The 13-year Cicada—Conclusion of an Experiment Started in 1963[1]

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Introduction

The periodical cicada, Magicicada spp., a pest of orchards in many areas of the U.S., makes dramatic appearances at intervals of either 13 or 17 years. After years of feeding underground upon roots of the trees, they sudenly emerge in enormous numbers and move into trees and other woody vegetation in the area. Although adults are equipped with piercing-sucking mouthparts, they do not feed. Instead, they damage the tree with oviposition wounds made when the female deposits her eggs in the bark of the trees. Hamilton and Cleveland said, "The bark is pushed from the wood and the wood cut and raised so that series of small bundles of splinters protrude from the surface" (2). Each female lays from 400 to 600 eggs with 12 to 20 eggs deposited within each puncture. The damage can be severe in apple and peach orchards, causing die-back of terminals and death of even large branches.

Control of the adult cicadas is difficult. Since the insect does not feed actively after emergence, it must be reached with a contact insecticide to kill it. Moreover the insects emerge in large numbers daily over a period of 2 to 3 weeks, so in orchards adjacent to woodlands and in orchards heavily infested by the previous brood of cicadas, numerous applications of insecticides may be necessary.

Because of this difficulty during emergence of Brood XXIII of the periodical cicada in 1963, Hamilton and co-workers initiated research to determine the potential for controlling newly hatched cicada nymphs. Their investigations showed that as many as 63 nymphs 10.092 m^2 (1 ft^2) were common under mature apple trees in southern Indiana, that is about 43,000 nymphs were feeding on the roots of each tree. They suspected, therefore, that severe decline of apple trees, often attributed to other causes, might actually reflect the heavy feeding over 13 or 17years of an expanding population of cicadas. Hamilton identified all three species of the 13-year cicada, *Magicicada tredecim*-Walsh and Riley, *M. tredecassini*-Alexander and Moore, and *M. tredecula*-Alexander and Moore, in the 1963 population (1).

Materials and Methods

In 1963, Hamilton (unpublished data) tested 3 carbamates: Carbaryl (1-naphthyl methylcarbamate); aldicarb (2-methyl-2-(methylthio) propion-

[1]Mention of a pesticide in this paper does not constitute a recommendation for use by the U.S. Department of Agriculture nor does it imply registration under FITRA as amended.

[2]Now retired.

aldehyde *O*-(methylcarbamoyl)oxime); and mexacarbate (4-dimethylamino)-3 5-xylyl methylcarbamate); also 3 organophosphates: demeton (*O,O*-diethyl *O*-[2-(ethylthio)ethyl] phosphorothioate and *O,O*-diethyl *S*-[2-(ethylthio)ethyl] phosphorothioate); dimethoate (*O,O*-dimethyl *S*-[(methylcarbamoyl) methyl] phosphorodithioate); and phorate (*O,O*-diethyl *S*-[(ethylthio) methyl] phosphorodithioate. Foliar and ground applications of these materials were made in a heavily infested block of apple trees near Vincennes, Indiana, July 30 as eggs of Brood XXIII began to hatch. Carbaryl, aldicarb, and mexacarbate were applied at a rate of 453.6g a.i./378 liters (1 lb a.i./100 gal), and demeton, phorate, and dimethoate at 170g a.i./378 liters (6 oz a.i./100 gal). For the foliar application, trees were sprayed to run-off; for the ground treatment, ca. 5-10 gal/tree were applied. A randomized complete block design with 4 replications and 13 treatments (check plus foliar and ground application of the 6 chemicals) was utilized in the test.

Counts of egg mortality made during 1963 by Hamilton and Cleveland indicated that the foliar applications of aldicarb and mexacarbate were effective in reducing egg hatch. However, they had to wait for emergence of the adults in 1976 before the real evaluation could be made. Meanwhile, the entire research staff of the Vincennes laboratory was completely replaced though Hamilton did return to live in Vincennes after retirement. He was therefore available during the spring of 1976 and was able to work with the current staff of the laboratory to locate the plots used during 1963. Although some identity tags had been lost during the 13 years, enough remained to allow reconstruction of the experimental plots by using the plot maps in "Special Reports from 1963". Afterwards, screen cages, 67.09 cm^2 (2.2 ft^2), (1 cage/tree) were placed under the treated and check trees, and emergence of adult cicadas was monitored weekly during 1976 (May 20 through mid-June). No attempt was made to separate the 3 species of 13-year cicadas in the count. The resulting data were subjected to analysis of variance and the treatments were orthogonally partitioned.

TABLE 1. *Effect of foliar (F) and ground (G) application of chemicals applied in 1963 to apple trees on emergence of 13-year cicada in 1976.*

	No. of cicadas emerged		
Treatment	(F)	(G)	Total
Untreated	316	225	541
Carbaryl	192	156	348
Demeton	111	162	273
Dimethoate	134	127	261
Phorate	123	68	191
Aldicarb	71	91	162
Mexacarbate	52	83	135

LSD 0.05 = 36.9
LSD 0.01 = 45.1

Results and Discussion

The difference in emergence in the check and treated plots was highly significant (Table 1), but emergence in plots treated with carbamates was not

significantly different from emergence in plots treated with organophosphates. Aldicarb and mexacarbate were significantly (only 90% confidence limits) more effective than the other organophosphates dimethoate and demeton. The ground and foliar applications did not differ significantly.

All chemical treatments therefore gave some degree of control of freshly hatched cicadas. Mexacarbate, aldicarb, and phorate appeared to be most effective. It is impressive that differences between treatments still show so clearly despite the length of time that had elapsed and the impact of nature upon these populations. Obviously, the 1963 treatments against the eggs had produced quite large differences.

Literature Cited

1. HAMILTON, D. W., and M. L. CLEVELAND. 1963. Periodical cicadas in 1963, Broods 23 and 3. Special Report VI-7-63, Oct. 15, 1963. USDA 17p.

2. HAMILTON, D. W., and M. L. CLEVELAND. 1964. Periodical cicadas in 1963, Brood 23. Proc. Indiana Acad. Sci. **73**:167-170.