PACIFIC SOUTHWEST
Forest and Range
Experiment Station

FOREST SERVICE
U.S.DEPARTMENT OF AGRICULTURE
P.O. BOX 245, BERKELEY, CALIFORNIA 94701

Toxicity of INSECTICIDE AEROSOLS TO NEEDLE MINER ADULTS of the genus *Coleotechnites*

Robert L. Lyon Marion Page

USDA Forest Service
Research Note PSW-243
1971

Abstract: Ten insecticides were tested in aerosol form against adult needle miners of the genus *Coleotechnites* collected from the Winema National Forest in Oregon and from the Inyo National Forest in California. In these laboratory tests, the pyrethrins were the most toxic. They were about six to seven times more toxic than malathion–the insecticide considered the most effective in suppressing needle miner epidemics. None of the chemicals other than pyrethrins was clearly more toxic than malathion. All candidates except trichlorfon caused 90 percent mortalities at 0.35 μg. per sq. cm. (equivalent to 0.5 oz. per acre) or less.

Oxford: 145.7 X 18.28 *Coleotechnites* spp.: 453–414.12 [+ 414.12 Malathion + 414.12 Pyrethrins].
Retrieval Terms: Coleotechnites spp.; insecticides; toxicity; aerosols; Pyrethrins; Malathion; California; Oregon; Inyo National Forest; Winema National Forest.

The lodgepole needle miner *(Coleotechnites milleri* [Busck]*)* is one of the most destructive defoliators of lodgepole pine forests in the Western United States and Canada. Its outbreaks are long lasting. And in combination with attacks by the mountain pine beetle *(Dendroctonus ponderosae* [Hopk.]*)*, they have caused extensive tree mortality.[1]

An aerial spray of malathion is considered the most effective insecticide for control of *C. milleri* adults in California.[2] Recommended dosage per acre is 13 fluid ounces in 10 gallons of fuel oil.

Other species of *Coleotechnites* have not yet been studied in as much detail as *C. milleri,* but they also defoliate thousands of acres. Recently we tested 10 insecticides, in aerosol form, on two populations of needle miner adults. Both populations lack positive identification, but are closely related to *C. milleri.* One population came from the Inyo National Forest in California; the other from the Winema National Forest in Oregon. No control has been attempted against either the Inyo or the Winema needle miners. The purpose of these laboratory tests was to find promising candidate chemicals for field tests against these defoliators in the adult stage.

If properly timed, spraying adults–in contrast to spraying larvae–may help spare the parasites of the insect.[3] Struble reported that spraying malathion on *C. milleri* adults did not adversely affect the post-treatment ratio of the pest insect to its parasites.[4]

Among the 10 insecticides tested, pyrethrins were the most toxic. We also found that less malathion than is now suggested for effective control may be feasible for suppression of *C. milleri.*

INSECTS

Overwintering needle miner larvae in lodgepole pine foliage were shipped to Berkeley,[5] California, and refrigerated at 5°C. The infested foliage was brought out at regular intervals so the larvae could be

reared to the adult stage for insecticide testing. The lodgepole pine branches were placed in water in sleeve cages and provided with a photophase of 24 hours (8 of which were low light intensity) and temperature of 23 to 26°C. Relative humidity ranged from 33 to 52 percent in the rearing room, but was undoubtedly much higher in the sleeve cages. Adults matured and began emerging from the needles usually 4 to 6 weeks later.

INSECTICIDES

These 10 insecticides, in aerosol form, were tested:[6]

Allethrin	Naled
Aminocarb	Pyrethrins
DDT	Sumithion
Malathion	Trichlorfon
Methomyl	Zectran

The insecticides were freshly formulated on each day of use in tripropylene glycol monomethyl ether (Dowanol TPM). All expressions of dosage were based on the active ingredient.

The nomenclature of insecticides used here is that of the Committee on Insecticide Terminology of the Entomological Society of America. Proprietary names are used where common names have not yet been approved by the Committee. Chemical names and molecular structure may be found in Frear's *Pesticide Index.*[7]

TESTING PROCEDURE

Adults were collected with an aspirator lined inside with facial tissue to reduce injuries to the moth. They were treated in groups of 10 to 20 in a spray chamber. The technique was similar to that reported by Lyon, *et al.*[8] except that the atomizer was an unmodified No. 40 Devilbiss nebulizer. The aerosol produced had a mass median diameter of 19μ, that is, 50 percent of the spray mass or volume was in droplets greater than 19μ in diameter and 50 percent less. Maximum droplet size was about 50μ.[9]

The adults were anesthetized with CO_2 and treated while lying inactive in a paper "dish" 9 cm. in diameter and 1 cm. deep. Insecticide concentrations were 0.1, 1, or 5 mg. per ml. and dosage was varied by adjusting the volume of aerosol delivered into the chamber. This volume ranged from 0.0095 to .055 μl. per sq. cm. which is equivalent to 0.81 to 4.7 pints per acre.

The insecticides were tested on each insect population usually at four to six dosage levels and replicated 2 or 3 times. Control insects were treated only with the solvent.

Dosage was measured as μg. of insecticide per sq. cm. and converted to its equivalent in oz. per acre by the transformation: μg. per sq. cm. $\div$ 0.7 = oz. per acre.

Treated adults were transferred to 100 by 20-mm. sterile, plastic petri dishes. Moist filter paper was added to the dishes to minimize mortality from desiccation. The insects were not fed. Dead and living insects were tallied 24 hours after treatment.

RESULTS

All compounds except trichlorfon were highly toxic to the needle miner adults, requiring less than 0.5 oz. per acre (0.35 μg. per sq. cm.) for 90 percent mortality *(table 1).* Pyrethrins were most toxic to both needle miner populations: 6.2 times more toxic than malathion against California adults and 7.2 times more so against the Oregon adults. No other compound besides pyrethrins was clearly more toxic than malathion.

The candidate insecticides differed only slightly in their spectrum of activity when arranged in order of toxicity. All but Sumithion showed similar relative and absolute toxicities to both needle miners *(fig. 1).*

We know of no similar data for *C. milleri,* but it seems likely that this related insect would respond similarly to the insecticides tested. It follows that suppression of epidemic populations of needle miners in lodgepole pine might be accomplished with less insecticide than is now suggested (13 fluid oz. or

Table 1—*Toxicity of 10 insecticide aerosols to needle miner (genus Coleotechnites) adults*

Insecticide	Dosage causing 90 percent mortality[1] of insects treated			
	Oregon needle miner		California needle miner	
	Oz./acre	*No.*	*Oz./acre*	*No.*
Pyrethrins	0.018	265	0.016	236
Zectran	.081	454	.12	167
DDT	.12	400	–	–
Malathion	.13	524	.10	288
Naled	.13	303	.19	98
Aminocarb	.16	314	.17	130
Allethrin	.20	174	.11	58
Methomyl	.29	229	.25	101
Sumithion	.44	274	.11	122
Trichlorfon	–	–	>[2]1.00	92

[1]Corrected for natural mortality by Abbott's formula; 131 of 566 or 23 percent of Oregon adults died in the controls; 64 of 262 or 24 percent of California adults died in the controls.
[2]LD_{90} is at least greater than 1 oz./acre; because of low toxicity, this insecticide was not further tested.

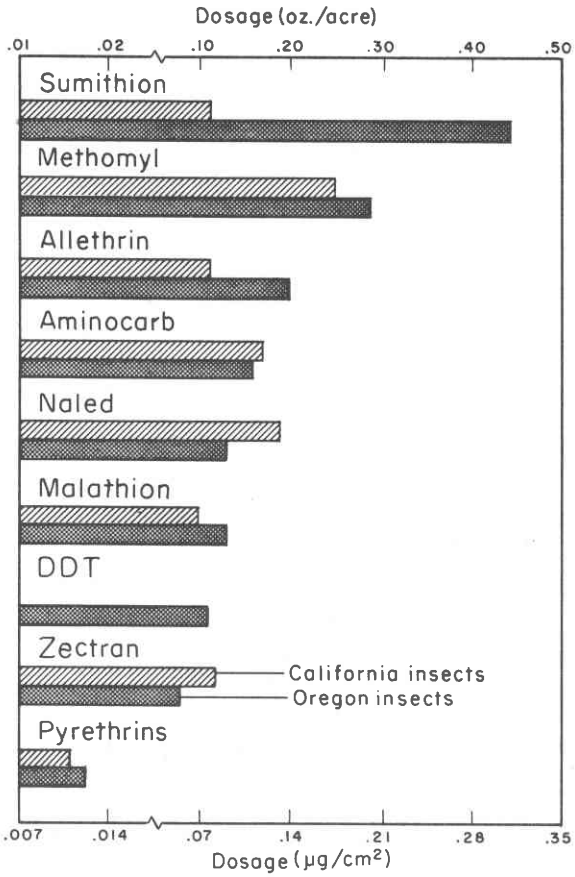

Figure 1—*Among nine insecticides tested, only Sumithion did not show a similar toxicity to both the California and Oregon populations of the needle miner (genus Coleotechnites). The dosage shown is that needed for 90 percent mortality.*

about 1 lb. per acre) for suppression of *C. milleri*. Field tests would be needed to establish the minimum effective dose level. The relatively higher toxicity of pyrethrins together with their recent stabilization for outdoor use[10] make them a promising candidate for such field testing.

NOTES

[1]Struble, G. R. *Lodgepole needle miner.* U.S. Dep. Agr. Forest Pest Leafl. 22, 7 p. 1958.

[2]Struble, G. R. *Lodgepole needle miner controlled by aerial sprays.* Proc. 6th World Forestry Congr. 2(1966): 1946-1950. 1969.

U.S. Department of Agriculture. *Suggested guide for the use of insecticides to control insects affecting crops, livestock, households, stored products, forests, and forest products—1968.* Agr. Handb. 331, p. 267. Washington, D. C. 1968.

[3]Telford, A. D. *Lodgepole needle miner parasites: biological control and insecticides.* J. Econ. Entomol. 54(2): 347-355. 1961.

[4]Struble, G. R. *Effect of aerial sprays on parasites of the lodgepole needle miner.* J. Econ. Entomol. 58(2): 226-227. 1965.

[5]We thank Thomas W. Koerber, Pacific SW. Forest & Range Exp. Sta., Berkeley, Calif., and Boyd E. Wickman, Pacific Northwest Forest & Range Exp. Sta., Corvallis, Oregon, for their help in collecting the needle miners used in these tests.

[6]Brand names and commercial enterprises or products are named solely for necessary information. No endorsement by the U.S. Department of Agriculture is implied.

[7]Frear, D. E. H. *Pesticide Index.* 4th ed. 399 p. State College, Penn.: College Sci. Publishers. 1969.

[8]Lyon, R. L., M. Page, and S. J. Brown. *Tolerance of spruce budworm to malathion—Montana, New Mexico populations show no differences.* USDA Forest Serv. Res. Note PSW-173, Pacific SW. Forest & Range Exp. Sta., Berkeley, Calif. 6 p. 1968.

[9]May, K. R. *The measurement of airborne droplets by the magnesium oxide method.* J. Sci. Instr. 27: 128-130. 1950.

[10]Miskus, R. P., and T. L. Andrews. *Stabilization of pyrethroid compositions.* Patent granted May 20, 1970.

The Authors

ROBERT L. LYON, an entomologist, is responsible for insect culture and bioassay in the Station's studies in the evaluation of chemical insecticides. He attended New York State University College of Forestry, where he earned B.S. (1953) and M.S. (1954) degrees. He received a doctorate in entomology (1961) from the University of California, Berkeley. **MARION PAGE**, a research biologist with the Station staff since 1965, is 1963 biology graduate of San Francisco State College.

The Forest Service of the U.S. Department of Agriculture

. . . Conducts forest and range research at more than 75 locations from Puerto Rico to Alaska and Hawaii.

. . . Participates with all State forestry agencies in cooperative programs to protect and improve the Nation's 395 million acres of State, local, and private forest lands.

. . . Manages and protects the 187-million-acre National Forest System for sustained yield of its many products and services.

The Pacific Southwest Forest and Range Experiment Station

represents the research branch of the Forest Service in California and Hawaii.

This publication reports research involving pesticides. It does not contain recommendations for their use, nor does it imply that the uses discussed here have been registered. All uses of pesticides must be registered by appropriate State and/or Federal agencies before they can be recommended.

CAUTION: Pesticides can be injurious to humans, domestic animals, desirable plants, and fish or other wildlife—if they are not handled or applied properly. Use all pesticides selectively and carefully. Follow recommended practices for the disposal of surplus pesticides and pesticide containers.

GPO 981-090