

Biological control of *Solanum mauritianum* Scopoli (Solanaceae) in South Africa: a review of candidate agents, progress and future prospects

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The South American tree *Solanum mauritianum* Scopoli (Solanaceae), naturalized in the higher rainfall regions of South Africa for over a century, was targeted for biological control in 1984. However, progress has been constrained by the problem of expanded host ranges of the candidate agents during host-specificity tests in quarantine. Despite identical problems in projects against the congeneric weeds *Solanum elaeagnifolium* Cavanilles and *S. sisymbriifolium* Lamarck, releases of insect agents on these two weeds in South Africa during the 1990s have set a precedent regarding the interpretation of routine host-specificity tests. This new approach of using risk assessments to overrule conservative evaluative methods has similarly advanced the prospects for releases on *S. mauritianum*. These developments influenced the introduction of several new candidate agents during 1994–1998, including defoliating, flower-feeding and stem-boring species. However, the recurrence of unacceptably broad 'physiological' host ranges in captivity has disqualified several of these and only one species, the leaf-sucking lace bug *Gargaphia decoris* Drake (Tingidae), was deemed suitable for release. Permission to release *G. decoris* was granted in early 1999. This paper reviews the biological control programme against *S. mauritianum*, including (i) the types of agents prioritized for release, (ii) those introduced and evaluated and (iii) procedures that may reduce the risk of rejection of otherwise suitable agents. Despite the inherent problems, prospects for the biological control of *S. mauritianum* have improved considerably.

Key words: *Solanum mauritianum*, biological weed control, insect agents, host specificity.

Solanum mauritianum Scopoli (bugweed, woolly nightshade; Fig. 1) is a perennial tree from South America that has become naturalized in Africa, Australasia, India and islands in the Atlantic, Indian and Pacific oceans, presumably via the Portuguese trade routes in the early 16th century (Roe 1972). The plant has been in South Africa for at least 135 years and has invaded agricultural lands, forestry plantations, riverine habitats and conservation areas, particularly in the higher rainfall regions (Fig. 2). The status of the weed in South Africa was reviewed by Olckers & Zimmermann (1991) and Olckers (1996). The success of the weed in South Africa is largely due to its excessively high fruit set and long-range seed dispersal by frugivorous birds, some of which prefer the fruit of *S. mauritianum* over those of indigenous plants. Control is dependent on chemical treatments, as mechanical control is ineffective on its own because of rapid regrowth from severed roots and stems. Although *S. mauritianum* is easily killed by herbicides, this is negated by the extent of current invasions and the rapid recruitment of bird-

dispersed seedlings in cleared areas. Biological control was thus invoked to augment conventional control methods and render integrated control sustainable.

Attempts at biocontrol of *Solanum* weeds in South Africa were reviewed by Nesar *et al.* (1990), Olckers & Zimmermann (1991) and Olckers (1996), but much of the focus was centred on *Solanum elaeagnifolium* Cavanilles and *S. sisymbriifolium* Lamarck (see Olckers *et al.*, this issue) and the problems constraining these programmes. The programme against *S. mauritianum* has also been plagued by problems relating to the host specificity of imported agents, in particular the well-documented phenomenon of expanded host ranges. The susceptibility of cultivated species of *Solanum*, in particular *S. melongena* Linnaeus (eggplant, aubergine) but also *S. tuberosum* Linnaeus (potato) to a lesser degree, has made releases of agents on *S. mauritianum* extremely difficult to justify. Despite these obstacles, agents have been established on the congeneric *S. elaeagnifolium* and *S. sisymbriifolium* since 1992 (Olckers 1996), with



Fig. 1

***Solanum mauritianum*.**

(Drawn by G. Condy, National Botanical Institute, Pretoria.)

spectacular results in the case of *S. elaeagnifolium* (Hoffmann *et al.* 1998; Olckers *et al.*, this issue). These recent developments have raised hopes of a solution for *S. mauritianum* and South Africa is currently the only country that has imported and tested biological control agents for this weed.

In this paper, the biological control programme against *S. mauritianum* in South Africa is reviewed, with special reference to (i) the types of agents that have been prioritized for release, (ii) the biologies, host specificity and prospects of all the insect agents that have been introduced and evaluated so far and (iii) procedures that may reduce the risk of rejection of otherwise suitable agents.

CANDIDATE AGENTS PRIORITIZED FOR RELEASE ON *S. MAURITIANUM*

Searches for potential agents of *S. mauritianum* were initiated in 1984 and were continued opportunistically for the next decade. Several short surveys were carried out in northeastern Argentina, southern Brazil, Paraguay and Uruguay, mostly in combination with surveys on other weeds of South American origin. Although these identified some 80 phytophagous species on *S. mauritianum* and closely related plants, very few were suitable for introduction (Neser *et al.* 1990). Indeed, a lack of demonstrable host specificity was experienced with the first three agents that were introduced

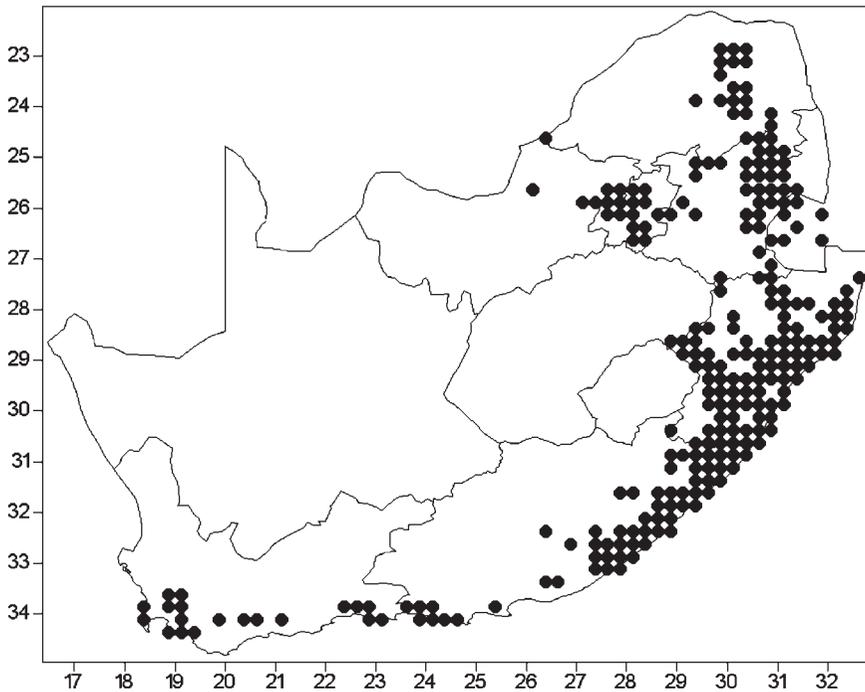


Fig. 2
Distribution of *Solanum mauritianum* in South Africa.

(Drawn by L. Henderson, Plant Protection Research Institute, Pretoria.)

and the project was later suspended in the early 1990s. However, there have been considerable advances since 1994, when the *S. mauritianum* programme was resumed. Since then, at least three collecting trips were carried out in South America, the most recent in early 1998.

The first three agents were opportunistically selected because of their relative abundance and obvious damage and not in any particular order of priority. However, since 1994, agents were prioritized according to their desired impact on weed populations. It has been proposed that agents that reduce fruit set or destroy seeds should be used as the first line of attack in a biocontrol programme (Hoffmann & Moran 1998) and this is particularly appropriate in this situation. The extremely high incidence of fruit set and seed dispersal of *S. mauritianum* populations in South Africa has necessitated the use of agents that reduce fruiting, as these can limit reinvasion and long-range seed dispersal. Flowerbud-feeding weevils were prioritized for this, but difficulties in culturing and testing temporarily shifted the focus to other promising species.

The high rate of vegetative growth of *S. mauritianum* plants also requires the use of agents that

can reduce growth rates as well as the density of existing populations. Defoliating insects with high reproductive and feeding rates and high rates of population increase were chosen for this particular purpose. Additionally, the stress of high herbivore loads and defoliation could indirectly reduce flowering and fruit set. The relative ease with which folivorous agents can be cultured and screened in quarantine permitted the first real progress after 14 years of effort. The availability of several stem-boring species has also provided the option of debilitating plants through structural damage, but these are more likely to be effective in the latter stages of the programme. Ultimately, the objective is to establish at least three agents representing the abovementioned feeding guilds so that the stress on plant populations is maximized (e.g. Hoffmann & Moran 1998). However, unique problems associated with clearing the agents for release on *Solanum* weeds have influenced the direction of research.

INTRODUCTION AND SCREENING OF CANDIDATE AGENTS

Some 15 insect species have so far been imported into quarantine in South Africa for observations

and screening as potential agents (Table 1). Two species were rejected before any tests were conducted because, once their identity was confirmed, they were linked to other plant species in South America. Six species were subjected to host-specificity tests but later rejected because of attacks on cultivated and native *Solanum* species, while only one species was deemed suitable for release. The remaining six species are still under consideration. The biology, host specificity and status of these candidate agents are reviewed below in the order of their introduction.

***Nealcidion bicristatum* (Cerambycidae)**

This stem-boring beetle was originally imported in 1984, but the cultures were destroyed when host records from Brazil (Silva *et al.* 1968) indicated a host range including several plant families and five cultivated species of Solanaceae. The authenticity of these records was later questioned and a colony of the beetles was reintroduced in 1995 for further observations. The adults are bark feeders and cause severe scarring of the stems. Eggs are inserted below the bark and early instar larvae initiate small surface tunnels. Later instars bore into the pith of the wood where they complete their feeding and development after six weeks. Adults emerge from the pupal cell after two weeks and chew their way out of the damaged stems. Larval damage weakens the plants structurally and causes branches to break off. The beetles were finally rejected because the adults fed on tomato and eggplant during exploratory choice tests and because recent host records from Argentina (di Iorio, pers. comm.) confirmed that they feed and develop on plants in families other than Solanaceae.

***Corythaica cyathicollis* (Tingidae)**

These lace bugs are particularly abundant in South America, where both adult and nymphal feeding causes extensive leaf damage. Also imported in 1984, the cultures were destroyed before any studies were initiated because of doubts about their host specificity (Olckers & Zimmermann 1991) and the insects were never reintroduced. Host records from Brazil (Silva *et al.* 1968) indicated that *C. cyathicollis* feeds on several genera of Solanaceae, including four cultivated species, and this was confirmed by surveys in Argentina in 1998 (Olckers & Gandolfo, unpubl.). Furthermore, recent studies in Florida, USA, aimed at evaluating their potential for release on *Solanum viarum* Dunal, have confirmed their unacceptably broad

host range (Medal, pers. comm.) and they will not be considered any further.

***Acrolepia xylophragma* (Acrolepiidae)**

Caterpillars of this tiny moth cause blotch mines that destroy the leaves of young, vigorously growing plants in shady habitats. The moths were imported on several occasions, starting in 1984, for biology studies and host-range evaluation (De Beer, unpubl.). Eggs are laid singly in the layers of leaf trichomes on the lower leaf surfaces. The neonates enter the leaves, causing small linear mines, which later assume the typical blotch form. The larvae are fully developed 15–17 days after oviposition and pupate within cocoons that are attached to either leaf surfaces, stems or objects on the soil surface. The moths emerge after 10 days and oviposit within a few days. Although the moths are restricted to the genus *Solanum*, larvae developed completely on several non-target species, including eggplant, potato and some native plants. Despite strong oviposition preferences for *S. mauritianum* during choice tests, some eggs were laid on these non-target species, making it very difficult to advocate release. Research was suspended in the early 1990s when the *S. mauritianum* project was temporarily discontinued. The moths will not be re-evaluated until agents with higher ratings and potentially narrower host ranges have been tested.

***Platyphora* spp. (Chrysomelidae: Chrysomelinae)**

The spectacular defoliation caused by chrysomelids released on *S. elaeagnifolium* in South Africa (Hoffmann *et al.* 1998; Olckers *et al.* this issue) led to the introduction of five species of *Platyphora* Gistel from South America in 1994 (Table 1). Besides having very localized distributions, all five species display very similar and highly specialized biologies in the field, including viviparity, monophagy and sensitivity to food quality and microhabitat (Olckers 1998, in prep.). Batches of larvae are deposited on the lower leaf surfaces and these pass through four instars lasting 16–18 days. The late instars burrow into the soil for pupation and adults emerge after 19–26 days.

Despite their specialized lifestyles and apparent monophagy in the field, all five species displayed considerably broader host ranges in captivity, which included eggplant, potato and several native *Solanum* species. These results contradict perceptions that *Platyphora* species associated with Solanaceae have very narrow host ranges and do

Table 1
Candidate agents that have been introduced into quarantine in South Africa for biological control of *Solanum mauritianum*.

Agent	Year	Origin	Damage	Status
<i>Corythaica cyathicollis</i> (Costa) (Tingidae)	1984	Argentina	Leaf-feeding	Rejected ¹
<i>Nealcidion bicristatum</i> (Bates) (Cerambycidae)	1984	Argentina	Stem-boring	Rejected ¹
	1995	Argentina		Rejected ²
<i>Acrolepia xylophragma</i> (Meyrick) (Acrolepiidae)	1984	Argentina	Leaf-mining	Rejected ³
<i>Platyphora conviva</i> (Stål) (Chrysomelidae)	1994	Brazil	Leaf-feeding	Rejected ³
<i>Platyphora biforis</i> (Germar)	1994	Brazil	Leaf-feeding	Rejected ⁴
<i>Platyphora nigronotata</i> (Stål)	1994	Brazil	Leaf-feeding	Rejected ⁴
<i>Platyphora paraguana</i> (Jacoby)	1994	Argentina	Leaf-feeding	Rejected ³
<i>Platyphora semiviridis</i> (Jacoby)	1994	Brazil	Leaf-feeding	Rejected ³
<i>Acallepitrix</i> sp. (Chrysomelidae)	1994	Brazil	Leaf-mining	Not cultured
	1997	Brazil		In culture, undergoing tests
	1998	Argentina		
<i>Gargaphia decoris</i> Drake (Tingidae)	1995	Argentina	Leaf-feeding	Released ⁴
<i>Anthonomus santacruzi</i> Hustache (Curculionidae)	1994	Argentina and Brazil	Flowerbud-feeding	Not cultured
	1995	Argentina		Cultured but lost
	1998	Argentina and Paraguay		In culture, undergoing tests
<i>Anthonomus morticinus</i> Clark	1998	Argentina and Paraguay	Flowerbud-feeding	Culture destroyed ⁵
<i>Adesmus hemispilus</i> (Germar) (Cerambycidae)	1995	Argentina	Stem-boring	Cultured but lost
	1997	Brazil		Under observation
<i>Conotrachelus squalidus</i> Boheman (Curculionidae)	1995	Argentina	Stem-boring	Not cultured
	1998	Argentina and Paraguay		Not cultured
<i>Collabismus notulatus</i> Boheman (Curculionidae)	1995	Argentina	?Shoot-galling	Not cultured
	1998	Argentina		Not cultured

1: not tested but rejected on the basis of host records.

2: accepted different genera of plants in the Solanaceae.

3: restricted to *Solanum* species but accepted potato, eggplant and many native species.

4: narrow host range in the genus *Solanum*, but accepted eggplant and some native species.

5: to prevent mixing with *A. santacruzi*.

not attack cultivated *Solanum* species in South America (Jolivet & Hawkeswood 1995; Jolivet, pers. comm.). Despite these obvious laboratory artefacts, all five *Platyphora* species were deemed unsuitable for release because of their broad 'physiological' host ranges but also because they seemed unlikely to establish over the entire range of *S. mauritianum* in South Africa (Olckers 1998).

***Gargaphia decoris* (Tingidae)**

Unlike *C. cyathicollis*, these lace bugs are particularly rare but also inflict extensive foliar damage. *Gargaphia decoris* was imported from Argentina in 1995 and has shown great potential during quarantine evaluations (Olckers, in prep.). Batches of up to 900 eggs are laid on the leaf undersides and neonates emerge after 10–14 days. The nymphs feed gregariously in large clusters and undergo five instars lasting 17–20 days before

moulting into adults. Newly-emerged females oviposit after three weeks and adults survive for several months, resulting in an overlap of generations and high rates of population increases. Extensive feeding causes the leaves to discolour, desiccate and abscise prematurely.

In contrast to the other agents evaluated so far, *G. decoris* has a narrow potential host range within the genus *Solanum* and is unable to survive on potato. Despite survival on eggplant and some native solanums, which were largely inferior hosts, *G. decoris* displayed very strong feeding and oviposition preferences for *S. mauritianum* in choice tests (Olckers, in prep.). Host records from South America (Silva *et al.* 1968; Cordo, pers. comm.) also provided no evidence of attacks on solanums other than *S. mauritianum*. Permission for the release of *G. decoris* was sought in 1998 and this was granted in February 1999.

***Anthonomus* spp. (Curculionidae)**

These flowerbud-feeding weevils occur throughout the range of *S. mauritianum* in South America where they contribute to the comparatively low levels of fruit set. Two species, *Anthonomus santacruzi* Hustache and *A. morticinus* Clark, have so far been identified although others may occur on *S. mauritianum*. Both species coexist in the field and have been collected at the same localities (Clark, pers. comm.). *Anthonomus santacruzi* is currently in culture.

The weevils were cultured and studied for the first time in late 1995, when a small founder colony of 18 adults was imported from Argentina. Earlier attempts at culturing failed because of excessive mortality during importations. The tendency of *S. mauritianum* plants to abort their flowerbuds in quarantine necessitates that developing larvae be transferred to fresh flowerbuds, rendering culturing labour-intensive. The weevils feed mainly on the flowers and flowerbuds, causing high levels of abortion, but also on the young leaves at the shoot tips. Eggs are inserted into the anthers of maturing buds and the developing larvae consume the entire bud contents. Usually one larva develops in a bud, but occasionally two or three larvae occur together. Feeding inhibits the opening of buds and the larvae complete their development in 10–18 days. The larvae pupate inside the excavated bud and adults emerge after 4–10 days. Although the culture was lost in 1997, the introduction of some 200 weevils from Argentina in 1998 has allowed host-specificity tests to commence.

Although there are several species of *Anthonomus* associated with Solanaceae, none are reported as pests of *Solanum* crops in South America (Silva *et al.* 1968; Clark & Burke 1996). During collections of insects associated with eggplant in Argentina in 1998 (Olckers & Gandolfo, unpubl.), there were no recoveries of weevils despite their presence on *S. mauritianum* growing adjacent to the cultivations.

Field studies on the host relationships of these weevils were initiated in Brazil in 1998, in cooperation with a local university, to provide further evidence of narrow host ranges in their natural habitats. Host-specificity tests in quarantine have so far indicated that the weevils are restricted to the genus *Solanum* and that, despite oviposition and development on native species, they may be suitable for release.

***Acallepitrax* sp. (Chrysomelidae: Alticinae)**

These small leaf-mining flea beetles are uncommon and occur mostly on *S. mauritianum* plants

growing in shaded or semi-shaded conditions. The beetles were first cultured in late 1997 when seven specimens, collected in southeastern Brazil for identification, fortuitously produced high numbers of offspring in quarantine. The beetle is considered to be an undescribed species of *Acallepitrax* Bechyne, near to *A. basilepta* Bechyne and *A. aegida* Bechyne, which also occur in southeastern Brazil (Furth, pers. comm.). Adults feed on the leaves, causing the 'shot hole' damage typical of flea beetles. Minute eggs are deposited in depressions made on the upper leaf surfaces and covered with frass. The neonate larvae tunnel into the upper epidermal layers and feeding by these and later instars causes serpentine leaf mines. The larvae develop in the leaves for 20–25 days and then vacate the mines and drop onto the soil for pupation. The prepupae burrow into the soil and adults emerge after 18–20 days. Extensive adult feeding and leaf mining causes abscission of leaves and early indications are that this species may also be able to suppress plant growth rates. Host-specificity tests have so far revealed that the beetles are restricted to *Solanum* species and that, despite some oviposition and development on native species, they may be suitable for release.

***Adesmus hemispilus* (Cerambycidae)**

These stem-boring beetles are uncommon and occur mostly on younger plants growing in shade or semi-shade. Only a few adults have been introduced into quarantine for preliminary observations. The adults, which damage leaves structurally by chewing out the midribs and veins, are solitary and act aggressively towards others except during mating. The females store sperm for lengthy periods and oviposit repeatedly, long after mating. During oviposition, the epidermal layers on sections of the stem are chewed away, eggs are inserted singly into the pith and the sites are covered with masticated plant material. The orange-coloured larvae are easily distinguished from the white larvae of *N. bicristatum* and spend 7–12 months boring inside the pith of the stems. The final instars construct a pupal cell in the tunnel from masticated wood fibres and the adults chew their way out after five weeks. *Adesmus hemispilus* currently has a low priority and is unlikely to be tested in the near future.

***Conotrachelus squalidus* (Curculionidae)**

Adults of these stem-boring weevils, which are abundant on *S. mauritianum* in South America, were first introduced in 1994. Although the

females oviposited in quarantine, the larvae were not reared to adulthood, possibly because they require the more succulent stems of younger plants or coppice and are not suited to older, woodier stems. The adults, which appear to be crepuscular or nocturnal, feed on the leaves, causing considerable damage. The eggs appear to be laid below the auricles and the resultant structural damage of the stem-boring larvae is comparable to that of the two cerambycids already discussed. Although biological data is limited, *C. squalidus* is the most promising of the stem borers. A small founder colony was reintroduced in early 1998 for further observations but this also failed to initiate a culture.

PROCEDURES FOR REDUCING AGENT REJECTION

The problems experienced with conservative host-specificity tests will always remain an obstacle in the clearing of agents for release against *S. mauritianum*. Expanded host ranges typical of agents evaluated so far have often included potato, a phenomenon not observed with agents tested on the other two *Solanum* weeds (Olckers *et al.* this issue) and which poses considerably greater problems than the instances of attacks on eggplant. Because of the very high agronomic status of potato, feeding on this crop inevitably results in the agents being rejected. Despite these problems, realistic interpretation of the results generated by different testing procedures and the use of quantified risk assessments can provide justification for overruling obvious laboratory artefacts and advocating releases of apparently non-specific agents.

Interpretation of results

There have been several attempts to develop testing procedures that minimize the likelihood of ambiguous results (*e.g.* Wapshere 1989, Clement & Cristofaro 1995). In reviewing the behavioural phenomena that affect the results of current testing methods, Marohasy (1998) proposed a new, but as yet untested, approach that compensates for the behavioural mechanisms that influence host location and acceptance. Although this method may yield the desired results in most situations, there is always the possibility that weeds with several congeneric relatives (*e.g.* *S. mauritianum*) will remain problematic. In any event, the traditional testing procedures (starvation and choice tests) provide strong evidence of host suitability, even though this may represent a

'worst case' scenario. Ultimately, interpretation of the spectrum of results obtained becomes paramount and agents should not be rejected on the basis of negative results obtained during one type of test only. Fortunately, the regulatory authorities in South Africa have so far been amenable to the arguments presented in explanation of ambiguous results (Olckers *et al.*, this issue).

In the case of *Solanum* weeds, much emphasis has been placed on host records from the agents' country of origin and the results of choice tests on closely related test species. Starvation tests have been conclusive in the case of test species that are either unrelated (different families) or distantly related (other genera) to the target weed, since these have clearly demonstrated that the agents are not polyphagous. So far, survival on agronomic *Solanum* species during starvation tests has not resulted in the rejection of agents, provided that they display strong feeding and oviposition preferences and avoid the crops during choice tests (Olckers *et al.* this issue).

Studies on priority agents in their country of origin, including open-field tests (Clement & Cristofaro 1995), can also provide strong evidence of host specificity. For example, Balciunas *et al.* (1996) demonstrated that a stem-boring weevil, which displayed a broad 'physiological' host range in laboratory tests, had a narrow realized host range in the field, allowing it to be released on *Hydrilla verticillata* (L.f.) Royle in Florida, USA. Field studies on the flowerbud-feeding weevil (*A. santacruzi*) in southern Brazil, in which its field host range and the incidence of attacks on cultivated solanums is currently under investigation, could similarly facilitate its release in South Africa.

Risk assessments

Potential risks that might accompany the release of agents must be thoroughly assessed and weighed against future predictions of the weed's impact. Although ecological risks, notably attacks on native plants, are difficult to predict (*e.g.* Louda *et al.* 1997), these should be acknowledged and addressed. In this respect, preintroduction surveys have provided considerable information on the insect herbivore communities associated with exotic, native and cultivated species of *Solanum* in South Africa (Olckers & Hulley 1989, 1991, 1994, 1995; Olckers *et al.* 1995) that can facilitate such predictions. For example, the fact that very few of the native solanaceous insects attack *S. mauritianum* in South Africa (Olckers & Hulley 1989, 1991, 1995), despite its abundance, provides some justi-

fication for arguing that imported agents are also unlikely to exploit and inflict serious damage on native *Solanum* species.

In an attempt to quantify potential risks, Wan & Harris (1997) developed a scoring system whereby an insect's performance on a non-target plant, during different stages of the host selection process, is measured as a proportion of its performance on the natural host. The product of the different measurements indicates that sequential reductions in fitness on a non-target plant, at each stage of the selection process (*e.g.* feeding, oviposition, survival), should select against that plant's utilization. This system incorporates all of the standard evaluative tests, both conservative and otherwise, and thus provides a balanced perspective based on all available data. This protocol was used to assess the lace bug *G. decoris* and indicated that, despite an expanded host range, the risks to non-target *Solanum* species were extremely low (Olckers, in prep.). This approach may thus provide a solution to the conservative nature of host-specificity testing.

Ultimately, post-release evaluations of agents already established on other *Solanum* weeds in South Africa should provide the strongest evidence, by demonstrating that earlier predictions about their safety have been realized.

CONCLUSIONS

The biological control programme against *S. mauritianum* in South Africa has been ongoing for some 14 years, but progress has been limited compared to that on other *Solanum* weeds (Olckers *et al.* this issue). This was largely caused by the opportunistic nature of the programme during its first 10 years and the unique problems that have plagued all programmes against *Solanum* weeds for more than two decades. However, advances made with the *S. elaeagnifolium* programme, and subsequently with that against *S. sisymbriifolium*, have intensified the efforts on *S. mauritianum* since 1994. The suite of potential agents that are available for evaluation includes several promising species (Table 1) and it is believed that a complex of flowerbud feeders, defoliators and stem borers need to be established in South Africa to ensure biological control of *S. mauritianum*. Indeed, the programme against *Sesbania punicea* (Cav.) Benth. in South Africa, where the sequential release of three agents (a flowerbud feeder, seed feeder and stem borer) resulted in complete biological control, has provided an exemplary case history (Hoffmann & Moran 1998). The prospects for

biological control of *S. mauritianum* thus appear promising.

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