Euphorine (Hymenoptera: Braconidae) Parasitism of the Tarnished Plant Bug (Heteroptera: Miridae) in Areas of Washington County, Mississippi Disturbed and Undisturbed by Agricultural Production[1]

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ABSTRACT Tarnished plant bugs (TPB), *Lygus lineolaris* (Palisot de Beauvois), were collected from wild host plants growing in weed fields undistrubed by agricultural practices, and from the same plant species found in disturbed areas adjacent to cotton fields in Washington County, MS during 1984 and 1985. Euphorine parasitism of TPB adults and nymphs collected in these 2 types of habitats was determined by dissection. For each year of the study period, parasitism of TPB collected from all host plant species sampled in weed fields peaked at 8 and 32% on 28 June 1984, and at 6 and 12% on 30 May 1985 for nymphs and adults, respectively. On these 2 dates parasitism of adult TPB found on all host plant species sampled in the weed fields was significantly higher ($P \leq 0.01$) than parasitism of those TPB collected from the same plant species in areas adjacent to cotton fields. Parasitism of TPB in the undisturbed areas may have been sufficient to locally reduce TPB populations. However, undisturbed areas are uncommon in Washington County and the parasitoids are probably univoltine. Consequently, the impact of euphorine parasitoids on area-wide TPB populations was probably small.

KEY WORDS Tarnished plant bug, *Lygus lineolaris*, parasitoid, Braconidae, Euphorinae.

The genus *Lygus* (Heteroptera: Miridae) is represented by 34 species in North America, with 8 additional species occurring in the Old World (Kelton 1975). In the southeastern United States the tarnished plant bug (TPB), *Lygus lineolaris* (Palisot de Beauvois), is the most common species of *Lygus*, occurring on several hundred species of wild and cultivated plants (Young 1986). Parasitoids of *Lygus* and other mirids are poorly known in North America, although many species of mirids are attacked by parasitoids in the tribe Euphorini, family Braconidae (Hymenoptera). Most of the Euphorini species that have been associated with their hosts have a restricted host range and are univoltine, with the adult diapausing in the cocoon (Loan and Shaw 1987). The most frequently found euphorine parasites of mirids are species in the genera *Leipohron* and *Peristenus*. Adults in these genera attack early-instar nymphs, and a single larva develops in the host and emerges from the fifth instar nymph (Loan and Shaw 1987). In some cases development of the first instar larva is arrested until the host is an adult (Leston 1961, Loan 1965, 1966). In North America, mirid hosts are known for 14 species of *Peristenus* and 4 species of

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Leiophron, with unidentified euphorine larvae recorded from 24 additional host species (Loan 1980).

Scales (1973) reported the only work on parasitoids of the TPB from the southeastern United States. The most prevalent parastoid he found in the Delta of Mississippi was *Peristenus pallipes* (Curtis), with an unidentified species of *Leiophron* also occurring. Parasitism of adult TPB by *P. pallipes* reached a maximum incidence of 62% in some weed fields. He suggested that the movement of parasitzed adult plant bugs into cotton depleted the area-wide parasitoid populations, due to exposure to insecticides in cotton and subsequent increased mortality. Fall and spring farming practices could also kill the parasitoid pupae in the soil.

The tarnished plant bug utilizes a variety of wild host plant species in the Delta (Snodgrass et al. 1984a), and populations increase on these wild hosts in the spring and early summer prior to their movement into cotton (Snodgrass et al. 1984b). Most of the land in the Delta is used in field crop production, thus wild hosts are most abundant along field edges, drainage ditches, or roadsides. Consequently, plant bug populations and their parasitoids are subject to agricultural practices such as discing, mowing, and exposure to pesticides used in crop production. We studied parasitism of TPB found in disturbed areas adjacent to cotton fields, and compared parasitism in these areas to parasitism of TPB collected in undisturbed areas in Washington County, MS. Washington County is located on the west side of the Mississippi Delta near the north-south center of the Delta. This research was conducted to better understand the effect of parasitoids on TPB populations in the Mississippi Delta.

Materials and Methods

Five crop (cotton) fields, ranging in size from approximately 75 to 175 ha, located near Greenville, MS were selected to represent areas disturbed by agricultural practices. The wild host plants sampled at these 5 locations occurred in the adjacent field margins, drainage ditches, and road margins. The sites representing undisturbed fields were 5 small, approximately 0.3 to 2.4 ha, weedy fields in or near Greenville and were at least 0.8 km from the nearest crop field. Host plants common to all 10 locations were sampled on each sample date. Samples were taken at approximately 2-week intervals from May through October 1984, and again at approximately 2-week intervals during May, June, and part of July 1985. Tarnished plant bugs were collected from wild host plants using a 38-cm (diam.) sweep net.

The sample sites were each surveyed for stands of host plants suitable for sweepnet sampling. Sites at a location were chosen at random on each sample date from among the sites previously identified as having homogeneous stands of the host plants. To sample a host plant species, 5-10 sweeps were taken and the captured TPB aspirated from the sweepnet. If 10 or more adults and nymphs were captured, sampling of the plant species at the site was stopped. If less than 10 TPB were obtained, the procedure was repeated until 10 were collected, or until all stands of the plant species had been sampled. TPB collected in a sample were placed in a 0.473-liter cardboard carton, which was placed in an ice chest to keep the TPB chilled but alive until they could be brought back to the laboratory. Difficulty in finding a given plant species in numbers suitable for sampling at all 10 locations limited the number of host plants sampled. However, the host plants

sampled were usually among the most abundant species in the sample areas and were all important host of the TPB.

The plants and dates that were sampled during the study included: white heath aster, *Aster pilosus* Willendow, October 1984; tickseed, *Coreopsis tinctoria* Nuttall, June 1984, May-July 1985, cynosciadium, *Cynosciadium digitatum* de Candolle, June 1984, May-June 1985; annual fleabane, *Erigeron annuus* (L.) Persoon, May-July 1984 and 1985; horseweed, *E. canadensis* L., July-September 1984, July 1985, cutleaf geranium, *Geranium dissectum* L., May 1984; primrose, *Oenothera* spp., May-June 1984 and 1985; sour dock, *Rumex crispus* L., May-June 1984 and 1985; tall goldenrod, *Solidago altissima* L., September-October 1984; and narrowleaf vetch, *Vicia angustifolia* Reichard, May-June 1984, May 1985.

To determine the presence of parasitoids, TPB adults and 3rd-5th instar nymphs were immobilized with CO_2, pinned in saline solution (5% NaCl), and dissected under magnification. In most cases, at least 10% of the adults and nymphs from each sample were dissected. TPB not dissected in 1984 in each sample were maintained using a method similar to that used by Clancy and Pierce (1966) to obtain adult parasites. Specimens of the euphorine larvae obtained by dissection were sent to C. C. Loan (Ottawa Research Station, Agriculture Canada) for identification.

Data were analyzed using the SAS General Linear Model procedure (SAS Institute 1985).

Results

In 1984, a total of 3795 TPB adults and 4209 nymphs were collected from wild host plants in the 5 undisturbed weed fields. Of these, 1241 (32.7%) adults and 590 (14.0%) nymphs were dissected to determine parasitization. From the disturbed areas adjacent to the 5 cotton fields, 2807 adults and 2496 nymphs were collected, with 950 (33.8%) adults and 391 (15.7%) nymphs dissected. In 1985, 1191 TPB adults and 1328 nymphs were collected in the weed fields, with 555 (46.6%) adults and 432 (32.5%) nymphs dissected. Adjacent to the cotton fields 982 adults and 622 nymphs were collected, with 436 (44.4%) adults and 269 (43.3%) nymphs dissected.

The 1984 data (Table 1) indicate that while parasitized TPB adults or nymphs were present as early as 4 May, the incidence of parasitism remained relatively low through 11 June. A sharp peak in parasitism occurred sometime between 12 June and 15 July, especially in the adults from the undisturbed weed fields. On 16 July parasitism of adults had dropped to 3.6% as compared to 31.8% in the previous samples taken on 28 June, while parasitism of nymphs was at a non-detectable level. This same pattern was seen in 1985, though parasitism peaked at a lower level (12.4%) for all plant species, and at an earlier date (30 May) in the weed fields. In 1984, no parasitoids were found in plant bugs collected and dissected in August-October.

No adult parasitoids were obtained from the TPB reared in 1984. Thus, rearing to obtain adult parasitoids was not attempted in 1985. Although the larval stages of euphorine parasitoids cannot be identified to genus or species, most of the larvae sent to C. C. Loan were recognized as being the larvae of a species not yet associated with its adult stage.

Table 1. Euphorine parasitism of tarnished plant bug adults and nymphs on wild host plants growing adjacent to 5 cotton fields and from the same plant species found in 5 undisturbed weed fields in Washington County, Mississippi, 1984 and 1985.

		TPB adults				TPB nymphs			
		Adjacent to cotton		Weed fields		Adjacent to cotton		Weed fields	
Date	Plant species†	Mean % parasitism‡	No. dissected	Mean % parasitism	No. dissected	Mean % parasitism	No. dissected	Mean % parasitism	No. dissected
1984§									
4 May	all species	3.3	145	5.0	112	0.0	50	0.0	32
25 May	all species	0.0	150	0.7	94	0.0	72	0.9	136
11 June	*V. angustifolia*	0.0	21	7.3*	58	0.0	13	0.0	22
	all species	1.1	120	5.0	255	1.3	58	0.0	143
28 June	*E. annuus*	1.8	33	37.2**	53	0.0	17	0.0	14
	C. tinctoria	3.3	30	10.7	49	0.0	16	0.0	7
	C. digitatum	4.0	19	39.1**	59	0.0	12	16.7	14
	all species	3.1	82	31.8***	161	0.0	45	8.0	35
16 July	all species	5.0	21	3.6	44	0.0	11	0.0	26
26 July	all species	0.0	26	8.0	22	0.0	13	0.0	22

Table 1. Continued.

Date	Plant species*	TPB adults				TPB nymphs			
		Adjacent to cotton		Weed fields		Adjacent to cotton		Weed fields	
		Mean % parasitism†	No. dissected	Mean % parasitism	No. dissected	Mean % parasitism	No. dissected	Mean % parasitism	No. dissected
1985									
3 May	all species	3.7	101	0.0	97	0.0	19	2.5	23
30 May	*Oenothera* spp.	0.0	29	7.4**	45	0.0	6	0.0	9
	R. crispus	0.0	27	11.3*	42	0.0	16	0.0	14
	E. annuus	0.0	33	13.0***	53	0.0	15	12.7**	31
	C. digitatum	0.0	39	17.5**	32	0.0	2	16.7	11
	all species	0.0	128	12.4***	172	0.0	39	6.3*	65
13 June	*E. annuus*	1.0	34	17.1*	39	0.0	8	15.0	14
	all species	3.6	100	9.6	106	0.0	17	5.6	40
27 June	all species	0.0	36	4.0	75	0.0	34	0.0	91
5 July	all species	0.0	71	1.1	105	0.0	160	0.0	213

† See text for the plant species sampled each month.

‡ Parasitism was determined by dissection of adults and nymphs for immature parasites, and is the mean for 5 locations.

§ No parasitoids were found by dissection of tarnished plant bugs during August-October from the areas adjacent to cotton (303 adults and 84 nymphs), or from the weed fields (334 adults and 139 nymphs).

*, **, *** indicates a significant difference between parasitism levels in weed fields and in weeds adjacent to cotton fields at the 0.10(*), 0.05(**), and 0.01(***) levels.

Discussion

The occurrence of a single peak in parasitism, and the absence of parasitoids during August-October, suggests that the parasitoids involved were univoltine. Parasitism of the TPB in the areas disturbed by agricultural practices was low in both years, as compared to the parasitism of TPB found in the undistrubed weed fields. The higher rate of parasitism in TPB from the undisturbed weed fields was similar to the findings of Sillings and Broersima (1974), who determined that *P. pallipes* was much more successful in parasitizing TPB in areas where the host-parasitoid relationship was undisturbed by farming practices.

Loan and Craig (1976) reported that *P. pallipes* kills TPB nymphs before the nymphs become adults or, more frequently, kills the teneral adult. However, Scales (1973) reported that some of the adult TPB parasitized by *P. pallipes* lived long enough to have fully developed eggs, and in one case, the genital pouch was fully distended which probably indicated a recent mating. Scales (1973) also reported that many adults and nymphs collected on goldenrod and white heath aster in the fall were parasitized by *P. pallipes* or *Leiophron* sp. In the present study no parasitoids were found in the dissection of over 800 TPB adults and nymphs collected in September and October on these 2 host plant species. If *P. pallipes* is univoltine in Mississippi, as the species is in Canada and the northeastern United States (Loan 1970), then it probably should not have been collected by Scales in the fall. He may have dealt with parasitoids which were not *P. pallipes.* Loan (1970) reported that *P. pseudopallipes* (Loan) is nearly inseparable morphologically from *P. pallipes. P. pallipes* develops in Canada in the first generation of the TPB in May and June, while *P. pseudopallipes* develops in the second TPB generation in August and September. The time of emergence is probably the most important factor separating the 2 species. However, *P. pseudopallipes* has not been reported in Mississippi.

Parasitism of TPB in undisturbed weed fields in Washington County may have been high enough to impact TPB populations in these areas. However, undisturbed areas are uncommon in this county and in most of the Mississippi Delta. The data also suggests that the parasitoids are univoltine. Thus, they would have little direct effect on the fall population of their host. These factors may greatly reduce the overall impact of the parasitoids on TPB populations. Additional research in the Mississippi Delta and in other areas of the southeastern United States is needed to identify the species of TPB parasitoids, and then to document their biologies and impact on TPB populations.

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