

Peristenus relictus (stygicus) (Hymenoptera: Braconidae)
A Possible Biological Control Agent
For Tarnished Plant Bug, *Lygus lineolaris*, (Hemiptera: Miridae)
In New Jersey

Annual Report
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INTRODUCTION

Tarnished plant bug, (TPB), *Lygus lineolaris*, (Hemiptera: Miridae) (Figure 1) is a piercing sucking insect native to North America that feeds on over 300 plant species and causes at least two billion dollars in losses and control costs each year (Day 2002). Adults over-winter under leaf litter and become active during the first warm days of spring with mating and oviposition occurring within days and females laying 30 to 120 eggs during their lifespan. Eggs hatch within 10 – 12 days with life cycle completion in 3 to 4 weeks. Generally, there are 3 generations per year in New Jersey (Chianese 2001).



Figure 1. Tarnished plant bugs in rearing box.

The insect is widely distributed, and is present in all states east of the Rocky Mountains where it is a pest of many agricultural crops including vegetables, fruits and seed crops (Schwartz and Footit 1998). Damage to these crops frequently goes unnoticed because there are no early visible signs of TPB feeding and the injury is often not obvious until weeks after feeding has occurred. Generally, the feeding damage causes a reduction in yield due to severe distortion of fruit or plant terminals. Growers routinely use broad-spectrum insecticides as a prophylactic treatment on high value crops; however, these spray treatments may cause secondary pest problems by reducing beneficial insect populations that keep minor agricultural pests at tolerable levels.

In early spring, the majority of TPB damage occurs on tree fruit, due to the reservoir of TPB found in the annual weeds then in bloom. The TPB feed on these weeds and as the weeds die or senesce, they move up onto the developing fruit buds, blossoms and young fruit in the orchard (PSU 2000). Damaged flower clusters appear dried and the leaves have a distorted appearance but the damage to the fruit is the major concern, because it can cause punctures or deep dimples to form as the fruit develops, resulting in deformities known as “cat facing” (Spangler et. al. 1991). In New Jersey, the TPB and other “cat facing” insects are the single largest cause for insect fruit damage in most varieties of peaches grown in NJ according to Rutgers Cooperative Extension Fruit IPM coordinator Dean Polk (Chianese 2001).

The TPB has a number of natural enemies such as other true bugs (nabids, geocorids), ladybird beetles, spiders and parasitic wasps, but they are not able to effectively control the pest (Spangler et. al.1991). In an attempt to reduce indigenous TPB populations, the United States Department of Agriculture – Agriculture Research Service (USDA-ARS) introduced two species of European parasitoids, *Peristenus digoneutis* and *Peristenus relictus* (Hymenoptera: Braconidae) previously known as *Peristenus stygicus* (Figure 2).

These multivoltine species have been found to parasitize significant numbers of TPB nymphs in certain forage crops and strawberries (Day and Tatman 2005, unpublished data). In addition, *P. digoneutis* has also been shown to reduce “cat facing” damage to apples in New Hampshire by 63% (Day et. al. 2003).

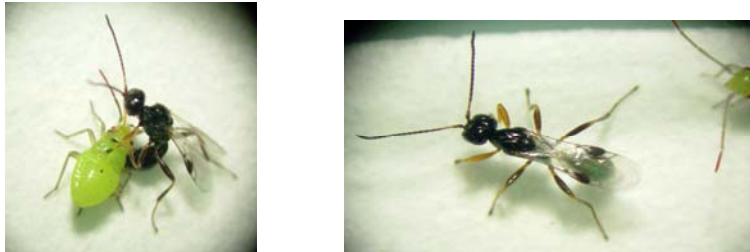


Figure 2. *P. relictus* attacking tarnished plant bug nymph (L) and adult female (R).

Dr. William Day of USDA-ARS released *P. digoneutis*, a native of Northern Europe, in New Jersey in the early 1980's. The parasitoid became well established in Northwestern New Jersey by 1988 (Day, et. al. 1990), and had not been recovered south of Hunterdon County until it was recovered in Gloucester County in 2003. Researchers speculated that the Southern New Jersey climate was not conducive to the establishment of *P. digoneutis*, which thrives in a more northerly European climate. This resulted in the USDA-APHIS shipping a second species, *P. relictus*, a close European relative of *P. digoneutis* for rearing and release in NJ by the Phillip Alampi Beneficial Insect Laboratory. *P. relictus* was imported from Southern Europe where the climatic match is similar to that found in Central and Southern NJ, the regions where most of the high cash crops such as peaches, apples and strawberries are grown.

MATERIALS AND METHODS

In the fall of 2000, field staff from PABIL surveyed alfalfa, hay, and fallow fields for the presence of TPB. The surveys resulted in a list of possible locations for initial parasitoid releases. Survey results, were also used to establish baseline TPB population data and native parasitoid occurrence.

The original 2001 Whig Lane and subsequent 2002-2003 Cedar Road release sites were in Gloucester County alfalfa fields in close proximity to both apple and peach orchards. These alfalfa fields were minimally disturbed, seldom treated with insecticides and the growers' alfalfa management practices at the release sites were favorable for parasitoid development and establishment. The alfalfa was harvested in strips staggered throughout the growing season, a practice that allows some percentages of TPB to remain in the field, providing a continuous reservoir of nymphs for parasitism.

The “uncut strips” in the release field were sampled weekly using standard insect sweep nets and one sample consisted of 100 sweeps/field (Figure 3). The collections were placed into a sleeve cage (Figure 4) and the number of TPB adults and nymphs were

counted and recorded. If a minimum of 100 TPB nymphs was not collected in the first 100 sweep sample additional sweeps were taken. The nymphs were kept cool overnight, until delivered to PABIL, where they were held for parasite recovery.



Figure 3. Sweeping for TPB



Figure 4. Sleeve cage

In 2004, two additional release sites were set up, one in Mantua Township, Gloucester County and the other at the Rutgers Research Farm in Upper Deerfield Township, Cumberland County. The same sampling procedures used for 2001-2003 were followed at the two new sites. Both new sites were on “set-aside” or fallow ground with high weed populations, including Marestalk, *Conyza canadensis* (Asteracea), the predominant weed species at both sites. Preliminary field studies in 2000 found high TPB populations in weedy locations.

During the 2005 season, three new alfalfa field releases sites were added to the program. The sites were in Vineland, Cumberland County and Mannington, Salem County. Additionally, the a 2004 Cumberland County site at Rutgers Centerton Farm was strip-planted with wild flowers to attract more TPB and provide a more diverse weed population. During the 2005 season, a new laboratory rearing technique using an artificial diet was implemented. This gave the laboratory the potential to produce significantly more *P. relictus* than previous years (Table 1.)

In 2006, the PABIL entered into a cooperative agreement with the USDA-ARS and Delaware State University to produce *P. relictus* for release in Delaware and New Jersey. Under the terms of the agreement, PABIL would provide parasitized *L. lineolaris* nymphs and adult *P. relictus* for the Delaware releases and release and monitor in New Jersey sites. There were six alfalfa study sites consisting of two *P. relictus* adult release sites, two parasitized TPB nymph release sites and two control sites in each state. Delaware cooperators were responsible for processing of weekly nymph collections from both states, as well as rearing and dissecting a portion of the collections.

The total number and quantity of New Jersey releases is found in Table 1. A list of *Peristenus relictus* release sites may be found in the Appendix.

Table 1. *Peristenus relictus* Releases in New Jersey

Release Year	Number of Sites	Number Released
2001	1	250
2002	1	1,650
2003	1	930
2004	2	3,400
2005	10	18,625
2006	13	21,500
2007	23	40,000
2008	39	51,000

Results and Discussion

In 2008, weekly surveys and collections were initiated in June and continued through September. The Gloucester County fields (Whig Lane and Cedar Rd) were each sampled 11 times. TPB nymphs first appeared in late June with peak populations occurring in early to mid July. Between June 25 and September 15, field personnel made seven nymphal collections at Whig Lane and three at Cedar Rd, which were sent to the laboratory for processing and parasitoid recovery. The Salem County (Acton Station Rd) and the two Cumberland County fields (Polk Lane and Maple Ave) were surveyed 10 times during the season with four collections made from the three sites from June 18 thru August 26. Only, two species of Braconids were recovered, the native species, *Leiophron uniformis*, and *Peristenus digoneutis*. No overwintering *P. relictus* were recovered in New Jersey in 2008.

Table 2 shows the site location and the year of *Peristenus* recoveries for the USDA/Delaware State/PABIL project. The initial recovery of a female *P. relictus* in 2006 from a 2004 release site (Polk Lane, Rutgers) was a major highlight. Plans for the 2008 season included surveying the Polk Lane site more frequently in an effort to get additional recoveries of *P. relictus*, however, due to extremely dry conditions during crucial growth periods farmers were forced to cut their alfalfa fields early to preserve their crops just when the *Lygus* populations were building. This resulted in fewer surveys and reduced nymphal collections over the past two seasons. No surveys from non-project fields are included

Table 2. Location and Year of Recovery of *Peristenus* Species

County	Location/(Year established)	2004 # of <i>Peristenus</i> species	2005 # of <i>Peristenus</i> species	2006 # of <i>Peristenus</i> species	2007 # of <i>Peristenus</i> species	2008 # of <i>Peristenus</i> species
Gloucester	Elk, Whig Lane (2001)	(1) <i>P. digoneutis</i>	(6) <i>P. digoneutis</i>	(8) <i>P. digoneutis</i>	(1) <i>P. digoneutis</i>	(4) <i>P. digoneutis</i>
Gloucester	East Greenwich, Cedar Road (2003)	(1) <i>P. digoneutis</i>	(6) <i>P. digoneutis</i>			(9) <i>P. digoneutis</i>
Cumberland	Upper Deerfield, Polk Lane (2004)			(1) <i>P. relictus</i>		
Salem	Upper Pittsgrove, Daretown Road (USDA) (2006)			(1) <i>P. digoneutis</i>		
Gloucester	Woolwich, Davidson Road (USDA) (2006)			(1) <i>P. digoneutis</i>		
Salem	Pilesgrove, Acton Station Rd. (2005)					(1) <i>P. digoneutis</i>

Conclusion

In 2008, the recovery of *P. digoneutis* for the sixth consecutive year demonstrates that it has established in Gloucester and Salem Counties. The lack of *P. relictus* recoveries in 2008 is probably due to the dry weather conditions experienced during the field season causing reduced TPB populations. In order for this program to be successful, a significant *Lygus* host population is needed but this does not always occur due to harvest practices and weather conditions that are beyond our control. The recoveries of parasites will be difficult as long as host populations remain low. This could mean that a much longer period will be necessary for the parasites to build up their numbers to noticeable levels as occurred with *P. digoneutis* (Day, et. al. 1990).

2009 Plans

The same protocol for surveys and collections will be used as in 2008. The 2004 release site in Cumberland County where *P. relictus* was initially recovered in 2006 will be extensively surveyed. New release sites of *P. relictus* will be at least a ½-mile away from all previous release sites. Releases will begin at the first appearance of nymphs and will continue weekly or biweekly throughout the growing season. Release locations will continue to expand into Burlington, Mercer and Monmouth Counties.

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Photo credits: M. Mayer, New Jersey Department of Agriculture-Phillip Alampi Beneficial Insect Laboratory

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Appendix 1. *Peristenus relictus* Release Sites in New Jersey.

County	Location (Township & Road)	Release Year	Dates	Number Released	Total
Gloucester	Elk, Whig Lane *	2001	7/27-8/24	250	250
Gloucester	Elk, Whig Lane	2002	6/14-9/25	1,650	1,650
Gloucester	East Greenwich, Cedar Road *	2003	8/1-10/30	930	930
Gloucester	Mantua, Jackson Road	2004	7/2-9/30	1,750	
Cumberland	Upper Deerfield, Polk Lane *	2004	7/23-9/17	1,650	3,400
Cumberland	Vineland, Maple Avenue *	2005	6/21-8/23	4,750	
Salem	Mannington, Acton Station Road *	2005	6/24-8/29	5,125	
Salem	Mannington, Rt. 45 Acton Sta. Rd. *	2005	6/24-8/19	3,625	
Atlantic	Buena Vista, Brewster Road	2005	9/2-9/9	1,375	
Salem	Upper Pittsgrove, Burl.-Shirley Rd.	2005	9/9	500	
Salem	Pittsgrove, Daretown-Aldine Rd.	2005	9/23	750	
Salem	Oldmans, Pennsville-Pedricktown Rd.	2005	9/30	750	
Salem	Elsinboro, Mason Point Road	2005	10/7	500	
Cumberland	Stow Creek, Causeway Rd. & Stow Creek Rd.	2005	9/16	750	
Cumberland	Fairfield, Rahmah & Cedarville Road	2005	10/14	500	18,625
Gloucester	<i>USDA-Harrison, Bishop Rd. * PN</i>	2006	6/30-8/25	3000	
Gloucester	<i>USDA-Woolwich, Davidson Rd. * PN</i>	2006	6/30-9/22	5000	
Salem	<i>USDA-Lower Alloways Ck, Beasley Neck Rd.*</i>	2006	6/30-9/01	1750	
Salem	<i>USDA-Upper Pittsgrove, Daretown Lake *</i>	2006	6/30-9/22	2750	
Cumberland	Upper Deerfield, Friesburg Road 4 Fields	2006	6/8-10/13	3000	
Mercer	Hopewell, Honey Brook Organic	2006	5/25	500	
Salem	Upper Pittsgrove, Route 581	2006	7/5	500	
Cumberland	Downe, Route 734 and 637	2006	7/7	1000	
Cumberland	Upper Deerfield, Tice Lane	2006	11/1	1000	
Cumberland	Hopewell, Trench Road	2006	11/1	500	
Cumberland	Upper Deerfield, Griens Lane and Burlington Rd	2006	6/23	500	
Cumberland	Hopewell, Barretts Run	2006	6/16-10/20	1000	
Cumberland	Hopewell, Beals Mill Road	2006	6/20-10/13	1000	21,500
Gloucester	<i>USDA-Harrison, Bishop Rd. * PN</i>	2007	6/26-9/27	7,000	
Gloucester	<i>USDA-Woolwich, Davidson Rd. * PN</i>	2007	6/26-9/27	7,000	
Salem	<i>USDA-Lower Alloways Ck, Beasley Neck Rd.*</i>	2007	6/26-9/27	3,500	
Salem	<i>USDA-Upper Pittsgrove, Daretown Lake *</i>	2007	6/26-9/27	3,500	
Atlantic	Buena Vista, Brewster Road	2007	7/17	1,000	
Cumberland	Hopewell, Barretts Run and Trench Road	2007	6/26	1,000	
Cumberland	Hopewell, Bridgeton and Greenwich Road	2007	7/20	1,000	
Cumberland	Hopewell, Greenwich Rd. & Mosley Rd. field 1	2007	6/12	1,000	
Cumberland	Hopewell, Minches Corner Rd. & Mosley Rd.	2007	6/15	1,000	
Cumberland	Hopewell, Roadstown-Greenwich Rd.	2007	7/20-8/14	1,500	
Cumberland	Hopewell, Sewall Rd. & Beebe Run Rd.	2007	6/15	1,000	
Cumberland	Hopewell, Shoemaker Rd.	2007	6/12	1,000	
Cumberland	Greenwich, Springtown Rd.	2007	7/6	1,000	
Cumberland	Hopewell, Greenwich Rd. & Mosley Rd. field 2	2007	10/4	500	
Cumberland	Deerfield, Alvin Rd. & Route 56	2007	10/4	500	
Cumberland	Hopewell, Earnest Garton Road	2007	10/4	500	
Salem	Mannington, Haines Neck Road	2007	7/13	1000	
Salem	Pilesgrove, Layton Road	2007	6/29	1000	
Salem	Mannington, Money Island Road	2007	7/3	1000	
Salem	Pilesgrove, Pointers-Auburn Rd. & Featherbed Ln.	2007	6/29-8/16	1,500	
Salem	Pilesgrove, Whig Lane	2007	6/19	1,000	
Salem	Pennsville, Chestnut Ln. & Supawna Rd.	2007	10/11-10/18	2,000	
Salem	Pittsgrove, Foote Lane	2007	10/11	500	40,000

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County	Location (Township & Road)	Release		Number Released	Total
		Year	Dates		
Gloucester	USDA-Harrison, Bishop Rd. * PN	2008	6/24-9/18	6,500	
Gloucester	USDA-Woolwich, Davidson Rd. * PN	2008	6/24-9/18	6,500	
Salem	USDA-Lower Alloways Ck, Beasley Neck Rd. *	2008	6/24-9/18	3,250	
Salem	USDA-Upper Pittsgrove, Daretown Lake *	2008	6/24-9/18	3,250	
Atlantic	Buena Vista Twp. Route 655	2008	7/15	1,000	
Atlantic	Galloway Twp., Cologne Ave	2008	7/29, 8/12	1,250	
Burlington	Westampton Twp., Rt. 541, by MBB plot #44	2008	6/12	500	
Burlington	North Hanover Twp., Rt. 664 & Stewart Rd.	2008	6/12	500	
Burlington	Shamong Twp., Route 206 South	2008	8/12, 8/15	1,750	
Burlington	Hainesport Twp., Eayrestown road by the ship	2008	8/19	1,000	
Burlington	Hainesport Twp., Centerton road by the ship	2008	8/19	1,000	
Cumberland	Deerfield Twp. Carmel Road	2008	6/27, 8/22	1,000	
Cumberland	Hopewell Twp. Columbia Hwy. & Minches Corner Rd.	2008	6/24	500	
Cumberland	Hopewell Twp., Barretts Run Rd.	2008	6/24	500	
Cumberland	Deerfield Twp., Kenyon Ave.	2008	7/18-8/22	1,500	
Cumberland	Deerfield Twp., Central Ave.	2008	7/25, 8/26	1,000	
Cumberland	Deerfield Twp., Alvine Rd.	2008	7/25- 8/26	2,000	
Cumberland	Hopewell Twp. Earnest Garton Rd.	2008	8/15	1,000	
Gloucester	Harrison Twp. Harrisonville Rd.	2008	7/11	500	
Gloucester	Franklin Twp. Route 40 Malaga	2008	8/8, 8/22	1,250	
Gloucester	Harrison Twp. Harrisonville Way	2008	8/15	1,000	
Gloucester	Harrison Twp. Eldridge's Hill Rd. Harrisonville	2008	8/29	500	
Gloucester	Logan Twp. Mill Rd. & Stone Meeting House Rd.	2008	10/16	1,000	
Gloucester	Logan Twp. Rt. 130 and Floodgate Rd.	2008	10/16	1,000	
Salem	Pittsgrove Twp. Alvin Rd.	2008	7/1, 8/22	1,000	
Salem	Pittsgrove Twp. Crow Pond Rd.	2008	7/1	500	
Salem	Alloway Twp. Canhouse Rd.	2008	7/3	500	
Salem	Pittsgrove Twp. Hughes Rd.	2008	7/3, 8/22	1,000	
Salem	Pittsgrove Twp. Holdcraft Rd.	2008	7/3	500	
Salem	Pittsgrove Twp. Upper Neck Rd.	2008	7/18, 8/22	1,000	
Salem	Quinton Twp. Pecks Corner Rd.	2008	7/22	500	
Salem	Pilesgrove Twp. Haines Neck Rd.	2008	8/8	750	
Salem	Pittsgrove Twp. Pole Tavern Monroeville Rd.	2008	9/11	500	
Salem	Alloway Twp. Rt. 603 before Brickyard Rd.	2008	9/11	500	
Salem	Pittsgrove Twp. Rt. 553 past Christian Dr.	2008	10/9	1,000	
Mercer	Hopewell Twp. Honey Brook Organic Farm	2008	5/29, 6/5	2,000	
Monmouth	Colts Neck Twp. Dorbrook Rec. area off Rt. 537	2008	8/27	1,000	
Monmouth	Upper Freehold Twp. Assunpink WMA	2008	6/20	1,000	
Grand Total					51,000
					137,355

* 2008 collection fields, PN = parasitized nymphs