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SIMRU Report

Monitoring Acephate Resistance in Populations of the Tarnished Plant Bug

The mid-South region of the United States is famous for its production of cash crops that directly affect the American economy, and the scientists at the USDA-ARS branch in Stoneville, MS conduct research that helps farmers control crop pests that could potentially cause harmful consequences for this region. Farmers have continuously battled plant pests and are always looking for new solutions to improve crop production. Insecticides are used to control pests, but **no** insecticide is perfect. Pests are always adapting and can develop resistance. One main area of research at Stoneville is devoted to "resistance monitoring." Scientists are able to test classes of insecticides on pests and determine if a pest population has developed resistance. Through resistance monitoring, levels of pest resistance to current insecticides can be reported along with advice on which insecticides are appropriate for use on certain crops in different areas of the mid-South.

Dr. Gordon L. Snodgrass works for the Southern Insect Management Research Unit (SIMRU) at Stoneville, and he studies resistance levels of the tarnished plant bug (*Lygus lineolaris*), which feed on cotton. He has successfully created glass-vial bioassays for each class of insecticide. Different methods are used depending on which insecticide is being tested. Insecticide classes that have been tested include the pyrethroids, organophosphates, carbamates, and neonicotinoids. This report will focus on the glass-vial bioassay that monitors resistance levels of the tarnished plant bug to acephate, an organophosphate.

The glass-vial bioassay developed by Snodgrass for detecting acephate resistance provides a rapid method for determining mortality rates, and the process for carrying out this bioassay is explained in the article, "Acephate Resistance in Populations of the Tarnished Plant

Bug (Heteroptera: Miridae) From the Mississippi River Delta." Each year, tarnished plant bugs are collected from specific locations in the Delta. The bugs are placed in paper ice cream cartons with previously washed green bean pods for food, and they are used for testing the next day. The insecticide is prepared by diluting it with acetone, and different doses of the insecticide are used for testing. These doses are 5 pg/vial, 10 jag/vial, 15 μ g/vial, 20 ug/vial and 25 μ g/vial. The insecticide is placed inside 20-mL glass scintillation vials by pipetting 0.5 mL into each vial. Each dose is applied to 15 vials; this gives three replications with five vials per replication (Snodgrass, et al., 701). The vials are then placed on a hotdog cooker. This causes the acetone to evaporate, and the insecticide is left as a residue on the inner surface of the vial. A previously washed green bean piece is placed inside each vial along with two tarnished plant bug adults. A cotton ball is placed in the opening of the vial to confine the bugs. Mortality is determined after 24 hours.

The main purpose of this bioassay is to compare the LC50 value of the tested field population to the LC50 value of a susceptible population so that a resistance ratio (RR50) can be calculated. The LC50 is the lethal concentration (dose) of insecticide that kills 50% of the population. A resistance ratio can be determined by dividing the LC50 value from the tested field population by the LC50 value of the susceptible population. The susceptible population used in this study comes from Crossett, AR. These tarnished plant bugs are susceptible to the insecticide because they have never been exposed to it; they do not live near cotton fields. The higher the RR50 for a tarnished plant bug population, the more resistant that population is toward acephate. Field tests have determined that populations with RR50 values >3.0 are difficult to control, meaning that other control methods must be evaluated (706). In 2005, Dr. Snodgrass discovered a few populations with RR50 values >3.0 , and within two years this resistance spread to most

populations in the mid-South. The alleles controlling resistance to acephate are semidominant, meaning that this trait will remain in the population once it has been selected for (705).

Resistance monitoring is important because it enables scientists to determine the best method available to control pests. Alternation of insecticide classes was once a useful method in controlling plant bug populations in the mid-South. This is no longer true for most populations of the tarnished plant bug because they have developed resistance to multiple classes, including the pyrethroids, organophosphates, and carbamates. Neonicotinoid insecticides are available and are now used to help control tarnished plant bug populations. No resistance has been developed to **the** neonicotinoids, but these insecticides are not as effective as the older insecticides were years ago (706-7).

Works Cited

Snodgrass, Gordon L., et al. "Acephate Resistance in Populations of the Tarnished Plant Bug (Heteroptera: Miridae) From the Mississippi River Delta." *Journal of Economic Entomology* 102 (2009): 699-707.