EVALUATION OF THE RAINFASTNESS OF SELECTED INSECTICIDES AGAINST TARNISHED PLANT BUG

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Abstract

Insect pest management is a critical component of cotton production in the mid-south. Foliar insecticides are an important part of integrated pest management and multiple factors can impact their efficacy. Little information is available on the impact of rainfall on the efficacy of foliar insecticides. This is an important aspect of pest management given the unpredictable nature of rainfall during the growing season. To determine the impact of rainfall on insecticide performance, studies were conducted in 2019. Plots were sprayed with insecticides recommended for use against tarnished plant bug, *Lygus lineolaris* (Palisot de Beauvois), and rinsed with water to simulate rainfall. Each plot was checked for the presence of the tarnished plant bugs at 3-4 days and again at 6-8 days with a black drop cloth. Insecticides tested included sulfoxaflor, thiamethoxam, and novaluron. In general, all insecticides provided better control of tarnished plant bug when they were allowed to dry for at least one hour. Chemical analysis showed that all of these insecticides were still impacted by rainfall at four hours after application.

Introduction

Tarnished plant bug, *Lygus lineolaris* (Palisot de Beauvois), is capable of causing severe damage to cotton by feeding on developing squares, growing points, and small bolls (Strong 1968; Wilson and George 1984; Leigh et al. 1988). The most vulnerable time for a plant bug to damage cotton is during the reproductive stages of the crop. Tarnished plant bug populations in cotton correlate closely with the period of most abundant rainfall during the growing season. Additionally, most insecticide labels avoid mention of the product's rainfastness or give a very broad window, such as, "runoff can be prevented by avoiding applications when rainfall is expected within the next 48 hours." This project will be using smaller time increments to refine the amount of time needed without rainfall to ensure optimum efficacy.

Willis et al. (1994a) was able to show that two different insecticides became more resistant to wash off as time between application and rainfall increased. They concluded that insecticide application should be postponed when rain is approaching. Another study showed that quantity of rainfall had a greater impact on insecticide wash off than rainfall intensity (McDowell et al 1984). Willis et al. (1994b) carried out another study where insecticide residual increased when there was more time between application and rainfall. The authors propose this could be due to more time allowed for the plants to absorb the insecticide and/or find cracks or other uneven areas in the plant surface to drop into. Additional literature has shown that even when paired with adjuvants, rainfastness is best when the insecticide has been allowed time to dry or absorb on/into the plant (Mulrooney and Elmore 2000).

Materials and Methods

Field studies were conducted in 2019 in Stoneville, MS to evaluate the impact of rainfall on select insecticides. A randomized complete block design was used with treatments replicated four times. Plots were sprayed with selected insecticides once, with a consistent amount of simulated rainfall (~1") applied at each designated timing. Insecticides applied included: Transform at 1.5 oz./ac, Centric at 1.5 oz./ac, and Diamond at 6 oz./ac. Timings of rainfall after application included: 0, 15, 30, 60, 120, and 240 minutes after insecticide application as well as an untreated control and positive control with no rain. All plots were sampled at 3-4 and 6-8 days after treatment using a black drop cloth, with one drop per plot. Nymph and adult plant bug numbers were recorded. Data were analyzed using SAS PROC GLIMMIX and PROC MEANS procedure.

Chemical analyses were performed on leaves collected after each field trial was completed. Approximately 20 leaves were collected from the upper canopy throughout each plot and stored in quart Ziploc bags and frozen until chemical analyses were performed.

Leaf samples were crushed and subjected to a series of centrifugation in order to extract insecticide content. This liquid portion was then analyzed using an Agilent Technologies 6460 Triple Quad LC/MS, which has a system of four filters by which the insecticide concentration is measured and given in parts per billion.

Results and Discussion

Results from each rainfall trial suggests that these insecticides require at least one hour between application and a rainfall event for optimum efficacy. Willis et al. (1994) suggests that increasing resistance to wash off with increased time between application and rainfall could mean that insecticides are better able to be absorbed by the plant and those with less time between application and initial rainfall are more prone to wash off.

Transform (sulfoxaflor) at four days after treatment (DAT) supports the 60 minute or less suggestion, showing a significant increase in control after that interval, with all timings being significantly different from the non-treated control. At 8 DAT, no relationship was seen, suggesting that rainfall did have some impact on efficacy.

Centric (thiamethoxam) at 3 DAT showed poor control overall with no significant relationship. At 6 DAT, there was a significant relationship where all treatments provided better efficacy than the non-treated control.

Diamond (novaluron) at 4 DAT showed no significant relationship, however, all treatments provided between 50-60% control despite the rainfall events. At 8 DAT, Diamond showed a much more variable response, but a reiteration of the 60-minute requirement for improved efficacy.

Results from both chemical analyses show a linear relationship. An increase in minutes between insecticide application and rainfall show an increase in control. This could be due to longer exposure time to the insecticide before wash off.

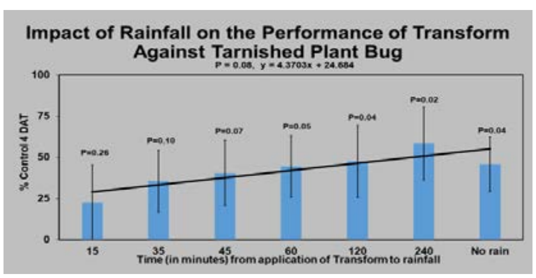

Figure 1. Transform performance at 4 DAT.

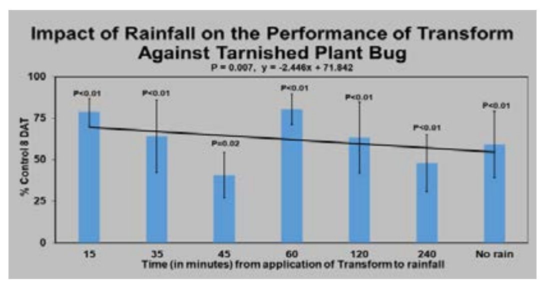

Figure 2. Transform performance at 8 DAT.

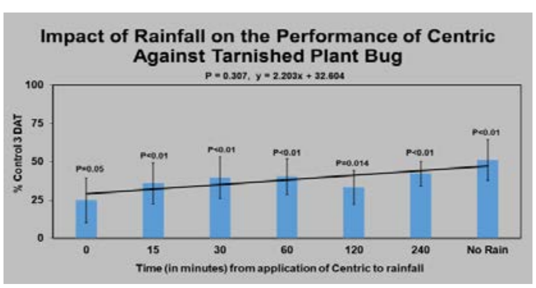

Figure 3. Centric performance at 3 DAT.

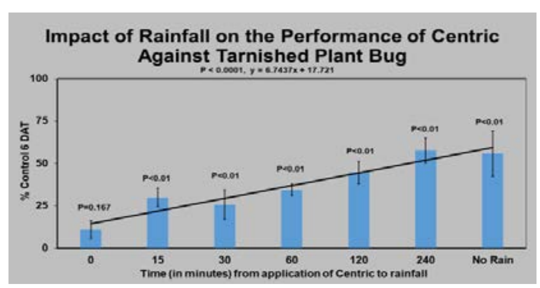

Figure 4. Centric performance at 6 DAT.

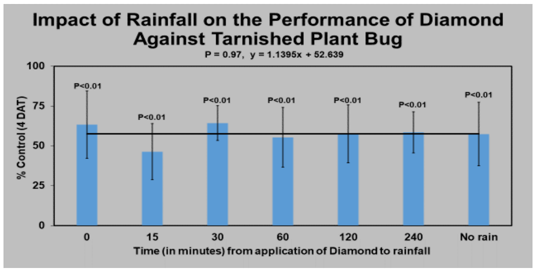

Figure 5. Diamond performance at 4 DAT.

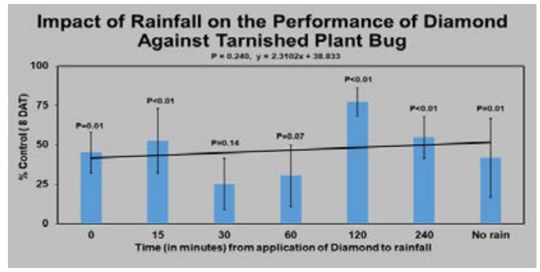

Figure 6. Diamond performance at 8 DAT.

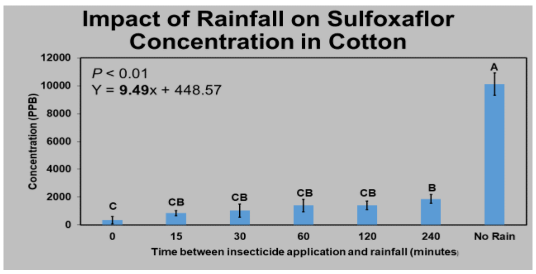

Figure 7. Chemical analysis of Transform after rainfall.

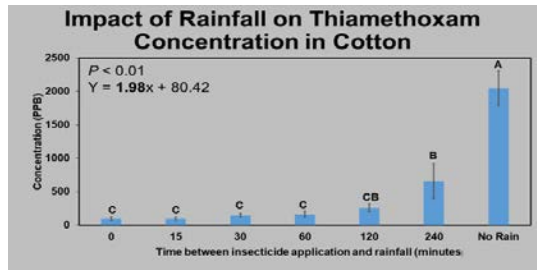

Figure 8. Chemical analysis of Centric after rainfall.

Summary

Rainfastness of insecticides is an understudied facet of agricultural research, therefore, further studies are needed to determine the efficacy of insecticides following rainfall. Transgenic Bt cotton along with foliar applied insecticides are the primary modes of defense against damage from cotton pests. July, August, and September are times in the cotton growing season when insecticides are most frequently applied but are also the months with the most unpredictable rainfall. With the sporadic control that some Bt cotton varieties are showing, control with foliar applied insecticides will become more important.

The trials conducted in the 2019 growing season showed that most insecticides performed significantly better when applied >60 minutes before a rainfall event. Further work is being done to determine rainfastness of ten different insecticides commonly used against key cotton pests. Future work will include chemical analysis of cotton leaf samples collected from each trial to determine actual residual of the selected insecticides as a measure of wash off from simulated rainfall. Additionally, lab assays will be conducted using tarnished plant bugs and corresponding insecticides to account for natural circumstances such as dew, humidity, and natural rainfall events.

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References

Leigh, T. F., T. A. Kerby, and P. F. Wynholds. 1988. Cotton square damage by the plant bug Lygus hesperus (Hemiptera: Heteroptera: Miridae) and abscission rates. J. Econ. Entomol. 81: 1328-1337.

McDowell, L.L., Willis, G.H., Southwick, L.M., and Smith, S. 1984. Methyl Parathion and EPN Washoff from Cotton Plants by Simulated Rainfall. Environ. Sci. Technol. 18: 423-427.

Mulrooney, J.E., and Elmore, C.D. 2000. Rainfastening of Bifenthrin to Cotton Leaves with Selected Adjuvants. Journal of Environmental Quality. 29: 1863-1866.

Strong, F. E. 1968. The selective advantage accruing to lygus bugs that cause blasting of floral parts. J. Econ. Entomol. 61: 315-316.

Willis, G.H., McDowell, L.L., Smith, S., and Southwick, L.M. 1994a. Azinphosmethyl and Fenvalerate Washoff from Cotton Plants as a Function of Time between Application and Initial Rainfall. Archives of Environmental and Contamination and Toxicology. 27: 115-120.

Willis, G.H., McDowell, L.L., Smith, S., and Southwick, L.M. 1994b. Permethrin and Sulprofos Washoff from Cotton Plants as a Function of Time between Application and Initial Rainfall. Journal of Environmental Quality. 23: 96-100.

Wilson, F. D. and B. W. George. 1984. Pink bollworm (Lepidoptera: Gelechiidae): selecting for antibiosis in artificially and naturally infested cotton plants. J. Econ. Entomol. 77: 720-724.