COMPARISON OF NEW INSECTICIDES FOR THE CONTROL OF THE BOLLWORM *(HELIOCOVERPA ZEA)* AND TOBACCO BUDWORM(*HELIOTHIS VIRESCENS*) IN ARKANSAS

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Abstract

The Heliothine complex was controlled effectively four new insecticides Pirate (pyrrole), Proclaim (emamectrin benzoate), Tracer (spinosad), and Intrepid (RH-2485). However, the mixed population was best controlled and highest yields achieved by mixing the insecticides Pirate and Tracer with the pyrethroid Karate (lambda-cyhalothrin). The insecticide mixture utilized the lower rate of Pirate and a half rate of Tracer with the higher rate of Karate. Pirate and Tracer provide excellent control of pyrethroid resistant tobacco budworm, *Heliothis virescens*, and Karate probably improved the control of the bollworm, *Heliocoverpa zea*.

Introduction

The tobacco budworm has developed resistance to the pyrethroid insecticides and every other class of insecticides developed previously. The development of new chemistry to control tobacco budworm in cotton is a continuing challenge for the new discovery research component of agricultural industries. The most recent discoveries that are being developed include Pirate (pyrrole) by American Cyanamid, Tracer (spinosad) by Dow Elanco, Proclaim (emamectrin benzoate) by Merck and Intrepid (RH-2485) by Rhom & Hass. These insecticides were evaluated in field test and compared to the standard insecticide Karate manufactured by Zeneca.

Pirate, a pyrrole, was discovered and patented by American Cyanamid Company and is a novel insecticide-miticide from the pyrrole class of chemistry. Pirate is a wide spectrum insecticide that controls many pests associated with cotton. The mode of action of Pirate is unique and involves a mixed function oxidase that changes the insecticide into the active insecticide. Pirate is highly lipophilic which contributes to excellent rainfastness (French et al. 1996).

Proclaim or emamectrin benzoate is a second generation avermectin insecticide for crop protection being developed by Merck and Co. Inc. Emamectrin benzoate is a novel semi-synthetic avermectin insecticide derived from the fermentation product, avermectin B1 (abamectin) It is a broad spectrum lepidoptericide with good activity against beet armyworm, loopers, cotton bollworm and tobacco budworm. Research trials indicate that the product is active at very low rates in the range of 0.0075 to 0.015 lb ai/acre. The insecticide has low impact on beneficial arthropods (Dunbar et al. 1996).

Tracer or spinosad, the first product in the naturalyte class, is characterized by both contact and stomach activity and rapid knockdown which is highly unusual for a natural product (Thompson et al. 1996a). The spinosyns are a naturally derived group of insect control molecules from a new species of Actinomycetes, *Saccharopolyspora spinosa*, which is characterized as a bacteria. Spinosad is a mixture containing the two most active natural factors, A and D (Thompson et al. 1996b). Tracer controls a broad spectrum of lepidoptera including eggs, but has little or no activity against predacious insects or sucking pests (Peterson et al. 1996).

Intrepid or RH-2485 is novel chemistry discovered by Rhom and Haas Company. The insecticide is a growth regulator or molt accelerating compound that has activity against lepidoptera insect pests. It is highly effective on foliage larvae especially the bollworm, *Heliocoverpa zea*.

Karate or lambdacyhalothrin is a broad spectrum insecticide that is active against a wide range of insect pests. Karate is very active against the larvae of the bollworm. The tobacco budworm, a key pest of cotton, has developed resistance to this class of insecticides (Bagwell et al. 1995) and caused control problems to occur in cotton when this insect is present at treatment levels.

Methods

The treatment included in this test are Karate, at 0.033 lb. ai/A, Tracer at 0.067, Karate 0.033 plus Tracer 0.033, Pirate at 0.35, Karate at 0.033 plus Pirate at 0.25, Proclaim at 0.0075, Proclaim at 0.01, Intrepid at 0.25, Intrepid at 0.25 and Intrepid at 0.25 plus Larvin at 0.45. The test was arranged in a randomized complete block design and plots ere 8 rows by 50 feet long. The test site was located in Jefferson county approximately 8 miles southeast of Pine Bluff, Arkansas. The treatments were applied in 10 gallons total volume per acre. Treatments were applied on 24 June, 30 June, 26 July and 31 July, 1996. Larvae were collected from adjacent untreated areas and reared in diet cups to determine species composition. Data was collected by examining 50 terminals and squares at random from the center of each plot. The cotton crop was produced using standard agronomic practices and irrigated. The variety was DPL 50 planted May 10, l996. Yields were determined by harvesting the middle 2 rows using a John Deere cotton picker.

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Results and Discussion

The tobacco budworm and bollworm larvae occurred in cotton plots in varying frequency during 1996 (Table 1). The tobacco budworm is normally the most frequent the last week in June and around the last of July and first part of August. During 1996, the overall tobacco budworm population level was substantially lower than the 1995 growing season. The percent composition of the tobacco budworm population during the 1996 growing season compared to the total Heliothine population was 53% on 28 June, 67% on 3 July, 33% on 30 July and 59% on 3 August (Table 1).

The larval counts from treatments from the insecticides tested are presented in Table 2. The larval counts from the June 28 observation indicated that Karate with 1.75, Karate plus Pirate with 3.0, Tracer with 2.75, Proclaim 0.0075 with 2.0 and Proclaim 0.01 with 2.0 larvae were significantly lower in larvae number than the untreated check with 6.75 larvae per 50 terminals and squares examined. On 3 July, the untreated plot had 6.25 larvae significantly higher than all the other treatments. The combination treatments of Karate plus Pirate, Karate plus Tracer and Intrepid plus Larvin had the lowest larvae density but significantly different from only Proclaim 0.0075.

The observation of insecticide treatments on 30 July indicated that Tracer and Proclaim had the lowest number of larvae significantly lower than the untreated, Karate, Pirate, Karate plus Pirate, and the higher rate of Intrepid. Most treatments were significantly lower that the untreated except Pirate and Karate plus Pirate. Data collected from the 3 August observations indicated that larval numbers had declined in all plots. Treatments significantly lower in larval numbers than the untreated check included Pirate, Karate plus Pirate, Tracer, Karate plus Tracer, Proclaim low rate, all rates and combinations of Intrepid. Karate and the high rate of Proclaim were not significantly different from each other.

The varying levels of control during the duration of the test possibly indicates a selective difference in the measure of control by each insecticide toward the different species of the Heliothine complex present. The lack of control by Karate usually indicates the presence of a insecticide resistant population of tobacco budworms. This would explain the higher numbers larvae found in the Karate plots during the last two observation dates. The area where the test was conducted is known for the high level of resistance in the tobacco budworm population to the pyrethroid insecticides. The Tracer and Proclaim treatments both had lower larval counts in the last two observation periods perhaps indicating a higher degree of control of the tobacco budworm. In contrast, the same treatments had slightly higher numbers of larvae during the first two observation. Field observations of separate large block tests indicated that Tracer did not control the bollworm at the lower rates adequately and the earlier decreased control may have been bollworm survival in the plots. This hypothesis is strengthened by the fact that the combinations of Karate and Karate combinations had lower larval numbers indicating good control and suggests the surviving population may have been primarily bollworms.

The yields from the different treatments are shown in table 3. The highest yields were found in the combination treatments of Karate plus Pirate with 889 pounds lint/A significantly higher than all the other treatments except Karate plus Tracer and Karate alone. Karate plus Tracer with 861 pounds lint/A significantly higher Pirate, Proclaim at both rates, all rates and combinations of Intrepid. The treatments of Proclaim at both rates and Intrepid at all rates and combinations were not significantly different from one another. All treatments were significantly higher in yield that the untreated check.

In summary, the best results were achieved using the combinations of Karate plus either Pirate or Tracer. The improved results were probably the improved control of both species of the Heliothine complex. Karate gives excellent control of the bollworm but tobacco budworm has developed significant resistance to all pyrethroid class of insecticides. The identification of the species composition is vital in making decision on the proper selection of the insecticide to use for insect management with the new insecticides.

The newer insecticides classes are represented by Tracer and Pirate. The two different classes of insecticides have proven to be excellent against the pyrethroid resistant tobacco budworm. However, the performance of Pirate against bollworm is weak in comparison to Karate. Tracer is stronger against the bollworm but some weakness in control has been observed in large block trials when it is used at the lower rates. The newer insecticides Intrepid and Proclaim are excellent insecticides that will have a place in control of bollworm and tobacco budworm. Future field research should be directed toward identifying the roles of these insecticides in cotton insect management.

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Table 1. Species composition in Jefferson County cotton during 1996.

Date	% Tobacco Budworm	% Cotton Bollworm
28 June	53	47
3 July	67	33
30 July	33	67
3 August	59	41

Table 2. Infestation of Heliothine species in test plots using Karate, Pirate, Tracer, Proclaim and Intrepid.

Treatment	Total Larvae/50 Plant Terminal and Square			
	28 June	3 July	30 July	3 August
Untreated	6.75 a	6.25 a	12.5 a	6.25 a
Karate 0.033	1.75 b	1.25 bcd	5.50 bcd	3.75 ab
Pirate 0.35	4.5 ab	1.5 bcd	8.75 ab	2.00 b
Karate 0.033 + Pirate 0.25	3.00 b	0.00 d	8.5 ab	2.75 b
*Tracer 0.067	2.75 b	2.00 bcd	3.50 d	1.00 b
Karate 0.033 + Tracer 0.033	3.75 ab	0.25 cd	5.00 bcd	1.25 b
Proclaim 0.0075	2.00 b	3.25 b	6.75 bcd	2.50 b
Proclaim 0.01	2.00 b	2.75 bc	3.25 d	3.75 ab
Intrepid 0.25	3.75 ab	1.25 bcd	5.50 bcd	2.25 b
Intrepid 0.35	3.75 ab	2.50 bcd	8.25 bc	2.25 b
Intrepid 0.25 + Larvin 0.45	4.50 ab	0.25 cd	4.00 cd	2.50 b
Intrepid 0.25 + Curacron 0.5	4.00ab	1.00bcd	7.25bcd	3.00b

Means followed by same letter do not significantly differ(P=.05, Duncan's MRT)

Table 3. Yields resulting from plots treated with Karate, Pirate, Tracer, Proclaim and Intrepid.

Treatment	Yield Lint/Acre	
Untreated	376	f
Karate 0.033	792	abc
Pirate 0.35	693	cde
Karate 0.033 + Pirate 0.25	889	a
*Tracer 0.067	774	bcd
Karate 0.033 + Tracer 0.033	861	ab
Proclaim 0.0075	608	e
Proclaim 0.01	687	cde
Intrepid 0.25	671	de
Intrepid 0.35	627	e
Intrepid 0.25 + Larvin 0.45	723	cde
Intrepid 0.25 + Curacron 0.5	706	cde

Means followed by same letter do not significantly differ (P=.05, Duncan's MRT)