Thompson-Hayward Chemical Company 1974). Diflubenzuron is a member of a group of new chemicals that are proposed as potential alternatives for the more persistent insecticides. These chemicals are indirectly toxic to insects because they interfere with deposition of chitin in the exoskeleton (Wellinga et al. 1973). At molting the larvae are unable to cast their exoskeleton, and either die because the new cuticle ruptures, or from starvation.

Diflubenzuron is biologically active against a variety of target insects, such as mosquitoes (Mulla et al. 1975), house flies (Miller et al. 1975), and alfalfa weevils (Neal 1974). Persistence of this compound in water appears to be limited due to hydrolysis and to adsorption onto organic matter (Schaefer and Dupras 1976). The Environmental Protection Agency (EPA) has granted registration of diflubenzuron for use on the gypsy moth

[1] Reference to the trade name does not imply Government endorsement.