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INSECTICIDE RESIDUES

Residual Studies in Connection with Successive Applications of Heptachlor for Imported Fire Ant Eradication

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THE IMPORTED FIRE ANT, *Solenopsis saevissima richteri* Forel, is estimated to infest more than 21,000,000 acres in nine southern states. In 1957, the Congress appropriated $2,400,000 to commence the eradication of this pest. In a program of this size, even slight reduction in cost per acre can result in large savings. The present paper is concerned with residue studies aimed at determination of the minimum practical dosage of insecticide that can be used to accomplish eradication.

Lofgren (*7*) has reported that heptachlor is one of the most toxic insecticides tested against the imported fire ant. Heptachlor and dieldrin, at the rate of 2 pounds per acre in granular form, were the insecticides recommended for eradication purposes at the start of this program. The recommendations were based on research work conducted by the states of Mississippi and Alabama and the U. S. Department of Agriculture.

Recent work (*2–5*, *8*) has pointed out that heptachlor is lost very rapidly following application to the soil. Lofgren and coworkers (*6*) showed that two consecutive applications, each of 1/4 pound of actual heptachlor, spaced 3 or 6 months apart, are successful in the eradication of fire ants from small plots. Since it is physically impossible to treat the entire imported fire ant–infested area in the southern states in a short time, it was decided to determine the insecticide residue in the soil following

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Insecticide residue studies were undertaken in connection with the eradication of the imported fire ant, *Solenopsis saevissima richteri* Forel. These tests were part of an attempt to find ways to reduce the amount of insecticide applied with no resulting loss in the length of the effective residue. Two successive applications of small amounts of heptachlor gave as good fire ant control as one application of larger amounts. Chemical analysis of soil shows that the insecticide residue following two successive $^1/_4$-pound treatments of heptachlor is equivalent after 10 months to the residue following a single 1-pound treatment. Multiple applications have the added advantage that the number of application skips is reduced.

Table I. Residues of Heptachlor and Heptachlor Epoxide Found in Soil Following Consecutive Applications

(First application Jan. 26–28, 1959. Plots all sampled Nov. 24–25, 1959.)

Amount Applied		Date of	Residues, P.P.M.			
Pounds/ acre[a]	P.p.m.[b]	Second Application	Heptachlor	Heptachlor epoxide	Total	% Remaining
2	6.0	None	0.26	0.60	0.86	14.3
1	2.94	None	0.04	0.24	0.28	9.5
$^1/_2$	1.25	None	0.04	0.14	0.18	14.4
$^1/_2$	3.1	4–16	0.02	0.26	0.28	9.0
$^1/_2$	2.62	8–8	0.14	0.26	0.40	15.2
$^1/_4$	0.78	None	0.03	0.06	0.09	11.5
$^1/_4$	1.50	4–16	0.06	0.20	0.26	17.3
$^1/_4$	1.29	8–8	0.07	0.20	0.27	20.9
$^1/_8$	0.42	None	0.03	0.03	0.06	14.3
$^1/_8$	0.84	4–16	0.02	0.06	0.08	9.5
$^1/_8$	0.75	8–8	0.03	0.09	0.12	16.0

[a] Each treatment; nominal amount applied.
[b] Calculated as follows:

$$\text{P.p.m.} = \frac{W \times A \times 1{,}000{,}000}{w} = 3WA$$

where

W = weight of formulation applied in pounds (both applications), per acre
A = percentage toxicant in formulation
w = dry weight of soil (sandy loam) in 1 inch = 330,000 lb. per acre.

such applications, in order to determine the approximate length of protection provided by this treatment.

Methods

The plots used for the study were from two series of experiments for imported fire ant control. In series I, two applications of $^1/_8$, $^1/_4$, or $^1/_2$ pound per acre of heptachlor were tested at treatment intervals of 3 or 6 months. The biological results of this test have been reported (*6*). In the second series, which was part of a test on the effect of time of application on imported fire ant control with heptachlor, dosages of $^1/_4$, $^1/_2$, 1, and 2 pounds per acre were tested. Three replicates were run in the first series and two in the second. Both series of tests were conducted in the same field, a bahia grass pasture, and were applied with a Gandy fertilizer distributor over a period of 3 days. The plots in series I were 2 acres in size and in series II, 1 acre. The modified sampling and analytical technique described in previous investigations (*2*, *8*) was used. There were 44 plots in the test, including five untreated ones used as blanks.

Materials

The heptachlor was applied in granular formulations. The concentrations were adjusted so that for the $^1/_8$-, $^1/_4$-, and $^1/_2$-pound dosages in test series I, 10 pounds of total formulation per acre could be used, and for the $^1/_4$-, $^1/_2$-, 1-, and 2-pound dosages in series II, 20 pounds of total formulation. This was accomplished by providing 1.25, 2.5, and 5% heptachlor granules for series I, and 1.25 2.5, 5, and 10% for series II. The material varied only in heptachlor content. The granules were 24- to 48-mesh Attapulgus clay, extruded and dried. The deactivator used was Deactivator H (technical diethylene glycol). The heptachlor, in quantity sufficient to treat the required weight of clay, was dissolved in 10% (by weight of finished product) heavy aromatic naphtha, a petroleum fraction consisting of methylated aromatics boiling from 320° to 660° F. This material met specifications current at the time (*1*). The mixture was heated and stirred to facilitate solution and sprayed while still warm onto the clay, which was tumbling in a modified cement mixer. The deactivator was applied as a spray, either previous to or with the insecticide. These formulations were all commercially prepared, except for the 1.25% heptachlor. All were analyzed at time of application.

Results and Discussion

In Table I are given the results of residue analyses of the various treatments. The determinations for the identical treatments were averaged. None of the figures deviated sufficiently from the median to be open to question. The times of application, rates, and amounts of heptachlor and heptachlor epoxide found, with percentage remaining of that applied, are listed.

Previous studies (*2–5*, *8*) showed that there was an initial, very rapid, loss of heptachlor followed by a much slower loss of that remaining, with simultaneous conversion of a part to heptachlor epoxide. The present study confirms these findings, in that there is little difference in residue, if the second application went on 3 or 6 months following the first.

The success with consecutive quarter-pound applications of heptachlor for fire ant eradication is now more readily understood, as the two treatments yield a residue almost equal to a single 1-pound treatment applied at the beginning of the study. The efficiency with which an effective insecticidal residue is maintained in the soil is the important feature in the eradication efforts against the imported fire ant. It is apparent from this study and, in light of the very rapid loss of heptachlor from the soil, that two light applications of heptachlor at 3- to 6-month intervals are more efficient than one heavy application.

Since the two successive $^1/_4$-pound applications yield such a relatively high residue, the added advantage to be gained by two applications with consequent lower likelihood of skips makes this treatment the one of choice for imported fire ant eradication, confirming

the conclusions of Lofgren, Adler, and Barthel (*6*).

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