

TOXICITY OF CHEMICAL BAITS AGAINST THE  
RED IMPORTED FIRE ANT,  
SOLENOPSIS INVICTA<sup>1</sup>

(B)

R. LEVY<sup>2</sup>, J. F. CARROLL<sup>2</sup>, Y. J. CHIU<sup>2</sup>, AND W. A. BANKS<sup>3</sup>

ABSTRACT

Toxic baits of 402 chemicals were evaluated in the laboratory to determine their effectiveness in controlling the red imported fire ant, *Solenopsis invicta* Buren. No chemical bait was as consistently as effective as mirex for the control of the red imported fire ant, although compounds ENT-27931, ENT-27932, ENT-27933, ENT-27934, ENT-27935, ENT-27936, ENT-27937, and ENT-62469 were promising and exhibited relatively consistent delayed action over a 10 to 99-fold dosage.

Mirex has been found to be the most effective toxicant for use in baits against the red and black imported fire ants, *Solenopsis invicta* Buren and *S. richteri* Forel, respectively (Lofgren et al. 1962, 1963, 1964, 1967; Stringer et al. 1964). Despite an extensive program for laboratory evaluation of alternate bait toxicants, no other compound has been found to possess mirex's consistent delayed action over a 100-fold or greater dosage range (i.e. Class V compound) (Lofgren et al. 1967, Levy et al. 1973, Wojcik et al. 1973). Levy et al. (1973) reported that although Shell SD23687 exhibited Class V mortality against the imported fire ant when cold-aged before testing, the compound was not consistently as effective as mirex in repeated laboratory tests. Field tests have shown that it is ineffective against natural infestations of the fire ant (Banks et al. unpublished).

Only 11 chemicals out of a total of more than 1500 tested toxicants have demonstrated delayed action over a 10-fold to 99-fold dosage range (i.e. Class IV compounds) (Lofgren et al. 1967, Wojcik et al. 1972, and Levy et al. 1973). Most of these compounds have been mirex analogs and have not shown consistent delayed toxicity in the laboratory and/or field tests.

This paper summarizes the mortality data of 402 bait toxicants which have been evaluated in the laboratory to determine their potential for controlling the red imported fire ant.

METHODS AND MATERIALS

Toxicants were tested in once-refined soybean oil at concentrations of 0.01, 0.1, and 1.0% against red imported fire ants collected from several mounds in the Gainesville, Florida area. The evaluation procedures described by Lofgren et al. (1967) and modified by Levy et al. (1973) were used for the tests.

All chemicals, with the exception of those compounds identified by Entomology Number (ENT) are listed by item number according to their chemical name and structural formula in USDA Agricultural Handbook No. 340 (1967). The chemical names of compounds identified by ENT are given.

<sup>1</sup> Florida Agricultural Experiment Station Journal Series No. 5099.

<sup>2</sup> Department of Entomology and Nematology, University of Florida, Gainesville, Florida 32611.

<sup>3</sup> Insects Affecting Man Research Laboratory, USDA-ARS, Gainesville, Florida 32601.

Bait toxicants were classified by the following system (Lofgren et al. 1967). Delayed toxicity was defined as less than 15% mortality after 24 hrs and more than 89% mortality at the end of the test period.

*Class I.*—Compounds that gave insufficient kill at the preliminary test concentrations (less than 90% kill at the end of the test period).

*Class*

Ia—Maximum kill 0 to 29%.

Ib—Maximum kill 30 to 59%.

Ic—Maximum kill 60 to 89%.

*Class II.*—Compounds that killed too fast at the higher concentrations but gave insufficient kill at the lower concentrations; that is, 15% or more kill after 24 hrs and 90 to 100% at the end of the test period at the higher concentrations but less than 90% kill with the lower concentrations at the end of the test period.

*Class*

IIa—Produced fast kill at 1.0%.

IIb—Produced fast kill at 0.1 and 1.0%.

IIc—Produced fast kill at 0.01, 0.1, and 1.0%.

*Class III.*—Compounds that show delayed action over a onefold to ninefold dosage range.

*Class*

IIIa—Delayed action occurred between 0.25 to 1%.

IIIb—Delayed action occurred between 0.025 to 0.1%.

IIIc—Delayed action occurred between 0.0025 to 0.01%.

*Class IV.*—Compounds that show delayed action over a tenfold to ninety-ninefold dosage range.

*Class V.*—Compounds that show delayed action over a hundredfold or greater dosage range.

## RESULTS AND DISCUSSION

Results from the tests are shown in Table 1. No chemical bait was as consistently as effective as mirex (5008) for the control of the red imported fire ant, although compounds ENT-27931, ENT-27932, ENT-27933, ENT-27934, ENT-27935, ENT-27936, ENT-27937, and ENT-62469 were promising and exhibited relatively consistent delayed action over a 10 to 99-fold dosage.

The similar structures of the 7 phosphorothioic acid bait toxicants from Hebrew University indicated that ortho, para, or meta substitution of one or more bromophenyl or fluorophenyl radical(s) on the basic benzene configuration did not increase delayed toxicity over a wider range of concentrations. No significant additive or synergistic effect resulted when several of these compounds were mixed at a 1:1 dilution at the 3 test concentrations. In addition, these compounds, as well as ENT-62469 are basically phosphatic and should not exhibit the environmental persistence (i.e. slow environmental [ecological] degradability) that has been attributed to mirex and other chlorinated hydrocarbon insecticides.

TABLE 1. CHEMICALS EVALUATED FOR CONTROL OF THE RED IMPORTED FIRE ANT.

Mortality Class	Toxicant Item Number																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																
Ia	0102	0105	0122	0180	0181	0184	0205	0273	0279	0280	0326	0351	0434	0561	1001	1209	1340	1360	1362	1374	1391	1392	1395	1398	1400	1404	1406	1450	1552	1753	1756	1758	1759	1761	1990	1995	2003	2080	2183	2185	2193	2311	2315	2316	2320	2326	2332	2340	2342	2344	2348	2349	2351	2630	2632	2644	3163	4181	4207	4260	4891	4896	4898	4902	4905	4907	4909	4913	4918	4922	4924	4925	4929	4930	4932	4936	4938	4992	4993	5039	5091	5284	5437	5470	5541	5670	5671	5681	5683	5684	5686	5687	5689	5693	5694	5697	5698	5699	5702	5713	5822	5839	5841	5844	5848	5853	5858	5859	5860	5868	5879	5881	5895	5896	5897	5898	5899	5905	5906	5907	5908	5912	5913	5914	5916	5923	5926	5927	5932	5933	5939	5940	5942	5944	5947	5956	5960	5961	5963	5970	5971	5973	5974	5980	5984	5986	6002	6042	6048	6068	6070	6073	6074	6096	6100	6101	6105	6112	6114	6116	6117	6122	6124	6125	6130	6133	6135	6144	6145	6146	6147	6148	6150	6153	6157	6165	6207	6214	6227	6239	6240	6248	6252	6268	6269	6273	6276	6296	6301	6348	6353	6355	6356	6358	6361	6365	6366	6367	6368	6373	6374	6377	6380	6383	6384	6391	6404	6413	6414	6416	6417	6419	6420	6424	6425	6426	6427	6428	6433	6436	6438	6439	6444	6445	6462	6468	6708	7112	7119	7132	7138	7144	7310	7346	7540	7575	7576	7577	7651	7655	7674	7686	7980	8047	8048	8056	8100	8101	8102	8110	8114	8115	8117	8139	8144	8150	8152	8169	8170	8184	8186	8210	8215	8373	8399	8408	8470	8549	8703	8817	8819	8821	8823	8825	8827	8829	8831	8833	8835	8837	8839	8841	8843	8845	8847	8849	8851	8853	8855	8857	8859	8861	8863	8865	8867	8869	8871	8873	8875	8877	8879	8881	8883	8885	8887	8889	8891	8893	8895	8897	8899	8901	8903	8905	8907	8909	8911	8913	8915	8917	8919	8921	8923	8925	8927	8929	8931	8933	8935	8937	8939	8941	8943	8945	8947	8949	8951	8953	8955	8957	8959	8961	8963	8965	8967	8969	8971	8973	8975	8977	8979	8981	8983	8985	8987	8989	8991	8993	8995	8997	8999	9001	9003	9005	9007	9009	9011	9013	9015	9017	9019	9021	9023	9025	9027	9029	9031	9033	9035	9037	9039	9041	9043	9045	9047	9049	9051	9053	9055	9057	9059	9061	9063	9065	9067	9069	9071	9073	9075	9077	9079	9081	9083	9085	9087	9089	9091	9093	9095	9097	9099	9101	9103	9105	9107	9109	9111	9113	9115	9117	9119	9121	9123	9125	9127	9129	9131	9133	9135	9137	9139	9141	9143	9145	9147	9149	9151	9153	9155	9157	9159	9161	9163	9165	9167	9169	9171	9173	9175	9177	9179	9181	9183	9185	9187	9189	9191	9193	9195	9197	9199	9201	9203	9205	9207	9209	9211	9213	9215	9217	9219	9221	9223	9225	9227	9229	9231	9233	9235	9237	9239

Table 1. (Continued)

Ic	0101 0126 0269 0281 0340 1244 1281 1368 1390 1410 2220 4068 4972 5189 5845 5856 5874
	5931 5997 6005 6043 6126 6218 6237 6270 6278 6322 7519
IIa	2647 5921 6225 6288 6309 6343 6431 6433 6434
IIb	5991 5993 6113 6118 6136 6193 6199 6204 6286
IIc	6199 6343
IIIa	1889 5962 6018 6057 6067 6069 6079 6094 6129 6170 6172 6228 6305 7618
IIIb	5955 6013 6169 6200 6307
IIIc	5990 6019 6053 6111 6197 6223 6260 6295 6329
IV	ENT-27931 <sup>a</sup> ENT-27932 <sup>b</sup> ENT-27933 <sup>c</sup> ENT-27934 <sup>d</sup> ENT-27935 <sup>e</sup> ENT-27936 <sup>f</sup> ENT-27937 <sup>g</sup> ENT-62469 <sup>h</sup>
V	5008

- <sup>a</sup>Phosphorothioic acid, *O*-(*p*-bromophenyl) *O*,*O*-dimethyl ester (R. S. 11 Hebrew University)  
<sup>b</sup>Phosphorothioic acid, *O*-(*m*-bromophenyl) *O*,*O*-dimethyl ester (R. S. 12 Hebrew University)  
<sup>c</sup>Phosphorothioic acid, *O*-(*o*-bromophenyl) *O*,*O*-dimethyl ester (R. S. 13 Hebrew University)  
<sup>d</sup>Phosphorothioic acid, *O*-(*p*-fluorophenyl) *O*,*O*-dimethyl ester (R. S. 14 Hebrew University)  
<sup>e</sup>Phosphorothioic acid, *O*-(*o*-fluorophenyl) *O*,*O*-dimethyl ester (R. S. 15 Hebrew University)  
<sup>f</sup>Phosphorothioic acid, *O*-(2,5-dibromophenyl) *O*,*O*-dimethyl ester (R. S. 16 Hebrew University)  
<sup>g</sup>Phosphorothioic acid, *O*-(2,4-dibromophenyl) *O*,*O*-dimethyl ester (R. S. 17 Hebrew University)  
<sup>h</sup>Phosphoric diamide, *N,N,N',N'*-tetramethyl-*p*-propyl-[PHT-20666GD (PCRB)]

Although many phosphorothioic acid compounds have been tested against the imported fire ant in toxic baits (Lofgren et al. 1973), Nemacide® (Phosphorothioic acid, 0-2, 4-dichlorophenyl 0,0-diethyl ester), was the only chemical in this group of compounds that has shown effective Class IV delayed action in the laboratory. Field tests with Nemacide® gave poor control of the imported fire ant (Lofgren et al. unpublished).

Since an alternate compound that can replace mirex for extended field application is greatly needed, all bait toxicants exhibiting effective toxicity (i.e. compounds exhibiting consistent Class IV or greater delayed action) will be considered potential candidates for control of the red imported fire ant.

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