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## Current Researches of Brazilian Weeds in Paraná State - Biological Control of Weeds Program, Curitiba, Paraná, Brazil

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### Abstract

The history of the biological control program at Federal University of Paraná, Curitiba, Brazil, is presented. Studies on the insects attacking various native Brazilian species of *Senecio* are being conducted. Insects are being investigated to discover their potential for enhance control of *Senecio* species in agricultural situations. Cattle deaths attributable to this genus in the state of Rio Grande do Sul are estimated at US\$7.5 million annually. The remaining projects are all cooperative research projects with foreign universities studying the natural enemies of Brazilian species that are pests elsewhere in the world. Five potential control agents have been identified against strawberry guava which are now undergoing extensive host-range testing. A sawfly, *Heteroperreyia hubrichi*, that attacks Brazilian peppertree, *Schinus terebinthifolius*, is in the final stages of host-range testing in Hawaii and Florida. Other species, particularly *Pseudophilothrips ichini*, are also being evaluated. Exploratory studies are being conducted to find potential agents against *Tibouchina herbacea* and the apple snail (*Pomacea canaliculata*) for Hawaii. A study of *Anthonomus santacruxi* is which attacks *Solanum mauritianum* being conducted for South Africa.

### Introduction

In 1987, Dr. Charles Hodges, Institute of Pacific Island Forestry, Hawaii, began a series of visits to the Atlantic Forest of Brazil looking for araçá (*Psidium cattleianum*) on behalf of the U.S. National Park Service and the University of Hawaii. Several populations were located from north of Rio de Janeiro to southern Paraná in the coastal region known as restinga. He was unable to find the red-fruited form, the most common form in Hawaii. During his later visits he was instructed to locate potential cooperators who could assist Hawaii in sending potential biological control agents for further evaluation in quarantine. In 1989, Dr. Hodges contacted several universities with forestry programs in Minas Gerais, Rio de Janeiro, Sao Paulo and Paraná and recommended the Federal Universities in Viçosa and Curitiba. Small cooperative agreements were established to evaluate the local populations of araçá and their associated insects. The University of Viçosa was not suitable for further work because of its distance from the Atlantic Forest and restinga. Subsequent studies, dealing with pathogens as biological control agents against Melastomataceae, have been established at Viçosa.

A cooperative agreement with the Curitiba group was established with two objectives:

to conduct a broad survey of the insects attacking araçá; and, a broad geographic search for the red-fruited form. A year later the prospects for potential biological control agents were disappointing and the red-fruited form was still unknown in Brazil. A subsequent agreement, however, enabled further studies, after two years of much more encouraging and the red-fruited form was found in areas above 500 m. Potential agents were five different galls and preliminary studies confirmed that they were not found on commercial guava (*P. guajava*). Due to inadequate funding to support a project based in Hawaii and contradictory phenology of plants in Brazil and Hawaii, the approach to the program was revised. The Hawaii group committed to a long-term cooperative agreement with the University of Paraná through its associated foundation, FUFEP, to support all aspects of the research effort in Brazil. This approach enabled year-round studies of the insect species in their native environment without requiring Hawaiian quarantine facilities. Considerable savings to the project occurred with this change. Establishment of a biological control research group at Curitiba has attracted several other research projects from Hawaii, Florida and , recently, South Africa. This paper describes the current program.

### **Curitiba**

The School of Forestry at the University of Curitiba, Paraná, Brazil, is ideally located for studies on plants from subtropical Brazil that have become weeds elsewhere in the world. The diverse tropical Atlantic Forest (sea level to 650 m) and Restinga (sea level to 20 m), and subtropical (650 to 1100 m) ecosystems are all within a 90 km radius. Target plants and their associated diseases and insects can be studied throughout the year under natural situations as well as in greenhouse or garden conditions.

Coastal restinga vegetation consist of a wide variety of plants growing in sandy substrate with a high water table. The forest is all secondary and of short stature, not more than 5 m. There are few protected areas and the region has a marginal agricultural potential so disturbance is minimal. Climate is hot, humid with year-round average temperatures between 18 and 22°C (min 0.9°C, max 38°C) and annual rainfall between 1430-2450 mm (Maack 1968). Droughts are possible in June and July (Carpanezzi *et al.* 1986).

The Atlantic Forest is mostly secondary with some pockets of primary vegetation. Climate ranges from humid, tropical, temperatures of 15 -19°C (min. -5 °C, max. -10°C) and annual rainfall between 1250 - 2500 mm. In Paraná, much of the forest is now protected. However, limited some subsistence agriculture is practiced on a small scale in some areas (Carpanezzi *et al.* 1986).

The subtropical first plateau ranges from 650-1100 m. Within the region there are several protected forest areas, including *Araucaria angustifolia* cloud forest, as well as extensive secondary forest and submontane fields available for studies. The climate is hot, humid with temperature between 15 - 19 °C (min. -10 °C, max 35 °C), 0-40 frosts per year and, 1250 - 2500 mm annual rainfall. Droughts are extremely rare (Carpanezzi *et al.* 1986).

### **Biological Control Research Projects**

Current research programs include local efforts to control *Senecio brasiliensis* (Asteraceae) by enhancing native insect herbivore populations and interacting in several cooperative efforts on other species with foreign countries. Our initial program studying insects attacking *Psidium cattleianum* (Myrtaceae) for Hawaii has just concluded several promising candidate species have been evaluated and one is already in quarantine in

Hawaii for final host specificity testing. We are also studying potential biological control agents against *Tibouchina herbacea* (Melastomataceae) and conducting preliminary work on *Pomacea canaliculata* (Mollusca) for Hawaii. We have a major cooperative effort with the University of Florida evaluating insects that attack *Schinus terebinthifolius* (Anacardiaceae). Finally, we have an investigation on *Solanum mauritianum* (Solanaceae) with the Plant Protection Research Institute, South Africa.

### **Senecio in Brazil**

*Senecio* species are known to kill cattle (Riet-Correa *et al.* 1991). In the state of Rio Grande do Sul it is estimated that 90,000 cattle are killed each year due to the consumption of poisonous plants; estimated cost of US\$7.5 million (Méndez 1997). At least half of the deaths are attributable to poisoning by *Senecio*, (*S. brasiliensis*, *S. cisplatinus*, *S. heterotrichius*, *S. leptolobus*, *S. oxyphyllus*, *S. selloi*) principally. The total cost of livestock deaths caused by *Senecio* spp. in Brazil and adjacent countries has not been calculated but it must be enormous. We are studying the insects associated with these plants in order to enhance the populations of potential control agents.

Three insect species have been studied that feed on *S. brasiliensis*, *Agathomerus subfasciatus* (Coleoptera: Chrysomelidae), *Dysschema sacrifica* (Lepidoptera: Arctiidae) and *Phaedon confinis* (Coleoptera: Chrysomelidae). Several additional Coleoptera (Curculionidae) and Lepidoptera are also undergoing initial study. *Agathomerus subfasciatus* causes extensive shoot dieback. The larvae feed in the central pith. Adults frequently make a ring around young stems that are undergoing secondary thickening and kill the shoot. *Dysschema sacrifica* eat the leaves and buds causing extensive defoliation.

### **Psidium cattleianum**

*P. cattleianum* (or araçá) is a small tree bearing small 1-3 cm diameter fruits. The sweet and juicy fruits have a flavor reminiscent of strawberries, hence the plants other common name, strawberry guava. It has a smooth bark and dark, shiny leaves making it an attractive plant in formal landscaping. Consequently, it has been transported around the world and is now naturalized in the tropics and subtropics. In Hawaii, where it forms dense monotypic stands excluding all other vegetation, it has been ranked as the primary weed of forests and has been the subject of control efforts for a number of years (Smith 1985). Diong (1982) determined that there was positive feedback between araçá and feral pigs. It was, therefore, a primary target of forest and park managers, Araçá has proven difficult to control using conventional methods making this plant the most important candidate for biological control.

After initial problems locating suitable populations that covered the whole range of variation of the species, a number of insects have been found that attack this plant but not the commercially important, close relative *P. guajava*. Five potential agents have been discovered, all gall producing insects. They are:

*Dasineura gigantea* (Hymenoptera: Cecidomyiidae) - a bud gall

*Eurytoma* sp. (Hymenoptera: Eurytomidae) - a stem gall

Homoptera: Psyllidae - a leaf gall

*Sycophila* sp. (Hymenoptera: Eurytomidae) - a seed gall

*Tectococcus ovatus* (Homoptera: Eriococcidae) - a leaf gall

No diseases suitable for use as biological control agents were discovered. Details of this work can be found in Wikler *et al.* (this volume).

*Tectococcus ovatus* is in quarantine in Hawaii undergoing final evaluation of its host range. It appears to be host-specific to araçá. The species is easily transported to different localities and has survived a journey lasting 10 days.

Additional species such as the sawfly, *Haplostegus epimelas* (Hymenoptera: Pergidae) and *Lamprosoma azureum* (Coleoptera: Chrysomelidae) are common on araçá. However, both attack *P. guajava* and cannot be considered as potential agents.

### ***Tibouchina herbacea***

*Tibouchina herbacea* is a herbaceous plant with attractive pink flowers that was introduced to Hawaii as an ornamental. It forms dense, monotypic stands over 3 m tall, clogging waterways and infesting wet, upland pastures and rainforest. Cattle will not eat it. The seeds, produced in great abundance, are difficult to germinate because they require continuously moist conditions. Once established, however, the plant forms dense, monotypic thickets.

This study is complicated by the wide diversity of closely related herbaceous *Tibouchina* species in Brazil. None of these species are exactly like *T. herbacea*, even in common garden experiments. The stature of the plant in Hawaii greatly exceeds that of any of its herbaceous congeners in Brazil. In Brazil, the plant can be very common in abandoned pastures, along streams or wet roadsides but never forms the monotypic stands found in Hawaii.

A number of insects attack the plant including *Schrenkensteinia* sp. (Lepidoptera: Schrenkensteinidae), *Syphrea uberabensis* (Col.: Chrysomelidae: Alticinae), *Anthonomus opius* and *A. partarius* (Col.: Curculionidae: Sibinae), *Lius* sp. (Col.: Chrysomelidae: Alticinae). Studies with the *Schrenkensteinia* are the most advanced. It is a leaf-skeletonizer that only attacks herbaceous *Tibouchina* species. It is, however, very susceptible to *Beauveria*. It may not be suitable for biological control in Hawaii due to the presence of several generalist lepidopteran parasitoids. There is also a large, undescribed geometrid whose larvae mimic the stems, either purple or green. It is a voracious defoliator.

### ***Schinus terebinthifolius***

*Schinus terebinthifolius* (aroeira) is a large shrub to small tree that tends to sprawl into adjacent areas forming dense thickets. Its attractive red berries and shiny foliage resulted in its introduction to the United States as an ornamental early this century. Some people have used the seeds as a form of red pepper but in large quantities it is poisonous. This species is a major pest in Florida where there is considerable concern that it will overrun parts of the Everglades and other natural areas (Medal *et al.* 1999). In Hawaii it has infested most lowland habitats even recent lava flows where there is not much other vegetation. It is soon killed when shaded by other vegetation.

A sawfly (*Heteroperreya hubrichi* - Hymenoptera: Pergidae) has been proposed for release in Florida but is undergoing further host range testing (Medal *et al.* 1999). It is, also undergoing further tests in Hawaii. *Pseudophilothrips ichini* (Thysanoptera: Phleothripidae) appears to be a potential agent but we have been unable to maintain it through its life cycle in captivity. Some tortricid leaf rollers are also under investigation. A separate paper by Vitorino *et al.* (this volume) describes this work in more details.

### ***Solanum mauritianum***

*Solanum mauritianum* is a small shrub probably introduced as an ornamental for its

large, light colored leaves. This species is a major pest in reforestation projects in South Africa where it rapidly overtops plantation seedlings. The plant invades plantations and other disturbed areas that have been left fallow. However, the South Africans are particularly interested in *Anthonomus santacruxi* (Col.: Curculionidae: Sibinae), a common insect on this plant around Curitiba.

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### References

- Carpanezzi, A.A., C.A. Ferreira, E. Rotta, I.S. Namikawa, J.A. Sturion, J.C.D. Pereira, L.H. Montagner, M.J. Rauen, P.E.R. Carvalho, R.A. Silveira, and S.T. Alves. 1986. Zoneamento ecológico para plantios florestais no Estado do Paraná. Brasília, EMBRAPA-DDT. 89pp. (EMBRAPA-CNPF: Documentos, 17).
- Diong, C.H. 1982. Population biology and management of the feral pig (*Sus scrofa*) in Kipahulu Valley, Maui. Ph. D. dissertation, University of Hawaii, Honolulu.
- Maack, R. 1968. Geografia Física do Estado do Paraná. CODEPAR. Curitiba, Brazil. 350 pp.
- Medal, J.C., M.D. Vitorino, D.H. Habeck, J.L. Gillmore, J.H. Pedrosa, and L.P. De Sousa. Host specificity of *Heteroperreyia hubrichi* Mailaise (Hymenoptera: Pergidae), a Potential Biological Control Agent of Brazilian Peppertree (*Schinus terebinthifolius* Raddi). *Biological Control* 14: 60-65.
- Méndez, M. del C. 1997. Intoxicação por *Senecio* spp no Rio Grande do Sul. In Seminário Alternativas de Controle de *Senecio* spp. - Desenvolvimento de um projeto interdisciplinar e interinstitucional. Curso de Mestrado em Veterinária. Universidade Federal de Pelotas, RS.
- Riet-Correa, F., M. del C. Méndez, and A.L. Schild. 1991. Intoxicações por plantas e micotoxícoses em animais domésticos. Editorial Agropecuária Hemisfério Sur S.R.L., Montevideo, Uruguay. 340 pp.
- Smith, C.W. 1985. Impact of alien plants on Hawaii's native biota. Pp. 180-250, In Stone, C.P., and J. M. Scott [eds.], Hawaii's Terrestrial Ecosystems: Preservation and Management. Cooperative National Park Resources Studies Unit, University of Hawaii, Honolulu.