RESPONSE OF TARNISHED PLANT BUGS (HETEROPTERA: MIRIDAE) TO TRAPS BAITED WITH VIRGIN MALES OR FEMALES

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Abstract

The response of adult tarnished plant bugs, *Lygus lineolaris* (Palisot de Beauvois), to sticky traps baited with virgin males or females was studied in 1997 and 1998. Male-baited traps captured significantly higher number of males than unbaited check traps in 1997, and in 1998 they captured a 4-fold higher number of males than the check traps. Male-baited traps also captured a significantly higher number of females than the check traps in 1997, and in 1998 they captured a 2-fold higher number of females than the check traps. Female-baited traps did not capture significantly higher numbers of females than were captured in the check traps in either year. These results indicated that the male tarnished plant bug may produce an aggregating pheromone that is attractive to both sexes.

Introduction

The tarnished plant bug, *Lygus lineolaris*, (Palisot de Beauvois), has a wide range of host plants and has been reported on at least 130 economically important plants (Snodgrass et al. 1984, Young 1986). Female plant bugs release an unidentified pheromone to attract males for mating (Scales 1968, Graham 1987). In several studies (Scales 1968, Slaymaker & Tugwell 1984, Graham 1987) virgin females have been used to attract males for capture in sticky traps. Slaymaker & Tugwell (1984) found that virgin females were attractive to males for two weeks in traps. They also found, as did Scales (1968), that virgin females older than one week were more attractive than those younger. Mated females of *L. hesperus* Knight are less attractive than virgin females of this species in traps (Strong et al. 1970, McLaughlin 1996). However, Strong et al. (1970) also found that on the fifth day after mating the females became attractive again.

Female plant bugs have a low level of response to traps baited with females. Scales (1968) captured 171 *L. lineolaris* adults in traps in eight tests and only seven of the 171 adults captured were females. Graham (1987) caught a mean of 2.2 female and 43.2 male *L. lineolaris* per site in traps baited with females of this species. Slaymaker & Tugwell (1984) captured 596 adult *L. lineolaris* in traps baited with virgin females, and 42 of those captured were females.

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Studies using male plant bugs as bait in traps have found the male to be unattractive to males or females. Scales (1968) used 10 virgin *L. lineolaris* males in five of the eight trap tests he performed, but only two males and one female plant bugs were captured in the male-baited traps. Strong et al. (1970) captured no males or females in traps baited with five virgin males per trap.

Trap height can affect trap capture. Traps placed 1-2 m above the surface of the soil capture more adults than when placed at higher or lower heights (Prokopy et al. 1979, Capinera 1980, McPherson et al 1983). Trap color has also been shown to affect trap capture. Prokopy et al. (1980) caught significantly more *L. lineolaris* adults with sticky coated non-UV reflecting white or Zoecon Yellow rectangles as compared to several other colors of sticky coated rectangles.

The effect on trap capture of having different numbers of virgin females as bait was studied by Scott & Snodgrass (1998). They found that capture of male tarnished plant bugs was increased significantly as the number of females used as bait in traps was increased. The present study compares trap capture of males and females in traps baited with virgin females or males.

Materials and Methods

The sticky trap used in the tests was described in detail in Scott & Snodgrass (1998). In brief, the trap utilized a container at its top to hold virgin male or female plant bugs along with green beans used to feed them. These adults were the pheromone source for the trap. Plant bugs that responded to the trap were captured on a sticky panel hung below the adult holding container. The sticky cardboard panel was unpainted white and was non-UV reflecting (Gemplers, Mt. Horeb, WI). The panel hung about 1.5 m from the ground, and in each test weeds as tall or taller than the panel were cleared for a radius of 1.5 m around each trap.

Green beans were changed in the adult container of the trap every 2 or 3 d. Mortality of bait adults was determined each time a trap was checked (1-2 d intervals), and dead adults were replaced with adults of the same age and sex. Adults used as bait in the traps were 7-14-d old and were from a laboratory colony. They were sexed as 5th instar nymphs. Each gender was then reared separately. They were sexed again as adults when they were 1-3-d old (too young to mate, Bariola 1969) to insure virgin adults of a known sex were used in the traps. Wild adults that were captured on the sticky panel were counted, taken back to the laboratory, and sexed.

The test was conducted from 9-14 July 1997 in a weedy field about 6 ha in size located near Indianola in Sunflower County, MS. Tarnished plant bugs were abundant on wild host plants in the field, and the main host was annual

fleabane, *Erigeron annuus* (L.) Persoon. Treatments in the test were traps baited with 10 adult virgin male or female tarnished plant bugs. Ten adults were used since traps baited with 10 virgin females were found to capture higher numbers of male plant bugs than traps baited with lower numbers (1 or 5) (Scott and Snodgrass 1998). Check traps were identical to traps baited with males or females but had no adults as bait. Traps were placed in two lines of 6 traps with the traps spaced 30 m apart and the two lines 50 m apart. The field was mowed by its owner on 16 July and the test was discontinued at this location. It was performed again from 17 September through 7 October in a weedy field infested with tarnished plant bugs located near Leland in Washington County, MS. This field was about 2 ha in size and the main tarnished plant bug host plant in the field was horseweed, *E. canadensis* L. The treatments and trap placements used at this location were the same as that used in the first location. The same test performed at the two locations in 1997 was repeated from 27 August through 16 September 1998 in a weedy field located near Avon in Washington County, MS. This field was about 10 ha in size and had an abundant plant bug population on horseweed and goldenrod, *Solidago altissima* L.

Experimental design in both years was completely random with 4 replications. Data were not used from traps in which mortality in bait adults exceeded 20% during a test time period. Trap capture data from those time periods in which numbers of adults captured were low (usually periods of rain or windy conditions) were not used in the statistical analyses. Numbers of adults by sex captured in each treatment were compared using analysis of variance with the PROC MIXED procedure of SAS (SAS Institute 1996). Mean comparisons were made using the least significant difference test. Data from both years were also analyzed over time to test for treatment by time interactions, and for 1997, data were also analyzed for a location by treatment interaction.

Results

The date by treatment interactions were not significant for mean numbers of males ($F = 1.81$; $df = 5, 20$; $P = 0.22$) or females ($F = 0.74$; $df = 5, 29$; $P = 0.60$) captured in the different trap treatments at the test location near Indianola. This was also true for this test at the test location near Leland for males ($F = 0.50$; $df = 8, 44$; $P = 0.85$) and females ($F = 0.23$; $df = 8, 44$; $P = 0.98$). Analysis of combined data from both locations found that the location by treatment interaction was not significant ($F = 0.47$; $df = 2, 78$; $P = 0.62$). Therefore, results of the test are given from the analysis of the data combined over both locations. Significant differences were found between the treatments in mean numbers of males ($F = 3.08$; $df = 2, 9$; $P = 0.10$) and females ($F = 3.45$; $df = 2, 9$; $P = 0.07$) captured in the traps (Table 1). Mean numbers of males captured in traps baited with 10 males or 10 females were not significantly different, however, both treatments captured significantly higher numbers of males than were captured in the unbaited check. Mean numbers of females captured in the traps baited with 10 males or 10 females did not differ significantly. Traps baited with 10 males captured significantly higher numbers of females than were captured in the unbaited check traps. However, mean numbers of females captured in traps baited with 10 females were not significantly different from mean numbers of females captured in unbaited check traps. Female plant bugs had a moderate response to the female baited traps and unbaited check traps. Females made up 36% of the adults captured in the unbaited check traps and 27% of the adults captured in traps baited with 10 females.

The date by treatment interactions in 1998 were not significant for mean numbers of males ($F = 1.43$; $df = 18, 48$; $P = 0.16$) or females ($F = 0.86$; $df = 18, 44$; $P = 0.63$) captured in the different trap treatments at the test location near Avon. Significant differences were found between treatments in mean numbers of males ($F = 19.21$; $df = 2, 8$; $P = 0.001$) but not females ($F = 1.97$; $df = 2, 8$; $P = 0.20$) captured in the traps (Table 2). Total number of males and females captured in the traps were lower in 1998 (49 females, 135 males) than in 1997 (95 females, 189 males), although the traps were run for a total of 10 days in both years. The mean number of males captured in the traps baited with 10 females was significantly higher than the mean number of males captured in the unbaited check traps and traps baited with 10 males. The mean number of males captured by the traps baited with 10 males was numerically higher (4-fold) but the difference was only significant at $P = 0.13$. Although traps baited with males or females captured higher mean numbers of females than the unbaited check traps (2- and 1.4-fold, respectively) the differences were not significant. Females again responded to the female-baited traps and unbaited check traps. Females made up 52.2% of the adults captured in the unbaited check traps and 11.5% of the adults captured in traps baited with 10 females.

Discussion

Females comprised 4, 7, and 5% of all adults captured in studies by Scales (1968), Slaymaker and Tugwell (1984), and Graham (1987), respectively. In the present study, females were were captured in much higher numbers and made up 33% of the total number of adults captured in all traps in 1997, and 26.6% of this total in 1998. Part of this increased female response was due to the attractiveness of the white non-UV reflecting sticky panel used to capture adults. This can be seen in the mean numbers of males and females captured in the unbaited check traps. Capture of males and females in 1997 averaged 1.87 in the check traps as compared to the highest test value of 3.53 for the traps baited with 10 males. Capture of males and females averaged 0.58 in the check traps in 1998, as compared to the highest value of 3.83 for the traps baited with 10 females. In comparison, check traps used in previous studies by

Scales (1968) (sticky coated vinyl plastic), Strong et al. (1970) (1.89 liter ice cream cartons), and Slaymaker and Tugwell (1984) (sticky coated laminated cardboard) all captured 4% or less of the total number of adults captured.

Traps baited with males captured a significantly higher mean number of males than unbaited check traps in 1997. In 1998, they captured a 4-fold higher mean number of males than the check traps, although this difference was only significant at P = 0.13. The male-baited traps also captured a significantly higher number of females than the check traps in 1997. In 1998, the male-baited traps captured numerically higher numbers of females (2-fold) than the check traps. Female-baited traps did not capture significantly higher numbers of females than were captured in the check traps in either year. These results showed that the male plant bug may be producing an aggregating pheromone. This has never been reported for the tarnished plant bug, however, aggregating pheromones have been found in other heteropteran species (Aldrich 1988). This pheromone could function in helping males and females colonize host plants, although additional laboratory and field work confirming its existence and determining its function is needed.

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Table 1. Capture of tarnished plant bug adults in 1997 using sticky traps baited with 10 virgin male or female plant bugs.

Treatment	Mean[a] number captured	Treatment mean comparison	Mean difference	P > F
		Males		
Check	1.188	---	---	---
10 ♂	2.237	check	1.049	0.08
10 ♀	2.375	check	1.188	0.05
		10 ♂	0.138	0.81
		Females		
Check	0.681	---	---	---
10 ♂	1.291	check	0.609	0.03
10 ♀	0.883	check	0.202	0.44
		10 ♂	0.408	0.14

Mean comparisons were made using least significant difference (SAS Institute 1996).

[a] Means are numbers of males or females captured in 4 traps in each treatment. The number captured was determined at 1-2 d intervals, and the traps were run a total of 10 d.

Table 2. Capture of tarnished plant bug adults in 1998 using sticky traps baited with 10 virgin male or female plant bugs.

Treatment	Mean[a] number captured	Treatment mean comparison	Mean difference	P > F
		Males		
Check	0.275	---	---	---
10 ♂	1.148	check	0.873	0.13
10 ♀	3.385	check	3.110	0.004
		10 ♂	2.237	0.003
		Females		
Check	0.300NSD			
10 ♂	0.604			
10 ♀	0.440			

Mean comparisons were made using least significant difference (SAS Institute 1996). NSD = no significant differences.

[a]Means are numbers of males or females captured in 4 traps in each treatment. The number captured was determined at 1-2 d intervals, and the traps were run a total of 10 d.