RAINFASTNESS OF SELECTED INSECTICIDES USED FOR CONTROL OF TARNISHED PLANT BUG IN ARKANSAS COTTON

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Abstract

Studies were conducted in both the greenhouse and field to evaluate the rainfastness of five insecticides: Centric (thiamethoxam), Acephate, Bidrin (dicrotophos), Diamond (novaluron) (2011), and Transform (sulfoxaflor) (2012), currently recommended for control of tarnished plant bug (*Lygus lineolaris*) in Arkansas and the Midsouth. Both studies simulated one inch of rainfall at 0, 1, 3, 6, 12, and 24 hrs after application, as well as no rain for comparison. Mortality was checked at 24hrs (greenhouse) and 48hrs (greenhouse and field) after infestation. Greenhouse results indicated that all treatments experienced reduced mortality when rain occurred prior to 12 hrs after application. Field studies indicated that all treatments experienced reduced mortality compared to no rain at all rain event timings from 0 to 24 hrs after application with the exception of Bidrin having no loss of control compared to no rain at 12 hrs after application.

Introduction

The tarnished plant bug, *Lygus lineolaris (Palisot de Beauvois, 1818),* (TPB) has become the most destructive pest in Arkansas cotton since the eradication of the boll weevil and the development of Bt cotton. Before 1995, TPB were controlled with insecticides targeting other insect pests such as the tobacco budworm, cotton bollworm and boll weevil. Reduced applications for these pests have established the TPB as the primary insect pest of cotton in the Midsouth. Recently, TPB has become resistant to several classes of insecticides, further compounding the issue (Catchot, et. al., 2009). In 2010, Arkansas growers treated 92% of the cotton acreage planted an average of 2.58 times at a cost of $18.06/acre, with a total of 38, 946 bales of cotton lost to the TPB, 48% of the total bales lost for the year (Williams, et. al., 2011). In 2011, these numbers increased to 100% of cotton acreage treated an average of 4.4 times with an average cost of $30.48/acre. In spite of the increase in cost of control and number of applications growers were reported losing a total of 55,208 bales of cotton to the TPB, equaling 53% of the total bales lost for the year (Williams, et. al., 2012). The problem controlling TPB is exacerbated with the situation of “pop up” rain events that often occur in the Midsouth that can cause wash off of insecticide applications that can occur at any time after application. Also, many growers that have overhead irrigation may need to irrigate their crop to meet water demand of the crop as soon as possible behind applications. Labels do not provide adequate information on rainfastness, or the amount of time that is needed after an application before a rainfall event or overhead irrigation event can take place for the insecticide to still provide acceptable level of control. Overestimating wash-off can cause unwarranted re-applications of insecticide applications, while underestimating wash-off may result in inadequate crop protection (Pimentel et al. 1992). Studies were conducted in both the greenhouse and field to evaluate the rainfastness of selected insecticides currently recommended for control of TPB in Arkansas and the Midsouth.

Materials and Methods

Greenhouse trials were located at the Lonoke Extension and Research Center in Lonoke, AR. Field trials were located at the Northeast Research and Extension Center in Keiser, AR. Plant bug nymphs were collected 24 hrs prior to testing using a shake sheet and aspirator. Placed in cages and kept overnight on broccoli cleaned with a

0.1% bleach solution. Third and fourth instar nymphs were used for the studies.Treatments included an untreated check, Centric 2.5 oz/a, Acephate 1lb ai/a, Bidrin 8 oz/a, Diamond 9 oz/a (2011), and Transform 1.5 oz/a (2012). In the greenhouse study, cotton plants were sprayed with a CO2 backpack sprayer and hand-held boom fitted with TX6 hollow cone nozzles, spray volume was 10 GPA at 40psi. One inch of rainfall was simulated with overhead boom irrigation at 0, 1, 3, 6, 12, and 24 hrs after application, as well as no rain for comparison using a minimum of 2 plants per timing/per treatment to ensure adequate leaf samples for testing. After the "rain" dried, the three uppermost leaves were removed within each treatment and placed in separate petridishes for three replications per treatment. Each dish was infested with three plant bug nymphs. Mortality was checked at 24 and 48 hrs after infestation. Field trials were conducted similarly using overhead lateral irrigation at 10 GPA, TX6 hollow cone nozzles 50psi to simulate 1/2" rain. The highest four terminals were selected and caged using sleeve cages. Five plant bug nymphs were placed in each cage with six replications per treatment. Mortality was checked 48 hrs after infestation. Data was processed using ARM 8 and ARM ST 7, Duncan's New Multiple Range Test, and Analysis of Variance to separate means (p = 0.10). Greenhouse data is a summary of 7 trials and field data is a summary of 5 trials.

Results and Discussion

In 2011 studies, results were inconclusive with Diamond it was determined that due to mode of action Diamond required more time to observe efficacy and the effects of rain; therefore, it was replaced with Transform in 2012. In both the greenhouse and field portions of the study, the efficacy of all treatments was diminished at varying levels by rain events. Bidrin achieved a higher level of control in the greenhouse when compared to the field when no rain was applied. Similar levels of reduction in control (43%±2) in both the greenhouse and field were observed when rain occurred immediately after application (Table 1 and 2). Trendlines indicated that the mortality rate increased at similar rates in the greenhouse (R^2=0.7275) and field (R^2=0.941).

Table 1. Percent loss of control when compared to the no rain application in the greenhouse.

Greenhouse							
Rain Timing:	**0 hour**	**1 hour**	**3 hour**	**6 hour**	**12 hour**	**24 hour**	**no rain**
TREATMENT	**% loss of control**						**% control**
Bidrin 8 oz/a	42.9	40.5	25.4	38.7	23.7	23.7	**90.4**
Acephate 1 lb ai/a	42.9	23.9	25.4	14.9	0	0	**88.9**
Centric 2.5 oz/a	15.9	19.1	20.7	4	0	15.1	**53.9**
Transform 1.5 oz/a	29.6	26.1	29.6	34.3	0	15	**59.3**

Table 2. Percent loss of control when compared to the no rain application in the field.

Field							
Rain Timing:	**0 hour**	**1 hour**	**3 hour**	**6 hour**	**12 hour**	**24 hour**	**no rain**
TREATMENT	**% loss of control**						**% control**
Bidrin 8 oz/a	47.84	43.01	30.52	19.65	2.61	2.61	**81.9**
Acephate 1 lb ai/a	34.66	26.66	21.53	18.98	0	3.67	**66.27**
Centric 2.5 oz/a	19.41	25.52	15.6	20.8	11.47	5.96	**53.74**
Transform 1.5 oz/a	55.88	52.04	38.34	34.96	33.8	22.27	**76.44**

At the 12hr and 24hr timings, there was no difference in the amount of control lost in both greenhouse and field studies respectively; however, the field study had a control loss of only 2.61% while the greenhouse still had a loss of 23.6% control. Acephate also had a higher mortality rate in the greenhouse than it did in the field, with similar control loss percentages to Bidrin at the 0hr rain timing; however, by the 12hr timing Acephate had no loss of control in either the greenhouse or the field. Centric showed the same level of control (~ 54%) in both the greenhouse and field trials and the amount of control lost when rain occurred at 0hrs was the same at 17.66±2%. At the 6hr rain timing, Centric regained all but 4% of control in the greenhouse while in the field control was slower to return to the same level as the no rain observation with 11.47% control lost at 12hr and 5.96% lost at 24hr. Initially, Transform gave better control in the field than it did in the greenhouse with mortality rates dropping from 76% (field) and 59% (greenhouse) to between 20% and 30% respectively when rain occurred at 0hrs. At 12hr, Transform showed no loss of control in the greenhouse while never fully regaining control in the field. It seems that at the 24 hour timing, when loss of control was higher than the 12 hour timing, that the age of the plant bugs may have come into play. Some of the differences between the greenhouse data and the field data could have been caused by the differences in procedure as well as the different types of exposure used by the treatments. Studies in the greenhouse relied primarily on the plant bugs coming into contact with the insecticides by walking on the leaves while the field studies allowed plant bugs to behave more naturally within the confines of the cages. Bidrin and Acephate rely on contact while Centric and Transform utilize both contact and feeding. Regardless, results indicate that if a rain event does not occur before 12 hours after application of these insecticides it is safe to assume that they are rainfast.

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