EFFECTS OF FIVE DIFFERENT ADJUVANTS ADDED TO FIVE INSECTICIDES FOR CONTROL OF TARNISHED PLANT BUGS (*Lygus lineolaris*) IN MISSISSIPPI COTTON

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Abstract

Five adjuvants from different classes were selected and evaluated to determine if they improved efficacy of insecticides. No statistical differences were found between any insecticide and that insecticide mixed with an adjuvant. There was a trend across insecticides for the organo-silicone based spreader to reduce percent mortality, and for other adjuvants to slightly increase mortality.

Introduction

The tarnished plant bug (*Lygus lineolaris*) can damage cotton throughout the growing season, but economic damage is likely to occur from first square to first bloom. Feeding by the tarnished plant bug can damage small squares and result in delayed crop maturity which can lead to decreased yield. With the advent of transgenic cotton and the subsequent reduction in insecticide applications targeted for tobacco budworms (*Heliothis virescens*) and ongoing eradication of the boll weevil (*Anthonomous grandis grandis),* the likelihood of treating for plant bugs becomes greater. Insecticide applications targeted at controlling tobacco budworms and boll weevils have secondarily reduced plant bug numbers in the field, thus reducing the need for treatment of tarnished plant bugs.

In Mississippi, control of tarnished plant bugs is accomplished primarily by the use of insecticides. Along with insecticides, chemical companies manufacture many different adjuvants which are marketed with the intent to help improve the performance of various insecticides. Adjuvants may be defined as any substance added to a spray tank, excluding the pesticide, which improves the pesticide's performance (Grondin, 1985) (Berg, 1988). Spray adjuvants, which have no insecticidal action of their own, are designed to improve various aspects of insecticide application (Heim et al. 1992).

Unfortunately, little is known about the ability of an adjuvant to improve efficacy of an insecticide. In 1992, Heim et al. found that adjuvants did not significantly affect Ambush 2EC deposits. In other research, it was found that the addition of buffers slightly improved the performance of some insecticides, and that the addition of Kinetic to some insecticides slightly lowered the performance of the insecticides when treating tarnished plant bugs (Howell et al. 1998).

There are several classes of adjuvants available for use in cotton. Those included in these evaluations are: spreaders/stickers, buffers, crop oil concentrates, defoamers, and silicone based spreaders. Spreaders may be defined as an adjuvant which increases the area a given volume of liquid will cover on a solid or other liquid, and a sticker is an adjuvant which increases the tenacity with which finely divided solids or other materials attach to solid surfaces. Spreaders/stickers combine properties of both spreaders and stickers. Buffers are adjuvants designed to adjust the pH of alkaline waters and resist changes in solution pH. Crop oil concentrates are petroleum or vegetable based products generally containing 15 to 20 percent surfactant/emulsifier, and 80 to 85 percent oil. Finally, a defoamer is used to suppress both surface foam and trapped air in the spray system (Helena Chemical Company 1990).

The purpose of this research was to evaluate the performance of some of these adjuvants, and ultimately to determine the value of their use in controlling tarnished plant bugs.

Materials and Methods

Adjuvants selected for use in this research were chosen from these different classes of adjuvants, as well as being some of the more commonly used adjuvants. Insecticides were also chosen from different classes, as well as from different formulation types. Adjuvants used in this study included: Buffer ES, DeFoamer, Hyper-Active (mixture of crop oil concentrate and organo-silicone based surfactant), Kinetic (organo-silicone based surfactant), and Soydex (crop oil concentrate). Insecticides chosen for use included: Provado 1.6 F, Karate 2.08 SC, Orthene 90 S, Bidrin 8 E, and Thiodan 3 EC.

This series of tests was evaluated in cage trials in a field setting. Mesh sleeves were placed around two plants in each plot and were secured at the bottom with an elastic holder. Sleeves were gathered around the base of the plant and covered with aluminum foil to protect the sleeves from the spray. Plots were then treated with a high clearance spray tractor equipped with two TX-6 hollow cone nozzles per row. The machine was calibrated to deliver 7.2 gallons per acre traveling at four miles per hour. After treatment, plants were allowed to dry. Five adult tarnished plant bugs were put into each sleeve, and the sleeve was then closed above the top of the plant. Thirty-six hours after treatment, plants were cut from the field and transported to the lab. The live and dead insects were then counted and the percent mortality was calculated. All statistical analysis was preformed utilizing the SAS software package, and means were separated using Dunnett=s two tailed T-test.

Reprinted from the *Proceedings of the Beltwide Cotton Conference*
Volume 2:1052-1054 (1999)
National Cotton Council, Memphis TN

Results

There were no statistical differences in insect mortality between an insecticide treatment and the same insecticide combined with any of the adjuvants in terms of percent mortality. For Provado, all adjuvant treatments did numerically increase the percent mortality as compared to Provado alone. Kinetic HV, Hyperactive, and Soydex did tend to lower the percent mortality when compared to Karate alone, however, Buffer ES and DeFoamer numerically increased the percent mortality of Karate. Numerically, percent mortality of Orthene was lowered by the addition of Soydex, while Buffer ES, DeFoamer, Kinetic HV, and Hyperactive slightly increased the percent mortality of Orthene. Buffer ES, Kinetic HV, and Soydex did numerically lower percent mortality compared to Bidrin alone, and DeFoamer and Hyperactive slightly increased percent mortality of Bidrin. Finally, for Thiodan, Kinetic HV numerically reduced percent mortality relative to Thiodan alone, while Buffer ES, DeFoamer, Hyperactive, and Soydex slightly increased percent mortality of the insecticide (Tables 1-5).

Because there were no statistical differences in insect mortality between any insecticide and any insecticide adjuvant combination, data were pooled to provide an overall summary of possible change in efficacy attributable to adjuvants. These values were then analyzed as described previously. There were no statistical differences in insect mortality between any of the insecticides combined with any of the adjuvants. However, there were some trends that developed from these pooled results. Generally speaking, Kinetic HV tended to lower the percent mortality of tarnished plant bugs when used with the insecticides in this study. DeFoamer, Buffer ES, Hyper-Active, and Soydex tended to increase the plant bug percent mortality of the insecticides compared to insecticides without adjuvants (Table 6).

Still to Come

The research reported here is only a small portion of an ongoing research project funded in part by Mississippi Agricultural and Forestry Experiment Station special initiative funds. Ongoing research includes similar trials testing the efficacy of insecticide adjuvant combinations on cotton aphids (*Aphis gossypii*) and tobacco budworms (*Heliothis virescens*). This research will also be looking at other factors which may be improved by adjuvants. Droplet size will be determined by use of a Malvern particle analyzer (model 2600Lc, Malvern Instruments, Malvern, England). It has been shown that tobacco budworm larvae have the ability to avoid large droplets (Polles, 1968). However, some of these droplets were larger than 700 Fm, much larger than droplets produced for insect control in production agriculture. On the other hand, droplets smaller than 140 Fm cannot be dependably deposited on the target because of their higher potential for drift (Burt and Smith, 1974). Rainfastness, or the ability of the insecticide to remain on the plant after a rain, will also be determined. This will be done by treating plots, then simulating rainfall and evaluation of efficacy. Additionally, penetration of the plant canopy will be determined by use of chromecoat cards placed at two levels in the plant canopy. Finally, adjuvants will be evaluated as to their ability to improve the residual control of the insecticides. This will be done both with bioassays and by gas chromatography evaluations for those chemicals with reasonably inexpensive GC procedures.

Summary

The addition of adjuvants to insecticide tank mixes is commonly recommended to improve control of an insecticide. Data from this research, as well as others, indicates that the use of an organo-silicone based spreader reduces control of several insecticides. Results from other adjuvants show a slight trend toward an increase in percent mortality of plant bugs. In this series of tests, DeFoamer tended to improve mortality more than any other adjuvant used, however this improvement was not significant.

Acknowledgment

The author would like to express thanks to Dr. Gordon Snodgrass for providing the insects used in these trials.

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Table 1. Mortality of tarnished plant bugs in cages after 36 hours, and the difference in mortality between Provado alone and Provado plus adjuvants.

TREATMENT (Lb. ai /acre or %V/V)	PERCENT MORTALITY	DIFFERENCE*
Provado (0.02)	42.26	---
Provado (0.02) + Buffer ES (0.06)	48.01	5.74
Provado (0.02) + DeFoamer (0.02)	47.67	4.40
Provado (0.02) + Kinetic HV (0.31)	48.78	5.52
Provado (0.02) + Hyperactive (0.19)	61.46	19.20
Provado (0.02) + Soydex (5.00)	69.57	26.31

Confidence Limit= 36.207. Critical Value of Dunnett's T= 2.443.
*Difference in TPB mortality between insecticide adjuvant combination and insecticide alone.

Table 2. Mortality of tarnished plant bugs in cages after 36 hours, and the difference in mortality between Karate alone and Karate plus adjuvants.

TREATMENT (Lb. ai /acre or %V/V)	PERCENT MORTALITY	DIFFERENCE*
Karate (0.02)	52.78	---
Karate (0.02) + Buffer ES (0.06)	53.97	1.19
Karate (0.02) + DeFoamer (0.02)	63.33	10.56
Karate (0.02) + Kinetic HV (0.31)	29.32	-23.46
Karate (0.02) + Hyperactive (0.19)	45.63	-7.15
Karate (0.02) + Soydex (5.00)	39.17	-13.61

Confidence Limit= 46.673. Critical Value of Dunnett's T= 2.443.
*Difference in TPB mortality between insecticide adjuvant combination and insecticide alone.

Table 3. Mortality of tarnished plant bugs in cages after 36 hours, and the difference in mortality between Orthene alone and Orthene plus adjuvants.

TREATMENT (Lb. ai /acre or %V/V)	PERCENT MORTALITY	DIFFERENCE*
Orthene (0.25)	46.04	---
Orthene (0.25)+ Buffer ES (0.06)	55.00	8.96
Orthene (0.25)+ DeFoamer(0.02)	58.61	12.57
Orthene (0.25)+ Kinetic HV (0.31)	48.61	2.57
Orthene (0.25)+ Hyperactive (0.19)	47.01	0.97
Orthene (0.25)+ Soydex (5.00)	41.18	-4.86

Confidence Limit= 38.838. Critical Value of Dunnett's T= 2.443.
*Difference in TPB mortality between insecticide adjuvant combination and insecticide alone.

Table 4. Mortality of tarnished plant bugs in cages after 36 hours, and the difference in mortality between Bidrin alone and Bidrin plus adjuvants.

TREATMENT (Lb. ai /acre or %V/V)	PERCENT MORTALITY	DIFFERENCE*
Bidrin (0.25)	77.08	---
Bidrin (0.25)+ Buffer ES (0.06)	74.38	-2.71
Bidrin (0.25)+ DeFoamer (0.02)	83.33	6.25
Bidrin (0.25)+ Kinetic HV (0.31)	65.00	-12.08
Bidrin (0.25)+ Hyperactive (0.19)	87.50	10.42
Bidrin (0.25)+ Soydex (5.00)	67.29	-9.79

Confidence Limit= 36.401. Critical Value of Dunnett's T= 2.443.
*Difference in TPB mortality between insecticide adjuvant combination and insecticide alone.

Table 5. Mortality of tarnished plant bugs in cages after 36 hours, and the difference in mortality between Thiodan alone and Thiodan plus adjuvants.

TREATMENT (Lb. ai /acre or %V/V)	PERCENT MORTALITY	DIFFERENCE*
Thiodan (0.35)	52.05	---
Thiodan (0.35)+ Buffer ES (0.06)	74.38	22.32
Thiodan (0.35)+ DeFoamer (0.02)	59.59	7.54
Thiodan (0.35)+ Kinetic HV(0.31)	38.89	-13.16
Thiodan (0.35)+ Hyperactive (0.19)	59.03	6.97
Thiodan (0.35)+ Soydex (5.00)	66.02	13.97

Confidence Limit= 38.862. Critical Value of Dunnett's T= 2.443.
*Difference in TPB mortality between insecticide adjuvant combination and insecticide alone.

Table 6. Mortality of tarnished plant bugs in cages after 36 hours, and the difference in mortality between all insecticides alone and all insecticides plus adjuvants.

TREATMENT(%V/V)	CHANGE IN PERCENT MORTALITY	DIFFERENCE*
Insecticide	0.00	---
Insecticide+ Buffer ES(0.06)	14.80	14.80
Insecticide+ DeFoamer (0.02)	16.40	16.40
Insecticide+ Kinetic HV (0.31)	-12.80	-12.80
Insecticide+ Hyperactive (0.19)	12.00	12.00
Insecticide+ Soydex (5.00)	8.40	8.40

Confidence Limit= 27.873. Critical Value of Dunnett's T= 2.388.
*Difference in TPB mortality between insecticide adjuvant combination and insecticide alone.