EFFECTS OF KARATE® INSECTICIDE ON BENEFICIAL ARTHROPODS IN BOLLGARD® COTTON

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Abstract

The effects of the pyrethroid insecticide lambda-cyhalothrin (Karate®) on beneficial arthropods in Bollgard® cotton were investigated in Georgia during the 1996 cotton season. Two applications (mid-June and late July) of lambda-cyhalothrin were made on large (>3 acres) replicated plots, and effects were compared to control and methyl-parathion treated plots. Populations of natural enemies and pests were assessed throughout the season in the crop canopy by sweep-net and shake-cloth sampling, and on the ground using pit-fall traps. A comparison of final yield between the treated plots and the control was made at the end of the season. Over 30 species of beneficial arthropods were identified during the study, including big-eyed bugs, pirate bugs, lady beetles, lacewings, spiders, parasitoid wasps and ground beetles. Results showed the first lambda-cyhalothrin spray was applied before the beneficial population had built up and therefore had little effect. The second application caused a transient reduction in the natural enemy population, numbers however recovered within 10 days. Applications of methyl-parathion had a longer duration of effect on some important natural enemy groups, principally big-eyed bugs (*Geocoris* spp.). Effects of insecticide applications were primarily confined to arthropods in the crop canopy, with little impact on ground dwelling species. Good pest control was demonstrated following applications of lambda-cyhalothrin, in particular of fleahoppers, stink bugs and plant bugs. By direct comparison of total natural enemy and pest populations numbers, lambda-cyhalothrin was shown to cause no significant disruption of season-long predator to pest ratios. Finally, a 12% increase in yield was evident following the application of lambda-cyhalothrin compared to control plots. In summary, lambda-cyhalothrin provided good pest control whilst maintaining beneficial populations, providing additional natural control. No significant disruption in the balance between predators and pests was caused, and overspraying Bollgard® cotton with lambda-cyhalothrin significantly increased yield.

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Introduction

Beneficial arthropods are of particular importance in integrated pest management (IPM) systems because they provide additional natural control of pest populations. The widespread introduction of Bt cotton potentially increases the role played by beneficials in cotton pest control because of the possible reduction in number of insecticide applications required. This study was therefore conducted to assess effects of the pyrethroid insecticide lambda-cyhalothrin (Karate®) on beneficial arthropods in Bollgard® cotton, and thus compatibility with IPM programmes. The specific aims of the study were;

1) Measure the magnitude and duration of effects on key natural enemies and monitor subsequent recovery after treatment.
2) Determine if any impact on natural enemy and pest populations translates into yield differences.

Methods

Study Site

The study was conducted in Berrien County, Georgia, on a 100 acre irrigated Bt cotton area. Each plot was over 3 acres, with four replicate plots per treatment arranged in a randomized complete block design.

Treatments

The treatments investigated were as follows:

1) Unsprayed check
2) Lambda-cyhalothrin (Karate 1E) at 0.025 lbs ai/acre
3) Methyl-parathion at 0.5 lbs ai/acre.

Spraying was carried out on the 17th June (9 nodes - 5 weeks post planting) and the 23rd July (13 nodes - 10 weeks post planting), by ground application from a John Deere 6000 Hi-cycle, 8-row sprayer using 15 operational jets.

Arthropod Assessments

To minimize edge effects, all invertebrate sampling was carried out in a central sampling zone in each plot, measuring 100 ft by 32 crop rows. The total area of each sampling zone was therefore 0.22 acres and the minimum distance between the plot boundary and the sampling area was 120 ft. Sampling was carried out during the whole study period, beginning in early June and continuing until early September.

Sweep-net and shake-cloth sampling was used to assess population numbers of beneficial arthropods and pests in the crop foliage, pit-fall trapping was used for ground active arthropods. Sweep-net sampling consisted of six replicate samples of 20 sweeps per plot. Six replicate shake-cloth samples were also taken from each plot by shaking foliage on 2 adjacent rows for 10 seconds over a tub (early season) or a cloth laid between the rows. Nine pit-fall traps were placed in each sampling zone of each plot, the traps were left open continuously during the study period and the catch collected weekly. In pit-fall traps saturated saline solution

was used as a preservative plus a small amount of concentrated detergent as surfactant to ensure immersion of the catch. Samples were transferred to individually labelled jars containing 70% ethanol and species identified and counted in the laboratory.

Yield

The area of each plot picked for yield assessments consisted of a 24-row strip between the plot boundaries.

Results

Over 30 species of beneficial arthropods were identified during the study, including big-eyed bugs, pirate bugs, lady beetles, lacewings, spiders, parasitoid wasps and ground beetles. Results showed the first lambda-cyhalothrin spray was applied before the beneficial population had built up and therefore had little effect (Figure 1). The second application caused a transient reduction in the natural enemy population, numbers however recovered within 10 days.

Applications of methyl-parathion had a longer duration of effect on some important natural enemy groups compared to lambda-cyhalothrin, principally big-eyed bugs (Figure 2).

Applications of lambda-cyhalothrin showed good pest control, in particular of fleahoppers, stink bugs and plant bugs as well as a low level population of lepidopteran pests (Figure 3).

By direct comparison of natural enemy and pest populations numbers, lambda-cyhalothrin was shown to cause no significant disruption of season-long predator to pest ratios (Figure 4). This indicates that the balance between predators and pests will be maintained following lambda-cyhalothrin application.

A 12% increase in yield was evident following the application of lambda-cyhalothrin compared to control plots (Figure 5).

Conclusion

The early season application of lambda-cyhalothrin had little impact on beneficial arthropod populations. The later application resulted in a transient reduction in beneficials, numbers however rapidly recovered reaching control levels within 10 days. Good pest control was demonstrated throughout the trial, particularly of the heteropteran bug complex. Applications of lambda-cyhalothrin did not significant disrupt the ratio between predators and pests, maintaining the relative degree of natural pest control throughout the season.

Overspraying Bt cotton with lambda-cyhalothrin significantly increased final yield, even under the low pest pressure conditions of the trial. Although the economic threshold level for a single pest species was not reached, the control of the entire pest complex most likely contributed to the recorded higher yield. An average 12% increase in seed cotton yield per acre above the control clearly demonstrates that overspraying with lambda-cyhalothrin improves the performance of Bt cotton. The total spend on 2 applications of lambda-cyhalothrin including spraying was approximately $20; assuming the weight of lint is 40% of seed cotton and a price of $0.7 per lb, the growers net profit increase per acre following lambda-cyhalothrin application was $70, under the conditions of this study.

Acknowledgments

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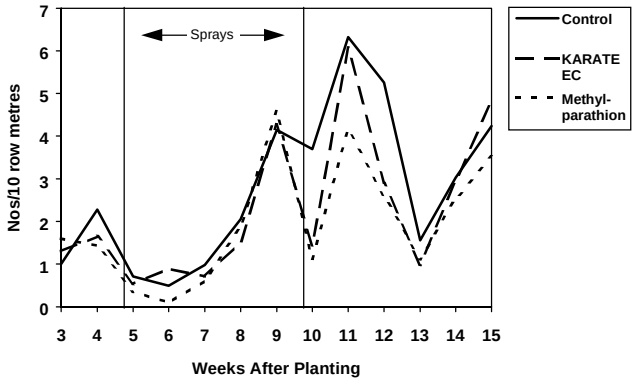

Figure 1. Effects of lambda-cyhalothrin on the total population of beneficial arthropods in Bt cotton.

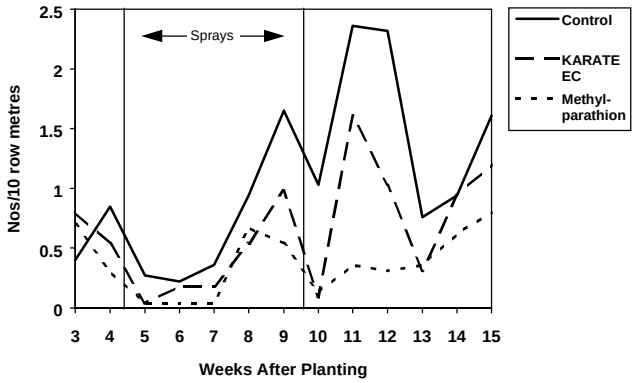

Figure 2. Effects of lambda-cyhalothrin on big-eyed bugs (*Geocoris* spp.) in Bt cotton.

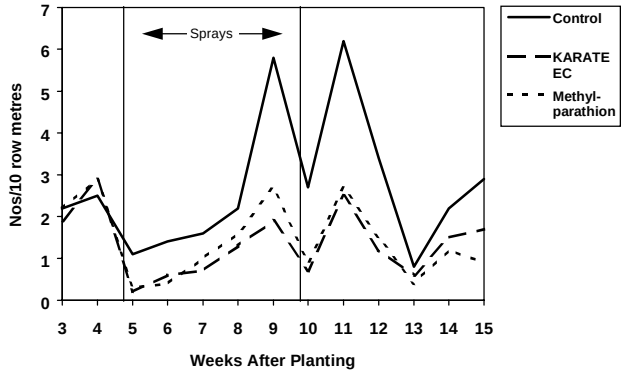

Figure 3. Effects of lambda-cyhalothrin on the total pest population (excluding aphids and thrips) in Bt cotton.

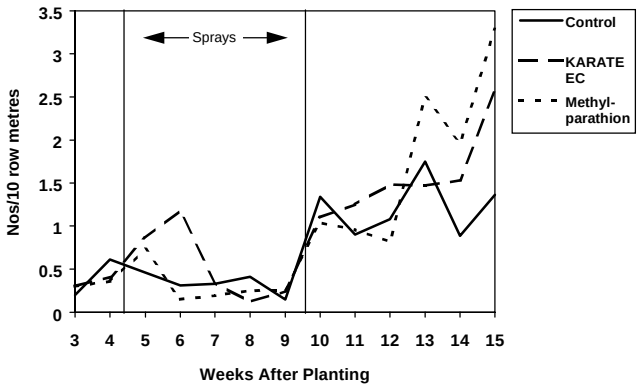

Figure 4. Predator to prey ratios.

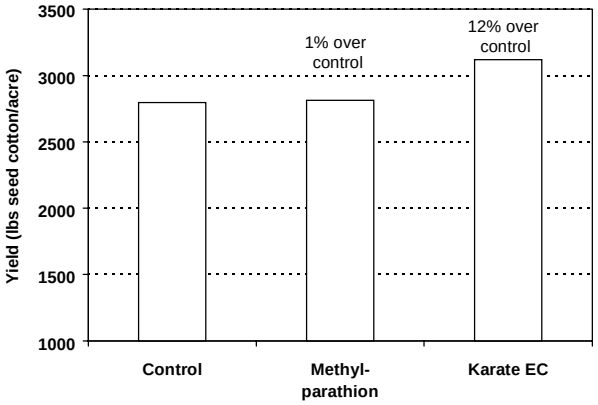

Figure 5. Total yield following lambda-cyhalothrin application in Bt cotton.