Insecticidal Baits on Field Plot Perimeters Suppress *Reticulitermes* [1,2]

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J. Econ. Entomol. 71. 604–607 (1978)

ABSTRACT

A field trial was conducted in southern Mississippi to determine if placing decayed wood bait blocks impregnated with mirex could suppress termite (*Reticulitermes* sp.) populations when placed around the perimeter of an area. Bait blocks treated with 10 mg mirex/block were buried at 1.5-m spacing at the perimeter of six 7.5 m-square plots, 3 of which also had treatment along the perimeter of an outer 30-m square. Noninsecticidal bait blocks were used to monitor termite activity within the treatment lines. During a 3.5-yr period, termite activity on the treated plots was suppressed. The efficacy of mirex bait treatment for the protection of man-made structures is discussed.

This study was to determine if decayed wood blocks impregnated with mirex and placed in the soil around the perimeter of an area would suppress termite activity within that area. If successful, such treatments would be practical for suppressing termite populations on residential properties to prevent invasion of buildings.

Several studies already have been conducted with mirex bait blocks buried in the soil to suppress termite activity. Blocks buried at 1.5-m intervals in a grid (Esenther and Beal 1974) were effective in a monitored field trial. Actual placement of baits around buildings also seemed effective (Esenther and Gray 1968, Ostaff and Gray 1975) but termite colonies could not be monitored thoroughly because of the area covered by the buildings. Also, some of these treatments failed to fully protect the buildings.

Spot treatments with mirex bait blocks have been tried for suppression of termite infestations. Beard (1974) reported some success when using mirex blocks as spot treatments to suppress ***Reticulitermes*** activity in buildings but monitoring the complete bait impact on termites was impossible.

We treated perimeters of unobstructed field plots with the mirex blocks to simulate the protection of residential properties and to allow thorough monitoring of termite activity over the entire area. Our aim was to establish the effectiveness of perimeter treatments to suppress *Reticulitermes* activity in the ground. The results also may help detail the sequence of events in bait suppression of termite activity.

Materials and Methods

Sweetgum, *Liquidambar styraciflua* L., blocks measuring 0.6×2.5×3.5 cm were first partially decayed by the brown-rot fungus, *Gloeophyllum trabeum* (Pers. ex Fr.) Murr. (*Lenzites trabea* Pers. ex Fr.). They were then impregnated with mirex as described by Esenther and Gray (1968) and Esenther and Beal (1974). These baits were placed with plastic marker tabs which identified their location. Individual baits averaged ca. 10 mg retention of mirex (0.4% wt/wt). Similar blocks without mirex were used to monitor termite foraging activity.

A tract of land in the Harrison Experimental Forest near Saucier, Miss., maintained as a clearing for ca. 10 yr, was used for the trial. *Reticulitermes virginicus Banks, R. flavipes (Kollar),* and *R. hageni Banks* occur in this area, but imagos could not be collected for specific identification of all species on the tract. Fig. 1 shows plot configurations and location of 360 mirex bait blocks on this tract. Mirex blocks were buried 3–5 cm below the soil surface and 1.5 m apart along the perimeter of six 7.5 m-square plots; 3 of these plots also had treatment along the perimeter of an outer 30-m square. Fig. 1 also shows location of 529 monitoring (nonmirex) baits both within the test squares and on adjoining buffer areas.

Bait monitoring of termite activity at distances greater than 30 m from our study plots was impossible because it would have interfered with other experimental work. Con-

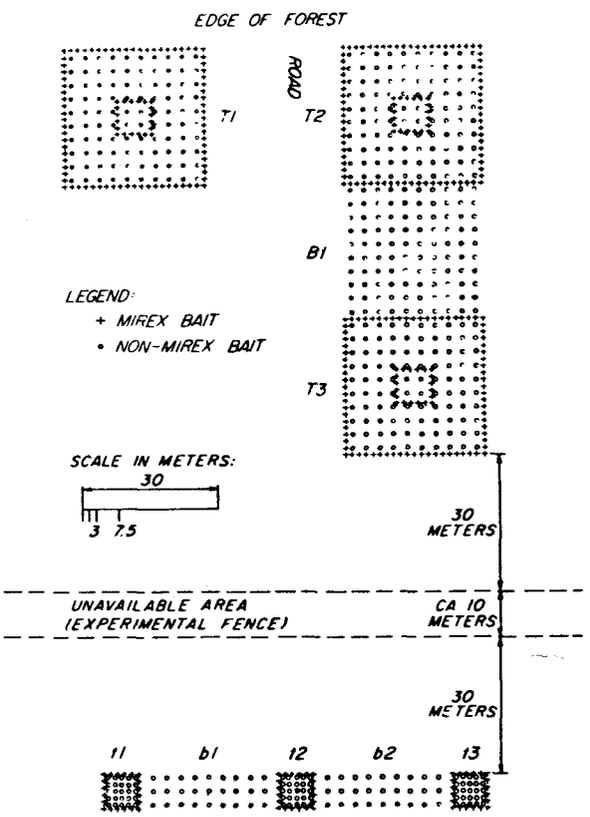

FIG. 1.—Arrangement of individual mirex (+) and monitoring (o) baits on field plots. Large plots: mirex treated = T1, T2, and T3; buffer area = B1. Small plots: mirex treated = t1, t2, and t3; buffer areas = b1 and b2.

[1] Isoptera: Rhidotermitidae.

[2] Mention of mirex in this paper does not constitute a recommendation by the USDA. Only chemicals registered by the U.S. Environmental Protection Agency may be recommended, and then only for uses prescribed in the registration, and in the manner and at the concentration prescribed. Received for publication Nov. 4, 1977.

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trol plots not more than 30 m from the baits might still allow colonies to find access to the mirex. Therefore, informal inspection of termite activity in natural wood debris was maintained throughout the study at distances beyond the influence of the mirex.

Monitoring baits were buried on plots and buffer areas in Dec. 1970. They were inspected in Apr. 1971 (pretreatment inspection); immediately afterward, the mirex bait treatments were installed. Thereafter, plots were inspected semiannually for 3.5 yr and any bait blocks damaged by termites or other destructive agents were replaced. Replacement of the blocks provided a record of all termite damage occurring between inspections.

Termite attacks on the treated and untreated bait blocks were rated on a 0-4 scale: 0 = no attack; 1 = <10% destroyed; 2 = 10-35% destroyed; 3 = 36-70% destroyed; 4 = > 70% destroyed. These ratings were used primarily to estimate total ingestion of insecticide from bait by the termites. Ratings from 1-4 were calculated as equivalent to an avg pickup per block, respectively, of 0.5, 2.5, 5.5, and 8.5 mg of mirex.

Results

Semiannual inspections of baits (Table 1) indicated that termite activity on the plots and buffer areas was suppressed to <3% blocks attacked during the 3.5 yr of the trial (Fig. 2). Suppression of attacks on monitoring blocks first became noticeable with the inspections at 1.5 and 2 yr after placement of blocks. At the final inspection, only 12 of 529 monitoring blocks showed evidence of attack. During the period of this study, the informal monitoring of termite activity at distances greater than 30 m from mirex bait treatment revealed no noticeable change in levels of termite activity.

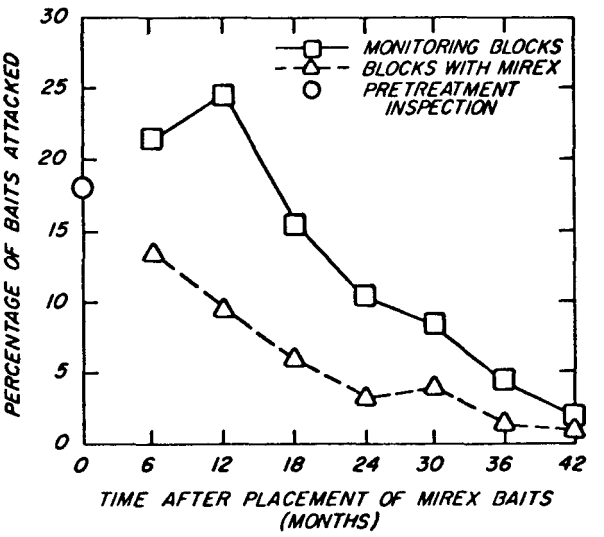

FIG. 2.—Percentage of mirex blocks and nonmirex monitoring blocks attacked for each of the 6-mo inspections. Pretrial attack on monitoring blocks also is shown.

Plot T1 was the most heavily infested, with 43 of 100 monitoring baits attacked at the 2nd posttreatment inspection (1 yr). Thereafter, the number of attacks declined at successive inspections until only 7 attacks were recorded at

Table 1.—Number of attacks by *Reticulitermes* on bait blocks[a] at semiannual inspections.

			Attacks on blocks at inspections								
				Posttreatment (mo)							
Type bait	Plot	Total blocks	Pretreatment[b]	6	12	18	24	30	36	42	Total attacks
Monitoring	T1	100	23	32	43	34	29	23	11	7	202
	T2	100	10	7	4	3	3	3	5	0	35
	T3	100	26	27	27	15	8	8	4	2	117
	Subtotal	300	59	66	74	52	40	34	20	9	354
	t1	25	6	8	10	3	3	4	0	0	34
	t2	25	6	3	7	4	1	0	0	0	21
	t3	25	4	4	8	1	2	0	0	0	19
	Subtotal	75	16	15	25	8	6	4	0	0	74
	B1	100	18	26	24	17	4	3	5	0	97
	b1	27	0	4	4	3	3	2	0	3	19
	b2	27	2	4	3	1	3	2	0	0	15
	Subtotal	154	20	34	31	21	10	7	5	3	131
	Total	529	95	115	130	81	56	45	25	12	559
Mirex	T1	100	—	25	18	19	8	11	2	3	86
	T2	100	—	2	3	1	1	0	2	0	9
	T3	100	—	10	7	0	1	1	2	0	21
	Subtotal	300	—	37	28	20	10	12	6	3	116
	t1	20	—	2	4	0	0	2	0	0	8
	t2	20	—	3	1	1	1	0	0	0	6
	t3	20	—	5	1	1	1	1	0	1	10
	Subtotal	60	—	10	6	2	2	3	0	1	24
	Total	360	—	47	34	22	12	15	6	4	140

[a] 529 total monitoring blocks and 360 total mirex blocks.
[b] Pretrial inspection of monitoring blocks and initial installation of mirex blocks, Apr. 1971.

the final inspection (3.5 yr). The intake of mirex by termites on TI was estimated to be 154 mg based on data in Table 2. The south edge of the plot was ca. 3 m from the pine forest, and 65.0 mg of the intake of mirex occurred here. The south edge of plot T2 also was ca. 3 m from the forest, but an unusually high concentration of attacks on mirex baits was not noted.

Table 2-Severity of attack on bait blocks and approximate amount of mirex ingestion by termites.

Type bait	Plot	Total termite attacks at rating 1	2	3	4	Sum	Total mirex[a] mg
Monitoring[b]	T1,T2,T3	17	27	26	284	354	
	B1	3	3	7	84	97	
	t1,t2,t3	0	7	6	61	74	
	b1,b2	4	2	3	25	34	
	Total	24	39	42	454	559	
	Percent	4.3	7.0	7.5	81.2	100.0	
Mirex	T1,T2,T3	65	35	12	4	116	220.0
	t1,t2,t3	11	7	5	1	24	59.0
	Total	76	42	17	5	140	279.0
	Percent	54.3	30.0	12.1	3.6	100.0	

[a] Estimated from avg 1–4 attack ratings as equivalant to 0.5, 2.5, 5.5, and 8.5 mg mirex picked up by termites.
[b] Inclujes pretreatment inspection.

As the experiment progressed, the centers of residual termite activity on the large plots (T1, T2, and T3) tended to become clustered ca. midway between the inner- and outer-treated perimeters. This is illustrated in Fig. 3 for plot T1, which had the greatest termite activity.

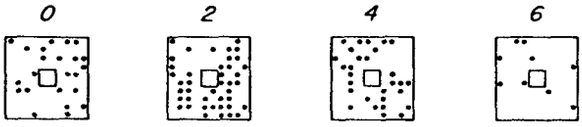

FIG. 3.—-Distributionf termite attacks on monitoring bait blocks at spring inspections of plot T1 (0 is pretreatment inspection; 2, 4, and 6 are posttreatment inspections).

Estimated mirex ingestion by termites (Table 2) indicates that suppression of termite activity on all of the 6 treated plots and 3 buffer areas may have required a total ingestion of only ca. 279-mg mirex.

The mirex baits seemed to be remarkably effective in buffer area B1. Initially, the activity in this area was centered ca. halfway between rows of mirex baits on the N and S sides of the area. The number of attacks on monitoring baits, successively for the 8 inspections, was 18, 26, 24, 17, 4, 3, 5, and 0. Associated with this fall-off in attacks on monitoring baits was damage to only 2 mirex blocks, estimated at 6 mg mirex ingested. This minimal contact with insecticide at ca. 15 m from the initial center of activity seemed to have caused a fatal disruption of the termite population in area B1. In other areas also, small ingestions of mirex were found to have a major effect on termite population. Intake of 5 and 1.5 mg mirex also may account for suppression on buffer areas bl and b2, respectively.

After the 5th posttreatment inspection (at 2.5 yr), 18 southern pine stakes (2.5×5.0×45.0 cm) were driven to half their length into the ground at locations of greatest residual termite activity on plots T1 (12 stakes) and T3 (6 stakes). Termites had only slightly grooved the surface of one stake during the final year of the study. This minimal damage and the low level of attack on the monitoring blocks suggest that termite colonies had been virtually eliminated.

Total elimination of termites seems improbable because new termite colonies became established during the trial. At the 4th posttreatment inspection (2 yr), 4 monitoring blocks on plot TI and one on plot T2 contained a dealated reproductive pair and typical, tiny, incipient colony worker forms. Tiny termites, possibly from incipient colonies, also were noticed in a few other baits, but these infestations were not definitely confirmed as new colonies because no dealated reproductives were seen.

Differences in seventy of attack became apparent between the monitoring and mirex blocks. About 81% of the termite attacks on monitoring baits were given No. 4 ratings (usually, totally destroyed), whereas only 2% of attacks on mirex blocks had a No. 4 rating. (In fact, only 16% of the mirex blocks were >36% destroyed). Complete records of baits replaced because of in situ deterioration by fungi or other agents were not kept, but often such deterioration became noticeable within a year.

Termite attack rarely would have resulted in complete destruction of a mirex bait at an individual mirex bait position even if damaged baits had not been replaced. Attacks occurred at 102 of the 360 mirex bait positions, including 26 positions with 2-4 repeated attacks. When the termite damage ratings as % destruction were summed, total attack was equivalent to complete destruction of the mirex bait blocks at only 6 positions.

Discussion

Perimeter bait treatments greatly suppressed the *Reticulitermes* population on 6 treated plots and 3 buffer areas. Since the treatments were placed on perimeters of plots to simulate practical treatments for residential properties, it appears that similar treatment would be effective to protect buildings from infestation.

Slight residual termite activity on monitoring baits at the final inspection (3.5 yr) (12 attacks on 529 baits) was attributable to either residual populations of original colonies or newly established incipient colonies. However, it appears that the remaining colonies were too small to cause appreciable damage to wood, because attacks on only a few monitoring blocks and slight damage to one wooden stake occurred during the final year of the trial. Presumably, if bait treatments were maintained, these residual colonies also would be suppressed–or resuppressed-when they became large enough to contact mirex baits during foraging.

Mirex baits were replaced when found to be damaged during inspections, but in a previous study with similar mirex blocks (Esenther and Beal 1974) suppression of termites was effective for up to 3 yr even if damaged blocks were not replaced. In that study, ca. 2/3 of the buried mirex blocks were found sufficiently intact to remain effective when they were inspected 2.5 yr after placement. Thus, retreating with baits at 2- to 3-yr intervals should continue to protect buildings from termite infestation.

Some evidence suggests that monitoring block data may be slow in revealing declines in termite activity. Esenther and Beal (1974) noted a lower frequency of termite infestation on untreated pine stakes during the 2nd yr after treatment, but attacks on nonmirex monitoring blocks increased in that year. One explanation is that colonies reduced in numbers by the bait treatment preferred the partially decayed monitoring blocks This hypothesis may explain partially the increase in monitoring blocks attacked at 12 mo (2nd inspection) (Fig. 2).

Partial protection of man-made structures may result during trials with mirex blocks before monitoring blocks reveal declines in termite foraging. Before the mirex treatment had begun to show a noticeable suppressive effect, termites tended to forage more actively away from the vicinity of the mirex baits (Fig. 3). This may reflect the failure of mirex-poisoned foragers to recruit other workers for continued foraging in the direction of the mirex baits. Ostaff and Gray (1975) noted that a similar diversion of foraging activity may have resulted in an infestation of a building. This would require remedial bait treatment as described by Beard (1974). Nevertheless, except for colonies nested under buildings. the mirex blocks located close to man-made structures may offer earlier protection than overall. monitoring block data would indicate.

As stated earlier, termite suppression achieved in this study was associated with a total pickup by termites of ca. 279 mg mirex, but the real significance of such a major effect by so little insecticide is impossible to determine because there was no way to estimate the initial size of the termite colonies. The bait treatment might be made more effective if a slower-acting insecticide than mirex would result in a greater initial intake of insecticide by the termites.

REFERENCES CITED

Beard, R. L. 1974. Termite biology and bait-block method of control. Conn. Agric. Exp. Stn. Bull. 748: 19 pp.

Esenther, G. R., and R. H. Beal. 1974. Attractant-mirex bait suppresses activity of *Reticulitermes* spp. J. Econ. Entomol. 67: 85–88.

Esenther, G. R., and D. E. Gray. 1968. Subterranean termite studies in southern Ontario. Can. Entomol. 100: 827–34.

Ostaff, D., and D. E. Gray. 1975. Termite *(Isoptera)* suppression with toxic bait. Ibid. 107: 1321–5.

U.S. GOVERNMENT PRINTING OFFICE 1978-750126/44