SCIENTIFIC NOTE

Phytophagous Arthropods Associated with *Solanum mauritianum* Scopoli (Solanaceae) in the First Plateau of Paraná, Brazil: A Cooperative Project on Biological Control of Weeds Between Brazil and South Africa

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Artrópodos Fitófagos Associados a *Solanum mauritianum* Scopoli (Solanaceae) no Primeiro Planalto Paranaense: Projeto Cooperativo Sobre Controle Biológico de Plantas - Brasil e África do Sul

RESUMO - O fumo-bravo, *Solanum mauritianum* Scopoli (Solanaceae), nativo do Sul do Brasil, é uma importante planta invasora na África do Sul, onde é tida como alvo do controle biológico. Em 1998 cientistas do Brasil (Curitiba) e da África do Sul (Pretoria) iniciaram a execução de um projeto cooperativo para pesquisas sobre controle biológico de plantas nativas do Brasil e que tornaram invasoras na África do Sul. Dentro desse projeto estudos biológicos e ecológicos dos inimigos naturais de fumo-bravo foram realizados no Primeiro Planalto do Paraná. Nessa região o fumo-bravo é abundante e as condições climáticas e de altitudes são similares às áreas invadidas naquele país. A população de fumo-bravo é suporte alimentício e abrigo de uma fauna herbívora diversa que inclui 34 espécies de insetos e uma espécie de ácaro. Foram coletadas cinco espécies de elevado potencial para uso no controle biológico, dentre elas duas desfolhadoras, duas espermatófagas e uma broca. Três espécies estão destinadas para futuros estudos na África do Sul, uma destas espécies já foi liberada para controle de *S. mauritianum,* enquanto uma quarta espécie, *Anthonomus morticinus* Clark (Coleoptera: Curculionidae), foi estudada no campo.

PALAVRAS-CHAVE: Fumo-bravo, inimigo natural, invasora

ABSTRACT - *Solanum mauritianum* Scopoli (bugweed), native to southern Brazil, is a major weed in South Africa where it has been targeted for biological control. In 1998, a cooperative project involving Brazilian and South African scientists was initiated to develop cooperative biological control studies involving native Brazilian plants that are invasive in South Africa. Surveys for natural enemies were carried out in the First Plateau of Paraná, where the plant is particularly abundant and where the climatic conditions are similar to high altitude areas in South Africa that are invaded by *S. mauritianum*. Populations of *S. mauritianum* supported a diverse herbivore fauna, which included at least 34 insect species and one mite species. Five species with high biological control potential were collected: two flower-feeding, two leaf-feeding and one stem-boring species. Three of these species have been studied in quarantine in South Africa, one of which has already been released for the biological control of *S. mauritianum*, while a fourth species, *Anthonomus morticinus* Clark (Coleoptera: Curculionidae), was studied in the field in Brazil.

KEY WORDS: Weed, natural enemy, bugweed

The perennial, woody tree, *Solanum mauritianum* Scop., native to Northeastern Argentina, Southern Brazil, Paraguay and Uruguay, is a major weed in the high rainfall regions of South Africa where it has been targeted for biological control for several years (Olckers 1999). As part of a biological control programme, surveys for natural enemies have been conducted and were mostly focused in Argentina and Paraguay (Neser *et al.* 1990, Olckers *et al.* 2002). In March 1998, a cooperative research project on biological control of weeds, involving Brazil and South Africa, was initiated to intensify studies on the natural enemies associated with *S. mauritianum* in Brazil and identify species that should be introduced to South Africa as potential biological control agents.

The first phase of this project focused on additional natural enemy surveys in the First Plateau of Paraná (25°27´S to 25°35´S; 48°58´W to 49°38´W) in Southern Brazil, where *S. mauritianum* is particularly abundant. This region was specifically targeted because of its eco-climatic similarity to the colder, high altitude areas in South Africa, where *S. mauritianum* is particularly invasive. So far, most of the biological control candidates have been imported from northeastern Argentina (Misiones Province) (Olckers 1999), where the climatic conditions are more tropical. The objective of these surveys was to make an inventory of the natural enemies associated with *S. mauritianum* in the First Plateau of Paraná, in order to: (i) identify 'new' species that could be used as a biological control agents; and (ii) record the occurrence of populations of species already identified as biocontrol agents that may be more cold tolerant and better suited to South African conditions.

Field observations and collections of the herbivorous species associated with *S. mauritianum* were carried out mostly during the summers of 1998 to 2000 in the First Plateau of Paraná. Several localities in and around Curitiba, particularly in the satellite districts of Almirante Tamandaré, Araucária, Balsa Nova, Campo Largo, Campo Magro, Colombo and Piraquara were sampled. More distant localities were also sampled, like Garuva and Guaratuba. At each locality, natural stands of plants were scanned for ectophagous herbivorous arthropods; damaged stems, flowers and fruit were taken to the laboratory and dissected to observe endophagous species. Voucher specimens of insects are lodged in the collection of the Laboratório Neotropical de Controle Biológico of the Universidade Federal do Paraná, Curitiba, while mite specimens are lodged in the collections of the Escola Superior de Agricultura "Luiz de Queiroz", Piracicaba, Brazil, and the National Collection of Arachnids of the Plant Protection Research Institute, Pretoria, South Africa.

A total of 34 insect species and one mite species were associated with *S. mauritianum* in the First Plateau of Paraná (Table 1). At least 18 of these species were previously recorded on *S. mauritianum* in Argentina (Misiones Province) and Paraguay (Neser *et al.* 1990, Olckers *et al.* 2002). Several of these species were also associated with *Solanum granuloso-leprosum* Dun., a species very closely related to, and often synonomized with, *S. mauritianum* (Kissmann and Groth 1997) (Table 1). Polyphagous species with no potential for safe biological control included the stem-boring beetle *Nealcidion bicristatum* (Bates) (Cerambycidae), lace bug *Corythaica cyathicollis* (Costa) (Tingidae), fruit-sucking bug *Arvelius albopunctatus* (De Geer) (Pentatomidae) and leaf-feeding beetles *Diabrotica speciosa* Germar and *Epitrix parvula* (F.) (both Chrysomelidae), all of which are recorded as pests of solanaceous crops in Brazil (Silva *et al.* 1968). Species, which have been, or are being, considered as potential biological control agents were also collected during this survey. These included two species of leaf-feeding beetles of the genus *Platyphora* Gistel (Chrysomelidae) and the leaf-mining moth *Acrolepia xylophragma* (Meyrick) (Acrolepiidae) (Table 1) which had been tested in quarantine in South Africa but were rejected because of a lack of host specificity (Olckers 1999, 2000a). However, other more promising species were found, some of which have been the focus of further studies.

One of the most important species collected was the leaf-sucking lace bug *Gargaphia decoris* Drake (Tingidae) which was released in South Africa in 1999 (Olckers 2000b). This agent was cultured from a few individuals collected at a single locality in Misiones in 1995. Further attempts to locate *G. decoris* in Argentina (Olckers *et al.* 2002) for the purpose of introducing additional genetic material were unsuccessful. Consequently, the insects that have been mass-reared and widely released in South Africa have arisen from a very narrow genetic base, which could also explain why *G. decoris* has not become widely established and has been relatively ineffective to date. *G. decoris* was located at several sites in the First Plateau and was particularly abundant around Curitiba. New stocks of *G. decoris*, originating from two localities in the First Plateau of Paraná, were introduced into South Africa during 2002 in an attempt to boost the variability of the current field populations. It remains to be seen whether these insects are more cold tolerant and thus better suited to South African conditions than were the insects from Argentina and, therefore, whether the Brazilian material will become more widely established and prove more effective than the Argentinian material.

Several other promising candidates, mostly identified from previous surveys in Argentina (Neser *et al.* 1990, Olckers 1999, Olckers *et al.* 2002), were also collected in the First Plateau of Paraná. Of particular importance were the flower-feeding weevils *Anthonomus morticinus* Clark and *A. santacruzi* Hustache (Curculionidae). Host-specificity testing on *A. santacruzi*, imported from Argentina, has been completed in quarantine in South Africa (Olckers não publicado) whereas open-field host-specificity tests on *A. morticinus* are nearing completion in Brazil. Should one or both of these species be cleared for release in South Africa, then fresh genetic stocks would best be introduced from the First Plateau. The same is true for other potential agents which include a leaf-mining flea beetle, an apparently undescribed species of *Acallepitrix* Bechyne (Chrysomelidae) (D.G. Furth, in litt.), and a stem-boring weevil, *Conotrachelus* prob. *squalidus* Boheman (Curculionidae). Host-specificity testing on *Acallepitrix* sp. nov. has recently been completed in quarantine in South Africa.

The only 'new' potential biological control agent from Paraná was a leaf-sucking mite *Aponychus schultzi* (Blanchard) Tuttler & Baker (Tetranychidae) which was collected in Curitiba in 2002. The mite was particularly damaging to the closely related *S. granuloso-leprosum*, possibly because of the lower leaf trichome density on this species relative to *S. mauritianum*. However, *A. schultzi* has been recorded from at least 17 different hosts, belonging to several plant families, in Argentina, Brazil and Paraguay (Bolland *et al.* 1998), suggesting that it is unsuile as a candidate agent. Despite this, there is a possibility that *A. schultzi* represents a complex of species or biotypes, each of which may be specific to its host. This is because *A. schultzi* failed to feed and survive on *Ricinus communis* L., a recorded host in South America, during preliminary laboratory trials and because it has the widest recorded host range of the known *Aponychus* species, which have mostly been recorded from

Table 1. Phytophagous insects and mite associated with *S. mauritianum* in the First Plateau of Paraná, Brazil, and their potential as biological control agents.

Insect or mite species	Mode of attack	Localities[1]	Abundance[2]	Potential
ACARINA				
Tetranychidae (Bryobinae)				
Aponychus schultzi (Blanchard) Tuttler & Baker[3]	Sap sucker	Cu	+++	Uncertain (pest?)
COLEOPTERA				
Chrysomelidae				
Acallepitrix sp. nov.[3, 4]	Leaf miner	At Bn Co Cu Ga Pa	+++	High
Colaspis sp. [3, 4]	Leaf feeder	Bn Co Cu	+++	None (pest)
Diabrotica speciosa Germar[3, 4]	Leaf & flower feeder	Co Pa Cu	+++	None (pest)
Epitrix prob. *parvula* (F.)[4]	Leaf & root (?) feeder	At	+++	None (pest)
Prob. *Nycterodina* sp.[4]	Flower feeder	At Bn Co Pa	+++	Low
Platyphora prob. *biforis* (Germar)[3] *)	Leaf feeder	At Co	++	Low
Platyphora prob. *nigronotata* (Stål)[3] *)	Leaf feeder	At Bn	++	Low
Unidentified species	Leaf feeder	Bn Gt	+	Low
Cerambycidae				
Nealcidion bicristatum (Bates) [4]	Stem borer	At	+++	None (pest)
Adesmus hemispilus (Germar)	Stem borer	At Cu Ga Gt	++	Low
Unidentified species	Stem borer	At Cu	+	Low
Curculionidae				
Anthonomus morticinus Clark[4]	Flower feeder	Au Bn Cl Cm Co Cu Pa	+++	High
Anthonomus santacruzi Hustache[4]	Flower feeder	At Co	++	High
Anthonomus tenebrosus Boheman[4]	Flower feeder	Cm	+	Low
Conotrachelus prob. *squalidus* Boheman[3, 4]	Stem borer	At Bn Cu Ga	+++	High
Unidentified species 1	Uncertain	Co Pa	+	Low
Unidentified species 2	Uncertain	Co Pa	+	Low
Elateridae				
Unidentified species	Uncertain	Co Pa	+	None
Nitidulidae				
Prob. *Carpophilus* sp.[4]	Flower feeder	Cu	+++	Low
Scarabaeidae				
Unidentified species (Melolonthinae)	Uncertain	Co	++	None
DIPTERA				
Cecidomyiidae				
Unidentified species	Stem galler	Co	+	Low
HEMIPTERA				
Lygaeidae				
Unidentified species 1	Seed feeder?	Co	+	None
Unidentified species 2	Seed feeder?	Co Pa	+	None
Membracidae				
Unidentified species 1 [3, 4]	Sap sucker	At Co	++	Low
Unidentified species 2	Sap sucker	Co Pa	++	Low
Miridae				
Unidentified species[4]	Sap sucker	Cu	++	None
Pentatomidae				
Arvelius albopunctatus (De Geer)[4]	Sap sucker (fruits)	Cu	+++	None (pest)
Prob. *Nezara* sp.[4]	Sap sucker	Cu	+++	None (pest)
Pyrrhocoridae				
Unidentified species	Sap sucker	Cu	+	None
Tingidae				
Corythaica cyathicollis (Costa)[3, 4]	Sap sucker	At Bn Co	+++	None (pest)
Gargaphia decoris Drake[3, 4]	Sap sucker	At Co Cu	+++	High
LEPIDOPTERA				
Acrolepiidae				
Acrolepia xylophragma (Meyrick)[3, 4,5]	Leaf miner	At Bn Co Cu Ga Pa	+++	Low
Unidentified family	Leaf roller	At Pa	++	Low
THYSANOPTERA				
Unidentified species	Flower feeder	At Bn Co Pa	+++	Low

[1]Recorded in Curitiba (Cu) or the satellite towns/ districts of Almirante Tamandaré (At), Araucária (Au), Balsa Nova (Bn), Campo Magro (Cm), Colombo (Co) and Piraquara (Pa). More distant localities are Garuva (Ga) and Guaratuba (Gt).

[2]Abundance reflects average population levels, where + = very few individuals, ++ = low numbers of individuals and +++ = high numbers of individuals.

[3]Also collected on *S. granuloso-leprosum*.

[4]Previously collected on *S. mauritianum* in Argentina and Paraguay (Neser *et al*. 1990, Olckers *et al*. 2002).

[5]Already tested as biocontrol agent.

only one or two host plant species (S. Neser, pers. comm.). Consequently, only further host range evaluations will reveal the true host range, and potential for biological control, of the material collected on *S. mauritianum* in Curitiba.

This study represents the first cooperative project on biological control of weeds between Brazil and South Africa. Since several of South Africa's most problematic alien weeds originate from Brazil (Henderson 2001), this study has created opportunities for other cooperative biological control projects involving native Brazilian plants that are invasive in South Africa. Besides the obvious benefits for South Africa, there are also advantages for Brazil where biological control of weeds is still an emerging scientific discipline. Indeed, funding from South Africa coupled with the training of young Brazilian scientists has facilitated the development of scientific capacity on weed biological control in Brazil.

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