EFFICACY OF DENIM® (EMAMECTIN BENZOATE) AGAINST SPIDER MITES IN COTTON Stephen M. White Syngenta Greensboro, NC Stephen T. Moore Syngenta Bebe, AR Keith Driggs Syngenta North Little Rock, AR

Introduction

Emamectin benzoate is the active ingredient in Denim[®] and is a second generation of avermectin insecticide for crop protection being developed by Syngenta Crop Protection. It is highly effective against a broad range of lepidopterous pests at very low use rates (8.4- 16.5 g ai/ha). It is most effective when ingested as a neurotoxin, but it also demonstrates contact activity. It's not systemic. However, through translaminar movement, Emamectin benzoate penetrates the plant cuticle to form a reservoir of the active ingredient. Emamectin benzoate is highly selective for Lepidopterous larvae and is not disruptive to beneficial arthropods in integrated pest management programs. The compound is being developed in the United States under the trade name Proclaim[™] for vegetables.

In 2000, Denim was granted Section 18 emergency exemptions by the U.S. EPA in seven states across the cotton belt. The Section 18's were granted based on the need for a insecticide product that would effectively control Beet Armyworm (Spodoptera exigua) and, in some states, resistant Tobacco Budworm (Heliothis virescens). This was the first widespread commercial use of Denim in the United States and the levels of control of the Beet Armyworm and the Heliothine complex were excellent. In some areas of the mid-south where Denim was used, consultants and scouts observed very good mite activity as well. In laboratory studies, Emamectin benzoate were evaluated against many different insect and mite species and the activity was compared to that of abamectin (Figure 1). The results of laboratory studies show that the LC 90 for the Two Spotted Spider Mite, Tetanychus urticae, 20 ppb and 290 ppb for Abamectin and Emamectin benzoate, respectively. The intrinsic toxicity of Abamectin is over 14 times more toxic to the Two Spotted Spider Mite than Emamectin benzoate. In 2000 field trials were initiated in Arkansas and in California to determine the level of mite control and residual activity that Denim provides under field conditions compared to Zephyr.

Materials and Methods

Replicated field trials were conducted at two locations in California and one location in Arkansas. In two of the trials, Denim was applied at the proposed labeled rates of six and eight ounces of product per acre. Zephyr was used as the commercial standard and was applied at 4, 8 and 12 ounces of product per acre. In the Arkansas trial, Curacron was also included as another commercial standard. All products, except Curacron, were applied in combination with a non-ionic surfactant to improve wetting and coverage. Mite counts were then taken out to 21 days or 29 days after the initiation of the studies. At the two California locations mites counts were based on mites per leaf; whereas, in Arkansas the mite density was reported in term of mites per square inch of leaf surface. Also, in the Arkansas study a leaf damage rating was taken at the last evaluation date. The damage rating is based on the percent leaf area damaged by mite feeding. Twenty leaves were evaluated from each plot.

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Results and Discussion

Kerman, California Study

The mite population, predominately Pacific spider mite, (Tetranycus pacificus) at the time of the study initiation was fairly high. The average number of mite motiles per leaf ranged from 13.8 to 22.9 per leaf (Figure 2). After the application of the treatments, the mite numbers in the nontreated plots increased from 16.2 at day zero to a high of 32.5 mites per leaf at seven days after treatment. After day seven the mite population declined to less than five mites per leaf at 21 days after the study was initiated. In the plots treated with Zephyr 0.15 EC, at the10 ounce rate, and the Denim 0.16 EC at the six and eight ounce rate the mite numbers rapidly declined to less than an average of six mites per leaf at seven days after treatment. The population in these plots continued to decline for the remainder of the study. The mite population in the plots treated with the eight ounce rate of Zephyr declined to approximately 10 mites per leaf and then declined down to less than two mites per leaf by day 21. In this trial, both rates of Denim provided mite control statistically equal to both rates of Zephyr; however, numerically superior to the low rate of Zephyr.

Lemor, California Study

At this location, the Two Spotted Spider mite, *Tetranychus urticae*, population at the time of the study initiation was greater that ten mites per leaf in all plots. The population in the non-treated plots continued to increase to greater that 30 mites per leaf at 21 days into the study and then declined to approximately 15 mites per leaf at the termination of the study at 29 days after study initiation. In all of the treated plots, the mite population declined to less than two mites per leaf until day 14 of the study. By day 21 the mite populations in the two Denim treatments increased to approximately five mites per leaf. By day 29 of the study, the low rate of Denim had approximately six mites per leaf. In addition, by day 29, the population in the plots treated with the high rate of Denim declined to less than two mites per leaf to both Zephyr treatments and significantly lower than the mite population in the non-treated control during the course of the entire study.

Pettus, Arkansas Study

The density of the Two Spotted Spider mite, *Tetranychus urticae*, population at the time of the study initiation was approximately 5 mites per square inch of leaf surface. In the non-treated plots, the population peaked 35 mites per square inch of leaf surface at four days after the application. However, as indicated in the cumulative mites sampled, over the duration of the study, mite pressure in the non-treated control plots was greater than when compared to the number of mites sampled in the non-treated plots (Figure 4). Similarly, when comparing the cumulative number of mites sampled during the study to the damage ratings, the trends are very comparable. The non-treated plot had the highest cumulative number and the highest leaf damage rating; whereas, Zephyr had the lowest cumulative mites sampled and the lowest lead damage rating. In fact, visually, the treated plots could be distinguished from the non-treated plots due to the level of leaf bronzing.

Conclusion

The Section 18 commercial experience and replicated field trials demonstrated that Denim provides very high levels of control of the Heliothine complex, Beet Armyworms and other lepidopterous pest in cotton. In addition, with Denim's mite efficacy, a distinct added benefit has been demonstrated when compared to other commercially available insecticides that target mainly lepidoptera pests of cotton. Denim's level of activity against mites does not appear to be as consistent as that of Zephyr. Which follows logically because the active ingredient in Zephyr, Abamectin, is over 14 times more toxic to spider mites than the active ingredient in Denim, Emamectin benzoate. Likewise, as reported before in

other Beltwide presentations, Denim is the most potent insecticide against lepidoptera ever discovered (White S. M. et. al 1997).

Literature Cited

White, S.M., D.M. Dunbar, R.Brown, B. Cartwright, D. Cox, C. Eckel, R.K. Jannson, P.K. Mookerjee, J.A. Norton, R.F. Peterson, and V.R. Starner. 1997. Emamectin benzoate: A novel avermectin derivative for control of lepidopterous pests in cotton. In, Proceedings Beltwide Cotton Conference, National Cotton Council, Memphis, TN pp. 1078-1082.



Figure 1. Comparitive toxicity of Abamectin to Emamectin benzoate against Two Spotted Spider Mite, *Tetranychus urticae*



Figure 2. Denim and Zephyr efficacy against the Pacific spider mite, *Tetranychus pacificus* in Kerman, California. Study initiation August 02, 2000.



Figure 3. Denim and Zephyr efficacy against the Two Spotted spider mite, *Tetranychus urticae* in Lemore, California. Study initiation August 21, 2000.



Figure 4. Cumulative mites sampled per square inch of leaf with respect to Zephyr, Denim and Curacron. Pettus, Arkansas. Study initiated August 8, 2000.



Figure 5. Percent leaf area damaged by mite feeding with respect to Zephyr, Denim, Curacron compared to the non-treated check. Arkansas. Study initiated August 8, 2000.