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EFFECTS OF CHLORPYRIFOS AND ACEPHATE ON POPULATIONS OF RED IMPORTED FIRE ANTS¹ IN CULTIVATED FIELDS²

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ABSTRACT

Chlorpyrifos or acephate sprayed on and disked into the soil during seed-bed preparation at the rate of 1.12 Kg/ha (1 lb AI/acre) gave only temporary suppression of populations of *Solenopsis invicta* Buren in cultivated fields. Foraging activity in the chlorpyrifos-treated fields resumed at low levels by 1-2 weeks posttreatment and by 4 weeks the number of ants trapped was near pretreatment levels. The number of ants trapped on the acephate-treated fields was slightly reduced at 1 week posttreatment but by 2 weeks was above pretreatment levels.

Key Words: *Solenopsis invicta*, control, insecticides, organophosphates

Opinions as to the impact of the imported fire ants (IFA), *Solenopsis invicta* Buren and *Solenopsis richteri* Forel on agriculture vary greatly. The ants have been variously reported as beneficial, as innocuous, or as extremely destructive (Burns and Melancon 1977, Green 1967, Harris 1971, Harris and Burns 1972, Lofgren *et al.* 1975, Sterling 1978). Studies by Adams *et al.* (1976, 1977) in Georgia and North Carolina and Stringer *et al.* (unpublished data) in Mississippi from 1974 to 1977, showed that the presence of large well-established IFA colonies in soybean fields at the time of harvest can cause substantial monetary losses to the farmer.

The loss of mirex (dodecachlorooctahydro-1,3,4-metheno-1*H*-cyclobuta [cd]pentalene) as a control agent in mid-1978 (Holden 1976, Johnson 1976) left no adequate means by which a farmer might control fire ants in his fields. Although Morrill and Greene (1975) reported that temporary reductions in the number of IFA colonies could be achieved in cultivated fields by deep plowing or disking, the number of mounds at harvest time was not significantly lower in cultivated fields than in adjacent undisturbed areas. No other methods of reducing ant populations in cultivated fields have been explored though Hillman (1976, 1977) and Morrill (1977) showed that chlorpyrifos (*O,O*-diethyl *O*-(3,5,6-trichloro-2-pyridyl)phosphorothioate) and diazinon (*O,O*-diethyl *O*-(2-isopropyl-6-methyl-4-pyrimidinyl)phosphorothioate) were effective as drench treatment of individual mounds.

¹ Hymenoptera: Formicidae.

² Mention of a pesticide, commercial or proprietary product in this paper does not constitute an endorsement or recommendation of this product by the U.S. Department of Agriculture.

We conducted tests in 1978 to evaluate the effectiveness of cultivation plus application of a non-persistent insecticide in reducing ant populations in cultivated fields.

MATERIALS AND METHODS

Chlorpyrifos and acephate (*O,S*-dimethyl acetylphosphoramidothioate) were chosen as the chemicals to be evaluated. Chlorpyrifos was an obvious candidate because of the results reported by Hillman (1976, 1977) and Morrill (1977) and results we have obtained in laboratory tests (unpublished data) that showed that levels as low as 0.1 ppm incorporated in the soil were highly toxic to IFA. Acephate was chosen on the basis of technical information from Chevron Chemical Company indicating that 4.48 to 8.96 Kg/378.5 liters (4 to 8 lb AI/100 gallons) water gave good control of IFA.

Two series of tests were conducted in adjacent fields in Hancock County, Mississippi, in 1978, one in June and the second in August. For each test, three 0.405 ha (one-acre) plots were disked four times at weekly intervals with a disk harrow and farm tractor. At the time of the fourth disking, chlorpyrifos at 1.12 Kg/ha (1 lb AI/acre) was applied to one plot, acephate at 1.12 Kg/ha (1 lb AI/acre) was applied to a second plot, and the third plot was left untreated as a check. For application, emulsifiable concentrate of an insecticide was mixed with 94.6 liters (25 gallons) of water and sprayed onto the soil between the front and rear disk gangs of the harrow.

The treatments were evaluated by running baited trap lines across the plots to determine presence or absence of ants. Traps were made from 29.6 ml (1 oz.) plastic cups (Dixie Cup PO1-10) covered with tight fitting lids (Dixie PO-1-70). A hole (ca. 2 mm) was opened in the side of each cup near the bottom and a bait of 1-2 g of ground beef was placed in the bottom near the hole. At each sampling, 20 such traps were placed at 4.58 m (15-foot) intervals along the diagonal of each 0.405 ha (1-acre) plot. After 1 hour exposure, the traps were collected, the hole was sealed with tape and the traps were returned to the laboratory for counting of the ants in each trap.

RESULTS AND DISCUSSION

The number of ants captured prior to the first disking varied from plot to plot, reflecting a variation in the number of nests and in the pattern of foraging on each plot.

Four consecutive diskings without any insecticide did not appear to adversely affect the ants since both the number of sites with ants and the number of ants remained relatively constraint or increased on both checks. Two of the four treated plots also showed an increase in the number of ants captured after three diskings. There was a decrease in the numbers captured on the other two plots but it is not known if this was due to the disking or to other factors.

Chlorpyrifos did not appear to produce any substantial reduction in ant populations. Preliminary captures taken at 1 and 2 weeks after treatment showed reductions of 100% and 75% over pretreatment levels, respectively, in test 1 and 90.7 and 65.2%, respectively, in test 2. By 4 weeks however,

Table 1. Effects of chlorpyrifos and acephate on natural populations of fire ants.

	Number of ants taken in baited traps at indicated intervals for indicated treatment														
	chlorpyrifos, 1.12 Kg/ha					acephate, 1.12 Kg/ha									
	Post-treat					untreated check									
	Pre-disk	Pre-treat	Post-treat	Pre-disk	Pre-treat	Post-treat	Pre-disk	Pre-treat	Post-treat	Pre-treat					
		1 wk	2 wk	4 wk		1 wk	2 wk	4 wk	1 wk	2 wk	4 wk				
Total No. Ants	1367	580	0	147	1231	870	1142	255	686	1840	1736	1099	865	1289	1728
% Sta. with Ants	80	85	0	25	85	72	90	15	55	70	100	80	45	75	80
						<i>Test 1</i> ²									
Total No. Ants	291	2342	216	815	854	60	892	872	2864	830	399	3299	735	3654	367
% Sta. with Ants	45	75	15	25	50	50	45	85	80	75	70	60	70	80	75
						<i>Test 2</i> ³									

¹ Sample taken after area disked 3 times but prior to insecticide application.

² Test made in June 1978.

³ Test made in August 1978.

captures in test 1 were 212.2% of pretreatment levels and were 90% of pre-disk levels. In test 2 four-week captures were only 36.4% of pretreatment levels but were 293.4% of pre-disk levels. While there may have been a reduction in the ant population the fact that captures in the untreated check were also reduced at this interval leads us to suspect that factors other than the insecticide were responsible. It appeared that the chlorpyrifos did not significantly reduce the ant populations but simply suppressed foraging activity during the first 7 to 14 days after treatment.

The data also indicate that 1.12 kg/ha (1 lb/acre) of acephate had little effect on the ants. In both tests the preliminary captures at 1 week showed a reduction of pretreatment levels; however, by 2 weeks captures were 117.3% and 110.8% of pretreatment levels in test 1 and 2, respectively. At 4 weeks captures in test 1 were still above pretreatment levels and were 99.5% of initial pre-disk levels; in test 2, 4-week captures were only 11.1% of pretreatment levels but were 92% of initial pre-disk levels.

The results of the tests indicate that economically feasible rates of chlorpyrifos or acephate would provide little relief from IFA if applied as a pre-plant broadcast treatment. Since chlorpyrifos was the most effective organophosphorus chemical we tested as a soil treatment in the laboratory, it does not appear likely that any other organophosphates would offer satisfactory control. Cultivation alone destroys the mound structure for a time but does not diminish populations of fire ants.

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