Section III Biological and Cultural Control

The Results of Research on the Bionomics of *Peristenus howardi* Shaw (Hymenoptera: Braconidae) for the Year 2000.

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Introduction

Peristenus howardi Shaw (Hymenoptera: Braconidae), a native species, was first discovered in the Pacific Northwest in 1995 (Mayer *et al.*, 1998) and subsequently described as a new species (Day *et al.*, 1999). Efforts to understand *P. howardi* biology and impact on its host, *Lygus* spp. (Heteroptera: Miridae) have been ongoing with the objective of incorporating the parasitoid into an Integrated Pest Management (IPM) program for *Lygus* species.

The initial objective of this study was to begin to elucidate basic aspects of *P. howardi* biology. Integrated Pest Management programs allow biological control agents to impact the pest population with little or no mortality to the agent from other aspects of the program such as chemical and cultural controls. We sampled for *P. howardi* at various locations to: A) understand the extent of the parasitoid's geographic range; B) examine the impact of various chemical controls on *P. howardi* populations; C) examine the possible impact of cultural practices on *P. howardi* populations; and D) understand the impact and extent of parasitism on the parasitoid's host.

Samples of the parasitoid larvae were also collected to describe the immature stages of the larvae. Description of the larvae will help to distinguish *P. howardi* from other *Peristenus* species. Preliminary research showed that *P. howardi* is common in alfalfa seed attacking *Lygus* species. However, it is possible that other *Peristenus* species may utilize *Lygus* species on other host plants. There is a need to identify and distinguish other possible species to eliminate any ambiguities that may arise.

Samples of the parasitoid adults were collected for studies of the basic biology of *P. howardi*. When sweep samples of *Lygus* are collected, part of those samples were set aside to await emergence of the parasitoid larvae from the host.

Methods

Sweep samples were taken in the Yakima Valley, Warden, and Touchet Valley areas of Washington State on a weekly basis in 2000. With the cooperation of local growers, 1/2 to 1 acre plots were established in alfalfa seed fields and were not treated with pesticides. Normal tillage practices as used by the local grower were done in the plots. Each week, samples were collected from both the treated and untreated areas of the fields. Each sample consisted of twenty-five sweeps with a 15 inch sweep net and *Lygus* nymphs were removed using a Bug-Vac®. An unquantified portion of each sample was placed in a plastic deli container covered with pieces of insect net to be held for parasitoid rearing. The remainder of the sample was placed in a 24 ml snap-cap glass vial. The vials and containers were marked and put into a cooler containing frozen Blue Ice® packs and transported to the lab at Washington State University Irrigated Agriculture and Extension Center (WSU-IAREC), Prosser, WA. The vials were placed in a non-frost free freezer and held for dissection. The *Lygus* nymphs in deli containers were taken to the Peter Stary Insectary at the WSU-IAREC for rearing.

The live samples were placed in specially constructed cages to recover parasites as they emerged from the host. The cages were constructed so that the parasite's larvae would crawl down into sifted vermiculite, spin their cocoons, and pupate. A screen, with openings large enough to allow the parasitoid larvae to pass yet retain the *Lygus* nymphs, separated the *Lygus* nymphs and the vermiculite. Flowered stems of alfalfa were placed in the cage with the *Lygus* nymphs to sustain the nymphs until parasitoids emerged. When larval emergence was complete, the vermiculite was recovered into another container with a screen top for adult parasitoid emergence. The containers for adult emergence were held in the insectary and, this fall, placed outside for winterization. Previous studies indicate that cocoons must be exposed to winter conditions for the parasitoid to emerge from the cocoon (Day *et al.*, 1999).

Lygus nymphs in the frozen samples were dissected and the percent parasitism assessed. Other information such as the developmental stage of the *Lygus* nymphs was collected and developmental stage of the parasitoid was estimated. Samples of the parasitoid larvae were placed in fixative for later analysis and description. It became apparent from the samples that many of the earlier instar nymphs were missed in the sampling. During the dissections, we were not able to distinguish eggs in the few early instar *Lygus* nymphs we collected and, therefore, the results given here are based on dissections of 4th and 5th instar *Lygus* nymphs.

Through cooperative efforts, samples of *Lygus* nymphs were also collected in Oregon, Idaho and California. Due to the time-consuming nature of dissection, processing of these samples is not yet complete.

Results

Geographic Range: *P. howardi* was officially only known from Benton County, WA and Parma, ID. This research has extended that range to include Grant County, Yakima County, and Walla Walla County, all in Washington State. Other collections have been made from Oregon, Idaho, and California but the results of dissection of the nymphs in those samples has not yet been completed. We expect to complete dissections by the end of the calendar year 2000.

Impact of Chemical Controls: Samples were collected from untreated and pesticide treated areas of alfalfa seed fields. Results varied by region. In the Touchet area, *P. howardi* was impacted by pesticide use. While abundance of *P. howardi* followed that of the *Lygus* bugs, Dibrom applied late in the season caused the population of *P. howardi* to disappear and a subsequent application of Warrior T kept their population from rebounding while the populations of *Lygus* bugs continued to increase (Fig. 1). At a different field in the Touchet area, results were similar but *Lygus* populations also responded to the insecticides (Fig. 2).

Population trends in the Warden area showed a similar pattern. However, other than a pre-bloom application of Warrior, only one application of Lorsban was used during the season as a clean-up before harvest. Similarly, after the insecticide application, the populations of *P. howardi* disappeared while populations of *Lygus* bugs continued to increase (Fig. 3).

A field located in Sunnyside, Washington represented the Yakima Valley area. Here, pesticides were used in a pattern that kept the *P. howardi* populations from impacting *Lygus* bugs populations. Dimethoate was applied in late May as a pre-bloom but a subsequent application of Warrior in early June kept *P. howar*di from establishing in the treated portion of the field. Further applications of Dibrom in the middle of July and the beginning of August kept parasitoid populations from ever becoming effective (Fig. 4).

Impact of Cultural Practices: *P. howardi* burrows into the ground and spins a cocoon upon emergence from the host. In some cases this is to over-winter but early in the season, some adults emerge for a second generation during the growing season. Cultural practices that may impact *P. howardi* populations include tillage. In the Touchet area, tillage consists of a light harrowing to knock down mole-hills and break up the surface of the ground. In the Warden area, tillage also includes "diker-daming" for water retention. Such a disruption of the parasitoid's over-wintering habitat may cause a high mortality of the pupae. Although parasitism rates compared well between areas (Table 1.), the effect of the parasitoid may be further enhanced by less disruption of the ground.

Impact of P. howardi on Lygus populations: In addition to *P. howardi* other natural enemies attack Lygus bugs. The data collected on *P. howardi* abundance is ambiguous at this point. In the Sunnyside field, populations never developed significant numbers despite the absence of insecticides (Fig. 5). Other pesticide-free fields had populations that followed *Lygus* abundance closely but only at certain times of the season (Figs. 6-8). Predation of parasitized nymphs by other natural enemies may account for

the ambiguities. In Warden, populations of Big-eyed bugs and Damsel bugs were apparently providing some natural control for most of the season and only one pesticide was applied at the end of the season as a "clean-up" spray. In other regions, natural enemies, other than *P. howardi*, were not quantified and the effects of other natural enemies can only be inferred with regard to *P. howardi*.

Another effect that needs to be accounted for is with-in field distribution of *Lygus* nymphs and *P. howardi*. If the nymphs or the parasite occurs with a "patchy" distribution, then areas within the field that were sampled may not represent the true abundance of both parasitoid and host.

Future research: Further research is needed to enhance P. howardi in the IPM program:

1. A variable sampling of plots to determine distributional effects. This will be done by varying the number of sweeps and comparing Lygus numbers per sample.
2. Quantification of predator abundance and comparing those abundances to population trends of *P. howardi* and *Lygus* bugs.
3. Further sampling to establish the identity of alternate plant hosts and the geographic range of *P. howardi*.
4. Describe the immature stages of *P. howardi* to distinguish between later instars of the parasitoid and other possible species.
5. Experiments to examine the impact of tillage practices on *P. howardi* populations.
6. Experiments to examine the effects of commonly used pesticides on *P. howardi* populations.
7. Experiments to examine developmental time, temperature effects, and oviposition rates of *P. howardi* with regard to the host.

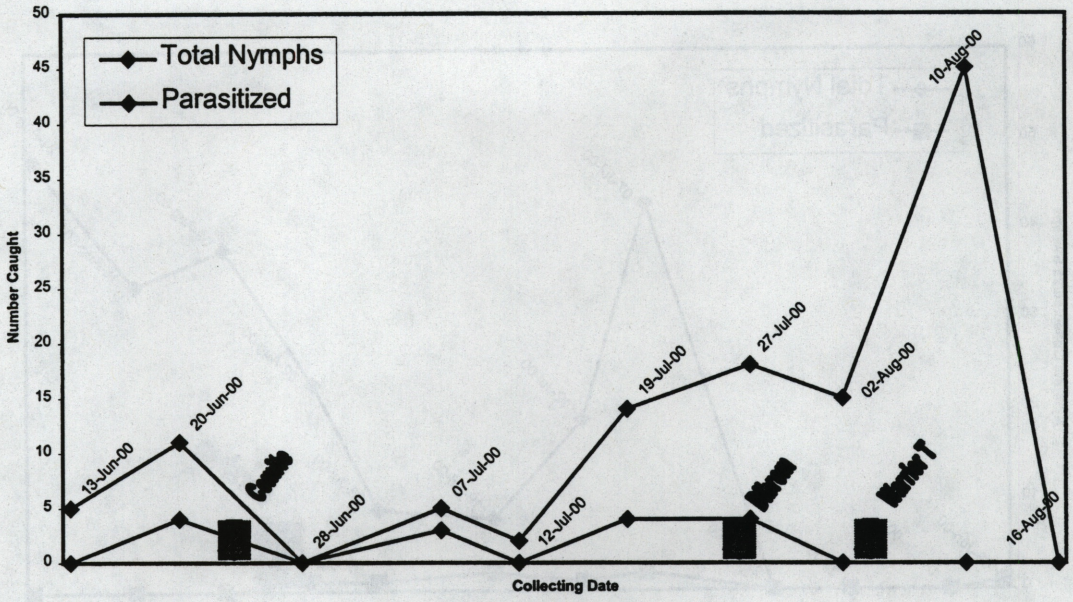

Figure 1. Pesticide applications and relative abundance of *P. howardi* and Lygus bugs, Buckley, Touchet, WA, 2000.

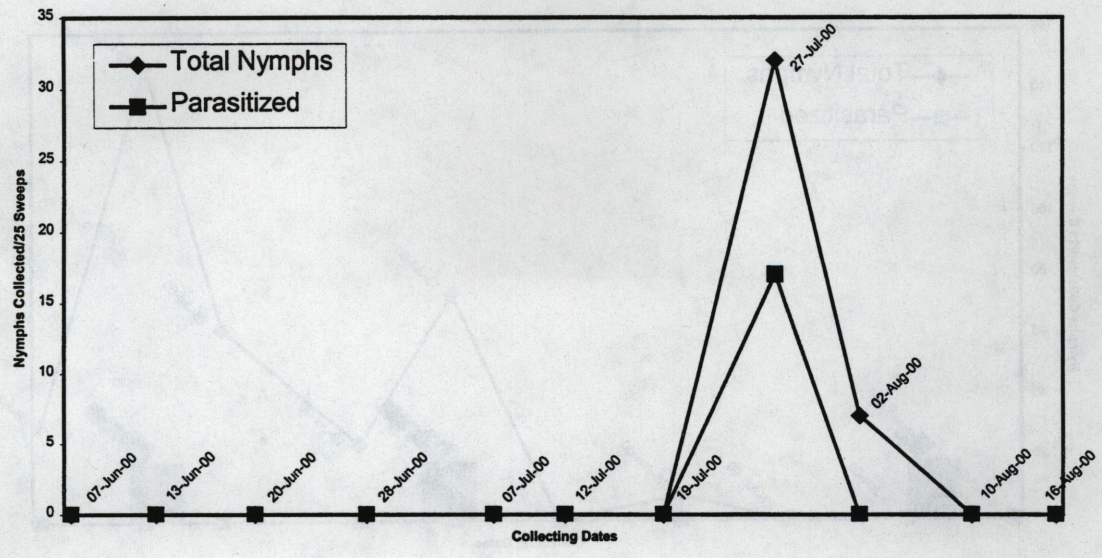

Figure 2. Populations of *P. howardi* and *Lygus* bugs in a pesticide treated field, Byerley, Touchet, WA, 2000.

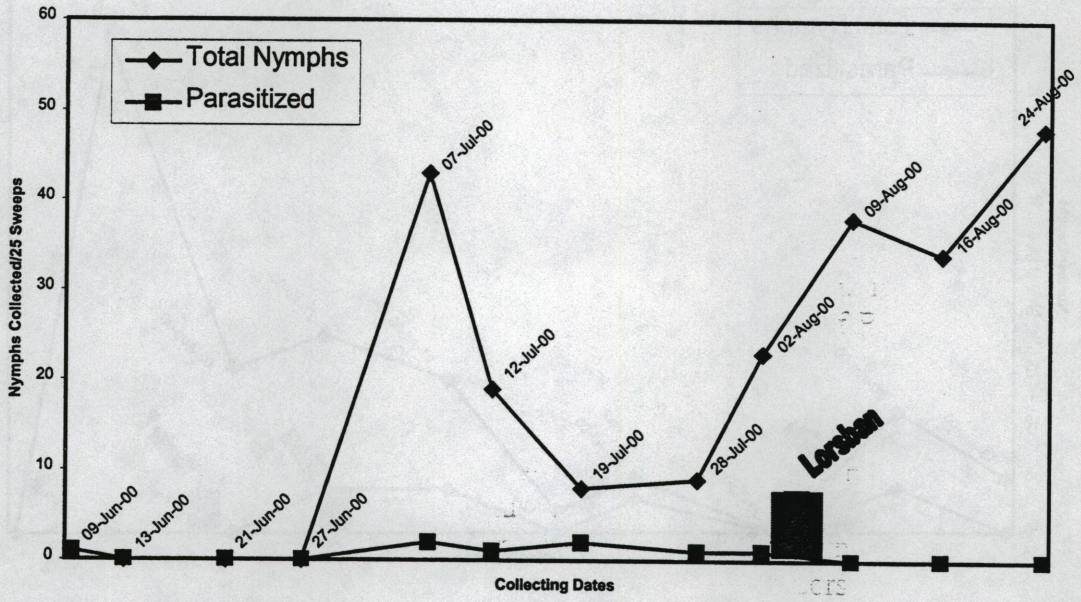

Figure 3. Pesticide applications and relative abundance of *P. howardi* and Lygus bugs, Estrada, Warden, WA, 2000.

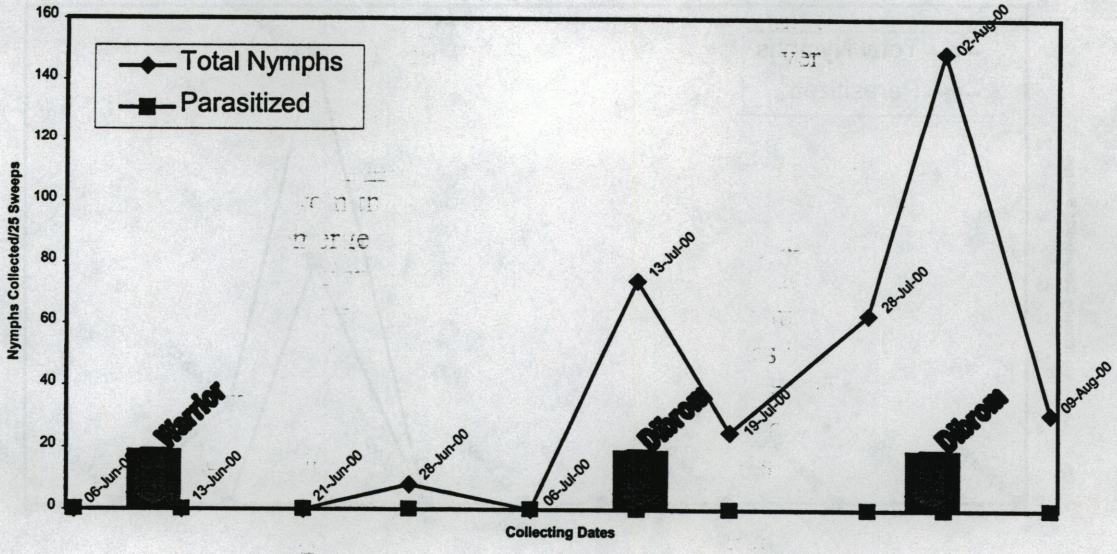

Figure 4. Pesticide applications and relative abundance of *P. howardi* and Lygus bugs, Larson, Sunnyside, WA, 2000.

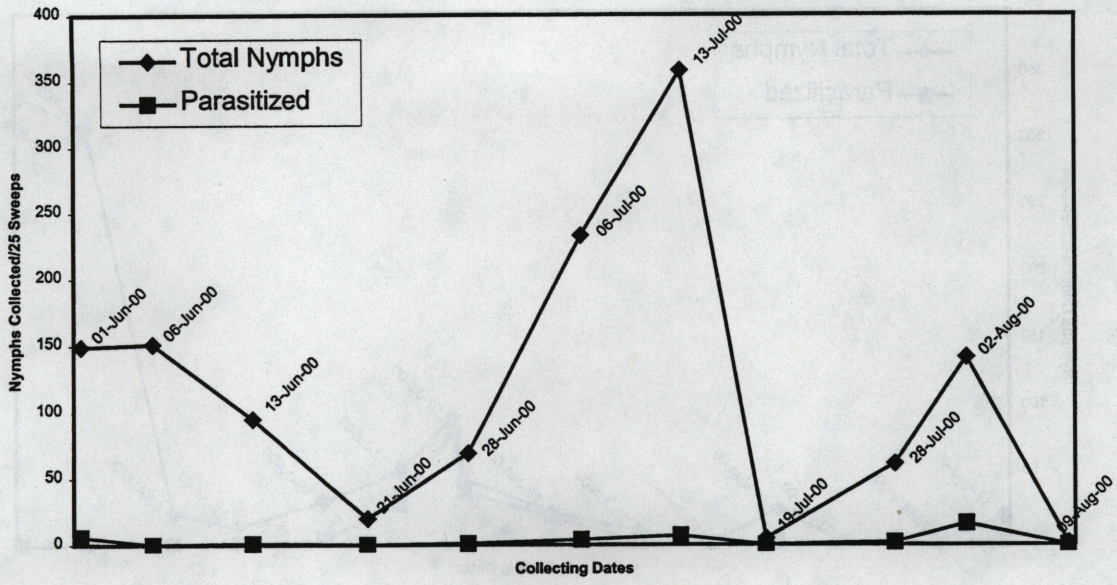

Figure 5. Populations of *P. howardi* and *Lygus* bugs in an untreated field, Larson, Sunnyside, WA, 2000.

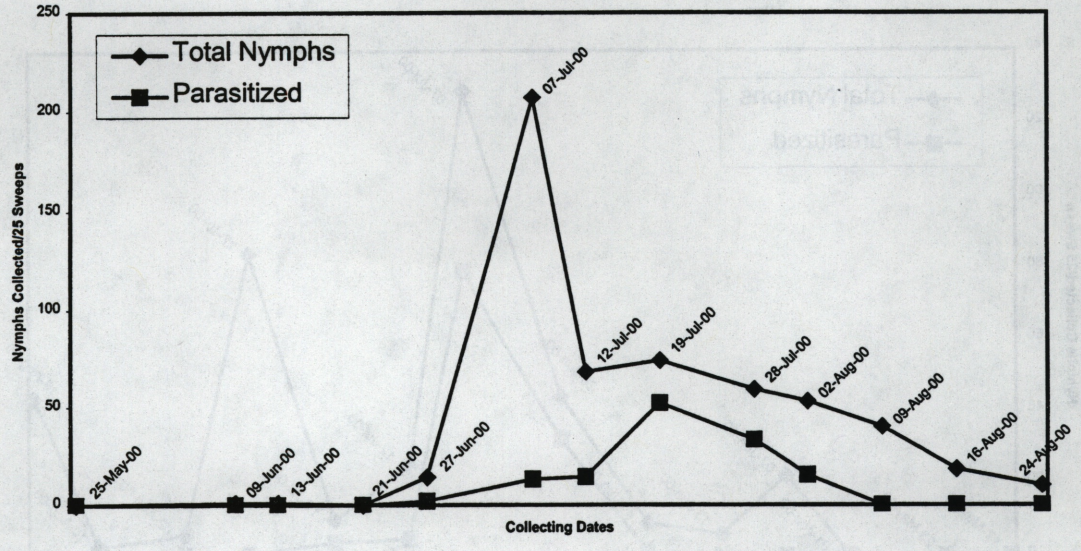

Figure 6. Populations of *P. howardi* and *Lygus* bugs in an untreated field, Estrada, Warden, WA, 2000.

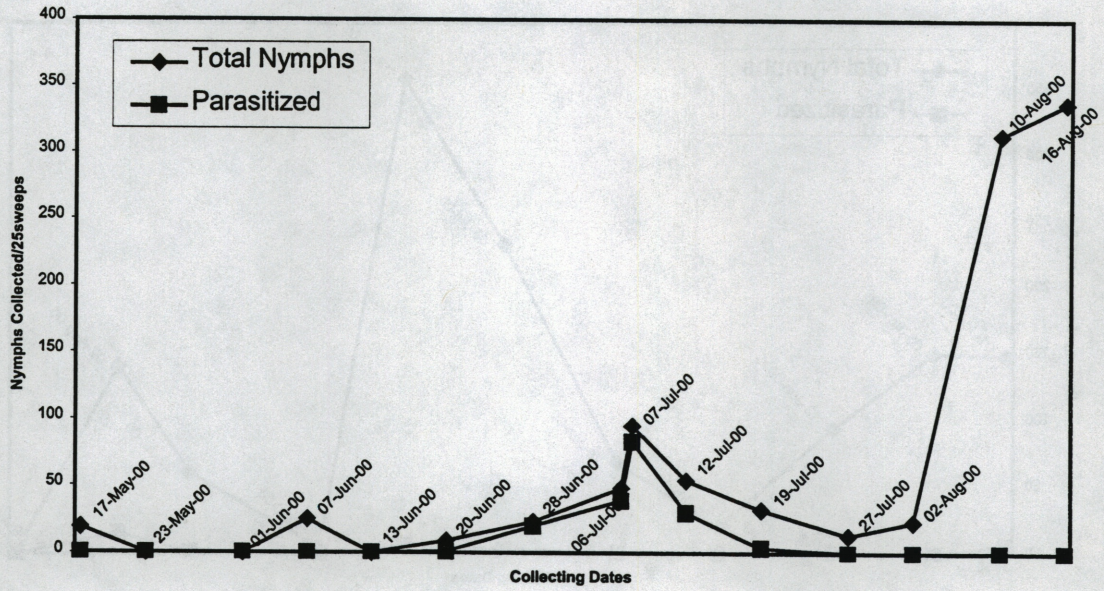

Figure 7. Populations of *P. howardi* and *Lygus* bugs in an untreated field, Buckley, Touchet, WA, 2000.

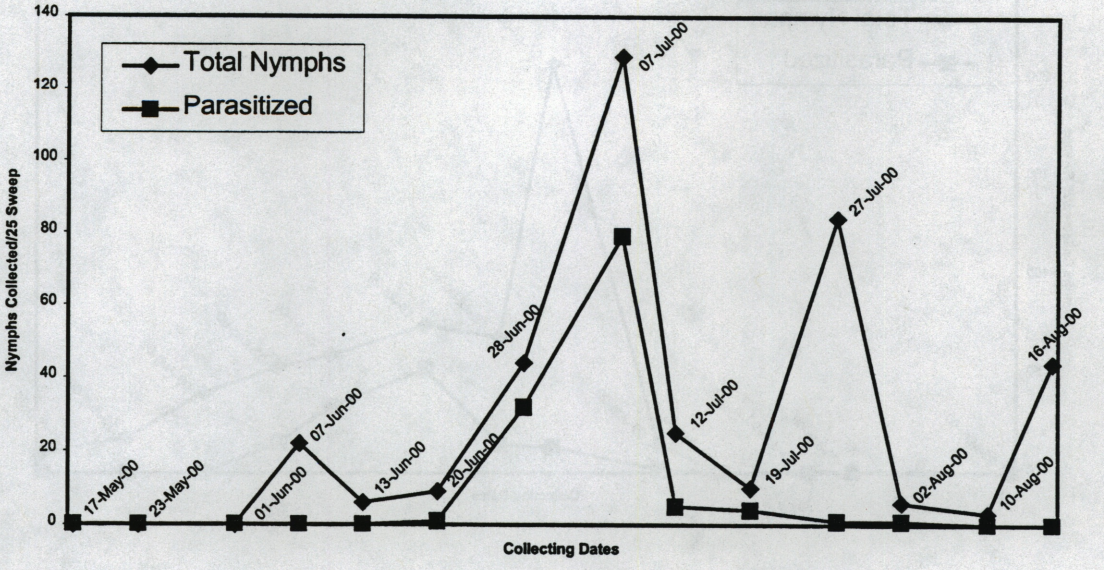

Figure 8. Populations of *P. howardi* and *Lygus* bugs in an untreated field, Byerley, Touchet, WA, 2000.

Table 1. Percent parasitism of *Lygus* 4th and 5th instar nymphs by *P. howardi*, 2000.

	6/9	6/13	6/21	6/27	7/7	7/12	7/19	7/28	8/2	8/9
Touchet-Buckley	0	0	11.1	87	87.4	55.6	12.5	0	0	0
Touchet-Byerley	0	0	11.1	72.7	61.2	20	40	1.2	1.4	0
Warden	0	0	0	14.3	6.3	20.6	70.3	55.9	28.3	0
Sunnyside	0	1.1	0	1.4	1.7	2	0	3.3	11.3	0

References Cited

Day, W. H., C. R. Baird, and S. R. Shaw. 1999. New, native species of *Peristenus* (Hymenoptera: Braconidae) parasitizing *Lygus hesperus* (Hemiptera: Miridae) in Idaho; biology, importance, and description. Ann. Entomol. Soc. Am. 92: 370-375.

Mayer, D. F., C. R. Baird, and B. Simko. 1998. Parsitism of *Lygus* spp. (Hemiptera: Miridae) by *Peristenus* (Hymenoptera: Braconidae) in the Pacific Northwest. J. Entomol. Soc. Brit. Col. 95: 53-57.