2003 BELTWIDE COTTON CONFERENCES, NASHVILLE, TN – JANUARY 6-10

TOXICITY OF SELECTED INSECTICIDES TO SOUTHERN GREEN STINK BUGS DETERMINED BY ADULT VIAL TEST: A PRELIMINARY REPORT

Juan D. López, Jr. and M.A. Latheef
USDA, ARS, SPA, SPARC
Areawide Pest Management Research Unit
College Station, TX

Abstract

An adult vial test (AVT) was used to determine the toxicity of acephate 97 (Orthene®) and technical cyfluthrin (Baythroid®) and dicrotophos (Bidrin®) to southern green stink bug, *Nezara virudula* adults, captured in the blacklight traps in the fall of 2002 in the Brazos River Valley, Texas. LC_{50} values (95% CL) at 24 h for acephate and cyfluthrin were 4.2312 (3.1352-4.9254) and 0.0443 (0.0311-0.0582) µg/vial, respectively. These values were significantly different. A statistically significant probit analysis model for dicrotophos was not developed because of highly variable mortality data. These data are discussed and possible explanations are presented relative to previously published reports.

Introduction

The southern green stink bug, *Nezara viridula* (L.), has long been an occasional and secondary pest of cotton with little economic importance in the United States (Swan and Papp 1972; McPherson and McPherson 2000). However, several workers have recently reported that eradication of the boll weevil and adoption of Bollgard® cotton has caused reduction in pesticide applications in the Southeast and that this decline in insecticide use has probably allowed other insects such as stink bugs to assume greater importance as economic pests of cotton (Turnipseed et al. 1995; Greene et al. 1999; Roof and Arnette 2000; Emfinger et al. 2001; Karner and Goodson 2002). Cyfluthrin (Baythroid®), acephate (Orthene®), bifenthrin (Capture®), dicrotophos (Bidrin®) and several others are currently being recommended for control of stink bugs on cotton in Texas (Moore et al. 2002). To assess efficacy of recommended insecticides to control stink bugs, it is useful to obtain information on the toxicity of these pesticides to various species of stink bugs using adult vial test (AVT). Also, these data provide information for evaluating insecticide resistance in stink bugs. In this paper, we report on a preliminary study designed to determine the toxicity of three insecticides to fall populations of southern green stink bugs, *N. viridula* in the Brazos River Valley, TX. We plan to conduct extensive studies on toxicity of recommended insecticides using AVT to various stink bug pest species present in the Brazos River Valley during 2003.

Materials and Methods

Insects

Southern green stink bug adults were captured in blacklight (BL) traps operated adjacent to cotton fields in Burleson County near College Station, TX in 2002. Each trap was equipped with a 40-W fluorescent lamps (40 BL) mounted vertically between four baffles and above a funnel (30-inch diameter) (Hollingsworth and Hartstack 1972). The original collection container to kill the insects captured was replaced with an inverted capture canister from a Texas cone trap (Hartstack et al. 1979) to keep the insects alive. Stink bugs were collected from BL traps each day and brought to the laboratory where the capture containers were placed in a walk-in chamber maintained at 55º F. After cooling down, the southern green stink bugs were sorted from the rest of the capture. The adults were maintained on string beans, *Phaseolus vulgaris* (L.) and provided 10% (wt:vol) sucrose solution in a 4-oz Glad® plastic cup with a lid through which two cotton wicks each 6 inches long were inserted. They were tested within 1-2 days after being captured.

AVT

Adult vial test procedures were similar to those described earlier (Plapp et al. 1987; Snodgrass 1996; Emfinger et al. 2001; Willrich et al. 2002). Briefly, stock solutions of technical grade insecticides and acephate 97 were mixed in acetone (assay 99.5% min.). Various concentrations of the insecticides were then prepared using the serial dilution procedure. One-half ml of each concentration was pipetted into a 20-ml scintillation vial. The vials were then placed over a hot dog roller (heating elements removed) and the roller was operated until the acetone was evaporated leaving behind insecticidal residues inside the vials.

Regardless of sex, stink bugs were placed into each insecticide-treated vial at one or two adults per vial and the mouth of the vial was closed with a ball of cotton. Depending upon the availability of the insect, 10-20 adults were used for each concentration at 1 or 2 adults per vial. An untreated control was maintained for all tests. Vials were kept in an environmental room maintained at 80º F, RH >60% and a photoperiod of 14:10 h L:D. Mortality was determined after 24 h. Stink bugs were considered dead when they could not right themselves after placing them upside down on a paper towel. POLO software (LeOra Software 1987) was used to compute lethal concentration (LCs) values from the mortality data. LC values were considered significantly different if 95% CL values did not overlap.

Results and Discussion

Table 1 shows that the dosage mortality equations provided good fit of the mortality data with χ^2 = 9.298 and 2.846 each with 9 and 5 df for 24 h responses, respectively, for acephate and cyfluthrin. The LC_{50} (95% CL) value of acephate at 24 h was 4.2312 µg/vial (3.1352-4.9254). The LC_{50} (95% CL) value of cyfluthrin at 24 h was 0.0443 µg/vial (0.0311-0.0582). Based upon the lack of overlap of the 95% CL values, cyfluthrin was significantly more toxic to *N. virudula* than acephate. Similarly, LC_{10} and LC_{90} values of cyfluthrin were significantly higher than those for acephate. Willrich et al. (2002) reported that acephate had an LC_{50} value of 0.17 µg/vial (95% CLs = 0.12-0.26) for brown stink bugs, *Euschistus servus*, (Say) in Louisiana. This suggests that although the Louisiana populations of brown stink bugs which are harder to control than other stink bug species, were sensitive to acephate, while southern green stink bugs from the Brazos River Valley in Texas were significantly more tolerant to acephate. Snodgrass (1996) reported that acephate showed considerable variability in toxicity to adult tarnished plant bugs, *Lygus lineolaris* (Beauvois) collected from different locations in Mississippi with LC_{50} values ranging from 8.48 and 12.60 µg/vial. Emfinger et al. (2001) reported data on the toxicity of cyfluthrin to southern green stink bugs from Louisiana and their results show less toxicity than those we tested from Texas.

Figure 1. shows dosage mortality data of southern green stink bugs for dicrotophos. In spite of fifteen concentrations tested on 655 *N. virudula* adults and compared to 120 control adults with very low mortality, we were unable to compute a statistically significant dosage mortality equation for dicrotophos. Note that the interval between the tested concentrations of dicrotophos encompassed varying increments of the insecticide. The data suggest that the southern green stink bug adults tested in this study appear to be more sensitive to dicrotophos than either acephate or cyfluthrin. In fact, Willrich et al. (2002) reported that *E. servus* collected during late June in Louisiana had an LC_{50} of 0.72 µg/vial for dicrotophos and the LC_{50} value more than doubled to near 1.68 µg/vial by late August, 2001. Although we tested a large number of adults, the long period of about 2 months over which the tests were conducted may have contributed to the variability. It is possible that differences between sexes may have contributed to variability as well.

Acknowledgements

We thank Chris Parker for his technical help in this study.

Disclaimer

Mention of a commercial or proprietary product does not constitute an endorsement for its use by the U. S. Department of Agriculture.

References

Emfinger, K., B. R. Leonard, J. Gore and D. Cook. 2001. Insecticide toxicity to southern green, *Nezara viridula* (L.) and brown, *Euchistus servus* (Say), stink bugs. *In*: Proc. Beltwide Cotton Prod. Res. Conf. 2: 1159-1161.

Greene, J. K., S. G. Turnipseed, M. J. Sullivan and G. A. Herzog. 1999. Boll damage by southern green stink bug (Hemiptera: Pentatomidae) and tarnished plant bug (Hemiptera: Miridae) caged on transgenic *Bacillus thuringiensis* cotton. J. Econ. Entomol. 92: 941-944.

Hartstack, A. W., J. A. Witz and D. R. Buck. 1979. Moth traps for the tobacco budworm. J. Econ. Entomol. 72: 519-522.

Hollingsworth, J. P. and A. W. Hartstack, Jr. 1972. Effects of components on insect light trap performance. Trans. ASAE (Amer. Soc. Agric. Engineers) 15: 924-927.

Karner, M. and J. Goodson. 2002. Stink bugs - An emerging pest in Oklahoma cotton fields. 3 pp. *In*: Proc. Beltwide Cotton Prod. Res. Conf.

LeOra Software. 1987. POLO-PC. A user’s guide to logit or probit analysis. LeOra software, Berkeley, CA.

McPherson, J. E. and R. M. McPherson. 2000. *Nezara viridula*, chapter 4. pp. 71-99. *In*: Stink bugs of economic importance in America north of Mexico. CRC press, Boca Raton, FL.

Moore, G. C., R. D. Parker, D. D. Fromme and A. E. Knutson. 2002. Suggested insecticides for managing cotton insects in the southern, eastern and blackland areas of Texas. pp 8.Texas Cooperative Extension, TX A&M Univ., Publication no. E-5A, 3-02.

Plapp, F. W., G. M. McWhorter and W. H. Vance. 1987. Monitoring for pyrethroid resistance in the tobacco budworm in Texas. *In:* Proc. Beltwide Cotton Prod. Res. Conf. 2: 324-326.

Roof, M. E. and F. Arnette. 2000. Monitoring stink bugs in cotton in South Carolina. *In*: Proc. Beltwide Cotton Prod. Res. Conf. 2: 1122-1123.

Snodgrass, G. L. 1996. Glass-vial bioassay to estimate insecticide resistance in adult tarnished plant bugs (Heteroptera: Miridae). J. Econ. Entomol. 89: 1053-1059.

Swan, L. A. and C. S. Papp. 1972. The common insects of North America. Harper & Row, Publ., New York, NY. 750 pp.

Turnipseed, S. G., M. J. Sullivan, J. E. Mann and M. E. Roof. 1995. Secondary pests in transgenic Bt cotton in South Carolina. *In*: Proc. Beltwide Cotton Prod. Res. Conf. 2: 768-769.

Willrich, M. M., K. Emfinger, B. R. Leonard, D. R. Cook and J. Gore. 2002. Modified AVT: Susceptibility of stink bugs to selected insecticides. 5 pp. *In:* Proc. Beltwide Cotton Prod. Res. Conf.

Table 1. Lethal concentration (LC) (µg/vial) data (24 h) for the toxicity of acephate 97 and cyfluthrin technical to BL trap-captured southern green stink bugs when exposed to insecticides prepared in acetone and placed inside 20 ml scintillation vials [a/].

Regression Statistics	Acephate 97	Cyfluthrin Technical
Slope (±SE)	4.354 ± 0.9095	1.9589 ± 0.2667
χ^2 (df)	9.298 (9)	2.846 (5)
LC_{10}	2.1484 a	0.0098 b
(95% lower-upper limits)	(0.8932-2.9678)	(0.0044-0.0161)
LC_{50}	4.2312 a	0.0443 b
(95% lower-upper limits)	(3.1352-4.9254)	(0.0311-0.0582)
LC_{90}	8.3335 a	0.2001 b
(95% lower-upper limits)	(6.9149-13.0086)	(0.1461-0.3177)

a/ Based upon 416 and 440 adults of both sexes for acephate and cyfluthrin, respectively. Calculated using POLO-PC (LeOra Software, 1987). LC values in the same row followed by the same lower case letter are not significantly different based on the presence of overlap in the 95% lower and upper confidence limits.

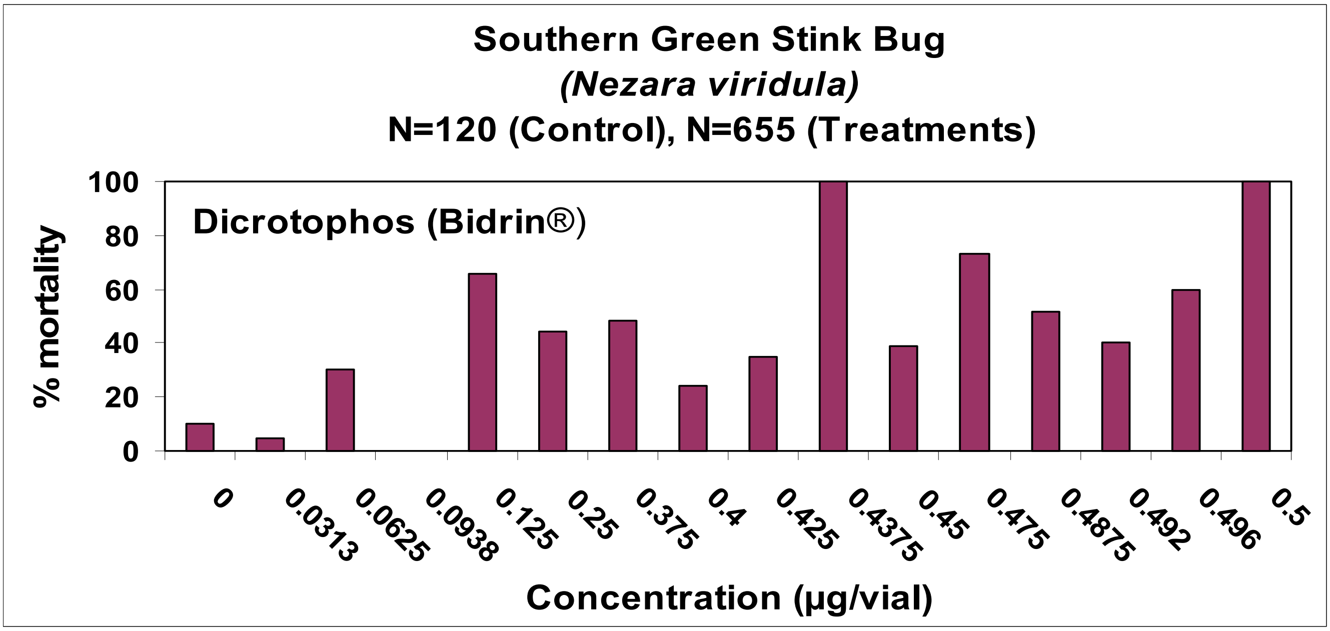

Figure 1. Lethal concentration (LC) (µg/vial) data (24 h) for the toxicity of dicrotophos technical to BL trap-captured southern green stink bugs of both sexes when exposed to the insecticide mixed in acetone and placed inside scintillation vials.