COMPARATIVE OVICIDAL ACTIVITY OF ACETAMIPRID, THIODICARB, AND LAMBDA-CYHALOTHRIN AGAINST BOLLWORM ON COTTON IN A FIELD ENVIRONMENT

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Abstract

Field trials were conducted to evaluate the ovicidal properties of acetamiprid (Assail™ 70WP), in Washington and Perquimans counties, North Carolina in 2001. Newly laid (white) bollworm eggs were collected from cotton foliage within respective treatments at 0, 1, and 2 days after application and evaluated in the laboratory for ovicidal and eclosion mortality. Acetamiprid initially (0 day) provided mortality of bollworm eggs comparable to that obtained with two ovicide standards, thiodicarb and lambda-cyhalothrin. For eggs collected at one day after application, ovicidal control of acetamiprid had declined more than that observed for the two standard ovicides; only the highest rate of acetamiprid provided comparable ovicide activity. There was no significant ovicidal activity with any of the insecticides for eggs deposited two nights after application (2 DAT). This study confirmed ovicidal activity of acetamiprid under field conditions; however, ovicidal activity of acetamiprid was ephemeral.

Introduction

The bollworm, *Helicoverpa zea* (Boddie), is the most economically important insect pest of cotton in North Carolina and requires some level of control in every cotton field annually to prevent yield loss. Bollworm control is achieved either through the planting of Bollgard cotton varieties or through the application of insecticides or both. Pyrethroid insecticides have been the products of choice for bollworm control since the late 1970's because of their effectiveness and low cost. Pyrethroids are effective because of their activity against both egg and larval stages (DuRant 1990). The ovicidal activities of lambda-cyhalothrin and thiodicarb have been documented by Bradley and Agnello (1988), Leonard et al. (1990), and others.

Acetamiprid is a new insecticide belonging to the neonicotinoid family of insecticides. This compound was discovered by Nippon Soda in Japan and is currently being sold in countries outside of the US and Canada as Mosiplan® and Rescate®. Aventis CropScience is presently developing acetamiprid for use in North America. Acetamiprid has exhibited outstanding control of sucking pests of cotton, such as aphids and whiteflies (Natwick 2001, Parrish 2001). Under greenhouse testing acetamiprid has shown excellent ovicidal activity across many pest species, including the bollworm, through doses ranging from 0.025 to 0.25 lb. ai/a. (Parrish et al. 2001).

The objectives of the study reported herein were 1) to determine if acetamiprid would provide effective ovicidal control of bollworm under field conditions as reported in greenhouse studies and 2) to compare the ovicidal activity of acetamiprid with that of current standards.

Materials and Methods

Two field trials were conducted during the summer of 2001 in Perquimans and Washington counties, North Carolina. Fields were divided into six blocks that were 8 rows x 70 ft in length. Treatments were applied on 15 August and 30 August in Perquimans and Washington counties, respectively. Insecticides were sprayed using a CO_2-backpack sprayer fitted with a single TX-12 nozzle per row delivering 12.1 gpa at 56 psi. The six middle rows of each block were sprayed with either acetamiprid (Assail™, Aventis CropScience, Research Triangle Park, NC) at 0.025, 0.05, and 0.1 lb. a. i./a, thiodicarb (Larvin® 4F, Aventis CropScience, Research Triangle Park, NC) at 0.2 lb. a. i./a, or lambda-cyhalothrin (Karate Z® 2.08 CS, Syngenta Crop Protection, Inc., Greensboro, NC) at 0.025 lb. a. i./acre. An untreated control was also included. Freshly laid bollworm eggs were collected from the upper 25% of the canopy of cotton plants at 2, 24, and 48h after application. Only newly laid eggs were chosen, which were identified by their pearly white color and the absence of any darkening or ring formation. At least 100 eggs were collected from each treatment on each sample date. A small amount of cotton foliage bearing each egg was collected and placed in labeled paper bags and transported on ice to the laboratory. Small sections of leaf tissue bearing each egg were cut from the leaves and placed singly into gelatin capsules of size #1 and held at 26°C. Mortality assessments were conducted four days after each egg collection date to ensure that egg hatch was complete. Each egg was categorized and recorded as hatched normally, failed to hatch, or that the larva died partially eclosed from the egg. Normally hatched eggs were those in which the larvae hatched and emerged completely from the eggshell.

All data were subjected to ANOVA using PROC GLM (SAS Institute 1990), and means for each treatment were separated ($P \leq 0.05$) using Fisher's Protected Least Significant Difference test in SAS.

Results

All insecticide treatments were significantly higher in egg mortality when compared to the untreated control at 0 days after application. Percent mortality ranged from 65 to 70% among insecticide treatments compared to 15% in the untreated control. The two highest rates of acetamiprid were comparable to the two standard ovicides, thiodicarb and lambda-cyhalothrin, at 0 days after treatment. Eggs collected 1 day after treatment consisted of eggs that were laid the night following insecticide application. The three rates of acetamiprid fell off dramatically with respect to percent mortality of bollworm eggs. All three rates of acetamiprid were statistically similar to the control. Only the highest rate of acetamiprid was comparable to the two standard ovicides, which were still significantly higher that the control at 1 day after treatment. None of the insecticides tested provided adequate control of eggs that were laid two nights after application.

Discussion

The mode of insecticidal action in insect eggs is not well understood and at least two types of mortality have been associated with death of the developing insect. The embryo in the egg may be killed and further development (embryogenesis) halted or the larva dies as it feeds on the chorion during eclosion. Bradley and Agnello (1988) reported substantial mortality from thiodicarb in which the larvae died partially eclosed from the egg. They concluded that this mortality was due to sublethal doses of insecticide incapable of halting embryo development. Leonard et al. (1990) reported both types of ovicidal activity for heliothine eggs exposed to lambda-cyhalothrin. We observed both types of mortality in this study, but no attempt was made to differentiate between the two.

Acetamiprid exhibited high initial ovicidal activity against bollworm eggs under field conditions in North Carolina; however, acetamiprid was not as persistent at lower rates compared to the ovicide standards, thiodicarb and lambda-cyhalothrin. Only the highest rate of acetamiprid demonstrated ovicidal activity comparable to that of standard ovicides with respect to eggs laid one night after application. Ovicidal activity of all three ovicides tested declined significantly for eggs deposited two nights after application. Since none of the ovicides tested demonstrated significant bollworm egg mortality at two days after application, this study suggests that the use of insecticides that exhibit only ovicidal activity against bollworm is unrealistic under North Carolina conditions where bollworm infestations are typically high. In contrast, lambda-cyhalothrin and thiodicarb have been demonstrated to provide highly effective bollworm control because they possess both ovicidal and larvicidal activities. It may be practical to use acetamiprid as an ovicide only on Bollgard cotton where supplemental control is all that is required. Such a situation may arise where threshold levels of aphids or some other sucking insect pest occur during a time when bollworm moths are depositing eggs on cotton. Having additional characteristics such as ovicidal activity against bollworms may increase the benefits of using this new insecticide in those situations where multiple pests occur simultaneously.

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Table 1. Percent mortality of bollworm (*Helicoverpa zea*) eggs collected from cotton plants at 0, 1, and 2 days after treatment with insecticides, Perquimans and Washington counties N.C., 2001.

Insecticide	**Rate (lb. a. i./a)**	**0 DAT**	**1 DAT**	**2 DAT**
acetamiprid	0.025	65.4 b	22.0 c	27.8 a
acetamiprid	0.050	74.6 ab	29.0 bc	29.6 a
acetamiprid	0.100	85.7 a	43.8 ab	33.5 a
thiodicarb	0.200	80.6 ab	57.0 a	35.0 a
lambda-cyhalothrin	0.025	70.6 ab	64.4 a	41.9 a
Control	--	15.6 c	23.3 bc	35.0 a

Means within the same column followed by the same letter are not significantly different, Fisher's Protected LSD, ($P \leq 0.05$).