

Evaluation of Systemic Insecticides for Control of Trombiculid Mites

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OBJECTIVE: To determine if rodent baits treated with organophosphate insecticides are effective against larval trombiculid mites (chiggers) on wild rodents in areas of Thailand where these mites are known to carry scrub typhus.

BACKGROUND: In World War II more than 7,000 casualties were caused by scrub typhus in U.S. Forces stationed in the Western Pacific and Burma. Control measures used at that time to prevent scrub typhus included the burning of grass and the stripping of soil with bulldozers in encampments; DDT was effective for control of mosquitoes and flies, but ineffective against the scrub typhus mites. Impregnation of clothing with repellents such as dimethyl phthalate was the most effective method of personal protection against chiggers, but it did not enjoy a high degree of troop acceptance. Scrub typhus continued to be a problem during the Korean Conflict; control and prevention measures used during that period were essentially the same as used during WWII. Some of the later chlorinated hydrocarbons, such as chlordane, dieldrin and lindane, were found to be effective for area control of trombiculid mites. However, large quantities of these insecticides were required (up to 5 lbs/acre) for effective control, and because of their non-specificity these compounds destroyed innocuous and beneficial organisms. More recently, organophosphates, such as ronnel and Ruelene, have been employed as systemic insecticides to control fleas on rats and dogs and ticks on cattle with a significant degree of success. Another of these compounds, Phoxim, has been used in New Mexico to control fleas and several types of mites on wild rodents which fed on Phoxim-treated grain (1).

The principal vector of scrub typhus in Thailand is *Leptotrombidium (L.) deliense* (Walch) which parasitizes rodents, chiefly *Rattus rattus*, living in scrub forest. This mite is widely distributed throughout Thailand. During the reporting period preliminary tests of Phoxim were carried out on wild-caught *Rattus rattus* trapped near Sakaerat in Nakornratchasima province. This area is located near the site of an outbreak of scrub typhus which occurred in a unit of Thai Army personnel in 1965 (2).

DESCRIPTION: In each series of tests, wild-caught *Rattus rattus* trapped in the vicinity of Sakaerat, were inspected for the presence of larval trombiculid mites in their ears. Previous experience trapping rats in that area indicated that a high proportion of the trombiculid mites infesting *R. rattus* were *T. deliense*. Infested rats were separated into two equal groups; one was given a diet of Phoxim-treated corn and the other untreated corn. During these tests each rat was confined to a cage suspended over pans of water to catch all mites that detached from their hosts. The water was removed daily from these pans, after a visual inspection for mites on the surface, and filtered through cotton muslin which was examined under a stereoscopic microscope for chiggers. Mites found were removed and placed in vials containing a moistened plaster of Paris-charcoal base and examined daily until it was established whether death had occurred or if metamorphosis had taken place. Dead mites were placed in 70% alcohol to be later mounted and identified. Larval trombiculid mites which underwent metamorphosis were discarded and were considered to have survived. Upon conclusion of the tests all rats were sacrificed, and any chiggers still attached were removed and processed in the same manner as those recovered during the tests.

PROGRESS: Uncracked, dried corn, treated with two concentrations of Phoxim (0.24% and 0.36%), was fed to wild-caught *Rattus rattus* infected with trombiculid mites. No significant increase in mortality of mites on the rats fed treated grain was observed in either test (Tables 1, 2). In the two Phoxim trials the proportions of *T. deliense* in the mites recovered from the *R. rattus* were 53 and 70 percent for the 0.24% and 0.36% trials, respectively. In a single test with 0.36% dimethoate-treated corn, the overall mortality in mites on the animals fed treated grain was greater (24%) than among mites on the control animals (3%), but not significantly higher than was observed for either group in the Phoxim tests (Table 3). However, an unusually high proportion of the mites on the rats fed dimethoate detached on the first day of the test; 83% of the mites recovered from these animals detached on day 1, while at the same time only 22% of the mites on the control animals dropped off. If the data for the first day are excluded, the toxic effects of dimethoate appear more impressive: 89% of the mites recovered between days 2 and 10 from rats fed dimethoate treated grain were dead, while only 3% of the mites recovered during the same period from control animals died. It is probable that the dimethoate-treated grain (which had a powerful odor) had a fumigant effect on the mites, causing large numbers to detach from their host on the first day of the test before the test rats had a chance to ingest much of the treated grain. Seventy-two percent of the mites recovered from the animals in these tests were *T. deliense*.

REFERENCES:

1. Miller, B.E., et al: Field Studies on Systemic Insecticides I. Evaluation of Phoxim for Control of Cotton Rat Fleas. *J. Econ. Ent.* (In press).
2. Sangkasuwan, V., et al: SEATO Medical Research Laboratory Annual Report, April, 1966.

Table 1. Effects of 0.24% Phoxim-treated Bait on Trombiculid Mites Infecting *Rattus rattus*.

Day	TEST ANIMALS (12)		CONTROL ANIMALS (12)	
	Total No. Mites Recovered	Mite Mortality (Per cent)	Total No. Mites Recovered	Mite Mortality (Per cent)
1	285	15.1	172	23.8
2	341	27.5	323	31.8
3	71	39.4	92	15.2
4	11	27.3	25	32
5	4	100	14	50
6	10	70	46	26
7	2	50	28	0
8	1	100	5	0
9	0	—	0	—
10	2	100	0	—
11	2	50	0	—
12	2	0	0	—
13	1	0	1	100
14	667*	32.4	784*	15.6
Total	1399	28.6	1493	20.7

*Recovered after rats sacrificed

Table 2. Effects of 0.36% Phoxim-treated Bait on Trombiculid Mites Infecting *Rattus rattus*.

Day	TEST ANIMALS (13)		CONTROL ANIMALS (13)	
	Total No. Mites Recovered	Mite Mortality (Per cent)	Total No. Mites Recovered	Mite Mortality (Per cent)
1	681	15	505	8
2	1519	10	953	9
3	292	20	311	9
4	107	24	159	11
5	25	56	28	53
6	3	33	20	10
7	1	100	8	62
8	12	17	2	100
9	2	50	5	80
10	2	100	3	33
11	0	—	0	—
12	0	—	5	80
13	0	—	7	86
14	359*	44	1844*	24
Total	3003	17	3850	17

*Recovered after rats sacrificed

Table 3. Effects of 0.36% Dimethoate-treated Bait on Trombiculid Mites Infecting *Rattus rattus*.

Day	TEST ANIMALS (10)		CONTROL ANIMALS (10)	
	Total No. Mites Recovered	Mite Mortality (Per cent)	Total No. Mites Recovered	Mite Mortality (Per cent)
1	2300	10.5	632	0.2
2	162	86	846	0.3
3	29	93	94	9.5
4	6	100	71	0.6
5	1	100	20	5
6	1	100	7	14
7	0	—	27	7
8	0	—	13	7
9	0	—	0	—
10	273*	91	1153*	2
Total	2772	24	2863	3

*Recovered after rats sacrificed