Proceedings of the 2011 Imported Fire Ant Conference
Galveston, Texas, USA
April 4-7, 2011

Conference hosted by:
Texas AgriLIFE Research and
Texas AgriLIFE Extension Service
Department of Entomology
Texas A&M University
College Station, TX 77843-2475

Organizing Committee

Paul R. Nester, *Chair*
Bastiaan "Bart" Drees, *Co-Chair*
S. Bradleigh Vinson
Robert Puckett
Alejandro Calixto
Wizzie Brown
Molly Keck
Kimberly Schofield
Doug Van Gundy

Proceedings compiled by:
Paul R. Nester
Texas AgriLIFE Extension Service
Houston, TX

Knock-down and residual efficacy of contact insecticides against the little fire ant, *Wasmannia auropunctata* (Roger) (Hymenoptera: Formicidae)

Susan K. Cabral, Arnold H. Hara and Ruth Niino-DuPonte
University of Hawaii at Manoa
Komohana Research and Extension Center
875 Komohana St.
Hilo, Hawaii 96720
email: arnold@hawaii.edu

Abstract: The contact insecticides, Termidor SC (fipronil 9.1%) at 0.8 fl oz per gal water (0.06%) and Phantom SC (chlorfenapyr 21.4%) at 3.0 fl oz per gal water (0.50%) were tested against the workers of the little fire ant (LFA), *Wasmannia auropunctata* (Roger). In a directed spray application (knock-down) onto LFA worker ants, >98% mortality was achieved 4 hr after treatment (HAT) with chlorfenapyr, while fipronil took 24 hr for 100% mortality of LFA. To evaluate residual toxicity, LFA workers were exposed to insecticide deposits aged for 7 days under greenhouse conditions; chlorfenapyr achieved 100% mortality 3 days after exposure (DAE), while fipronil achieved only 10% mortality after 12 DAE, but reached 100% by 21 DAE. This study demonstrates that the delayed toxicity of LFA workers exposed to fipronil should allow for horizontal transfer to other workers resulting in greater proportion of the colony being exposed to the toxicant.

Introduction

The little fire ant (LFA), *Wasmannia auropunctata* (Roger) (Hymenoptera: Formicidae) is considered one of the top 100 of the world's worst alien species species (Lowe *et al.* 2000). Native to South America, LFA first occurred throughout most of the warmer parts of the New World, from subtropical Argentina to subtropical Mexico and through much of the Caribbean (Wetterer and Porter 2003). During the past century, invasive populations of *W. auropunctata* have become established in many other areas, including the Galapagos Islands, Africa, Melanesia (New Caledonia, Solomon Islands, Vanuatu), Polynesia (Wallis, Futuna, Tahiti, Tuvalu and Hawaii), Cairns Australia, the mainland US (Florida), and Atlantic islands (the Bahamas and Bermuda) (Krushelnycky *et al.* 2005, Lubin 1984, Mikheyev *et al.* 2009, Vanderwoude 2007, Wetterer *et al.* 1999, Wetterer and Porter 2003). The latitudinal range of known outdoor populations of *W. auropunctata* spans from 32°40'S in Argentina to 32° 20'N in Bermuda; LFA is also a greenhouse pest in more temperate regions, such as England and Canada (Wetterer and Porter 2003). Once established, LFA is extremely difficult to control in all but arid, two-dimensional (ground only) simple ecosystems; LFA was eradicated from ca. 21 ha on Marchena Island in a dryland forest area with an eight-month season of little or no rain on the Galápagos Archipelago using hydramethylnon (Amdro) fire ant bait (Causton *et al.* 2005). Hara *et al.* (2010) tested bait insecticides and hot water drenches against LFA in Hawaii; two applications one month apart of either a bait containing 0.365% hydramethylnon and 0.25% S-methoprene (Extinguish Plus) or a spray containing 24% metaflumizone (BAS 320 I 240 SC) reduced foraging worker numbers by >97% as compared with untreated controls. The persistence of weather-exposed metaflumizone (0.063%) bait was also evaluated: bait applied fresh or after 7 days of weather exposure resulted in >98% ant mortality; bait

exposed to weather for 14 d before application still achieved >90% mortality. *In vitro* submersion of *W. auropunctata* in 45 °C water for 10 min resulted in >99% mortality as compared with 28.9% mortality from submersion in ambient temperature water (26 °C) for 12 min (Hara *et al.* 2010).

This study evaluated two non-repellent contact insecticides, fipronil and chlorfenapyr, against LFA workers in knock-down (direct spray) and residual trials.

Materials and Methods

Trials were conducted at the University of Hawaii at Hilo, College of Agriculture, Forestry and Natural Resource Management (CAFNRM) instructional farm near Hilo, Hawaii to determine the knock-down (direct spray) and residual activity of Termidor SC (fipronil 9.1%, BASF, Research Triangle Park, NC) and chlorfenapyr (Phantom 21.4%, BASF) against the little fire ant (LFA), *Wasmannia auropunctata* (Roger). Treatments consisted of: 1) Termidor SC (0.06%) at 0.8 fl oz per gal water; 2) Phantom SC (0.50%) at 3.0 fl oz per gal water, 3) Phantom SC (0.50%) at 3.0 fl oz/ gal water and Silwet L-77 (100% silicone-polyether copolymer; Loveland Products, Greeley, CO) at 0.03 fl oz per gal water (0.25%), and 4) water (control). Each treatment consisted of four replicates of *W. auropunctata* colonies (100 adult worker ants per colony). Each replicate was transferred to a 7 cm deep x 9 cm diam. (400 ml) plastic tub (Better Plastics, Inc. # 800-932-7151) lined with filter paper (Whatman #1, 90 mm diameter). Sides of the containers were coated with 1:1 water: fluoropolymer (Insect-A-Slip) solution to prevent ants from escaping. Treatments were applied using a hand held 1-liter trigger spray bottle with five sprays (1 ml delivered per spray) through a cone-shaped acetate sleeve (5.5" wide x 8.5" length sheet of acetate) to direct the spray onto the ants and avoid contact with the coated sides of the tubs.

For the residual trials, treatments were applied as described above to the filter paper, which was then aged 24 hours or 7 days under greenhouse conditions to simulate light rainfall (30 ml of overhead irrigation daily) and moderate sunlight. The treated filter papers were placed into the plastic tubs prior to the transfer of ant colony replicates. All colonies were provided food and water after treatment application and housed in a room where the average temperature was 23° C and the relative humidity was 78% during the trial.

For the direct spray trial, colonies were monitored for mortality at 0.5, 2, 4, 6, 8 and 24 h after treatment (HAT). For the residual trials, colonies were monitored at 3, 5, 7, 10, 12, 14, 17 and 21 days after treatment (DAT). Mortality data were corrected using Abbott's formula and then arcsine transformed prior to ANOVA and Tukey's mean separation (Minitab).

Results and Discussion

Knockdown Trial

Within the first half-hour after application, 74.6% of the ants sprayed with Phantom (chlorfenapyr) plus Silwet L-77 were dead, and nearly 50% of those ants sprayed with Phantom alone were dead. By 4 HAT, mortality in both Phantom treatments were >98%, and 100% mortality was achieved at 6 HAT (Table 1). Direct spray on ants took longer with Termidor, with 50% mortality at 6 HAT and 100% mortality at 24 HAT (Table 1). By linear regression, 95% mortality by Termidor was predicted at 13.7 h after treatment.

Table 1: Mortality of little fire ant (*Wasmannia auropunctata*) exposed to direct deposit of Termidor and Phantom

	Hours After Treatment					
Treatment (% a.i.)	0.5	2	4	6	8	24
	% mortality*					
Control (water)	3.4 a	4.1 a	5.9 a	5.1 a	6.6 a	10.1 a
Termidor (0.06%)	5.3 a	10.6 a	50.4b	42.5b	72.2b	100.0b
Phantom (0.50%)	47.6b	76.0b	98.7c	100.0c	100.0c	100.0b
Phantom (0.50%) + Silwet (0.25%)	73.7b	85.3b	99.7c	100.0c	100.0c	100.0b

*Means in a column followed by different letters were different ($P < 0.05$).

Residual Efficacy Trial

At 3 days after exposure (DAE) to 24 h aged deposits of either Termidor or Phantom, 100% mortality was achieved as compared to 1.8% mortality among the control. At 3 DAE to 7-day aged deposits of either Phantom or Phantom + Silwet L-77, 100% mortality was achieved (Table 2), while mortality after exposure to 7-d aged Termidor deposits was not different from the control for up to 17 DAE. At 21 DAE, however, 100% mortality was achieved by the 7-d aged Termidor deposit.

Table 2: Mortality of little fire ant (*Wasmannia auropunctata*) exposed to 7-day aged deposit of Termidor and Phantom

	Days after Exposure (DAE) to 7-Day Aged Deposit							
Treatment	3	5	7	10	12	14	17	21
	% mortality*							
Control (water)	7.8 a	8.5 a	9.5 a	9.7 a	11.2 a	15.0 a	17.1 a	15.5a
Termidor (0.06%)	7.9 a	9.3 a	8.7 a	9.1 a	10.0 a	10.5 a	11.4 a	99.1b
Phantom (0.50%)	100.0b	100.0b	100.0b	100.0b	100.0b	100.0b	100.0b	100.0b
Phantom (0.50%) + Silwet (0.25%)	100.0b	100.00b	100.0b	100.0b	100.00b	100.0b	100.0b	100.0b

*Means in a column followed by different letters were different ($P < 0.05$)

Fipronil acted much slower against LFA than chlorfenapyr in both our direct spray and residual trials. In the direct spray trial, chlorfenapyr attained >98% mortality among LFA by 4 HAT, whereas fipronil took 24 HAT to reach 100% mortality. In residual tests, 7-d aged deposits of chlorfenapyr achieved 100% mortality at 3 DAE, while fipronil took seven times longer (21 DAE) to reach >99% mortality. The slower activity of fipronil against LFA should allow more opportunity for horizontally induced toxicity and recruitment across treated areas, thereby exposing a greater proportion of the ant colony as observed with the Argentine ant, *Linepithema humile* (Mayrt) (Chole and Rust 2008; Wiltz *et al.* 2009; Soeprono and Rust 2004). The potential horizontal movement of fipronil in LFA colonies will be due to contamination of nesting material, interaction with nestmates and necrophoresis as observed by Wiltz *et al.* (2010) on red imported fire ant, *Solenopsis invicta* Buren.

References Cited

Causton, C.E., Sevilla, C.R., and S.D. Porter. 2005. Eradication of the little fire ant *Wasmannia auropunctata*, (Hymeoptera: Formicidae) from Marchena Island, Galapagos: on the edge of success? Florida Entomol. 88: 159-168.

Chole, D.H. and M.K. Rust. 2008. Horizontal transfer of insecticides in laboratory colonies of the Argentine ant (Hymenoptera: Formicidae). J. Econ. Entomol. 101:1397-1405.

Hara, A. H., S. K. Cabral, R. Y. Niino-DuPonte, C. M. Jacobsen and K. Onuma. 2010. Bait insecticides and hot water drenches against the little fire ant, *Wasmannia auropunctata* (Roger) (Hymenoptera: Formicidae) infesting containerized nursery plants, pp. 135-140. *In* J. D. Hopkins, (ed.) Conference Proceedings 2010 Imported Fire Ant and Invasive Ant, Little Rock, Arkansas, University of Arkansas.

Krushelnycky, P.D., Loope, L.L., and N.J. Reimer. 2005. The ecology, policy, and management of ants in Hawai'i. Proc. Hawaiian Entomol. Soc. 37:1-25.

Lowe, S., Browne, M., Boudjelas, S., and M. De Poorter. 2000. 100 of the World's Worst Invasive Alien Species: A Selection from the Global Invasive Species Database. The Invasive Species Specialist Group (ISSG) a specialist group of the Species Survival Commission (SSC) of the World Conservation Union (IUCN), World Conservation Union (IUCN), Auckland, New Zealand, 12pp.

Lubin, Y. D. 1984. Changes in the native fauna of the Galapagos Islands following invasion by the little red fire ant, *Wasmannia auropunctata*. Biological Journal of the Linnean Society 21:229-242.

Mikheyev, A. S., S. Bresson, and P. Conant. 2009. Single-queen introductions characterize regional and local invasions by the facultatively clonal little fire ant *Wasmannia auropunctata*. Mol. Ecol. 18: 2937-2944.

Minitab. 2010. Version 16. Minitab, Inc. State College, PA.

Soeprono, A.M. and M.K. Rust. 2004. Effect of horizontal transfer of barrier insecticides to control Argentine ants (Hymenoptera: Formicidae). J. Econ. Entomol. 97:1675-1681.

Vanderwoude, C. 2007. Little Fire Ant (*Wasmannia auropunctata*) in Port Vila: Report to Secretariat of the Pacific Community on activities 5-14th October 2007, and recommendations for future management. VCL New Zealand. Available at http://sites.google.com/site/casvanderwoude/hawaii-lfa/my-research/lfa-bibliography (accessed 11 February 2011).

Wetterer, J., and S. Porter. 2003. The little fire ant, *Wasmannia auropunctata*: distribution, impact and control. Sociobiology 41: 1-41.

Wetterer, J.K., Walsh, P.D., and L.J.T. White. 1999. *Wasmannia auropunctata* (Roger) (Hymenoptera: Formicidae), a destructive tramp ant, in wildlife refuges of Gabon, West Africa. African Entomol. 7: 292-294.

Wiltz, B.A., D.R. Sutter, and W.A. Gardner. 2009. Activity of bifenthrin, chlorenapyr, fipronil, and thiamethoxam against Argentine ants (Hymenoptera: Formicidae). J. Econ. Entomol. 102:2279-2288.

Wiltz, B.A., D.R. Sutter, and W.A. Gardner. 2010. Activity of bifenthrin, chlorenapyr, fipronil, and thiamethoxam against red imported fire ants (Hymenoptera: Formicidae). J. Econ. Entomol. 103:754-761.