Western Tent Caterpillar:[1] Contact Toxicity of Ten Insecticides Applied to the Larvae[2]

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ABSTRACT

Ten chemicals representative of four insecticide groups (carbamate, organophosphate, chlorinated hydrocarbon, and pyrethroid) were applied topically to mixed groups of 5th- and 6th-stage larvae of *Malacosoma californicum californicum* (Packard). Only 2—the pyrethroid NIA 24110 ((5-benzyl-3-furyl) methyl *trans*-(+)-3-(cyclopentylidene-methyl)-2,2-dimethylcyclopropanecarboxylate), and resmethrin—were more toxic than DDT at LD_{50}. Because of the low slope of DDT, however, 8 insecticides exceeded it in toxicity at LD_{90}. These were, in decreasing order of toxicity, NIA 24110, resmethrin, methomyl, pyrethrins, mexicarbate, carbaryl, and malathion.

The western tent caterpillar, *Malacosoma californicum* (Packard), is a defoliator of many deciduous trees and shrubs in the western United States. Carbaryl has been recommended for its control (Stelzer 1971). Lyon et al. (1972b) reported laboratory tests of insecticides applied to another species, *M. disstria* Hübner. In a recent revision of the genus, Stehr and Cook (1968) described several subspecies of *M. californicum*. Insecticide tests against one of these, *M. californicum lutescens*, have been reported by Page and Lyon (1973).

Another subspecies, *M. californicum californicum* (Packard), though commonly found on fruit trees, is particularly abundant on coast live oak, *Quercus agrifolia* Neé., in the San Francisco Bay area. This paper reports laboratory tests of 10 insecticides applied to *M. c. californicum*. The results provide a basis for comparing the differential responses of this subspecies, *M. c. lutescens*, and *M. disstria* to the same insecticides.[3]

METHODS AND MATERIALS.—*Insect Culture*.—Tents containing larvae in all stages of development were collected on 2 occasions in April 1972, from live oaks in Sonoma County, north of San Francisco. They were transferred to twigs of live oak which were held in 16-oz plastic containers filled with water. The twigs and insect larvae were held in 30×21×17-in. wooden sleeve-cages with glass tops. Fresh foliage was provided as necessary.

Larvae emerging from egg masses that had been collected from the same area in July 1971 were reared singly on the artificial diet of Lyon et al. (1972a). Each larva was checked daily for the presence of shed skin and head capsule. Head capsules were measured to the nearest 0.05 mm with an ocular micrometer in a binocular dissecting microscope. These measurements provided information for proper identification of 5th- and 6th-stage larvae.

Insecticide Formulation.—Ten chemicals were evaluated. Three were pyrethroids: NIA 24110 ((5-benzyl-3-furyl) methyl *trans*-(+)-3-(cyclopentylidenemethyl)-2,2-dimethylcyclopropanecarboxylate), resmethrin, and pyrethrins. Three were carbamates: carbaryl, mexicarbate, and methomyl. Three were organophosphates: malathion, trichlorfon, and Gardona® (2-chloro-1-(2,4,5-trichlorophenyl) vinyl dimethyl phosphate). One was a hydrocarbon: DDT.

Each insecticide was formulated in reagent grade acetone on the basis of weight/volume concentrations of the active ingredient. Fresh formulations were made for each of at least 3 replicates. Four to 8 concn/insecticide were used to compute dose-response curves by probit analysis (Daum 1970).

Treatment Procedure.—Fifth- and 6th-stage larvae were segregated, by weight, in groups of 10 into sterile plastic petri dishes (20×100 mm) lined with filter paper and treated at the dose rate of 1 µl/100 mg body weight. No anesthesia was used. Control insects were treated with acetone only. Test insects (119.1±36.6 mg avg wt) (mean±SD) were treated topically by using an ISCO model M microapplicator equipped with ¼-cc tuberculin syringe fitted with a 27-gauge hypodermic needle. Each insecticide was applied to the thoracic dorsum of test larvae. After treatment, the filter paper in the treatment dishes was moistened with water. Fresh foliage was provided as necessary. Mortality counts were made 7 days after treatment.

RESULTS AND DISCUSSION.—Larvae displayed 6 instars, the same number reported for *M. californicum lutescens* (Page and Lyon 1973), and *M. californicum fragile* (Baker 1969). The average widths (millimeters) of head capsules for the 6 instars were 0.40, 0.59, 0.99, 1.25, 1.64, and 2.36.

NIA 24110, the most active compound tested (Table 1), was about 9× more active at both LD_{50} and LD_{90} than the 2nd most active compound, resmethrin. The toxicity of resmethrin was the same for the 5th and 6th instars when insects in these larval stages were tested separately. Resmethrin, in turn, was about 8× more active than the 3rd most active compound, DDT, at LD_{50} and 63× more active at LD_{90}. The position of DDT as 3rd most active compound at LD_{50} was unexpected, since it was least active compound tested on *M. californicum lutescens* and the 3rd to least toxic tested on *M. disstria* (Table 2). Because the slope of DDT was so low, however, 8 insecticides exceeded it in toxicity at LD_{90}. These were, in decreasing order of toxicity, NIA 24110, resmethrin, methomyl, pyrethrins, mexicarbate, trichlorfon, carbaryl, and malathion.

Six chemicals—NIA 24110, resmethrin, DDT, methomyl, pyrethrins, and mexicarbate—exceeded carbaryl in toxicity to *M. californicum californicum* at LD_{50}. Six—NIA 24110, resmethrin, methomyl, pyrethrins, mexicarbate, and trichlorfon—exceeded it in toxicity at LD_{90}. Table 1 gives the toxicity ratio of each insecticide tested relative to carbaryl.

Any comparison between the responses of *M. californicum lutescens*, *M. disstria*, and *M. c. californicum* is complicated by the differences in development stages

[1] Lepidoptera: Lasiocampidae.

[2] Received for publication Jan. 8, 1973.

[3] This paper reports research involving chemical insecticides. It does not include recommendations for their use, nor does it imply that 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.

Table 1.—Toxicity of 10 insecticides applied topically to 5th- and 6-stage *M. c. californicum*.

Insecticide	No. insects treated	Slope±SE	LD_{50} [a]	95% fiducial limits	LD_{90} [a]	95% fiducial limits	Toxicity[b] ratio	
							LD_{50}	LD_{90}
NIA 24110	542	2.06±0.43	0.005	0.003–0.008	0.023	0.014– 0.073	434	276
Resmethrin	297[c]	2.02± .24	.038	.029– .046	.161	.129– .222	57	40
	298[d]	2.75± .57	.042	.019– .062	.123	.082– .354	49	31
	865	1.94± .31	.044	.024– .063	.202	.138– .417	52	52
DDT	480	0.83± .20	.345	.012–1.16	12.7	7.15 –25.7	6.3	0.50
Methomyl	241	3.75± .20	.356	.335– .375	.781	.737– .837	6.1	8.1
Pyrethrins	291	2.16± .36	.614	.405– .800	2.41	1.81 – 3.86	3.5	2.6
Mexicarbate	302	2.54± .31	.777	.612– .923	2.48	2.07 – 3.21	2.8	2.6
Carbaryl	369	2.74± .32	2.17	1.84 –2.50	6.36	5.12 – 8.77	1.0	1.0
Trichlorfon	430	3.03± .39	2.22	1.75 –2.64	5.87	4.94 – 7.48	0.97	1.1
Malathion	250	4.13± .72	3.97	3.21 –4.61	8.11	6.78 –11.03	.55	.78
Gardona	311	2.41± .49	4.50	2.74 –5.87	15.3	11.7 –25.2	.48	.42

[a] Dose expression is mg/g body weight.
[b] Toxicity index = LD carbaryl/LD candidate.
[c] 6th stage only.
[d] 5th stage only.

of the insects tested. Fifth-stage larvae of *M. californicum lutescens*, 4th-stage larvae of *M. disstria*, and 5th- and 6th-stage larvae of *M. c. californicum* were used in this and earlier tests. Whether these differences affect the comparison is not known.

When the responses of the 3 insect groups were compared, the following chemicals were more toxic at LD_{50} to *M. c. californicum* than to *M. californicum lutescens* (Table 2): resmethrin (1.5×), DDT (105×), mexicarbate (1.7×), trichlorfon (1.4×), and Gardona (1.7×). Chemicals more toxic to *M. c. californicum* than to *M. disstria* were: DDT (19×), mexicarbate (1.1×), carbaryl (1.1×), trichlorfon (5.8×), and malathion (1.9×). Three chemicals were more toxic to *M. californicum lutescens* than to *M. c. californicum*: methomyl (1.2×), pyrethrins (2.3×), and malathion (1.5×); methomyl (1.4×) and pyrethrins (5.1×) were more toxic to *M. disstria* than to *M. c. californicum*.

Table 2.—LD_{50} values (µg/g body weight) of 9 insecticides applied topically to *Malacosoma* species.

Insecticide	*M. c. californicum*	*M. c. lutescens*[a]	*M. disstria*[b]
Resmethrin	0.04	0.06	—
DDT	.34	35.8	6.46
Methomyl	.36	.29	0.25
Pyrethrins	.61	.26	.12
Mexicarbate	.78	1.30	.88
Carbaryl	2.17	—	2.31
Trichlorfon	2.22	3.21	12.9
Malathion	3.97	2.63	7.55
Gardona	4.50	7.50	—

[a] Data from Page and Lyon (1973).
[b] Data from Lyon et al. (1972b).

The results show that *M. c. californicum*, *M. californicum lutescens*, and *M. disstria* differed little in their response to the chemicals except DDT. Only in response to that one insecticide did there seem to be wide interspecific and subspecific variation.

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