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Attractant-Mirex Bait Suppresses Activity of *Reticulitermes* Spp.[1,2,3]

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ABSTRACT

A field trial with mirex as bait for *Reticulitermes* spp. was initiated in S Mississippi. Sound wood and attractant (decayed) wood-bait blocks, 0.6×2.5×3.8 cm, pressure impregnated with mirex solution to a retention of 32 mg/block, were placed individually in the soil at 1.5-m spacing. Termite attacks on southern pine reference stakes were suppressed effectively. Since the termites fed more heavily on decayed than on sound wood, pickup of insecticides by the termites was far greater from the attractant blocks. An original installation of the mirex-attractant blocks effectively suppressed termites for 3 years.

The below-ground installation of toxic-attractant wood baits suppressed Reticulitermes spp. activity in S Ontario, Canada (Esenther and Gray 1968). Because that investigation was conducted near the N boundary of the Reticulitermes range and on a small isolated population, we initiated a new trial of the toxic bait. We wanted to determine if the bait would be effective in a warm climate in which termites are abundant and severely destructive, and to determine if the attractant would increase effectiveness of the bait. We also wanted to establish the duration of effectiveness of a single installation of a toxic-attractant bait. We report the results of the trial on the Harrison Experimental Forest in Mississippi.

MATERIAL AND METHODS. —Twelve plots, each 7.5 × 15.0 m (FIG. 1), were established in a mixed-pine hardwood stand in December 1.968. Individual plots were separated by a 7.5-m buffer zone. Fifty southern pine stakes (2.5×5.0×45.0 cm) were driven individually to ca. ½ their length into the sandy-loam soil at 1.5-m spacing, to form 10 rows and 5 columns/individual plot. Two inspections of the stakes pretreatment (placement of bait, blocks) were made at 3-month intervals to determine relative termite activity in the 12 plots. Attacks on the stakes were the basis for future evaluation of treatment effectiveness.

Immediately after the 2nd inspection of the pine stakes, baits were installed. The bait, a small block ca. 0.6×2.5×3.8-cm sweetgum sapwood, *Liquidambar styraciflua* L., with a plastic marker tab, was buried ca. 2.5 cm below the soil's surface. FIG. 2 shows the arrangement for 66 bait blocks and the 50 southern pine stakes/individual plot; each stake was protected at, the renter of a 1.5-m square by 4 bait blocks at the corners.

Bait, blocks were assigned according to 4 treatments on 12 plots by a completely random method (FIG. 1). Treatment and type of wood block were designated as follows: *A,* attractant (decayed wood only) ; *M,* mirex (furnished by Allied Chemical Corp., sound wood pressure-impregnated to a retention of 32-mg technical-grade mirex, ca. 1.3% wt/wt); *A + M,* attractant + mirex (decayed wood pressure-impregnated with 32 mg mirex) ; and Sup, supplementary attractant-mirex (same as A + M except for inspection procedure to be described).

The decayed wood block was highly attractive to *Reticulitermes,* because of brown-rot fungus infection (*Lenzites trabea* Mad. 617) (Esenther et al. 1961); infected blocks were mass-produced by a large-scale modification (2-qt mason jars rather than 8-oz bottles) of a soil-bottle method (Esenther and Gray 1968). After a 5, to 6-week incubation in the soil bottle, attractant blocks were autoclaved (15 lb, 30 min), and oven-dried (60°C). Dry blocks were stored at ca. - 10°C until used, but they have an unrefrigerated shelf life of at least 2 years.

The plots were inspected during 3 periods: pretreatment (2 times) ; treatment (6 times) ; and posttreatment (4 times).

Pretreatment Period, 2 Inspections at 3-Month Intervals. —Each pine stake on the 12 plots was recorded as attacked or not attacked; and if an attack was active (termites present), the stake was discarded, and a new stake was placed in the stake hole.

Treatment Period, 6 Inspections at 3-Month Intervals. —Bait blocks were in the plots during the treatment period, and comparative effects of the 4 treatments on the stakes were determined. The stake procedure was continued, as noted, on the plots. In addition, A, M, and *A + M* bait blocks of sweetgum sapwood were rated individually on the following scale for termite attack: 0 = no attack; 1 = 10% eaten; 2 = 10–39%; 3 = 40–70%; 4 = >70% eaten.

The old bait block was discarded and, except at the 6th inspection, a replacement block was inserted in the hole. In Sup plots, residues of treatment blocks were not removed during the posttreatment period, and inspections determined the duration of effectiveness of the initial treatment. Therefore, after the 6th treatment inspection, only remnants of the original supplementary attractant-mirex blocks remained on the plots.

Posttreatment Period, 4 Inspections at 6-Month Intervals. - During the posttreatment period, bait blocks were removed from the *A, M,* and *A + M* plots, and the time required for termite repopulation was determined. The stake-inspection procedure was continued as described previously.

RESULTS. —Table 1 summarizes the termite attacks (total/active) on southern pine stakes. Analysis of data from the 2 pretreatment inspections showed that termite attack on the stakes were the same in all plot areas. Consequently, we feel that just prior to installation of the treated bait blocks, termite population was equivalent for all treatments.

At the 1st inspection (June) during the treatment

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[1] Isoptera: Rhinotermitidae

[2] *Reticulitermes virginicus* Banks. *R. flavipes* (Kollar), and *R. hageni* Ranks occur in area studied here. However, only 1 sample of alates (*R. virginicus*) was obtainable for identification.

[3] This publication reports research involving a pesticide and does not contain recommendations for its use nor imply that the uses discussed here have been registered. All uses of pesticides must be registered by appropriate state or Federal agencies, or by both. before they can be recommended. Mention of a trade name or a proprietary product does not constitute an endorsement by the USDA. Received for publication May 25. 1973.

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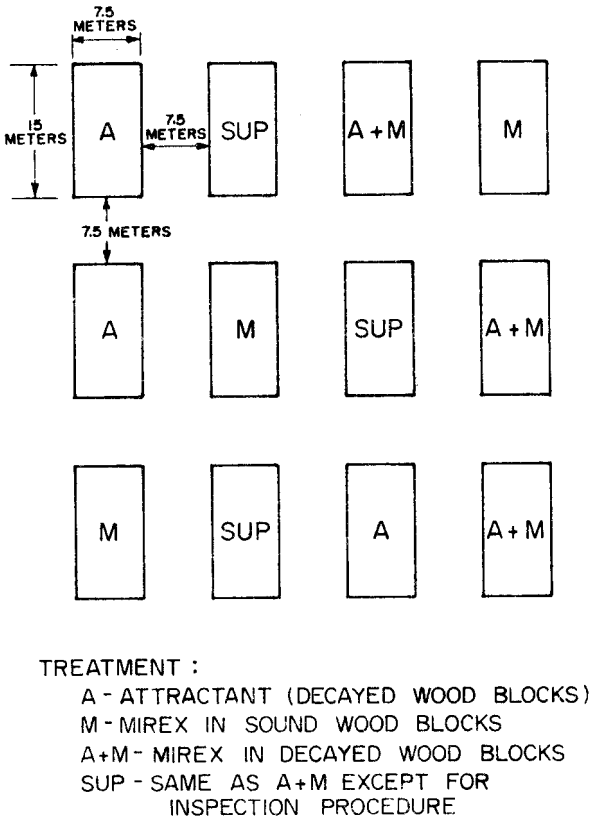

FIG. 1. —Spatial relationships of 3 replicate plots/4 treatments.

period, the number of stakes attacked increased greatly in the 3 replicates of the noninsecticidal attractant plots, which reflected normal increase of termite activity after onset of warm weather. In mirex, attractant-mires, and supplementary attractant-mires plots, the number of attacks remained at about pretreatment levels (total attacks, respectively. 33, 37, 31). However, active attacks were much fewer (respectively 13, 12, and 13).

At the 2nd through 6th inspections during the treatment period, the number of attacked stakes in any treatment fluctuated, but the 3 insecticidal treatments, except at the 2nd inspection of the mirex plots, did not exceed a total of 13 active attacks on the 3 replicate plots at any of these inspections. Moreover, attacks on individual plots progressively disappeared from the interior of the plot, and the number of attacks near the periphery fluctuated

The following are totals of termite attacks on bait blocks for the 1st through 6th inspections in the treatment period: 419 attractant blocks; 4 mirex blocks; and 54 attractant-mirex blocks. Most of these attractant blocks were consumed and rated 4. The 4 termite-attacked mires blocks were rated 1. The 54 attractant-mirex blocks were rated 1, 2, 3, or 4; and block totals were, respectively, 17, 26, 7, and 4. Thus, only 11 of these blocks were more than 40% eaten by termites.

The 4 inspections in the posttreatment period revealed a buildup of termite activity that followed the discontinuation of 3 bait-block treatments at the 6th treatment-period inspection. At the 1st and 2nd post-treatment inspection of the attractant plots, termite activity decreased with cold weather (September–March). However, attacks at the 4 post-treatment inspections of the mirex plots and the attractant-mires plots continued to reflect a buildup of termite activity from the very low levels of the bait-suppressed period

At the 1st posttreatment inspection of the supplementary plots, and again at the 3rd posttreatment inspection, attacks increased slightly from the low level of their preceding inspections. This response was unlike that on plots when insecticidal treatments were discontinued because attack was less than at the 2nd posttreatment inspection. The number of attacks on the supplementary plots increased greatly at the final inspection (3½ years posttreatment).

DISCUSSION. — Results (Table 1) demonstrated that a toxic bait effectively suppressed natural subterranean termite colonies in a region where termites are a major economic pest. Indications were that a termite attractant. + an insecticide might be effective in these situations (Esenther et al. 1961; Esenther and Coppel 1961; Esenther and Gray 1968; Lund 1970). Our bait controlled a wood-destroying termite, whereas Synman (1970) reported that J. J. C. Nels has developed a toxic bait to control a. grass-eating termite.

Our mirex bait and attractant-mirex bait were equally effective because the baits reduced the active attacks on groups of 3 plots to 13 or fewer attacks within 3 months (1st treatment inspection). Thereafter, except at the 2nd treatment inspection of the mirex bait plots, an even lower frequency of attacks on the pine stakes was maintained during the treatmetit period.

The attractant-mires block was far more efficient, than the mires block at getting the insecticide to the termites: 54 attractant-mirex blocks were attacked vs. 4 mirex blocks. Moreover, insecticide pickup by the termites may be estimated by determining the average amount eaten multiplied by the 32-mg insecticide content. insecticide pickup by this method was only 6.4 mg for the 4 mirex blocks. A similar assessment of the 6 inspection records on the attractant-mires blocks showed pickups of 403.2-, 28.8-, 20.8-, 0-, 0-, and 14.4-mg insecticide (total, 467.2 mg).

Data on the supplementary attractant-mirex treatment indicate that the original bait blocks suppressed termite activity to very low levels (Table I) for 2

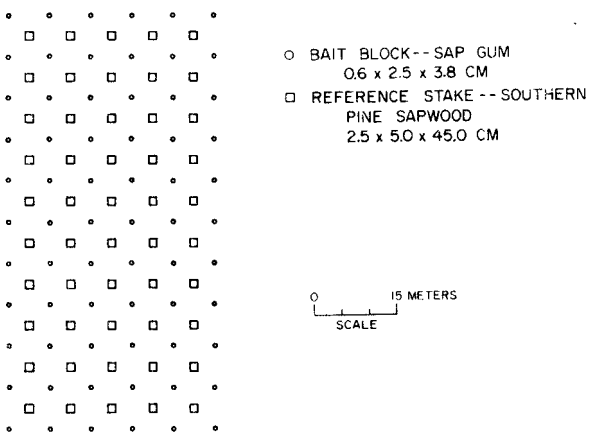

FIG. 2. — Placement of 66 bait blocks (*o*) and 50 southern pine stakes (□)/plot.

Table 1.—Number of termite-attacked southern pine stakes (total attacks/active attacks) during 3 treatment periods.

Treatment[a] and plot replicate	Number of termite-attacked southern pine stakes by period of inspection											
	Pretreatment[b]		Treatment[b,c]						Posttreatment[d]			
	1	2	1	2	3	4	5	6	1	2	3	4
A1	7/5	5/5	13/11	23/16	22/18	11/10	22/18	19/14	14/13	28/22	10/10	29/14
A2	13/11	11/11	26/24	38/28	28/23	12/11	17/14	17/15	23/17	26/25	18/14	31/25
A3	11/8	7/7	31/27	25/10	13/10	4/4	13/9	8/3	7/6	20/12	10/9	32/20
Total	31/24	23/23	70/62	86/54	63/51	27/25	52/41	44/32	44/36	74/59	38/33	92/59
M1	7/7	4/4	7/4	9/2	3/2	1/1	3/2	5/3	12/9	11/8	12/10	20/13
M2	4/4	3/2	5/1	7/4	5/4	2/2	4/3	4/2	0	6/3	4/3	7/3
M3	12/12	16/13	21/8	14/13	3/3	2/0	2/1	2/1	3/1	5/4	9/6	23/18
Total	23/23	23/19	33/13	30/19	11/9	5/3	9/6	11/6	15/10	22/15	25/19	50/34
A+M 1	8/8	10/8	9/3	3/1	5/2	0	0	2/1	1/1	6/5	10/8	12/4
A+M 2	19/16	8/8	12/3	5/1	1/1	0	0	1/0	3/2	4/2	10/9	15/11
A+M 3	15/14	11/11	16/6	14/3	1/1	0	1/1	6/3	11/8	13/11	8/7	13/9
Total	42/38	29/27	37/12	22/5	7/4	0	1/1	9/4	15/11	23/18	28/24	40/24
Sup 1	6/5	4/3	7/3	2/1	1/1	1/1	2/2	1/1	0	6/5	1/1	7/4
Sup 2	13/12	6/6	8/4	7/4	4/3	1/1	2/2	4/2	1/1	6/4	4/3	15/9
Sup 3	22/20	19/19	16/6	4/2	1/1	1/0	1/1	1/1	11/8	2/2	6/4	9/7
Total	41/37	29/28	31/13	13/7	6/5	3/2	5/5	6/4	12/9	14/11	11/8	31/20

[a] A, attractant (decayed) wood blocks; M, mirex-sound wood blocks; A+M, attractant (decayed) wood-mirex blocks; and Sup, same as A+M but only an initial installation of blocks, whereas blocks were replaced with fresh blocks at the 4th through 7th inspections of A, M, and A+M plots.

[b] 3-Month inspection interval after plots initiated September 1968.

[c] Treatments installed after 2nd pretreatment inspection; residue of original Sup-treatment blocks remained on plots for duration of trial; and the A, M, and A+M treatment blocks were replaced by matching new blocks at the 1st through 5th inspections, and were removed from plots at 6th inspection.

[d] 6-Month inspection interval.

years, and had residual effectiveness for a 3rd year. This prolonged effectiveness was unexpected; we thought the severe bio-deterioration in the soil would destroy the small wood-bait block in ea. 1 year. However, 66 blocks on 1 supplementary plot were inspected after they had been in the soil 2½ years; 33, 15, and 18 blocks contained the following percentages of residual firm wood, respectively—atleast 30, between 5 and 10, and 0. Therefore, apparently after 2½ years, the firm wood in 48 of the original 66 blocks had residual effectiveness.

Toxic termite bait theoretically should have an impact on a colony whose nest is not close to the bait; analysis of our results indicated that, despite the 7.5-m buffer zone between plots, insecticidal baits affected colonies on noninsecticidal attractant plots. Data on the attractant plots (Table 1) show that a 2nd peak of termite activity (5th treatment-period inspection, June 1970) on these plots was much lower than was a 1st peak of activity (2nd treatment-period inspection, September 1969). The total stakes attacked at the 3rd through 6th treatment-period inspections were compared with those attacked at the first 4 inspections (2 pretreatment and 2 treatment inspections). Presumably, the comparison should have shown either a similar amount of attack or an increase in the attacks for the 4 later inspections, because the attractant plots did not have insecticide. However, the actual compari-

son for the individual attractant plots (A1-3) showed the following:

Plot	Total stakes attacked: Second 4 inspections	First 4 inspections	% difference
A1	74	48	+54.2
A2	74	88	−15.9
A3	38	74	−48.6

The order of the decreasing percentages was associated with whether an attractant plot was adjacent to 1, 2 or 3 insecticidal plots (FIG. 1), indicating that the installation of toxic baits on the periphery of a plot may effectively suppress the termite colonies on that plot.

A bait method is an efficient use of insecticide, e.g., the total insecticide on 1 supplementary plot (112.5 m^2) was ca. 2.1 g (equivalent to a dosage rate of 0.16 lb/acre). The small pickup of insecticide on the mires-treatment plots (estimated at 6.4 mg) indicates that we could have used a much lower mirex concentration in the attractant-mirex blocks than we did, because of the greater termite feeding on the fungal-infected wood.

Our field notes on attractant plots also show the relative effectiveness of southern pine stakes and decayed sweetgum wood blocks to detect termite activity in soil. When field stakes and bait, blocks were inspected on attractant-treatment plots, the greatest number of attacked stakes at 1 inspection was 86 in 1968, and 51 in 1969, and the greatest number of attacked blocks was, comparably, 81 and 93. Therefore, blocks and stakes were, initially, about equally effective to measure termite activity. However, after termite population on plots had declined (1969), bait blocks were almost twice as effective as were stakes. Perhaps blocks more effectively detect low population density, because termites tend to concentrate their foraging activity on attractant (decayed) wood blocks.

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