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4 August 2011

SIMRU Report

Tarnished Plant Bug Resistance Monitoring in the Mid-South

The research conducted at the USDA-ARS branch in Stoneville, MS addresses issues that have a significant impact on the agriculture of the mid-South region and especially the Mississippi Delta. This region produces cash crops such as cotton, corn, and soybeans, which are important sources of food and textiles that directly affect the American economy. Of particular interest to scientists is monitoring levels of insect resistance to pesticides used to control populations of plant pests that feed on these crops. Farmers have long battled such pests as cotton bollworms, tobacco budworms, aphids, and plant bugs, which without the use of toxic chemicals would destroy entire yields of valuable crops. A chemical solution has not been perfect. Early use of pesticides introduced harsh contaminants into the environment (e.g., DDT), and despite the advancements which have led to safer products both sprayed topically and genetically engineered into the plants themselves, concerns remain about the effects of insecticides on humans, food, wildlife, and a delicate ecosystem. Moreover, one of the most fascinating aspects of nature is that it is always changing and adapting. Scientists learned early on that eradicating one pest simply replaced it with another on the food chain. Also, relying too heavily on one pesticide meant that insects quickly began becoming more tolerant and eventually resistant. Balance has been the key lesson. Science seeks to manage and control pest populations, develop new classes of insecticides, and alternate approaches in order to reap successful harvests and maintain a healthy ecosystem. The crucial work of scientists continues to be "resistance monitoring," i.e., testing and reporting levels of insect resistance to current pesticides in order to aid the agricultural industry.

The Southern Insect Management Research Unit (SIMRU) of ARS in Stoneville, MS specializes in resistance monitoring in the mid-South region. A number of scientists comprise this group, each offering a unique perspective and demonstrating a vital area of research. The tarnished plant bug (*Lygus lineolaris*) is one of the major plant pests studied in this region because of the insects' resistance to pyrethroid, organophosphate, and carbamate insecticides. Gordon L. Snodgrass, an entomologist specializing in tarnished plant bug research, has recently developed a new laboratory experiment for testing of resistance to the neonicotinoid class of pesticides, and it is this research upon which this report will focus.

In order to monitor populations of the tarnished plant bugs and their level of resistance to neonicotinoid insecticides, Snodgrass devised an experiment that enabled mortality rates to be determined after exposing insects to different doses of an insecticide. Imidicloprid (Trimax) and thiamethoxam (Centric) are the neonicotinoid insecticides used in this study, as explained in the article "Bioassay for Determining Resistance Levels in Tarnished Plant Bug Populations to Neonicotinoid Insecticides." In order to carry out this experiment, 20-ml scintillation vials and floral foam (12-mm in diameter and 12-mm deep) are used, and one piece of floral foam is placed inside each vial. Stock solutions are made from which known doses (from low to high) of imidicloprid and thiamethoxam are mixed with a 10% solution of honey in water. Each dose is applied in 0.5 ml of solution pipetted onto the floral foam piece previously placed in each vial. The different doses made are replicated three or four times, using 10 vials per replication (Snodgrass, et al., 174). Once this has been completed, a single adult tarnished plant bug is placed into each vial and a cotton ball is used to cover the opening. Mortality is determined after 24 hours for thiamethoxam and after 72 hours for imidicloprid.

The goal of this experiment is to determine the LC_{50} values for different field populations of the tarnished plant bug and to compare these values with the values of a susceptible population. The LC_{50} is the lethal concentration or dose of insecticide that kills 50% of the population. The susceptible population used as a control in this study is from Crossett, AR because these plant bugs are not located near cotton fields, thus having never been exposed to the insecticides. Once the LC_{50} values for each population have been determined, a resistance ratio (RR_{50}) is calculated. The RR_{50} is calculated by dividing the LC_{50} value from the test population by the LC_{50} value of the susceptible population in Crossett, AR. The higher the RR_{50} of a population of tarnished plant bugs, the more resistant that population is toward the neonicotinoid insecticides.

According to his article, "Bioassay for Determining Resistance Levels in Tarnished Plant Bug Populations to Neonicotinoid Insecticides," Snodgrass determined that no resistance had developed against thiamethioxam and the resistance to imidacloprid remained the same or decreased in the two year period it was studied (177). This method of resistance monitoring is important because it gives rapid results and a basis for comparison in future studies.

Works Cited

Snodgrass, Gordon L., et al. "Bioassay for Determining Resistance Levels in Tarnished Plant Bug Populations to Neonicotinoid Insecticides." *Southwestern Entomologist* 33 (2008): 173-80.