
Biology and Specificity Tests of the Sawfly - *Heteroperreyia hubrichi* Malaise, 1955 (Hymenoptera: Pergidae) a Potential Biological Control Agent for Brazilian Peppertree - *Schinus terebinthifolius* Raddi (Anacardiaceae)

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Introduction

Brazilian peppertree (BP), *Schinus terebinthifolius* Raddi (Anacardiaceae) is a perennial tree native to Brazil, Paraguay and Argentina (Barkley, 1957). It was introduced in United States before 1900, like an ornamental plant displacing the native vegetation in parks, wildlife areas and near roads (Bennett and Habeck, 1991) infesting more than 4050 Km² in southern and central Florida (Habeck, 1995). This plant is listed as a Florida noxious weed (Florida Department of Agriculture and Consumer Services, 1994).

Surveys in South America were initiated in 1987 (Bennett *et al.*, 1990) with large number of insects associated to this weed in Brazil. A cooperative agreement between University of Florida and Universidade Federal do Paraná, Brazil began in 1994 increasing the known insect fauna and selecting some insects as potential biological control agents.

One of this insects is the sawfly *Heteroperreyia hubrichi* Malaise, 1955 (Hymenoptera: Pergidae) already introduced into a quarantine facility in Gainesville-FL for specificity tests (Medal *et al.*, 1999).

In this paper we report some biological aspects for this sawfly, host-specificity larvae tests (no-choice feeding tests) and also multiple choice and no-choice oviposition tests with adults.

Material and Methods

The surveys to obtain biological data were done mainly in three different places: Zoologico, Curitiba municipality; Juruqui, Almirante Tamandaré municipality and Balsa Nova municipality. All these municipalities are located on the First Plateau of Paraná State with altitude varying between 800 – 900 meters, the climate conditions presents an annual rainfall rate from 1250 – 2500 mm, medium temperature between 15 – 19° C, with no droughts and 1 – 40 frosts per year.

The insects collected were reared in the nursery at the Forest Protection Lab. in the Federal University of Parana State using entomological cages with 0,60 m x 0,60 m x 0,80 m. Were collected all stages of insect development in weekly surveys mainly in Zoologico and Juruqui places where plants attacked by sawfly were marked and monitoring since

March, 1996.

Studies about the populational fluctuation is under investigation in Zoo and Juruqui areas, where ten bushy plants were selected and marked using plates of aluminum (1 x 3 cm) tied to copper wire for identification. The sampling is weekly accomplished for both areas since March of 1997. It is being sampled in each plant the number of ovipositions present in the date of the sampling. As pre-requirement for plant selection a previous survey was accomplished with the presence of damages originating from the oviposition done by the insects.

The plants in both localities were not gathered in an only area, having niche variations among the same ones. However, both places where the plants were sampled demonstrate clear anthropism associated to the plants that are causing, mainly in Juruqui the loss of some plants (relocation) due action of vandals. The same pre-requirements selection above described were used in these cases, always relocating another plant close to that one lost. The obtained data of the relocated plants were added to those of the original plants.

Specificity tests are being conducted in the same nursery into similar entomological cages. Seedlings with young leaves are being used for releasing the sawfly larvae (1st instar) with a fine paintbrush. The number of larvae used in the no-choice feeding tests were 10 to 20 for most of the seedlings with 3 repetitions. We tested until now 9 different botanical families, with 14 different genera and 15 species. Also were tested 4 different morphotypes of *Schinus terebinthifolius* and 2 different morphotypes of *Schinus molle* L.

The adult oviposition tests are being conducted also, because the sawfly larvae fed and pupate on cashew seedlings. This tests include multiple and no-choice tests. In the multiple choice tests newly hatched females were released into the cages with the following plants: Mango *Mangifera indica* L., Cashew *Anacardium occidentale* L., California peppertree *Schinus molle* L. two different morphotypes (Brazil and Argentina), and 4 morphotypes of Brazilian peppertree *Schinus terebinthifolius* Raddi (rhoifolius, Raddianus, Pohlmanus and acutifolius). Recently a new plant from the Anacardiaceae family popular known in Brazil as Bugreiro *Lithraea brasiliensis* was included in the last tests. The no-choice tests were conducted only with cashew. All the plants used in the related tests presented ideal conditions for oviposition, as much as the branches diameter, as well the presence of young leaves.

Studies about the sawfly maternal behavior are under evaluation, where the newly hatched females are weight and compared with her oviposition (number of eggs, maternal behavior in days and diameter of selected branch).

Studies on leaves area consumption by the larvae are also under evaluation. This study include 4 different morphotypes of (BP) with 3 repetitions each and will provide the area consumed by each instar per sex, the sawfly preference feeding between the different morphological types of the target plant and the differences in the development for each type of Brazilian peppertree.

Results and Discussion

The Brazilian peppertree pergid sawfly *Heteroperreyia hubrichi* Malaise, 1955 in the adult form is a black wasp with legs and tegules yellow. The sexual dimorphism is easily perceptible for the bigger size of the female, the presence of the ovipositor and also in the antennal morphology. The antennal segment number is the same in both sexes (16), but in

the female they are round and thin while in the males they are enlarged, having in both sexes the black color. This specie is bivoltine, with a sexual rate from 0,75 when the sexual reproduction is present, there is also parthenogenetical reproduction (not clear yet, probably amphitokous) and occurrence of diapause before the summer and winter.

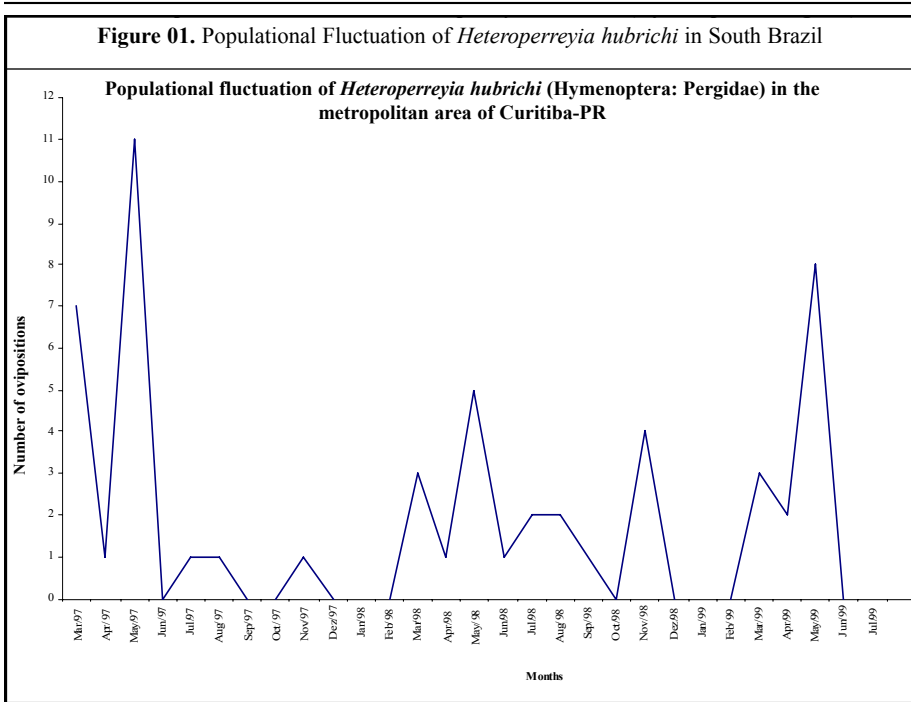
The oviposition happens in young branches but not so tender, avoiding problems with the exudation of the common resin of Brazilian peppertree. The female uses its ovipositor in saw shape to tear the vegetable tissue and to insert their eggs between the peel and the phloem. The eggs are elliptical with width variation between (1,87 – 2,04 mm) (n = 20) and length variation (2,21 – 2,38 mm) (n = 20) deposited in long arrays of variable size (1,3 – 4,5 cm) and in variable numbers (1 – 8) (n = 46) deposited side by side. The period of eggs maturation is about 15 days. The number of eggs is directly linked to the size of oviposition, and the average number of eggs counted up to now is of 99 (n = 46) with variation from 37 to 175 eggs per cluster. There is a preference of the branch diameter for the oviposition 2,4 – 4,7 mm (n = 46) also for the oviposition length in the plant 0,10 – 3,20 meters (n = 31). Most of the oviposition (76,5%) occur in plants with hairy leaves, morphotype *Pohlianus* and *rhoifolius*.

The female presents maternal behavior with the mass of eggs, staying over it during the period of the eggs incubation, approximately two weeks, when it abandons the posture as soon as the first larvae hatch. The maternal behavior was not observed in all the females raised and presented a relation with their weight being more frequent and longer in heavier or bigger females, suggesting better development and consequent better reproduction capacity. Studies about the maternal behavior, mainly as the relationship between the female weight and period of permanence over the oviposition are being conducted.

The larvae are phytophagous feeding on the leaves where they cause total defoliation depending on the size of the plant and quantity of larvae present on it. It is common to find bushes (\approx 2,0 meters) and more rarely trees (about 4 – 6 meters) defoliated in the sawfly occurrence period. The larvae are brilliant green with black cephalic capsule, having red stains in the end of the body and close to the cephalic capsule in the last two instars. Their habit is gregarious in the beginning of their development and in this phase they feed tender mainly new shoots approximately till the third instar when they spread out all over the plant attacking leaves of any ages. The larval phase has seven instars in the females and six on the males with the average of 45 days from the emergence of the new hatched larvae to the pupation. The pre-pupa phase is easily evidenced by the change in the size of the last instar larvae (about 25%) besides the interruption of its feeding. In this phase the larvae bury itself in the soil where the same pupate in depth varying among 3 – 4 cm (Lab. conditions). The pupation chamber acquires the soil color, with size varying among 0,83 – 1,14 cm of length (n = 60) and 0,36 – 0,50 cm of width (n = 60). The pupal stage varies from 1 to 5 months, with average of 4 months of pupation.

The obtained results (Figure 01) demonstrate that *Heteroperreyia hubrichi* presents populational peaks in the beginning of the year, mainly in the end of the first quarter and middle of the second quarter of every year (May), and in November. This 2 peaks show the bivoltine characteristic of this insect and this data confirm the data obtained in field collections accomplished by Vitorino, Meda, Pedrosa-Macedo and Habeck (data not published) among the years of 1995 and 1996.

The populational fluctuation data are being compared with climatic data from the survey area obtained in the Meteorological System of Paraná State (Simepar-PR), and suggests that sawfly benefits mainly with the influence of the pluviometric precipitation in



the months of February and March that can contribute for the higher presence in May, corroborating with the informations about the climatic influences (Knerer, 1993).

The results about the specificity tests are shown in (Table 01). The larvae fed and develop in all *Schinus terebinthifolius* morphotypes tested, but in acutifolius the duration of the development is bigger than the others types, also the feeding is only moderate with big mortality when compared with the others. The morphotype acutifolius is no hairy like Raddianus type that shows good to the insects development with only 20% of mortality, close the types rhoifolius and Pohlianus, the insects preferences and commonly associated to the sawfly in Brazil.

There was intense feeding on *Schinus molle*, however the mortality also was high. The intense feeding on this plant is associated with the young leaves (almost 50% of the plant in this species), so when the young leaves were consumed most of the larvae did not develop and died. Twenty percent developed on California peppertree but not pupated on it. For the species *Mangifera indica*, *Eugenia uniflora* and *Lithraea brasiliensis* the larvae presents soft to moderate feeding also associated with the young leaves but with 100 % of mortality.

The insects presented significant feeding on cashew *Anacardium occidentale* again associated with the young leaves, however 3 larvae (female) exposed to seedlings with young leaves during all the developmental period pupated, and only one adult emerged. This female was used in a no-choice oviposition test with cashew, during 4 days the female walk on the cashew seedling, no oviposition was made. In the 5th day one seedling of BP rhoifolius was offered to the insect and at the afternoon of that day, one small ovipo-

Table 01.
Specificity Tests with *Heteroperreyia hubrichi* Malaise, 1955
(Hymenoptera: Pergidae) in Brazil

Species	Popular names	N° of tests	N° of Insects	Mortality (%)	Feeding Longevity (Days)
ANACARDIACEAE					
<i>Schinus terebinthifolius</i> Raddi Type Raddianus	Brazilian peppertree	2	40	20	Heavy 1-45
<i>Schinus terebinthifolius</i> Raddi Type rhoifolius	Brazilian peppertree	3	60	15	Heavy 1-45
<i>Schinus terebinthifolius</i> Raddi Type acutifolius	Brazilian peppertree	3	60	50	Moderate 1-50
<i>Schinus terebinthifolius</i> Raddi Type pohlianus	Brazilian peppertree	3	60	15	Heavy 1-45
<i>Schinus molle</i> L. from Brasil	California peppertree	3	60	100	Heavy 2-6
<i>Schinus molle</i> L. from Argentina	California peppertree	1	20	80	Heavy 1-62
<i>Schinus polygamus</i> L.	?	?	?	?	?
<i>Mangifera indica</i> L.	Mango	7	95	100	Light 2-21
<i>Anacardium occidentale</i> L.	Cashew	9	148	97	Heavy 1-34
<i>Lithraea brasiliensis</i>	Bugreiro	1	20	100	Moderate 2-15
CONVOLVULACEAE					
<i>Ipomoea batatas</i> L.	Sweet potato	3	50	100	No 2-9
LAURACEAE					
<i>Persea americana</i> Mill.	Avocado	2	40	100	No 2-4
MYRTACEAE					
<i>Eucalyptus grandis</i> Hill ex Maiden	Rose gum	1	15	100	No 1-3
<i>Eugenia uniflora</i> L.	Surinam cherry	2	40	100	No 1-5
POACEAE					
<i>Saccharum officinarum</i> L.	Sugarcane	1	20	100	No 1-3
RUTACEAE					
<i>Citrus</i> sp.	Citros	2	40	100	No 2-4
SOLANACEAE					
<i>Capsicum annum</i> L.	Bell Pepper	3	54	100	No 2-9
<i>Lycopersicum esculentum</i> Mill.	Tomato	3	50	100	No 2-9
PINACEAE					
<i>Pinus taeda</i> L.	Pine	2	40	100	No 1-3
ACARICACEAE					
<i>Carica papaya</i> L.	Papaya	2	40	100	No 1

? Plant under testing

sition was observed on *Schinus* plant (7 eggs). The adult female after 4 days looking for a host plant looked very weak and all the eggs oviposited dry in few days. This data showed that the insect was no capable to oviposit in cashew and when the host plant were offered it did the oviposition in the same day demonstrating capacity to oviposit yet and her preference for Brazilian peppertree.

More 2 no-choice oviposition tests with newly hatched females were done and no oviposition were made. Also more 5 tests with multiple choice were conducted and the oviposition occurred only in hairy *Schinus terebinthifolius* (3 times), the other 2 insects did not oviposited in any plant into the cages.

Larval experiments about the leaves consumption area shows until now that the larvae development are the best (duration and health aspects) in the morphotypes rhoifolius, Pohlianus (hairy leaves, more common in Brazil) and Raddianus (no hairy, unique morphotype present in Florida).

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