REVIEW OF PESTICIDE EFFICACY TRIALS FOR CONTROL OF TARNISHED PLANT BUG, 1982 – 1996

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Abstract

Summarization of insecticide efficacy evaluations for tarnished plant bug management in Mississippi indicate that there is a trend for decreased efficacy for commonly used insecticides and insecticide classes over time. Results indicate that Mississippi tarnished plant bug populations are variable in respect to insecticide susceptibility between years. There was a general trend towards increased efficacy for compounds tested with a buffer or other adjuvant except for the organocilicone based adjuvant, Kinetic.

Introduction

With the advent of transgenic (Bt) cotton and boll weevil eradication procedures in Mississippi, the tarnished plant bug plays an important role in the 'new age' of integrated pest management of cotton insect pests in Mississippi. Following the removal of organophosphate insecticide applications for control of boll weevil and the promise of reduced number of insecticide applications for management of heliothine larvae, damage by tarnished plant bugs is expected to increase in cotton because insecticide applications for both boll weevil and heliothines secondarily reduced tarnished plant bug numbers.

In addition to the expected increase in the importance of the tarnished plant bug in Mississippi cotton, the insect has also been selected for resistance to the most commonly used insecticides in areas of high insecticide use. Reduced tolerance of populations of tarnished plant bug in Arkansas to three insecticides (λ-cyhalothrin, endosulfan, and oxamyl) has been reported by Hollingsworth et al. (1997). Snodgrass (1994, 1996), Snodgrass and Scott (1988) and Snodgrass and Elzen (1995) reported tarnished plant bug resistance to pyrethroid, organophosphate or cyclodiene insecticides. These reports indicate the possibility of reduced insecticide efficacy for commonly used insecticides for tarnished plant bug control and raises the question of which materials are to be recommended for control of this pest. Because of this, growers and consultants require knowledge about insecticide efficacy trends of insecticide classes as well as efficacy of individual compounds, mixtures and adjuvants. To this end the Mississippi insecticide evaluation tests targeted toward tarnished plant bug have been summarized and evaluated for general efficacy trends and comparative efficacy.

This paper provides a review of efficacy evaluations of insecticides for tarnished plant bug control in Mississippi from 1985 to 1996. By observing results in broad categories, general efficacy trends for various classes and compounds within classes may be identified.

A newly registered compound, imidacloprid (Provado), is effective against tarnished plant bugs but affects feeding behavior (Teague and Tugwell, 1996) and does not produce rapid mortality as do most standard insecticides. Sampling procedures in the tests reported herein were generally not adapted for specialized sampling that would identify efficacy of slower acting materials, and percent control results reported for Provado will likely be somewhat less that that expected under actual field conditions over time.

Materials and Methods

Data was taken from all tarnished plant bug (*Lygus lineolaris* [Palisot de Beauvois]) efficacy tests conducted in Mississippi published in Insecticide & Acaricide Tests from 1980 through 1993, and from Arthropod Management Tests form 1994 through 1996. Data was also taken from tests published in publications of the Mississippi Agriculture and Forestry Experiment Station, and from some yet unpublished research. The data was normalized by dividing the results in the treated plot by the results in the untreated plot resulting in an efficacy ratio (ER). Percent control was calculated using the following formula: (1 - ER) * 100 = percent control. In the case of tests reporting percent survival, as in some laboratory efficacy evaluations, percent control was calculated as 100 - percent survival.

Trials were typically sampled two to three days after treatment; however, data used for these summaries included sampling from one to ten days post treatment. Sampling was done by use of a sweep net, drop cloth, or visual inspection. There were a total of 19 tests included in this report, 11 from the hills, and 8 from the delta areas of Mississippi. Means reported in the results are summarized across rates under the assumption that virtually all tests utilized rates that should be close to optimum for plant bug management.

Results

Because the data summarized in this paper have a very broad base representing different locations, researchers, and test conclusions, results will be discussed in broad generalities. In general, results depicted in figures 1-8 with short standard error bars may be considered to give consistent results, and those with longer error bars give less consistent results. In addition, graphical use of whiskers representing 1.96 times the standard error will allow some generalized comparisons between entries in a graph;

Reprinted from the *Proceedings of the Beltwide Cotton Conference*
Volume 2:1203-1206 (1998)
National Cotton Council, Memphis TN

however, caution should be used in these comparisons, particularly when sample size is small. The number of samples is included parenthetically above each graph entry.

Fiprole class insecticides have generally resulted in higher percent control than did organophosphates, carbamates, pyrethroids, chloronicotinyl nitroguanidine, pyrole, and formadines. The single pyrole (Pirate) generally resulted in lower percent control than did organophosphates, pyrethroids, chloronicotinyl nitroguanidine (Provado), the fiprole (Fipronil), and an experimental inverted sugar. Results of insecticide classes averaged over years and rates indicate that efficacy was consistently high for the fiprole class insecticides with percent control averaging over 80 percent. Consistent percent control averaging about 60 percent was determined for pyrethroids and chloronicotinyl nitroguanidines (Provado). Mixtures of insecticides and insecticides with adjuvants also averaged 60 percent. Several of these mixtures contained Lorsban which is no longer in use for cotton in Mississippi (Figure 1).

For the Organophosphate insecticides, Guthion generally had lower percent control than did Cygon, Malathion, Bidrin, Monitor, and Swat. Ethyl Parathion generally had lower percent control than did Cygon, Malathion, and Bidrin. In order from lowest to highest, mean percent control by organophosphate insecticides was: Ethyl Parathion, Guthion, Curacron, MO070616, Bolstar, Methyl Parathion, Orthene, Lorsban, Monitor, Swat, Malathion, Cygon, and Bidrin (Figure 2). Of the organophosphate insecticides, the systemic insecticides, Bidrin and Cygon, provided about 60 percent control. All other organophosphates fell below this level of control.

Only two Carbamate insecticides were evaluated for control of tarnished plant bugs. Vydate and Furadan were approximately the same in terms of mean percent control of tarnished plant bugs; however, there was less variability with Vydate (Figure 3).

Pyrethroid insecticides resulted in mean percent control ranging from 20 to 100 percent. Ambush and Maverick generally had higher percent control than did all other pyrethroids; however, there are only two tests evaluating these compounds in the data set, and they occurred shortly after the introduction of pyrethroids on the market. Mean percent control by pyrethroid insecticides from lowest to highest was: Asana, Decis, Capture, Baythroid, Danitol, Fury, Karate, Scout, Payoff, Ammo, Maverick, and Ambush (Figure 4).

Several insecticides were tested with the addition of an adjuvant. The addition of a buffer did improve the percent control of the insecticide, based on the mean percent control of the insecticide and the insecticide plus buffer. The addition of Kinetic, an organosilicone based adjuvant, to Vydate and Provado generally slightly lowered the performance of those insecticides, and the addition of Kinetic to Monitor apparently did not alter performance of that insecticide (Figure 5).

The percent control of tarnished plant bugs by all insecticide classes and mixtures over the fourteen year period declined. This could be in part due to increasing resistance in the population; however, efficacy appears to fluctuate over time as exemplified by results in 1995, when overall percent control was at about 75 percent as compared to 40 percent for 1994, and 50 percent for 1996 (Figure 6). Individual classes of insecticides resulted in the same general trend of reduced but fluctuating efficacy over time (Figure 7).

When tests were identified by location (delta and hill areas of the state) there was no indication of differences in efficacy of insecticides or insecticide classes resulting from location (Figure 8).

Summary

The mean percent control of tarnished plant bugs by all classes of insecticides has apparently been reduced during the past 14 years. There is also a large amount of variation evident within each of the major classes of insecticides. If the decision has been made to add an adjuvant to an insecticide treatment, it should be selected with caution because of the indecisive results.

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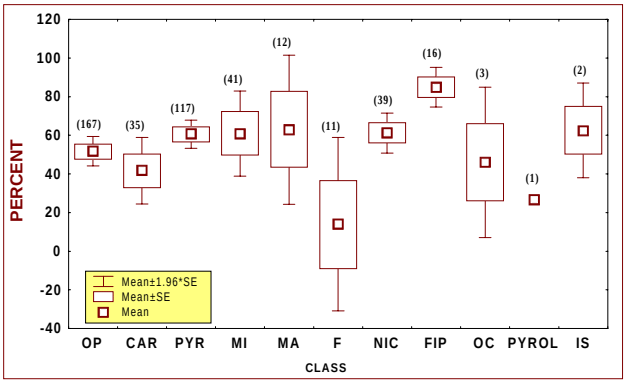

Figure 1. Percent control of tarnished plant bug by different classes of insecticides summarized across trials and rates from 1980 to 1996. Parenthetic numbers represent the number of samples in each bar. OP=organophosphate; CAR=carbamate; PYR=pyrethroids; MI=mixtures of insecticides; MA=insecticides plus adjuvant; F=formamadine; FIP=Fipronil; OC=organochlorine; PYROL=pyrole; IS=invert sugar (experimental).

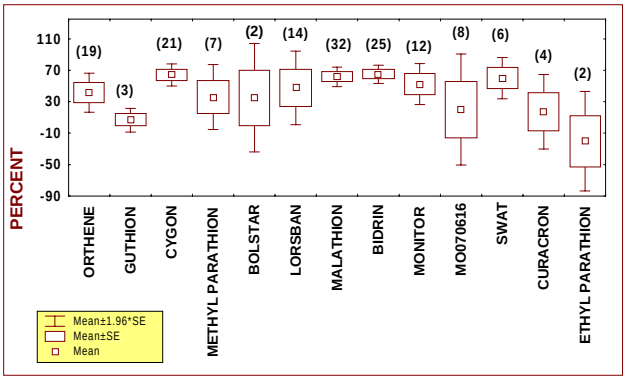

Figure 2. Percent control of tarnished plant bugs by organophosphate insecticides summarized across trials and rates from 1980 to 1996. Parenthetic numbers represent the number of samples in each bar.

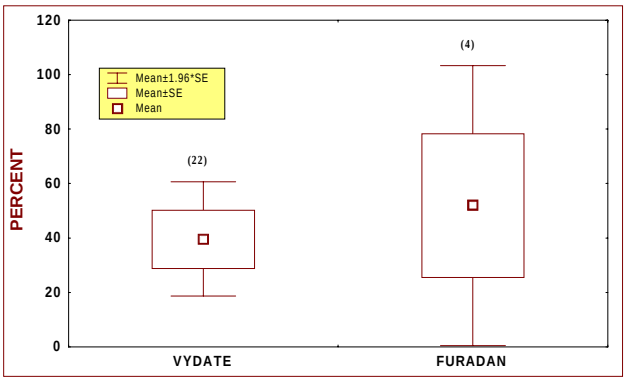

Figure 3. Percent control of tarnished plant bugs by carbamate insecticides summarized across trials and rates from 1980 to 1996. Parenthetic numbers represent the number of samples in each bar.

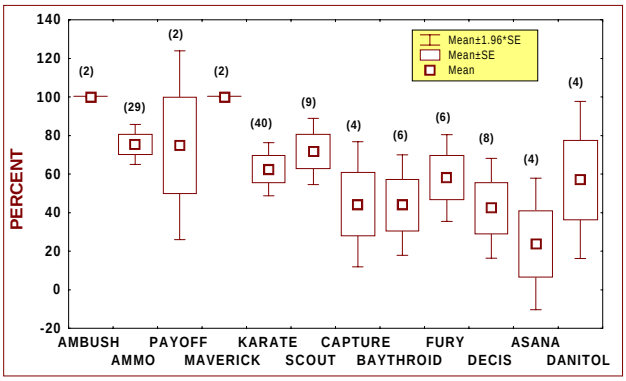

Figure 4. Percent control of tarnished plant bugs by pyrethroid insecticides summarized across trials and rates from 1980 to 1996. Parenthetic numbers represent the number of samples in each bar.

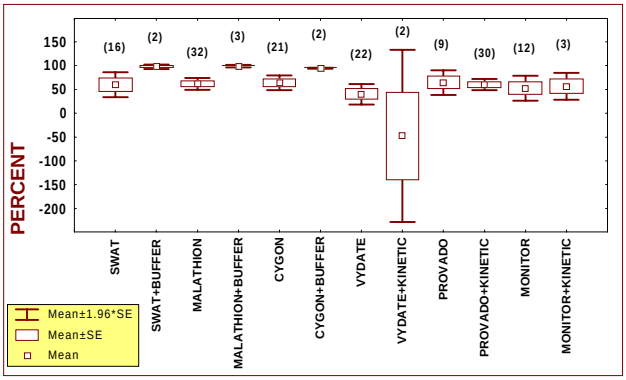

Figure 5. Percent control of various insecticides tested with and without an adjuvant summarized over years, trials and rates. Compounds may have been tested with and without insecticides in different trials and/or years. Parenthetic numbers represent the number of samples in each bar.

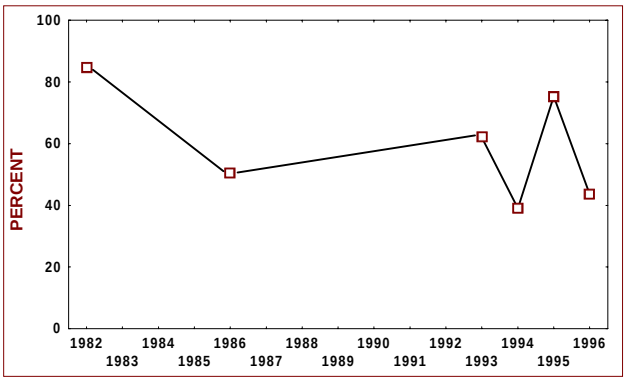

Figure 6. Percent control of tarnished plant bug by all insecticides summarized across insecticide classes and rates. Pesticide evaluations were not carried out in Mississippi in years without a data point.

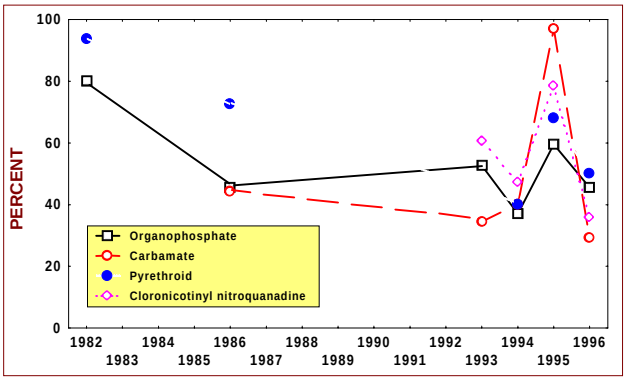

Figure 7. Percent control of tarnished plant bugs by various insecticide classes summarized across trials and rates. Pesticide evaluations were not carried out in Mississippi in years without a data point.

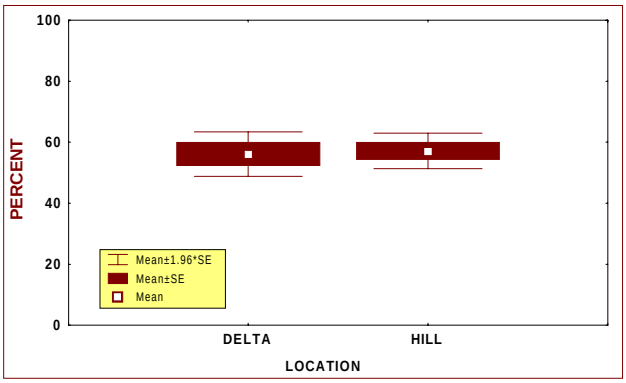

Figure 8. Percent control of tarnished plant bugs by insecticides summarized across years, insecticide classes and rates comparing evaluations completed in the Mississippi Delta region and hill region of Mississippi.