EFFECT OF INSECTICIDES APPLIED TO PECAN TREE TRUNKS AND THE ORCHARD FLOOR FOR THE SUPPRESSION OF THE RED IMPORTED FIRE ANT (HYMENOPTERA: FORMICIDAE)

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ABSTRACT

The red imported fire ant (RIFA), Solenopsis invicta Buren, is a pest of several aspects of pecan production and a natural enemy of several pecan pests. Investments made in insecticide treatments for RIFA suppression must be economically justified. To begin development of economic justification, the impact of registered treatments to RIFA foraging and mound activity were demonstrated. Trunk sprays effectively suppressed foraging in trees for up to 16 weeks following treatment. Broadcast applications to the orchard floor suppressed mound activity, with chlorpyrifos (Lorsban® 4E) performing better than bendiocarb (Rotate® 2 1/2G) and isazofos (Triumph®). These treatments may be effectively implemented to suppress ant activity in tree canopies or the orchard floor to suppress ant activity during field operations.

Introduction

The impact of the red imported fire ant (RIFA), Solenopsis invicta Buren, in pecan *Carya illenoiensis* orchards has not been conclusively documented. Pestiferous aspects of this insect include 1) interference of production operations such as grafting, mowing and harvesting operations, 2) predation by the ants on natural enemies of certain pests such as vulnerable stages of the green lacewing (Chrysopa spp.), which naturally suppresses population of the pecan aphid complex (Tedders et al. 1989), and 3) damaging drip or sprinkler irrigation systems by chewing into pipes, clogging nozzles or burying system components. Beneficial aspects of the ants include predation on primary pecan pests such as pecan weevil (*Curculio caryae* (Horn) (Dutcher and Sheppard 1981), hickory shuckworm (*Cydia caryana* (Fitch)) and perhaps others.

RIFA management options in pecan orchards include cultural and chemical methods. Dragging heavy objects (such as railroad ties) can reduce mound height temporarily so that hardened mounds will not interfere with mowing or ground harvesting machinery operations. Insecticides registered for RIFA in pecan include 1) bendiocarb (Rotate® 2 1/2G) registered for non-producing citrus and pecan orchards, and 2) chlorpyrifos (Lorsban® 4E). Alternative methods, such as the use of very hot water may also be used (Drees and Vinson 1989), although

the practicality of using these methods on a large scale is doubtful.

This series of applied research/result demonstration was conducted to document the effectiveness of available insecticidal methods of RIFA control in the pecan orchard. The goal was to demonstrate available methods of RIFA management. With this information, one could begin contemplating the economic justification of including these approaches into the pecan production system.

Materials and Method

Two tests were conducted at Royal Pecans in Burleson County, Texas: 1) use of chlorpyrifos trunk sprays to eliminate RIFA foraging activity in the pecan tree canopy, and 2) ground application of bendiocarb, chlorpyrifos and an experimental compound, isazofos (Triumph®) to eliminate RIFA foraging and mound activity in an abandoned portion of the orchard.

Trunk sprays: Two sections of the orchard were selected for this test: 1) an unmanaged area of relatively small young trees, and 2) a fully managed area of mature, producing trees. All of the trees were of a size where their canopies were not touching, therefore leaving only the individual trunks as a means of access for the ants into the tree canopies. On 23 June 1989, chlorpyrifos (Dursban® 4E) was applied at a rate of 1 fl. oz. per gal.(peach tree borer rate) to the trunks with a hand pressure sprayer to a height of about 4 feet to runoff three 3 sets of three trees in the managed area and 6 sets of 3 trees in the unmanaged area. These sets of treated trees were positioned between an equal number tree sets designated as untreated (control) trees. Due to rain shortly after application, a second application made on 13 July.

Evaluation was conducted weekly by attaching a 1.0 x 0.5 inch olive-oil soaked index card to each middle tree of the three-tree sets. Treated trees were sampled both above and below the treatment area. Untreated trees were sampled with on strip 3 feet above ground level. The number of RIFA in contact with these cards was documented and analyzed using the Student's test (P 0.05).

Broadcast applications: This test was initiated on 22 September 1989. Five non-replicated square 1-acre plots were established. Treatments were applied 25 Sept.1989; 1)bendiocarb (Rotate® 2 1/2G), at a rate if 12.5 lbs./acre (0.31 lb. active ingredients (AI)/acre) was applied using a Herd seeder, 2.25 setting, 5 - 7 mph. double-treated pattern; 2) chlorpyrifos (Lorsban®4E), 1 qt./acre (1 lb. AI/acre) + 30 gal. water; 3) isazofos (Triumph® 4E, FL-840876), 1 qt./acre (1 lb. AI/acre) + 30 gal. water (H. Ray Smith, Senior Field Research & Development Representative, Ceiba-Geigy). Treatments 2 and 3 were applied using Yamaha PS-50 Spray Equipment with a 24 ft. boom and 20 inch nozzle spacing; and 4) untreated (check).

The number of active RIFA mounds were determined using the minimal disturbance technique (Frankie 1983) in 6 permanently-established contiguous 0.03-acre square subplot areas (36 x 36 ft.) within treatment plots before and weekly following treatment. In addition, the number of RIFA foraging on 0.5 x 0.5 inch olive-oil soaked index cards affixed to 6 tree trunks within

treatment plots during an approximate 1 hour exposure period were documented. Results of monitoring procedures were analyzed using subplot analysis of variance with the Duncan's Multiple Range test (P 0.05) (Ecosoft 1981). Percent reductions were calculated using Henderson's formula (Henderson and Tilton 1955).

Results and Discussion

Trunk sprays: Tables 1 and 2 list the resulting impact of trunk sprays RIFA canopy foraging activity. Olive-oil card monitoring efforts produce erratic results as indicated by the "check" (c) column in these tables. However, within both managed and unmanaged orchards, RIFA foraging in trees above the trunk-treatment zones areas was virtually eliminated for more tan 16 weeks (112 days). Thus, trunk treatment appears to be an effective method for maintaining ant-free trees. This method could be used to eliminate the nuisance of ant presence during grafting and pruning operation and/or to preserve aphid predators during portions of the growing season. If insecticide treatments required for aphid species (*Monelliopsis pecanis* Bissell - yellow pecan aphid and *Monilia Caprella* (Fitch) - blackmargined aphid) could be reduced or eliminated as a result of the suppression of RIFA, such trunk spray treatments could be justified economically within a pecan production system.

Broadcast applications: Broadcast applications of chlorpyrifos, bendiocarb and isazofos all produced significant reductions in the number of active RIFA mounds relative to the untreated plot within the course of this study (**Table 3**). Statistically, chlorpyrifos performed overall better than the other materials, providing maximum suppression 27-35 days following treatment. Isazofos performed in a similar trend. Bendiocarb produced significant levels of suppression erratically (5, 27, 35, and 56 days following treatment).

Though weather conditions varied tremendously over the test period, with minimum low of 33 degrees and a maximum high of 96, all evaluations were conducted with ground temperatures between 70 and 90 degrees to ensure mound and forager ant activity. All insecticides tested gave virtually 100% control of foraging ants within 2 days (**Table 4**). After this time, though, the elimination of RIFA foraging in trees became statistically less consistent. Some trees had no ants for up to six weeks while others had ants after two and these numbers remained consistent. A possible explanation of the spotty, yet consistent results of monitoring efforts using olive oil-soaked cards on the tree trunks is the presence of mound close to , or at the base of the tree. Because the liquid pesticides were applied with a long boom, it is probable that the area around the base of the trees was left untreated.

Surface application of contact insecticides appear to provide almost 100% control of foraging RIFA, but only for a short time. There was an observed lag between pronounced worker death and mound number decrease of over a week. One would assume that such great worker mortality caused the mounds to become devoid of ant activity slowly as food gathering activities on the treated surface was eliminated. Of equal notability was the persistence of reduced RIFA activity. In some trees within treated areas, foraging RIFA returned quickly, while other remained free of ants after 6 weeks. These results were supported by the results of chlorpyrifos trunk treatment

test. Active mound numbers also remained remarkably consistent with little resurgence following treatment for 5 weeks.

These results document the feasibility of using broadcast orchard floor treatments to suppress ant activity prior to harvesting operations. Significant levels of suppression extend beyond the 28-day pre-harvest interval specified on the Lorsban 4E (chlorpyifos) label. Thus, an application made a month before the expected harvesting date should 1) provide RIFA suppression and 2) provide for the treatment may be particularly suitable when using ground harvesting equipment:

Model 420 Harvester	Savage Equipment, Inc. 400 Industrial Rd. Madill, OK 73446
Bag-A-Nut Harvester	Bag-A-Nut® 10601 Theresa Dr. Jacksonville, FL 32216
Nu-Harvester N-60	Nu Equipment Corporation 403 East Pecan Street San Saba, TX 76877
Model 8090 Pecan Harvester	Nut Hustler, Inc Star Rt. Box 18 Lampasas, TX 76550

However, the suppression of RIFA canopy foraging appears to be more effectively achieved using trunk treatments rather than with broadcast applications of sprays or granules to the orchard floor. Since the only direct effects of RIFA suppression using a broadcast application on pecan production appears to be worker safety and elimination of ants during period of specific field activity such as harvesting operations, the monetary benefit resulting from an investment in this pesticide application to control RIFA remains to be justified.

Acknowledgments

The authors are grateful to H. Ray Smith, Senior Field Research & Development Representative, Ceiba-Geigy, for providing materials and liquid application equipment and assisting in establishment of these plots. Other materials were provided by Bryan Stuart of Dow Chemicals U.S.A. and Lane Smith of Nor-Am Chemical Company. The Cooperation of Andy Sherrod, manager of Royalty Pecans is much appreciated.

Literature cited

Drees, B.M. and Vinson, S.B. 1989. Fire Ants and Their Control. B-1536. Texas Agricultural Extension Service. Texas A&M University System. College Station, TX. 12 pp.

Dutcher, J.D. and D.C. Sheppard. 1981. Predation of Pecan Weevil Larvae by Red Imported Fire Ants. J. Ga. Intimal. Soc. 16 (2):210-213.

Frankie, O. F. 1983. Efficacy Tests of Single-mound Treatments for Control of Red Imported Fire Ant Solenopsis invicta Buren. Southwestern Entomologist 8:237-238.

Henderson, C. F. and E. W. Tilton. 1955. Tests with acaricides against the brown wheat mite. J. Econ. Intimal. 63:1536-1539.

Tedders, W.L., C. C. Reilly, B. W. Wood, R. K. Morrison and C. S. Lofgren. 1989. Solenopsis invicta Buren (Hymenoptera: Formicidae) foraging behavior in pecan and other Carya spp. trees. Proceedings of 1989 IFA Research Conference. Billoxi, MS., (M. Mispagel, ed.), Univ. GA, Athens, GA.

Table 1. Results of Student's test form the mean number of foraging red imported fire ants in contact with olive-oil soaked 1.0 x0.5 inch index cards in chlorpyrifos (Dursban® 4E) treated (above and below treated area) and untreated pecan tree trunks before and weekly after treatment (28 June and repeated 13 July 1989). Royalty Pecan, Burleson County, Texas.

Date	Above (A)	Below (B)	t(A/B)	Check (C)	t(A/C)
Managed Areas					
23 June	28.7± 37.6	---	-	44.0±24.6	x
13 July	3.7±6.4	1.0±1.7	x		
(20)	"			5.8±40.5	-2.31
20 July	0±0	3.3±5.8	x		
(27)	"			113.3±51.1	-3.84
27 July	0±0	16.0±17.7	x		
(34)	"			51.7±37.6	-2.38
4 Aug.	0±0	0±0	x		
(42)	"			41.3±21.8	-3.29
10 Aug.	0±0	4.3±5.8	x		
(48)	"			19.3±21.2	x
18 Aug.	0±0	3.7±3.2	x		
(56)	"			26.0±22.6	x
24 Aug.	0±0	11.0±14.2	x		
(62)	"			18.3±16.5	x
1 Sept.	0±0	9.7±8.7	x		
(70)	"			22.3±18.0	-2.15
8 Sept.	0±0	13.7±11.8	x		
(77)	"			11.0±6.0	-3.18
15 Sept.	0±0	14.7±10.8	-2.36		
(84)	"			32.0±16.0	-3.46
22 Sept.	0±0	11.7±12.4	x		
(91)	"			13.0±3.6	-6.25
2 Oct.	0±0	7.7±2.1	-6.38		
(101)	"			6.3±5.7	x
6 Oct.	0.33±.58	9.0±5.3	-2.82		
(105)	"			11.3±5.0	-3.76
13 Oct.	0.67±1.15	5.7±5.1	x		
(112)	"			9.7±4.9	-3.08

x = means not significantly different (p 0.05)
(d. f. = 4)

Table 2. Result of Student's t test from the mean from the mean number of foraging red imported fire ants in contact with olive-oil soaked 1.0 x 0.5 inch index cards in chlorpyrifos (Dursban® 4E)treated (above and below treated area) and untreated pecan tree trunks before and weekly after treatment (28 June and repeated 13 July 1989). Royalty Pecan, Burleson County, Texas.

Date	Above (A)	Below (B)	t(A/B)	Check (C)	t(A/C)
Unmanaged Areas					
23 June	63.7±41.3	---	-	32.3±30.7	x
13 July	18.8±28.6	35.2±33.7	x		
(20)	"			46.8±47.0	x
20 July	0±0	10.0±13.3	-1.85		
(27)	"			15.0±10.3	-3.56
27 July	0±0	18.3±24.3	-1.85		
(34)	"			10.8±3.5	-7.61
4 August	0±0	4.7±8.6	x		
(42)	"			8.7±8.8	-2.40
10 August	0±0	3.3±4.5	-1.83		
(48)	"			4.2±5.2	-1.95
18 August	0.83±1.3	6.0±4.8	-2.51		
(56)	"			11.3±16.8	x
24 August	2.2±4.0	7.0±3.46	-2.23		
(62)	"			4.5±17.4	x
1 Sept.	0.17±41	6.2±10.6	x		
(70)	"			10.0±10.4	-2.30
8 Sept.	3.0±6.4	7.0±5.2	x		
(77)	"			4.7±4.4	x
15 Sept.	0.30±.52	11.3±8.9	-3.00		
(84)	"			7.7±9.4	-1.92
22 Sept.	0.67±1.0	12.7±7.7	-3.79		
(91)	"			2.5±4.5	x
2 October	0±0	2.8±4.9	x		
(101)	"			0.30±.80	x
6 October	4.5±6.3	4.0±3.4	x		
(105)	"			1.3±1.9	x
13 October	0.83±1.3	2.5±2.25	x		
(112)	"			1.0±1.3	x

x = means not significantly different (p 0.05)
(D. F. = 10)

Table 3. Active red imported fire ant mounds per 0.03-acre subplot (replicated 6 times) within 1 acre non-replicated 25 September treatment plots in an abandoned pecan orchard floor. Royalty Pecans, Burleson County, Texas. 1989.

No. active fire ant mounds per 0.03-acre subplot[1]/ and percent reduction[2]/ in parenthesis

	Sept.		Oct.				Nov.		
Date	**22**	**27**	**6**	**13**	**19**	**27**	**3**	**10**	**17**
Post-treatment Date	**0**	**5**	**14**	**21**	**27**	**35**	**42**	**49**	**56**
Treatment and rate									
chlorpyrifos	10.8a	6.0b	2.0c	2.0c	1.8d	1.7d	6.3c	5.5b	5.2c
(Lorsban 4E)		(44)	(79)	(85)	(83)	(86)	(50)	(52)	(59)
1 lb a.i./A									
isazofos	12.7	8.8ab	5.3b	6.2b	4.7c	4.0c	11.3ab	6.0b	7.7c
(Triumph®)		(30)	(53)	(61)	(61)	(73)	(0)	(56)	(48)
1 lb a.i./A									
bendiocarb	8.8a	7.7b	8.7a	11.5a	8.7b	8.2b	12.0ab	10.7a	10.7b
(Rotate® 2 1/2g)		(11)	(0)	(0)	(0)	(19)	(0)	(0)	(0)
0.3 lb a.i./a									
untreated	11.5a	11.3a	10.3a	14.5a	11.0a	13.2a	13.5a	12.3a	13.5a

[1]/ Means in columns followed by different letters are significantly different using the Duncan's Multiple Range Test (P# 0.005).

[2]/ Calculated using Henderson's Formula (Henderson and Tilton 1955).

Table 4. Mean number of red imported fire ants per 0.5 square inch olive oil soaked index card after 1 hour exposure on 6 trees (replicated 6 times) with 1- acre non-replicated 25 September treatment plots in an abandoned pecan orchard floor. Royalty Pecans, Burleson County, Texas. 1989.

No. foraging ant per oil-soaked card[1]/ and percent reduction [2]/ in parenthesis

	Sept.		Oct.				Nov.		
Date	**22**	**27**	**6**	**13**	**19**	**27**	**3**	**10**	**17**
Post-Treatment Date	**0**	**5**	**14**	**21**	**27**	**35**	**42**	**49**	**56**
Treatment and rate									
chlorpyrifos	15.3a	0.0b	7.8a	6.8a	4.2a	1.3b	11.5ab	4.7ab	15.8ab
(Lorsban® 4E)		(100)	(0)	(4)	(59)	(72)	(17)	(52)	(0)
1 lb a.i./A									
isazofos	6.2a	0.0b	3.2a	9.5a	9.8a	4.0b	0.5b	2.7b	4.3b
(Triumph®)		(100)	(0)	(0)	(0)	(0)	(91)	(32)	(21)
1 lb a.i./A									
bendiocarb	17.2a	0.7b	5.0a	10.8a	6.5a	13.3b	8.0ab	9.2ab	22.8a
(Rotate® 2 1/2g)		(91)	(34)	(0)	(41)	(0)	(49)	(17)	(0)
0.3 lb a.i./a									
untreated	22.2a	10.0a	9.7a	10.3a	15.0a	6.8a	20.2a	14.3a	19.5ab

[1]/ Means in columns followed by different letters are significantly different using the Duncan's Multiple Range Test (p #0.05).

[2]/ Calculated using Henderson's Formula (Henderson and Tilton 1955).