Imported Fire Ant Toxic Bait Studies: Further Tests with Granulated Mirex-Soybean Oil Bait[1]

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ABSTRACT

Additional tests with granulated mirex-soybean oil bait for control of the imported fire ant, *Solenopsis saevissima richteri* Forel, were conducted. An aerial application was made to a 960-acre plot containing land of variable terrain and ground cover. Eight months later 1 colony of ants was found on 1 of thirty-three ½- to 1½-acre observation plots. The total pretreatment count of ant colonies on these plots was 750, or an average of 23 per plot. Applications of bait made during the cooler part of the year (November-April) to open land in sunny weather gave good control (96–100%). However, fast and complete kills of ants was dependent upon warm weather. The bait in the previous tests contained 0.075% mirex, 14.925% soybean oil, and 85% corncob grits, and was applied at the rate of 12½ lb/acre. Bait containing 0.075, 0.15, or 0.3% mirex and applied at the rates of 3, 5, or 10 lb/acre all gave excellent control of ants. In general, observations have shown that areas treated with bait in the first half of the year become reinfested the next fall, while areas treated during the last half of the year will not become reinfested until the fall of the next year. In either case, the actual reinfestation appears to coincide with the period of greatest mating flight activity (May-June).

Control of the imported fire ant, *Solenopsis saevissima richteri* Forel, with a bait consisting of the toxicant mirex (0.075%), and the food material soybean oil (14.925%), impregnated on the granular carrier corncob grits (85%), was reported by Lofgren et al. (1963). Field tests with this bait on 6-acre plots consistently gave more than 95% control of imported fire ants at application rates of 5 to 20 lb/acre. At these rates the dosage of mirex applied was only 1.7 to 6.8 g/acre. It was pointed out also that because of its granular nature the bait was easy to formulate and could be applied with conventional granular application equipment. In subsequent residue tests (Darley),[2] it was shown that the bait when applied at the rate of 12.5 lb/acre (4.2 g of mirex) did not accumulate in the butterfat of cows grazing on pastures at the time of treatment or on vegetables which were treated at the same rate. The analytical methods employed were accurate to 3 ppb in the milk residue and 10 ppb in the vegetable residue studies. Baker (1963) has shown that the bait is harmless to wildlife. In studies which he conducted concurrently with the aerial application test reported in this paper, no adverse effect on quail or other wildlife was found. In subsequent pen tests no detrimental effects were noted on quail exposed to application rates of bait as high as 1000 lb/acre. Jenkins (1963) found no evidence that the bait was attractive to a wide variety of animals (quail, chickens, turkeys, ducks, cotton rats, goats, channel catfish, bluegills, or goldfish). Ten times the field dose was used under seminatural conditions without any losses to quail, turkeys, chickens, and ducks. In aquaria at least 30 times the field dosage had no effect on bluegills and goldfish.

Following the development of the bait, our laboratory continued a series of studies to determine its full potential for use in the Imported Fire Ant Eradication Program. The purpose of this paper is to present results on 3 phases of these studies: (1) a large-scale aerial application, (2) the effectiveness of bait applied during cool weather, and (3) the effectiveness of different application rates and mirex concentrations.

Aerial Application Test.—In the fall of 1961 a 960-acre block of land near Orange Grove, Mississippi, was selected for the first aerial application test. It included varying types of land cover and terrain. Approximately 50% of the area was in woodland or idle and waste land. The remaining area consisted of small pastures, cultivated fields, gardens, and pecan and tung groves. Thirty-three small plots were set up within the area for making pre- and post-treatment counts for ant colonies. The size of these plots ranged from about ½ to 1½ acres with the majority just slightly under 1 acre. The pretreatment count of fire ant colonies per plot ranged from 7 to 43.

The bait formulation consisted of 0.075% mirex, 14.925% crude soybean oil, and 85% 10–40 mesh corncob grits. It was prepared by a commercial formulator.

The bait was applied with a Piper Pawnee airplane equipped with a Texas A & M type granular distributor. The overall swath width obtained with the distributor was 60 ft; however, an actual swath width of

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[2] Personal communication from M. M. Darley, 1962.

30 ft was flown. This was done to insure an overlap of the swaths and it also permitted operation of the plane under higher wind conditions than would have been possible with a narrower overlap of swaths.

An application rate of 12½ lb/acre was used. At this rate the actual amount of mirex applied per acre was 4.2 g. The plots were treated September 21–23, 1961. The results of the tests are recorded in Table 1.

RESULTS.—From the data obtained it is evident that the bait treatment was very effective in controlling imported fire ants. At the end of 32 weeks 100% control had been obtained in all the observation plots except one. On this plot one colony was found. This colony was not present on the plot at the 26-week count. It is not known whether this was a new colony which had developed after treatment, or an old colony that had not been killed out. It will be noted that the kill of ants was very slow and that even after 4 weeks some of the plots showed no reduction in active ant mounds. General observations showed that the greatest effect of the bait was obtained 4 to 8 weeks after treatment. After about 5 weeks of extremely dry weather following the application of the bait, thousands of dead ants were found piled up in the road ditches surrounding the test area. The slow kill is undoubtedly attributable to the fact the test was initiated at the onset of cool weather and to light feeding of the ants on the bait. The effect of cool weather on control is discussed in the next section of this paper. The light feeding was evidenced by the lack of piles of bait around the ant mounds. Normally, when feeding activity is heavy, small piles of bait from which the ants have extracted the oil are found around the bases of the mounds within several days after the bait application. A rapid kill of ants is associated with this observation.

Observations in the test area during October 1962 showed that it had become heavily reinfested with small ant colonies with mounds ranging from 2–4 in. in diameter. The number of these colonies found on the plots ranged from 0 to 256. Heavy infestations of ants were present in all the surrounding area providing a ready source of new queens during mating flights. This reinfestation pattern is typical of that noted on small test plots and illustrates the fact that baits offer no residual protection against reinfestation. In general, observations have shown that areas treated with bait from January through July will become reinfested the next fall, while areas treated during the latter part of the year will not become reinfested until the fall of the next year. The actual reinfestation in either case appears to coincide with the period of greatest mating flight activity (May–June). It cannot be concluded from these observations that queens from mating flights late in the year will never establish colonies; however, the percentage which does successfully establish a colony is evidently very low. Green (1962) has suggested that large outbreaks of new imported fire ant infestations coincide with periods of frequent showers during June, July, and August. This indicates that warmth and moisture are essential for colony establishment. Green (1959) also noted that extremely cold weather can result in mortality of imported fire ants. This was noted also in the Gulfport, Mississippi, area when temperatures dropped to 10°F during January and December 1962, and January 1963. Large numbers of dead ants could be found outside some mounds after the weather became warmer and the live ants could remove the dead ones. Cold weather could be a factor in reducing or eliminating development of colonies by queens from mating flights late in the year.

Table 1.—Control of imported fire ants following aerial application of granular mirex-soybean oil bait to a 960-acre test area near Orange Grove, Mississippi.

Land usage	No. observation plots	Average pretreatment count of active mounds	% reduction in active mounds after following weeks: 4	8	16	32	52
Woods	9	20	27	72	92	100	60
Pecan grove	4	23	58	92	96	100	26
Pasture	8	32	49	83	97	100	27
Idle	6	22	39	74	92	100	36
Crops	6	15	40	82	99	99	0

Cool Weather Tests.—Since imported fire ant foraging activity is limited by low temperatures, a test was initiated to study the effectiveness of bait applied during the cooler part of the year. The bait formulation consisted of mirex (0.075%), soybean oil (14,925%), and corncob grits (85%). A large open Bahia grass pasture near Kiln, Mississippi, was selected as the test area. Six- to 8-acre plots containing three 1-acre count areas were established and treated at monthly intervals according to the procedure described by Lofgren et al. (1963). The first application was made in October 1961, and the last in May 1962. The bait-application rate was 12½ lb/acre. The control data and the temperature records during the 2 weeks following treatment are recorded in Table 2. The temperature records were obtained from climatological data of the U. S. Department of Commerce for Bay St. Louis, Mississippi, which is located about 13 miles south of the plot site. No rainfall occurred on any of the plots within the first 2 days after treatment. It is believed that if rainfall were to affect the test results, it would have had to occur shortly after application, as ant foraging on the plots was rapid, even in cool weather.

The data show that complete control was obtained on the plots treated in October, February, March, April, and May, while 98% control was obtained on the November and January plots and 96% on the December plot. It is evident that fast kill is definitely dependent on warm weather. For example, the reduction in active mounds on the December and January plots after 4 weeks was 5% and 46%, respectively, as compared with 93% and 98% for the April and May plots. The average of minimum temperatures for the 13 days following treatment was 34° and 47°F for the December and January plots, and 63° and 73°F for the April and May plots.

It is emphasized that these tests cannot be considered representative of the results which will always be obtained with cool-weather bait applications. Pickup of bait by the poikilothermic ants is dependent on their being warm and active enough to forage. The ants in this test were located in an open, closely grazed pasture. The weather at the time of each treatment was clear and sunny. Under these conditions, even on a relatively cold day, the ant mounds

Table 2.—Data from test to determine effect of cool temperatures on control of imported fire ant with granulated mirex-soybean oil bait.[a]

Month of treatment	Max. temp. (°F) on day of treatment	Min. temp. (°F) night after treatment	Avg. min. and max. temp. (°F) for 13 days after treatment		Avg. pretreatment count of active mounds	% reduction in active mounds after following weeks:				
			Max.	Min.		2	4	8	16	26
October	77	54	77	53	29	59	97	100	100	100
November	73	59	68	49	53	8	68	93	98	98
December	62	38	56	34	53	18	5	9	74	96
January	62	34	61	47	20	51	46	85	85	98
February	78	57	71	58	55	60	86	99	100	96
March	70	45	72	51	62	43	80	91	100	100
April	67	53	77	63	56	80	93	98	99	100
May	90	67	86	73	19	74	98	100	100	—
Check[b]	—	—	—	—	30	9	12	17	8	8

[a] Control data based on average results from three 1-acre subplots located within a 6- to 8-acre plot.
[b] Counts made at same time interval as those on October plot.

and the soil surface were comparatively warm, permitting foraging by the ants. This would not necessarily be true of heavily grassed land or woodland where the ground is shaded. However, it can be concluded that good control of imported fire ants can be obtained in the winter if the bait is applied to open land on clear days with the temperature above freezing.

Effect of Changes in Mirex Concentration and Application Rate.—A study was made to determine the effectiveness of granulated mirex-soybean oil bait containing 0.075, 0.15, or 0.3% mirex and applied at the rate of 3, 5, or 10 lb/acre. Previous to the initiation of this study the higher concentrations of mirex had not been tested because of concern with possible repellency. However, Stringer et al. (1964) have shown that mirex concentrations as high as 2% in soybean oil do not repel ants from feeding. Two complete tests were conducted; one was started in March and the second in June. Six- to 8-acre plots, each containing three 1-acre count areas, were established in pasture land and treated with the different formulations as described by Lofgren et al. (1963). The results of the pre- and post-treatment observations on the plots through 16 weeks are presented in Table 3.

No counts were made on any of the plots after 16 weeks, because they had become reinfested with new colonies. When this happens, it becomes extremely difficult to distinguish between the remnants of old colonies and the new ones. However, at the 16-week observations many of the remaining colonies showed symptoms characteristic of toxic bait poisoning, that is, only large workers remained, total worker population was below normal, the mounds were not worked, and no brood was present. In all tests, records are kept of the number of abnormal colonies present at each count period. Continued observations of these colonies has shown that they almost always die. Because of this fact, a percent reduction in active mounds for each treatment was calculated with the assumption that all abnormal colonies present after 16 weeks eventually died. While this information has little relevancy for small-acreage control, it does indicate the potential result if a similar treatment were applied over a large acreage in an eradication program where mating flights into the area would not be a factor.

The data show that a very high degree of control of the ant population present at treatment time was obtained on all the plots. There was no substantial difference in control attributable to the 3 different mirex concentrations and application rates with the possible exception of 0.075% mirex bait applied at the 3 lb/acre rate in March. However, even with this treatment, if all the abnormal colonies died the eventual control would have been 98%. Because the plots were not set up in randomized blocks, no statistical analysis for significance between the different treat-

Table 3.—The effect of mirex concentration and application rate on control of imported fire ants with granulated mirex-soybean oil bait.[a]

Mirex conc. (%)	Formulation application rate (lb/acre)	Pretreatment count of active ant mounds	% reduction in active mounds after following weeks:				% reduction in active mounds if all abnormal colonies died.[b]
			2	4	8	16	
		March 1962					
0.075	3	60	10	43	82	81	98.3
	5	67	13	65	87	97	99.5
	10	47	23	50	89	99	100
.15	3	94	20	53	79	98	98.9
	5	96	11	58	83	99	99.6
	10	40	84	100	100	100	100
.3	3	56	57	79	99	97	100
	5	58	10	56	95	98	98.8
	10	46	48	86	100	100	100
		June 1962					
.075	3	24	100	100	99	99	100
	5	22	100	100	100	100	100
	10	21	95	94	98	100	100
.15	3	32	100	99	99	99	100
	5	40	100	99	97	100	100
	10	31	100	100	100	100	100
.3	3	77	97	96	95	98	100
	5	79	99	99	100	99	100
	10	70	99	100	100	100	100

[a] Average results from three 1-acre subplots within a 6- to 8-acre plot.
[b] See text for description of abnormal colonies.

ments could be made. There was a marked difference in the speed of kill between the March and June treatments. This result was undoubtedly due to the temperature differences, as pointed out in the previous test.

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