RESPONSE OF DIFFERENT LIFE STAGES OF THE TARNISHED PLANT BUG TO VARIOUS INSECTICIDES

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Abstract

A laboratory experiment was conducted to examine the susceptibility of the nymphal stages and adult stage of the tarnished plant bug, *Lygus lineolaris* (Palisot de Beauvois), to a pyrethroid (permethrin) and an organophasphate (methamidophos) insecticide. One laboratory colony and the first generation of two field collected colonies were examined for their susceptibility to permethrin, while only the laboratory colony was used to examine susceptibility to methamidophos. Insects were individually placed into glass vials coated with various doses of each insecticide and mortality was recorded after three hours. Four replications of each of the first through fifth instar nymphs and adults were assayed with a different cohort of individuals used for each replication. For each insecticide, estimated LC_{50}'s of the fourth and fifth instar nymphs were approximately 1.5 to 2 times as high as that of adults for both insecticides examined, while the first through third instar nymphs were less than that of adults. Overall, this study indicates that the effectiveness of an insecticide application targeting tarnished plant bugs may be dependent upon the percentage of the various life stages present within a given field.

Introduction

The tarnished plant bug, *Lygus lineolaris* (Palisot de Beauvois), is one of the most serious pests of cotton in the mid-south. In some cotton growing areas, this insect has demonstrated increased tolerance to pyrethroid (Snodgrass 1996) and organophosphate insecticides (Snodgrass and Gore 2007). Generally, measurements of susceptibility have been conducted using the adult stage of these insects. In a previous study, fifth-instar nymphs were found to be 2.4 - 3.8 fold more tolerant than adults to several insecticides when assays were conducted using glass vials coated with a specific insecticide (Hollingsworth et al. 1997). The objective of this study was to measure the susceptibilities of all instars of tarnished plant bugs to a pyrethroid and an organophosphate insecticide and compare these susceptibilities to those of adults.

Materials and Methods

Three colonies of tarnished plant bugs were used to examine susceptibilities of the various life stages to permethrin. Two of these colonies were collected as adults from wild hosts during September of 2008. One was collected from pigweed in Stoneville, MS and the other was collected from horseweed in Louisville, MS. The first-generation offspring of these adults were used in assays. The third colony of tarnished plant bugs was obtained from a Mississippi State lab colony which has been in culture for more than a year. The Mississippi State colony was also tested for its susceptibility to methamidophos. Insects were placed individually in 20-ml glass liquid scintillation vials coated with at least four doses of technical grade insecticide diluted in acetone. Vials were capped with a cotton ball and mortality was recorded after three hours. Three to four replications were completed for each dose and a check dose consisting of acetone only. Data were analyzed with the PROC probit option of SAS.

Results and Discussion

Generally, the fourth and fifth instar nymphs were the most tolerant life stages to both permethrin (Fig. 1) and methamidophos (Fig. 2). In comparison to adults, the fifth instars were 1.93 and 2.28 less susceptible to permethrin for the Louisville and MSU lab colonies, respectively (Table 1). In the Stoneville colony, fourth instar nymphs had the highest estimated LC_{50} and were 2.12 times more tolerant to permethrin than adults. Based on the LC_{50} estimates, the first and second instars were significantly more susceptible to permethrin than adults for all colonies tested. Third instar nymphs had lower estimated LC50's to permethrin than adults, but these were not significantly

different.

Fifth instar nymphs was the life stage that least susceptible to methamidophos in the MSU lab colony. In comparison to adults, both the fourth and fifth instars were more tolerant than adults to methamidophos. There was no significant difference between second instars, third instars, or adults, while first instar nymphs were more susceptible than all other life stages. Overall, this study indicates that the effectiveness of an insecticide application targeting tarnished plant bugs may be dependent upon the percentage of the various life stages present within a given field.

References

Hollingsworth et al. 1997. Responses of Arkansas populations of tarnished plant bugs (Heteroptera: Miridae) to insecticides, and tolerance differences between nymphs and adults. J. Econ. Entomol. 90: 21-26.

Snodgrass. 1996. Insecticide resistance in field populations of the tarnished plant bug (Hetroptera: Miridae) in cotton in the Mississippi Delta. J. Econ Entomol. 89: 783-790.

Snodgrass and Gore. 2007. Status of insecticide resistance for the tarnished plant bug, pp. 56-61 *in* Proc. Beltwide Cotton Conf., National Cotton Council, Memphis, Tennessee.

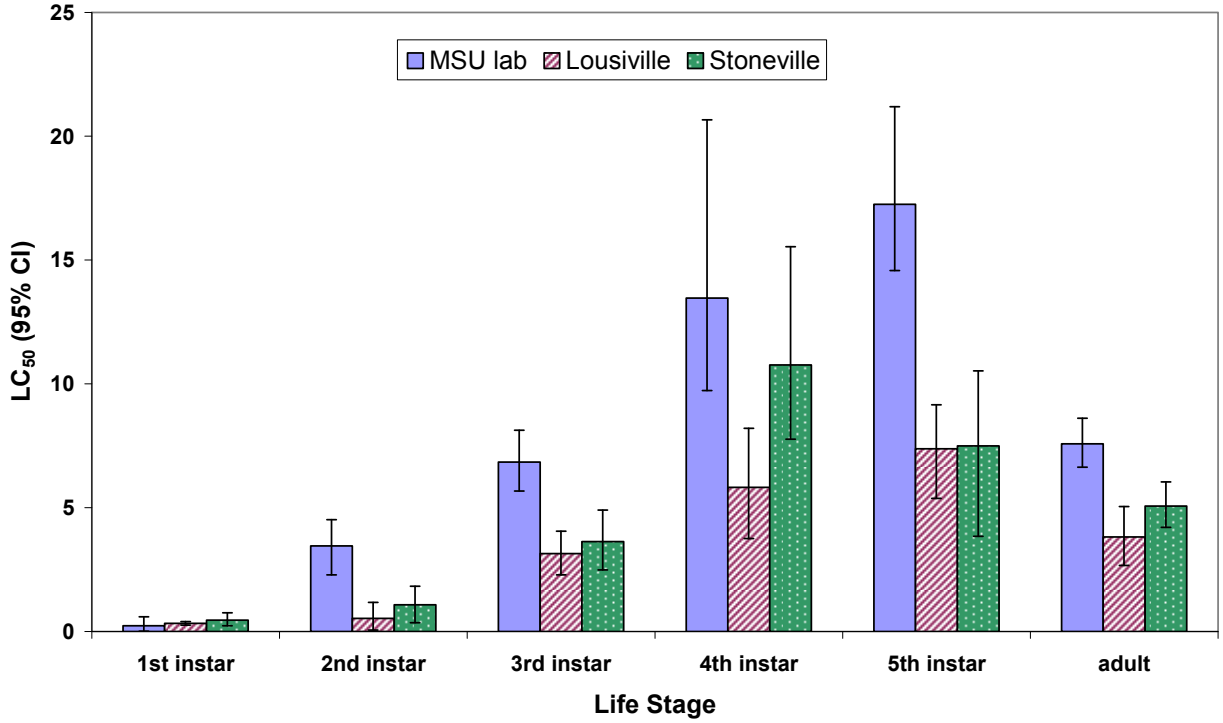

Figure 1. Estimated LC_{50}'s of different life stages of tarnished plant bug to permethrin in glass vial bioassays.

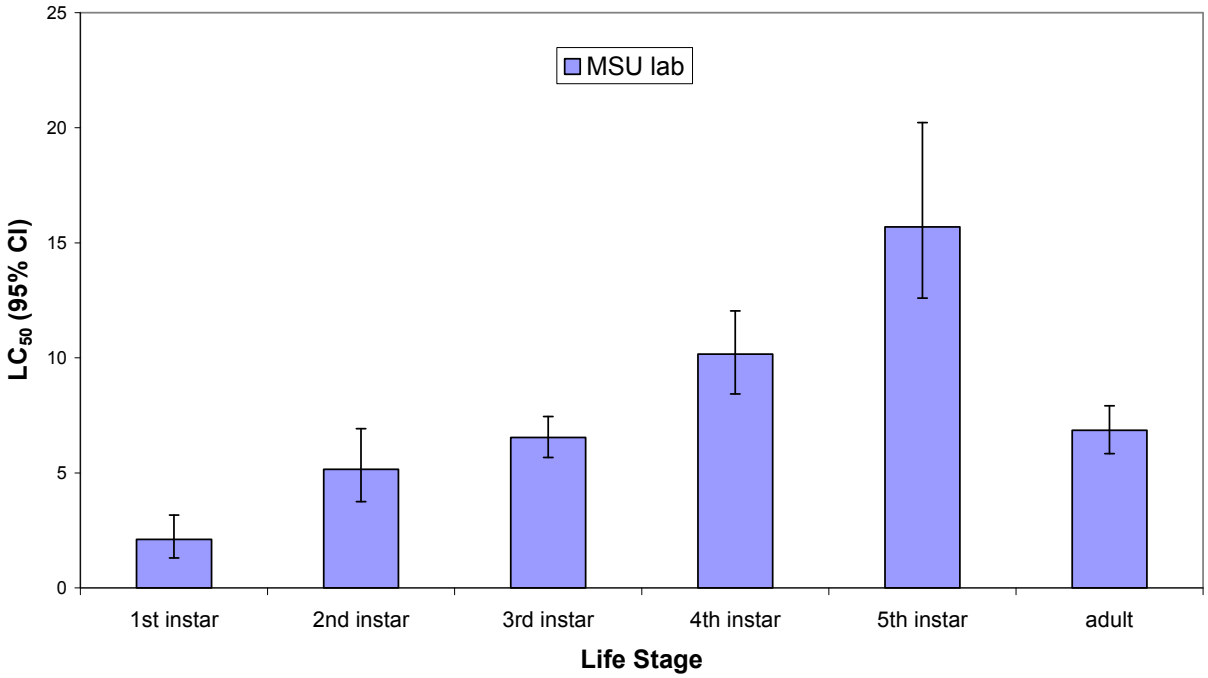

Figure 2. Estimated LC_{50}'s of different life stages of tarnished plant bug to methamidophos in glass vial bioassays.

Table 1. Mortality of tarnished plant bug colonies exposed to permethrin and methamidophos in glass vial bioassays.

Colony	Insecticide	Life stage	n	Slope ± SE[1]	LC_{50}	95% CI	TRA[2]
Louisville	Permethrin	1st instar	250	3.61 ± 0.50	0.32	0.25-0.40	0.08
Louisville	Permethrin	2nd instar	240	0.97 ± 0.26	0.53	0.05-1.18	0.14
Louisville	Permethrin	3rd instar	180	2.23 ± 0.34	3.14	2.29-4.04	0.82
Louisville	Permethrin	4th instar	170	2.41 ± 0.51	5.82	3.76-8.21	1.53
Louisville	Permethrin	5th instar	150	2.83 ± 0.54	7.37	5.37-9.15	1.93
Louisville	Permethrin	Adult	190	3.30 ± 0.67	3.82	2.67-5.05	1.00
Stoneville	Permethrin	1st instar	250	1.74 ± 0.33	0.46	0.23-0.75	0.09
Stoneville	Permethrin	2nd instar	240	1.13 ± 0.24	1.08	0.35-1.83	0.21
Stoneville	Permethrin	3rd instar	180	1.71 ± 0.29	3.63	2.48-4.91	0.72
Stoneville	Permethrin	4th instar	180	2.50 ± 0.49	10.76	7.77-15.54	2.12
Stoneville	Permethrin	5th instar	150	2.49 ± 0.64	7.49	3.84-10.52	1.48
Stoneville	Permethrin	Adult	190	3.15 ± 0.45	5.06	4.20-6.04	1.00
MSU Lab	Permethrin	1st instar	250	1.32 ± 0.39	0.23	0.01-0.60	0.03
MSU Lab	Permethrin	2nd instar	230	2.79 ± 0.51	3.46	2.29-4.52	0.46
MSU Lab	Permethrin	3rd instar	240	2.79 ± 0.34	6.84	5.67-8.13	0.90
MSU Lab	Permethrin	4th instar	240	2.02 ± 0.39	13.46	9.72-20.67	1.78
MSU Lab	Permethrin	5th instar	239	3.02 ± 0.43	17.25	14.57-21.19	2.28
MSU Lab	Permethrin	Adult	239	4.72 ± 0.55	7.58	6.63-8.61	1.00
MSU Lab	Methamidiphos	1st instar	240	2.40 ± 0.48	2.11	1.31-3.17	0.31
MSU Lab	Methamidiphos	2nd instar	240	3.12 ± 0.57	5.15	3.75-6.92	0.75

MSU Lab	Methamidiphos	3rd instar	240	4.30 ± 0.47	6.54	5.67-7.45	0.95
MSU Lab	Methamidiphos	4th instar	240	4.08 ± 0.63	10.16	8.43-12.04	1.48
MSU Lab	Methamidiphos	5th instar	300	3.21 ± 0.60	15.69	12.60-20.22	2.29
MSU Lab	Methamidiphos	Adult	300	4.47 ± 0.54	6.85	5.83-7.91	1.00

[1]Insecticide concentrations are in micrograms per vial.
[2]LC_{50} of an instar divided by the LC_{50} of the adult stage within the same colony.