

## **SUSCEPTIBILITIES OF TARNISHED PLANT BUG AND STINK BUG NYMPHS TO VARIOUS INSECTICIDES**

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### **Abstract**

Laboratory experiments were conducted to examine the susceptibility of the nymphal stages and adult stage of the tarnished plant bug to a pyrethroid (permethrin), organophosphate (methamidophos), and a neonicotinoid (thiamethoxam) insecticide. The susceptibilities of 5<sup>th</sup> instar and adult stages of the green, southern green, and redbanded stink bugs were examined using the pyrethroid, bifenthrin, and organophosphate, acephate. Insects were individually placed into glass vials coated with various doses of each insecticide and mortality was recorded after three hours for plant bugs and after 24 hours for stink bugs. Three to four replications of each life stage were assayed with a different cohort of individuals used for each replication. For tarnished plant bugs, estimated LC<sub>50</sub>'s of the 4<sup>th</sup> and 5<sup>th</sup> instar nymphs to permethrin and methamidophos were 1.2 to 3.3 times higher than that of adults for the insecticides examined, while the first through third instar nymphs were less than that of adults. There was no real difference in the response of 3<sup>rd</sup> through 5<sup>th</sup> instar tarnished plant bug nymphs and adults to thiamethoxam. The LC<sub>50</sub>'s of the 5<sup>th</sup> instars of the various stink bug species were 1.6 to 10.5 times as high as that of adults depending on stink bug species and insecticide tested.

### **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 1996b) 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, 5<sup>th</sup> 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). Although laboratory assays that measure the response of tarnished plant bug adults to neonicotinoid insecticides have been developed (Snodgrass et al. 2008), not much information is available regarding the comparative response of tarnished plant bug nymphs versus adults to these insecticides.

The susceptibilities different species of stink bug adults and nymphs have previously been examined in the laboratory (Greene et al. 2001, Willrich et al. 2003). Using laboratory reared 5<sup>th</sup> instars and field collected adults of *Nezara viridula* and *Euschistus servus*, Green et al. (2001) reported similar mortalities of *N. viridula* 5<sup>th</sup> instars and adults when using simulated field-use rates of several pyrethroid insecticides, while mortalities of 5<sup>th</sup> instar *E. servus* were generally greater than that of adults. Willrich et al. (2003) reported LC<sub>50</sub> values for 5<sup>th</sup> instar *N. viridula* 1.8-11 times greater than that of adults depending upon year of collection and the type of pyrethroid insecticide used in glass vial bioassays. In the same study, the LC<sub>50</sub> value of a population of adults of *E. servus* was over 20 times greater than that of 5<sup>th</sup> instar nymphs when tested with  $\lambda$ -cyhalothrin.

The objective of this study was to measure the susceptibilities of all instars of tarnished plant bugs to a pyrethroid, organophosphate and neonicotinoid insecticide and compare these susceptibilities to those of adults. The comparative susceptibilities of the 5<sup>th</sup> instar nymphs and adults of several stink bug species (*N. viridula* (southern green stink bug), *Piezodorus guildinii* (redbanded stink bug), and *Acrosternum hilare* (green stink bug)) were also examined using a pyrethroid and organophosphate insecticide.

### **Materials and Methods**

Four colonies of tarnished plant bugs were used to examine susceptibilities of the various life stages to permethrin. Three of these colonies were collected as adults from wild hosts during 2008 and 2009. During September 2008, one colony was collected from pigweed in Stoneville, MS and the other was collected from horseweed in Louisville, MS. During May 2009, a colony was established from vetch near Wayside, MS. The first-generation offspring of these adults were used in assays. The fourth colony of tarnished plant bugs was obtained from a Mississippi State lab colony which has been in culture for more than a year. The Wayside and Mississippi State colony was also tested for its susceptibility to methamidophos. The tarnished plant bug colony used to examine susceptibilities to thiamethoxam was collected in May 2009 in Stoneville, MS. All tarnished plant bug colonies were reared on artificial diet (Cohen 2001) before use in the bioassays.

Stink bugs used in bioassays were field-collected nymphs and adults from various locations in Mississippi during 2009. Stink bugs within a species and life stage were pooled together from all collections locations throughout the year.

For the pyrethroid and organophosphate insecticide assays, methods followed those of Snodgrass (1996a). 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 coated by pipetting 0.5 ml of an insecticide concentration into a vial and vials were rolled on a commercial hot dog roller (with no heat) until dry. Vials were capped with a cotton ball and mortality was recorded after three hours for tarnished plant bugs and 24 hours for stink bugs.

For assays using tarnished plant bugs on thiamethoxam, methods followed those of Snodgrass et al. (2008). A piece of floral foam was placed in glass vials and technical grade insecticide was diluted in water and 0.5 ml of a 10% honey water solution (by weight) was pipetted into the foam. Tarnished plant bugs were placed in the vials, vials were capped with a cotton ball and mortality readings were conducted at 24 hours.

At least three to four replications were completed for each dose (10 insects per dose per replication) and a check dose consisting of acetone or honey water only. Data were analyzed with the PROC probit option of SAS.

### **Results and Discussion**

Fourth and fifth instar tarnished plant bug nymphs were the most tolerant life stages to both permethrin (Fig. 1) and methamidophos (Fig. 2).

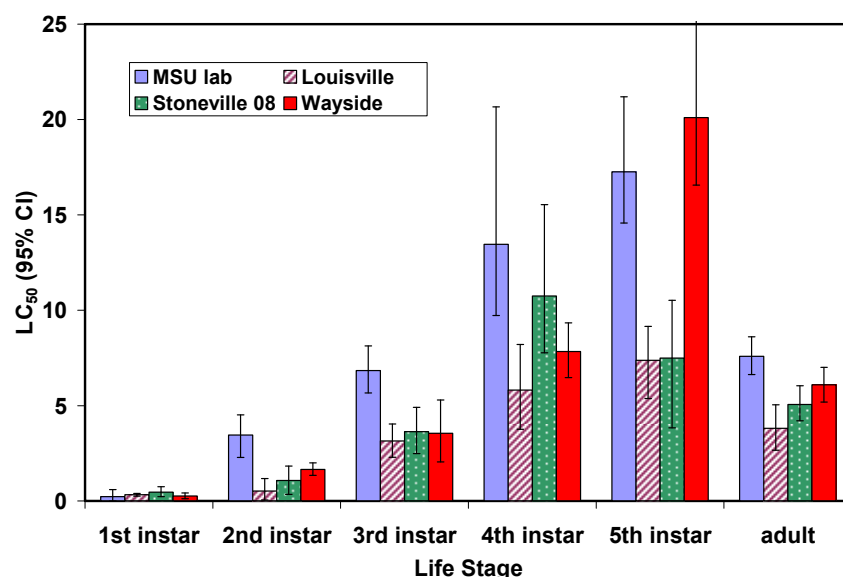


Figure 1. Estimated  $LC_{50}$ 's of different life stages of tarnished plant bug to permethrin in glass vial bioassays.

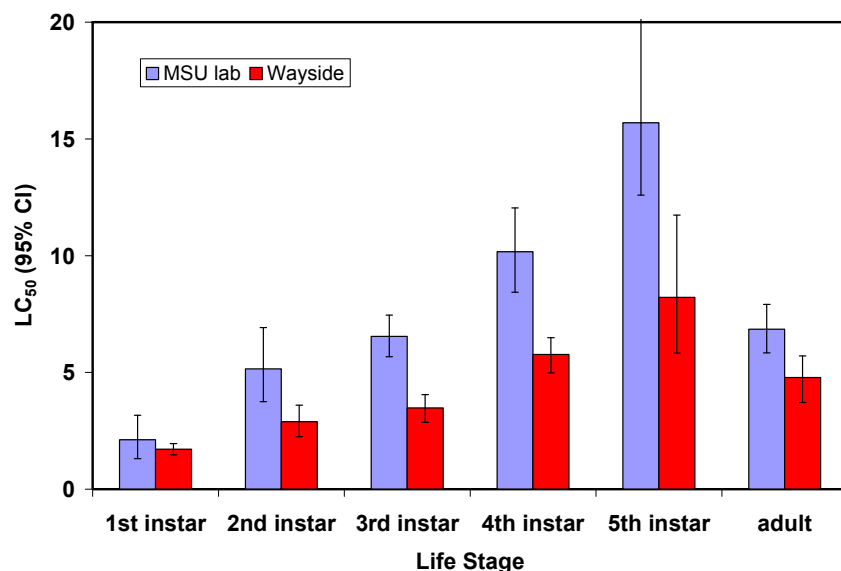


Figure 2. Estimated LC<sub>50</sub>'s of different life stages of tarnished plant bug to methamidophos in glass vial bioassays.

Based on estimated LC<sub>50</sub> values, fifth instar tarnished plant bugs were 1.48 to 3.30 times less susceptible to permethrin than adults for the colonies tested (Table 1). The 4<sup>th</sup> instars were 1.29 to 2.12 times less susceptible than adults within the respective colonies. The first through third instars were all more susceptible compared to adults within the respective colonies.

Table 1. Comparative susceptibilities of tarnished plant bug nymphs and adults in laboratory assays using permethrin insecticide (LC<sub>50</sub> of an instar divided by the LC<sub>50</sub> of the adult stage within the same colony).

Colony	Life Stage					
	1st	2nd	3rd	4th	5th	Adult
MSU Lab	0.03	0.46	0.90	1.78	2.28	1
Wayside	0.04	0.27	0.58	1.29	3.30	1
Stoneville 08	0.09	0.21	0.72	2.12	1.48	1
Louisville	0.08	0.14	0.82	1.53	1.93	1

For the two tarnished plant bug colonies tested to methamidophos, fifth instar tarnished plant bug nymphs were 1.72 and 2.29 times less susceptible than adults within a colony. Fourth instars were 1.21 and 1.28 times less susceptible than adults. The 1<sup>st</sup> through 3<sup>rd</sup> instars were more susceptible than the adult stage.

Table 2. Comparative susceptibilities of tarnished plant bug nymphs and adults in laboratory assays using methamidophos insecticide (LC<sub>50</sub> of an instar divided by the LC<sub>50</sub> of the adult stage within the same colony).

Colony	Life Stage					
	1st	2nd	3rd	4th	5th	Adult
MSU Lab	0.31	0.75	0.95	1.48	2.29	1
Wayside	0.36	0.60	0.73	1.21	1.72	1

The response of the different instars of tarnished plant bugs to thiamethoxam did not follow the same trend as those tested with permethrin or methamidophos. There were no real differences in the response of the 3<sup>rd</sup> through 5<sup>th</sup> instars and adults (Fig. 3).

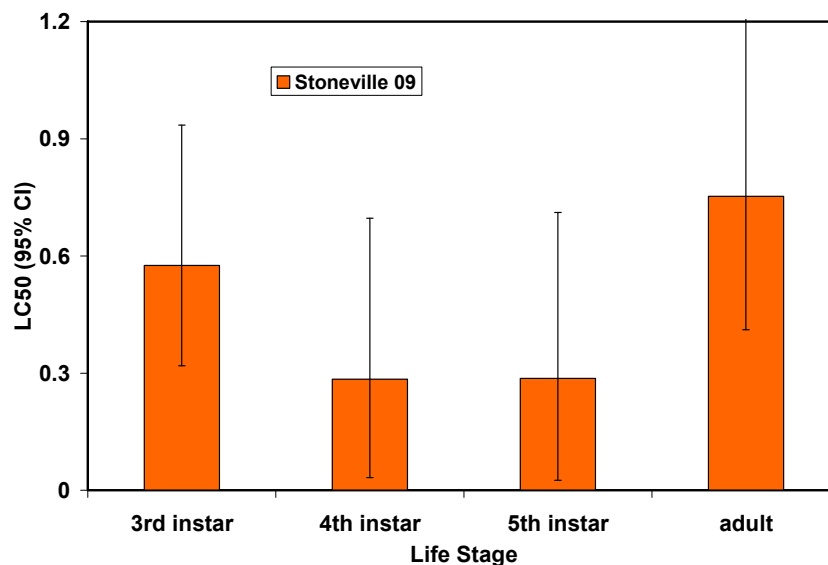


Figure 3. Estimated LC<sub>50</sub>'s of different life stages of tarnished plant bug to permethrin in glass vial bioassays.

In bioassays comparing both the adult and fifth instars of three stink bug species, southern green stink bug (SGSB), red banded stink bug (RBSB), and green stink bug (GSB) to bifenthrin and acephate, the fifth instars were less susceptible than the adults in all instances. (Figs. 4 and 5).

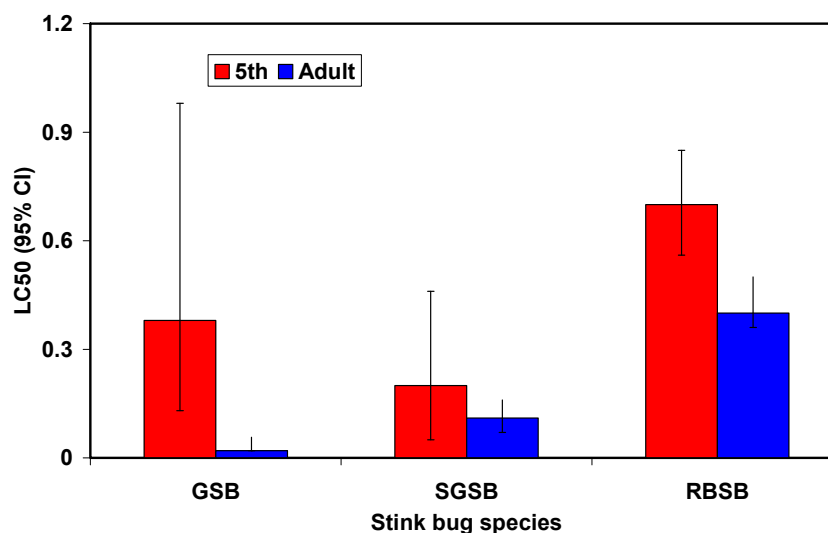


Figure 4. Estimated LC<sub>50</sub>'s of green stink bug (GSB), southern green stink bug (SGSB) and red-banded stink bug (RBSB) to bifenthrin in glass vial bioassays.

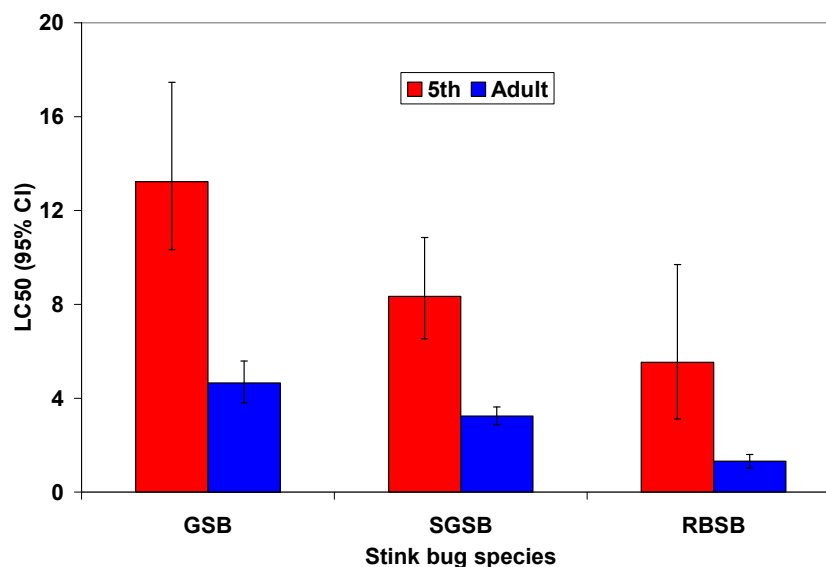


Figure 5. Estimated  $LC_{50}$ 's of green stink bug (GSB), southern green stink bug (SGSB) and red-banded stink bug (RBSB) to acephate in glass vial bioassays.

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