EFFICACY OF NEW AND STANDARD CHEMISTRY FOR HELIOTHINE CONTROL IN COTTON

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RESEARCH PROBLEM

Monitoring and comparing the performance of new and traditional insecticides is an essential part of managing Heliothine resistance and developing effective cotton pest management programs. Two experiments were conducted to compare the efficacy of new and standard insecticides for Heliothine control in cotton.

BACKGROUND INFORMATION

Development and testing of new compounds are essential components of managing Heliothine resistance to traditional cotton insecticides. In recent years, non-pyrethroid compounds such as Tracer (spinosad) have become an integral part of most cotton pest management programs in Arkansas. Many other non-pyrethroid compounds have been developed and continued evaluation of the efficacy of these new insecticides is necessary for their integration into cotton pest management programs.

Steward (indoxacarb) insecticide from Dupont Crop Protection received full registration for use on Arkansas cotton in 2001. This compound is a sodium-channel blocker, which causes paralysis and death by inhibiting the flow of sodium into nerve cells (Sherrod, 2001). Steward controls a broad spectrum of cotton worm pests including cotton bollworm, tobacco budworm, beet and fall armyworm, and loopers (Bierman, 1998). Previous research has indicated Steward (0.11 lb ai/acre) to be comparable to Tracer with respect to Heliothine control (Hopkins et al., 2001)

Denim contains emamectin benzoate, a second-generation avermectin insecticide that provides control of many Lepidopteran species including tobacco budworm, cotton bollworm, armyworms, and loopers (Dunbar et al., 1998). While emamectin benzoate is susceptible to photodegradation, reservoirs of the compound develop in cot-

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ton leaf tissue, resulting in long residual activity under field conditions. Low use rates (0.0075-0.015 lb ai/acre) have been shown to effectively control Heliothine species (Dunbar et al., 1998).

The molt-accelerating compound Intrepid belongs to the diacylhydrazine class of chemistry developed by Rohm and Haas Company (now a part of Dow AgroSciences). Intrepid mimics an insect-molting hormone when ingested, which causes feeding to cease within hours (Edgecomb and Schlesselman, 2001). Like Tracer, Intrepid has little effect on beneficial insects. Intrepid has provided excellent control of foliage-feeding insects, such as cotton bollworm and loopers, while demonstrating activity on tobacco budworm as well (Harrison et al., 1997).

XR-225 is a compound from Dow AgroSciences currently in the developmental stages. This compound is a gamma-cyhalothrin, a fully-resolved isomer of lambda-cyhalothrin (Karate). While its mode of action and pest spectrum are similar to other pyrethroids, XR-225 has shown equal activity to Karate at half the recommended Karate rate (Nead-Nylander, personal communication).

Two field experiments were conducted to compare the efficacies of these compounds to traditional insecticides and determine the effects of combinations of new and traditional insecticides for Heliothine control in cotton.

RESEARCH DESCRIPTION

The trials were conducted on the Chuck Hooker Farm in Jefferson County, Arkansas, in 2001. This farm was located within the boll weevil eradication zone and received programmed sprays of ULV malathion that virtually eliminated boll weevil and plant-bug pressure. The treatments observed in the two experiments are listed in Tables 1 and 2. The cultivar DeltaPine 425R was planted on 30 April in small plots (eight 38-inch rows x 50 ft) arranged in a randomized complete block design with four replications.

During the conduct of this trial, the cotton bollworm made up the majority of the Heliothine population (range 63 to 78%) based on pheromone trap catches (Fig. 1). Treatments were initiated based on estimated peak Heliothine egg lay.

Applications were made with a John Deere 6000 hi-cycle sprayer equipped with a compressed air delivery system. The boom was equipped with conejet TXVS 6 nozzles on 19-inch spacings. Operating pressure was 45 psi with a final spray volume of 8.6 GPA. Treatments were applied as foliar sprays on 11 July, 18 July, and 3 August. Insect counts and damage ratings were made on 16 July (5DAT#1), 23 July (5DAT#2), and 7 August (4DAT#3). Data were collected by randomly examining 50 squares and 50 terminals from the center of each plot for the presence of live larvae and damage. Seasonal averages of percentage square damage and total number of live larvae were calculated from the rating dates. The center two rows of each plot were machine harvested with a commercial two-row John Deere cotton harvester on 25 October (178DAP) and lint yields were determined based on a 36% gin turnout.

Data were processed using Agriculture Research Manager Ver. 6.0.1. Analysis of variance was conducted and Duncan's New Multiple Range Test (P=0.05) was used to separate means only when AOV Treatment P(F) was significant (P=0.05).

RESULTS AND DISCUSSION

All treatments in experiment 1 resulted in significantly less square damage than was found in the untreated control (Table 1). The seasonal live-larval count was suppressed with all treatments except Intrepid (0.15 lb ai/acre) and Karate (0.025 lb ai/acre), which were not significantly different from the untreated control. Steward (0.104 lb ai/acre) and Denim (0.01 lb ai/acre) resulted in lower percentage square damage than Intrepid, while Denim also significantly reduced the presence of live larvae when compared to Intrepid. All treatments, including the pyrethroids, provided statistically similar Heliothine suppression when compared to the Tracer (0.063 lb ai/acre) treatment. This lack of means separation may be explained by the high bollworm:budworm ratio experienced throughout the growing season. Typically, more budworms than bollworm are present from late July through mid-August. In 2001, populations of these pests were reversed.

Treatment differences were more apparent when cotton lint yield was obtained at season's end, with all treatments yielding higher than the untreated control. Tracer provided significantly greater yield than all treatments except Steward and Denim, which provided the best Heliothine suppression throughout the season. New products Intrepid and XR-225 failed to provide greater control and yield than the standard pyrethroid insecticides. No rate response was observed with XR-225 when applied at 0.0042 and 0.014 lb ai/acre.

In experiment 2, no statistically significant (P=0.05) treatment differences, including the untreated control, were observed with respect to square damage and seasonal live larval count (Table 2). Lower seasonal Heliothine pressure occurred in 2001 when compared to most years, and this may have influenced the lack of response for this particular experiment. Numerical trends in the data did suggest that all chemical treatments had an adverse effect on the Heliothine population. Treatment differences were much more evident with respect to cotton lint yield. All treatments resulted in greater yield than the untreated control. Only Denim (0.01 lb ai/acre) provided a yield greater than Intrepid (0.15 lb ai/acre) and all standard pyrethroid insecticides with the exception of Karate (0.028 lb ai/acre). No yield differences were observed between Denim, Tracer (0.063 lb ai/acre), Steward (0.104 lb ai/acre), XR-225 (0.014 lb ai/acre), Decis (0.01 lb ai/acre), Karate (0.028 lb ai/acre), and the Calypso + Steward tank mix.

PRACTICAL APPLICATION

The selective use of both new and traditional insecticides can decrease the development of Heliothine resistance and result in more effective cotton pest management programs. Continuous evaluation of new and traditional insecticides is necessary to monitor performance against possible Heliothine resistance. In 2001, lower than normal Heliothine populations resulted in little or no difference between new, non-pyrethroid insecticides and traditional insecticides. The results from these experiments indicated that newer insecticides Steward and Denim provided Heliothine control equal to that of Tracer and greater than the standard pyrethroids. Performance of Intrepid and XR-225 was significantly lower than the previously mentioned products. Further evaluation of these products is necessary to determine performance under different environmental conditions as well as observe how they may be integrated into cotton best management programs.

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Table 1. Seasonal average heliothine control in cotton using new and traditional insecticides (Experiment 1).

Treatment	Damaged squares[z]	Total live larvae[z]	Lint yield
(lb ai/acre)	(%)		(lb/acre)
Untreated control	25.64 a[y]	3.75 a	595 g
Tracer 4SC (0.063)	10.30 bc	1.23 bc	1054 a
Steward 1.25SC (0.104)	6.84 c	1.25 bc	984 abc
Intrepid 2F (0.15) + Latron CS-7 (0.125%v/v)	13.14 b	2.65 ab	813 ef
Denim 0.16EC (0.01)	5.96 c	0.90 c	1033 ab
Karate Z 2.09CS (0.025)	11.30 bc	2.42 abc	943 bcd
Decis 1.5EC (0.01)	9.50 bc	1.87 bc	864 def
XR-225 150CS (0.0042)	10.50 bc	1.92 bc	786 f
XR-225 150CS (0.014)	8.00 bc	1.32 bc	880 def
Karate Z 2.09CS (0.0084)	11.70 bc	1.67 bc	822 ef
Karate Z 2.09CS (0.028)	10.16 bc	2.27 bc	914 cde

[z] Damage based upon samples of 50 squares and 50 terminals per plot.
[y] Means followed by same letter do not significantly differ (P=0.05, Duncan's New MRT).

Table 2. Seasonal average heliothine control in cotton using new and traditional insecticides (Experiment 2).

Treatment	Damaged squares[z]	Total live larvae[z]	Lint yield
(lb ai/acre)	(%)		(lb/acre)
Untreated control	14.64 a[y]	2.10 a	735 d
Tracer 4SC (0.063)	10.20 a	1.67 a	1052 ab
Steward 1.25SC (0.104)	7.96 a	1.17 a	965 abc
Intrepid 2F (0.15) + Latron CS-7 (0.125%v/v)	12.26 a	2.75 a	933 bc
Denim 0.16EC (0.01)	8.86 a	0.97 a	1094 a
Decis 1.5EC (0.01)	10.50 a	1.35 a	985 bc
XR-225 150CS (0.014)	7.86 a	2.02 a	992 bc
Karate Z 2.08CS (0.028)	9.96 a	1.83 a	1025 abc
Baythroid 2EC (0.03)	9.60 a	1.25 a	882 c
Karate Z 2.08 (0.028) + Intrepid 2F (0.06) + Latron CS-7 (0.125%v/v)	8.70 a	1.67 a	901 bc
Calypso 4SC (0.047) + Steward 1.25SC (0.104)	5.46 a	1.07 a	997 abc

[z] Damage based upon samples of 50 squares and 50 terminals per plot.
[y] Means followed by same letter do not significantly differ (P=0.05, Duncan's New MRT).

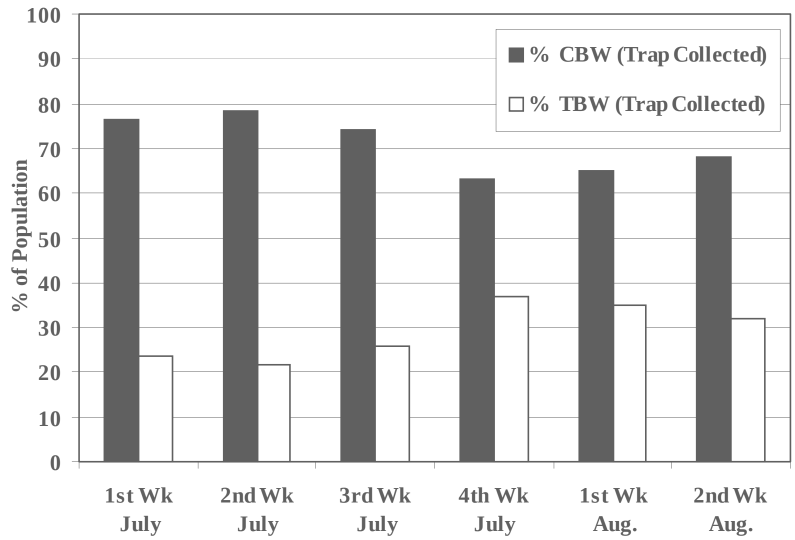

Fig. 1. Heliothine population distribution based on pheromone trap collection. Jefferson County, AR, 2001.