

KARATE® CS INSECTICIDE, A NOVEL MICROENCAPSULATED FORMULATION

S. H. Martin, J. S. Mink AND R.S. Boykin
ZENECA Ag Products
Ruston, LA

Abstract

Karate® CS is a novel microencapsulated formulation of lambda-cyhalothrin. Karate® CS is a water-based formulation and as a result provides significant improvements over Karate® 1 EC in environmental and handler's toxicity. Other unique properties of the microcapsule provide an improvement in rainfastness and the addition of a UV protectant inside the microcapsule gives an improvement in foliar persistence. These improvements were achieved while maintaining the superior broadspectrum insect control synonymous with Karate®.

Introduction

Karate® 1 EC was first registered in the United States in 1988. Since then Karate® 1 EC has become the leading pyrethroid used in cotton, *Gossypium hirsutum*, because of its broadspectrum activity. All solvent-based formulated products have common toxicological concerns associated with them. These concerns include environmental toxicity, handler's toxicity, superficial facial sensitization and low flash temperatures. These concerns prompted a project to develop a nonsolvent-based formulation of Karate®. Some of the unique properties of lambda-cyhalothrin made the development of a nonsolvent-based formulation very difficult. Another complicating factor in this development project was the difficulty in improving on an already outstanding product.

Discussion

Karate® CS is a water-based microencapsulated formulation of lambda-cyhalothrin. Many encapsulated pesticide formulations are designed to provide slow, controlled release of the active ingredient. In contrast, the microcapsules in Karate® CS were designed for the fast release of lambda-cyhalothrin to maintain the speed of activity of Karate®. The active ingredient moves out of the microcapsules rapidly after the application of Karate® CS. Within three to four hours 90% of the active ingredient has moved outside of the microcapsule. The remaining portion of the active ingredient moves out of the microcapsule within the first twenty-four hours after application.

In addition to the active ingredient, the microcapsules also contain an ultra violet protectant which reduces photo degradation of the active ingredient. In studies conducted

to evaluate persistence of Karate® CS compared to Karate® 1 EC, an increase in the percent of the active ingredient remaining on the leaf surface was observed for four days after application (Figure 1).

Another unique property of the microcapsules is the strong adherence to the plant tissue after contact. This strong adherence to the plant results in improved rainfastness compared to Karate® 1 EC. In studies conducted to evaluate the rainfastness of Karate® CS compared to Karate® 1 EC, a decrease in the amount of the active ingredient washed off was observed with Karate® CS in the first four days after application (Figure 2).

Significant improvements in environmental toxicity were also obtained with Karate® CS. Results of acute toxicity studies (Figure 3) indicate significant decreases in acute toxicity to the three aquatic species evaluated. The microcapsule size is also an important feature for environmental safety of the Karate® CS formulation. Studies have shown that some capsules ~30 microns in diameter have been found intermingling with stored pollen in honey bee, *Apis mellifera*, hives. In contrast, Karate® CS microcapsules are ~3 microns in diameter. These microcapsules are substantially smaller than pollen grains and are less likely to be mistaken for pollen.

The most significant improvements are in enhanced handler's safety and decreased superficial facial sensitization. Significant improvements were observed in most of the acute toxicity test conducted with Karate® CS (Table 1). Improvements in acute toxicity tests resulted in a change in the signal word from DANGER with Karate® 1 EC to WARNING with Karate® CS. In addition, significantly less skin sensitivity was observed after exposure to Karate® CS when compared to Karate® 1 EC in a human volunteer study to evaluate superficial facial sensitization.

An important criterion in development of Karate® CS was the maintenance of the broad spectrum insect control that has resulted in Karate® 1 EC becoming the leading cotton pyrethroid insecticide. Over 100 field trials have been conducted on a wide range of crops and pests to evaluate the efficacy of Karate® CS compared to Karate® 1 EC and other insecticides. Analysis of these trials have demonstrated that Karate® CS provides equal to or slightly better insect control than Karate® 1 EC. Results of field trials evaluating Karate® CS for boll weevil, *Anthonomus grandis grandis*, and boll worm, *Helicoverpa zea*, control in cotton are shown in Figures 4 and 5 respectively.

Summary

Karate® CS is a novel microencapsulated formulation of lambda-cyhalothrin. This formulation has provided significant improvements in environmental and handler's toxicity. The inclusion of a UV protectant in the

microcapsule has resulted in increased persistence of Karate® CS. The adhesive properties of the microcapsule result in increased rainfastness of Karate® CS compared to Karate® 1 EC. All of these improvements were achieved while maintaining or slightly improving the broad spectrum efficacy that has led Karate® to become the leading pyrethroid insecticide in cotton.

Table 1. Summary of Acute Toxicity of Karate CS and Karate EC.

TEST	KARATE EC	KARATE CS
Rat Acute Oral LD ₅₀ (mg/kg)	Female-101 Male-64	Female-180 Male-245
Rat Acute Dermal LD ₅₀ (mg/kg)	>1,800	>2,000
Inhalation LC ₅₀ (mg/l)	Female-0.18 Male-0.32	Female-3.12 Male-3.72
Rabbit Eye Irritation	Moderate to Severe	Mild
Rabbit Skin Irritation	Severe	None to Moderate
Skin Sensitization	Mild	Mild
SIGNAL WORD	DANGER	WARNING

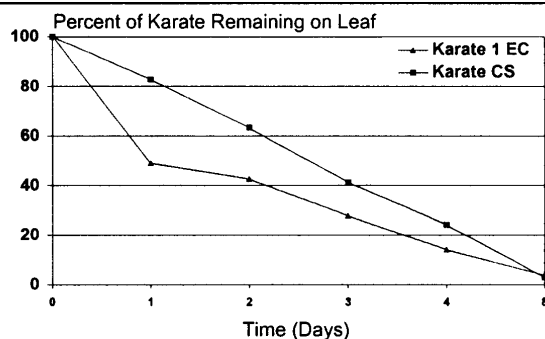


Figure 1. Foliar Persistence of Karate CS and Karate EC on Cotton Exposed to UV Light.

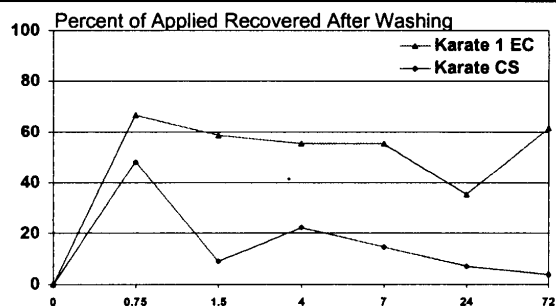


Figure 2. Comparison of Washoff of Karate CS and Karate EC from Cotton Leaves.

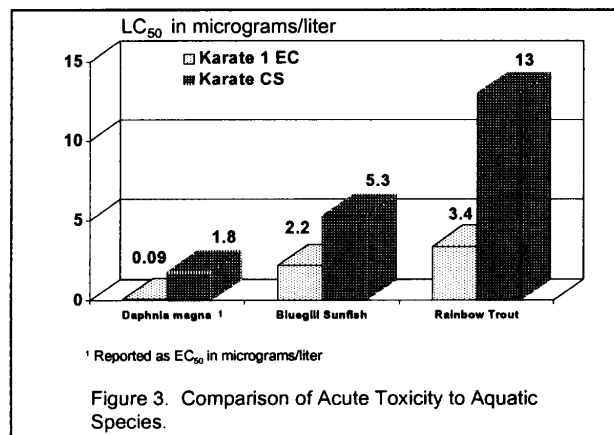
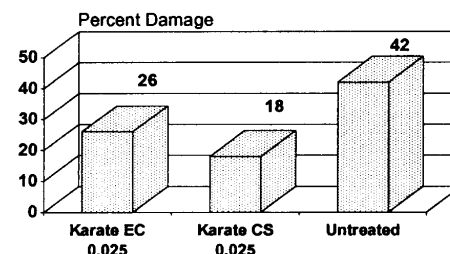
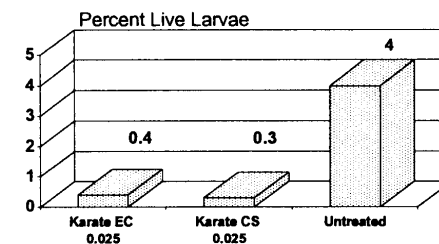


Figure 3. Comparison of Acute Toxicity to Aquatic Species.



Rates given in Lb ai/A

Figure 4. Control of Boll Weevil (*Anthonomus grandis*) in Cotton with Karate CS.



Rates given in Lb ai/A

Figure 5. Control of Boll Worm (*Helicoverpa zea*) in Cotton with Karate CS.