

EVALUATION OF NONSTEROIDAL ECDYSONE AGONISTS (CONFIRM AND INTREPID) FOR CONTROL OF HELIOTHINE SPECIES IN COTTON

Donald R. Johnson, Gus M. Lorenz, John D. Hopkins, and Larry M. Page¹

RESEARCH PROBLEM

The Heliothine complex (bollworm and tobacco budworm) are primary pests of cotton in Arkansas, with much of the state's acreage requiring control measures each year. Due to insecticide resistance issues with these pests, it is necessary to evaluate new chemistry in order to maintain effective control measures. Research is needed to verify the efficacy of potential new control materials and determine their feasibility for use in cotton production systems.

BACKGROUND INFORMATION

A review of all cotton pests in Arkansas during 1998 shows that the bollworm/tobacco budworm complex resulted in the most acres treated, the greatest number of insecticide applications, the greatest cost of control per acre, and the greatest reduction in yield of any cotton pest (Williams, 1999). The ability of Heliothine pests to develop resistance to organochlorine, organophosphate, carbamate, and pyrethroid classes of insecticides is a worldwide problem (McCaffery, 1998). Continued discovery of new pest control technology is essential to maintain a viable cotton production industry in Arkansas.

Confirm (tebufenozide) and Intrepid/RH-2485 (methoxyfenozide) are agonists of the insect molting hormone, 20-hydroxyecdysone (20E), and manifest their toxic action via interaction with ecdysteroid receptor complexes in the target species. Larvae intoxicated with Confirm or Intrepid stop feeding within 3-12 h and subsequently undergo a lethal molt. Both Confirm and Intrepid are selectively toxic to most lepidopteran pests and are safe to beneficial parasitoids and predators. Their novel mode of action, selective target pest toxicity, and safe eco-toxicological profiles make Confirm and Intrepid ideal components for integrated pest and resistance management programs (Dhadialla and Jansson, 2000). In this study, Confirm and Intrepid/RH-2485 were compared alone and in combination with Karate and also to Decis, Karate, Baythroid, Curacron, and an experimental insecticide, TD-2344-03, to determine their effectiveness in controlling the bollworm and tobacco budworm.

¹ Pest Management Section Leader and IPM Coordinator, University of Arkansas, Cooperative Extension Service, Little Rock, AR; Insecticide Testing Coordinator and Extension Associate (Pest Management), University of Arkansas Cooperative Extension Service, Lonoke, AR.

RESEARCH DESCRIPTION

This trial was conducted in Jefferson County in 1998 to evaluate the efficacy of Confirm and Intrepid against the bollworm and tobacco budworm. Insecticide treatments were evaluated in small plots arranged in a randomized complete-block design with four replications utilizing a conventional cotton variety (DP50). The seasonal population mix in the test location, as determined by trap counts, was 90% bollworm and 10% tobacco budworm. Treatments were initiated when egg or small worm densities were at or approaching recommended treatment levels. Applications were made with a John Deere 6000 hi-cycle at 65 psi/10 GPA using Teejet TXVS-6 nozzles on 20-inch centers.

The treatments (lb ai/acre) evaluated were an untreated control, Decis 1EC (0.025), Karate 1EC (0.033), Baythroid 2EC (0.03), Confirm 2F + Latron CS-7 (0.0625 + 0.25%v/v), Confirm 2F + Latron CS-7 + Karate 1EC (0.0625 + 0.25%v/v + 0.033), RH-2485 80WP + Karate 1EC + Penetrator (0.1 + 0.033 + 0.5%v/v), Karate 1EC + Latron CS-7 (0.033 + 0.25%v/v), TD-2344-03 0.83EC (0.035), RH-2485 80WP + Penetrator (0.1 + 0.5%v/v), and Curacron 8EC (1.0). Application dates in 1998 were 22 June, 10 July, 17 July, and 28 July. Evaluation dates in 1998 were 25 June 3DAT#1, 15 July 5DAT#2, 22 July 5DAT#3, 24 July 7DAT#3, 31 July 3DAT#4, and 23 October at harvest. Data were collected by examining 25-50 terminals and 25-100 squares at random from the center of each plot. Yields were determined by harvesting the middle rows of each plot with a commercial two-row John Deere cotton picker. Data were processed using Agriculture Research Manager Ver. 6.0.1. Analysis of variance was run and the least significant difference was used to separate means.

RESULTS AND DISCUSSION

There were no significant differences among treatments with respect to Heliothine square damage until 3DAT#4 when all insecticide treatments except Confirm 2F 0.0625 + Latron CS-7 0.25%v/v and Intrepid/RH-2485 80WP 0.1 + Penetrator 0.5%v/v resulted in a significant reduction in worm damage (Table 1). When rating the total live worm count, treatment with Karate 1EC 0.033, Baythroid 2EC 0.03, and RH-2485 80WP 0.1 + Karate 1EC 0.033 + Penetrator 0.5%v/v resulted in significantly fewer live worms compared to the untreated control at 3DAT#1. A significant reduction in the total worm count again occurred at 7DAT#3 when Karate 1EC 0.033, Confirm 2F 0.0625 + Latron CS-7 0.25%v/v + Karate 1EC 0.033, RH-2485 80WP 0.1 + Karate 1EC 0.033 + Penetrator 0.5%v/v, and Curacron 8EC 1.0 were the only effective treatments. All treatments significantly reduced the total live worm count compared to the untreated control at the final rating, 3DAT#4 (Table 2). Karate 1EC + Latron CS-7 0.033 + 0.25%v/v at 5DAT#3 and Karate 1EC 0.033 at 7DAT#3 were the only treatments to significantly reduce the terminal counts of live Heliothine larvae compared to the untreated control. Similar significant yield increases (406 to 546 lb lint/acre) were achieved with Decis 1EC 0.025, Karate 1EC 0.033, Baythroid 2EC 0.03, Confirm 2F 0.0625 + Latron CS-7 0.25%v/v + Karate 1EC 0.033, RH-2485 80WP 0.1 + Karate 1EC 0.033 + Penetrator 0.5%v/v, Karate 1EC 0.033 + Latron CS-7 0.25%v/v, TD-

2344-03 0.83 EC 0.035, and Curacron 8EC 1.0. Confirm 2F 0.0625 + Latron CS-7 0.25%v/v and RH-2485 80WP 0.1 + Penetrator 0.5%v/v failed to significantly out yield the untreated control (Table 3).

PRACTICAL APPLICATION

Based on this study, Decis, Karate, Baythroid, Curacron, and tankmixes containing a pyrethroid are still effective in controlling a primarily bollworm Heliiothine complex. Confirm and Intrepid (Sparks *et al.*, 1996; Terán-Vargas *et al.*, 1997) have been shown to be effective in controlling beet armyworms, however, these materials should not be considered as effective tools for Heliiothine pest control in cotton.

ACKNOWLEDGMENTS

The authors would like to express their appreciation to AgrEvo, Bayer, Novartis, Rohm and Haas, and Zeneca for their support of this work.

LITERATURE CITED

- Dhadialla, T.S. and R.K. Jansson.2000. Non-steroidal ecdysone agonists: new tools for IPM and insect resistance management. Insecticide Discovery Group, Rohm and Haas Company, 727 Norristown Road, Spring House, PA 19477.
- McCaffery, A.R. 1998. Resistance to insecticides in Heliiothine Lepidoptera: a global view. *In: Proceedings of the Royal Society, London.*
- Sparks, A.N., Jr., J.W. Norman, Jr., and D.A. Wolfenbarger. 1996. Efficacy of selected insecticides against the beet armyworm, *Spodoptera exigua*—field and laboratory evaluations. Proc. Beltwide Cotton Conf., National Cotton Council, Memphis, TN. pp. 844-846.
- Terán-Vargas, A.P., E. Garza-Urbina, C.A. Blanco-Montero, G. Pérez-Carmona, and J.M. Pellegaud-Rábago. 1997. Efficacy of new insecticides to control beet armyworm in northeastern Mexico. Proc. Beltwide Cotton Conf., National Cotton Council, Memphis, TN. pp. 1030-1031.
- Williams, M.R. 1999. Cotton Insect Losses 1998. Proc. Beltwide Cotton Conf., National Cotton Council, Memphis, TN. pp. 785-806.

Table 1. Heliothine square damage: Evaluation of Confirm, Intrepid/RH2485, and other insecticides for control of *Heliothine* spp. in cotton.

Treatment	Rate lb ai/acre	Heliothine Damage				
		3DAT#1 #/100 sq.	5DAT#2 #/25 sq.	5DAT#3 #/50 sq.	7DAT#3 #/50 sq.	3DAT#4
Untreated control	—	19.8 a ^z	1.5 ab	8.5 ab	7.8 b	24.3 a
Decis 1EC	0.025	15.8 a	0.5 ab	1.5 b	7.3 b	3.3 c
Karate 1EC	0.033	13.0 a	0.3 b	2.5 b	6.5 b	5.3 c
Baythroid 2EC	0.03	12.5 a	1.0 ab	3.8 ab	9.0 ab	4.3 c
Confirm 2F ^y	0.0625	20.5 a	1.0 ab	11.0 a	14.5 a	25.5 a
Confirm 2F + Karate 1EC ^z	0.0625 + 0.033	13.3 a	0.8 ab	4.5 ab	6.3 b	3.8 c
RH-2485 80WP + Karate 1EC ^y	0.1 + 0.033	15.3 a	0.3 b	4.0 ab	5.8 b	3.8 c
Karate 1EC ^z	0.033	13.5 a	0.3 b	2.0 b	5.5 b	6.3 bc
TD-2344-03 0.83EC	0.035	15.8 a	1.0 ab	1.5 b	10.5 ab	4.3 c
RH-2485 80WP ^y	0.1	22.0 a	1.8 a	7.8 ab	6.3 b	16.5 ab
Curacron 8EC	1.0	17.0 a	0.5 ab	4.8 ab	4.3 b	7.8 bc
LSD (P=0.05)		9.35	1.24	6.68	5.41	9.94

^z Means followed by same letter do not significantly differ (P=0.05, Duncan's New MRT).

^y Latron CS-7 added at 0.25%v/v.

^x Penetrator added at 0.5%v/v.

Table 2. Live Heliothine square counts: Evaluation of Confirm, Intrepid/RH2485, and other insecticides for control of *Heliothine* spp. in cotton.

Treatment	Rate lb ai/acre	Total Worms					
		3DAT#1 #/100 sq.	5DAT#2 #/25 sq.	5DAT#3	7DAT#3 #/50 sq.	3DAT#4	
Untreated control	-	3.8 ab ^z	30.0 a	2.5 ab	4.0 a	10.8 a	
Decis 1EC	0.025	1.5 bc	25.0 a	0.5 b	1.8 ab	1.0 b	
Karate 1EC	0.033	0.5 c	37.3 a	0.3 b	1.0 b	2.3 b	
Baythroid 2EC	0.03	1.0 c	26.8 a	0.8 b	2.0 ab	0.8 b	
Confirm 2F ^y	0.0625	4.3 a	30.3 a	4.8 a	2.5 ab	3.0 b	
Confirm 2F + Karate 1EC ^y	0.0625 + 0.033	2.8 abc	28.0 a	1.0 b	0.5 b	2.5 b	
RH-2485 80WP + Karate 1EC ^x	0.1 + 0.033	1.0 c	27.0 a	0.8 b	0.5 b	0.0 b	
Karate 1EC ^y	0.033	1.5 bc	24.5 a	1.3 b	2.3 ab	0.0 b	
TD-2344-03 0.83EC	0.035	2.3 abc	31.3 a	0.8 b	1.5 ab	0.3 b	
RH-2485 80WP ^x	0.1	4.8 a	19.3 a	3.0 ab	2.5 ab	3.5 b	
Curacron 8EC	1.0	1.3 bc	34.5 a	1.0 b	0.8 b	0.3 b	
LSD (P=0.05)		2.31	16.61	2.46	2.22	4.45	

^z Means followed by same letter do not significantly differ (P=0.05, Duncan's New MRT).

^y Latron CS-7 added at 0.25%v/v.

^x Penetrator added at 0.5%v/v.

Table 3. Lint yield: Evaluation of Confirm, RH2485, and other insecticides for control of *Heliothine* spp. in cotton.

Treatment	Rate lb ai/acre	Lint yield lb/acre
Untreated	—	308.3 b ^z
Decis 1EC	0.025	774.3 a
Karate 1EC	0.033	721.4 a
Baythroid 2EC	0.03	718.9 a
Confirm 2F ^y	0.0625	338.4 b
Confirm 2F + Karate 1EC ^y	0.0625 + 0.033	771.3 a
RH-2485 80WP + Karate 1EC ^x	0.1 + 0.033	853.8 a
Karate 1EC ^y	0.033	722.5 a
TD-2344-03 0.83EC	0.035	714.2 a
RH-2485 80WP ^x	0.1	415.8 b
Curacron 8EC	1.0	739.5 a
LSD (P=.05)		178.07

^z Means followed by same letter do not significantly differ (P=0.05, Duncan's New MRT).

^y Latron CS-7 added at 0.25%v/v.

^x Penetrator added at 0.5%v/v.