

SAPIA NEWS

SOUTHERN AFRICAN PLANT INVADERS ATLAS

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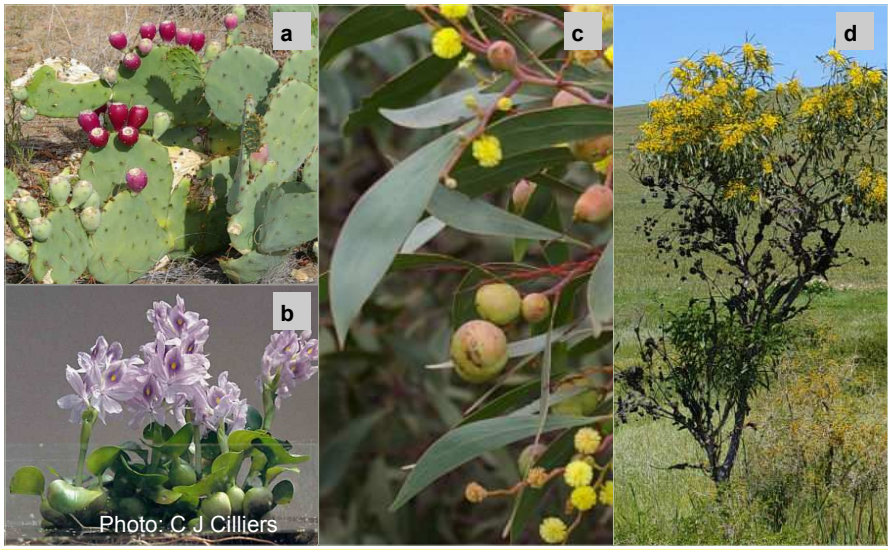
21st SAPIA News celebrates Biological Control of Invasive Alien Plants in South Africa

This issue of SAPIA News marks the 21st newsletter in the current series which began in October 2006. As a means of celebration, SAPIA News highlights the achievements and progress with the Biological Control of Invasive Alien Plants (IAPs) in South Africa which were recently published in a special edition of the journal *African Entomology*.

South Africa is regarded as one of the world leaders in the field of biological weed control, which is the use of natural enemies such as insects, mites and pathogens, to reduce the vigour or reproductive potential of an invasive alien plant. Natural enemies that are used for biological control are called biocontrol agents. Since the start of the first weed biocontrol programme in South Africa, biological control agents have resulted in the complete control of 10 (21 %) of the 48 plant species on which agents have become established, and in substantial levels of control in 18 (38 %) of the cases.

Biocontrol research has been supported by the Working for Water Programme of the Department of Water, and now Environmental, Affairs for the last 15 years.



Remarkable successes have been achieved with either controlling or reducing the invasive potential of many invasive plants particularly cacti (**photo a**), aquatic weeds (**photo b**) and Australian acacias (**photos c & d**).

Fact sheets with information and photos of more than 300 species are accessible at the Weeds and Invasive Plants website: www.agis.agric.za/wip

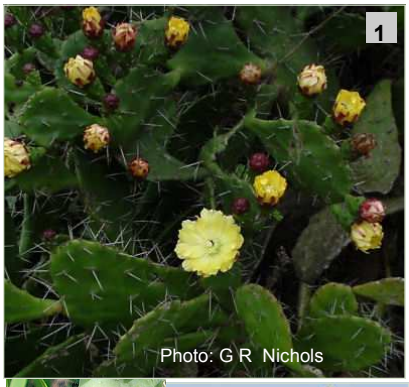
Requests for information from the SAPIA database and submission of records of invasive plants should be sent directly to Lesley Henderson at L.Henderson@sanbi.org.za.

SAPIA newsletters are posted at the ARC website: www.arc.agric.za
under 'News Articles'.

Biological control of Invasive Alien Plants in South Africa: Introduction and History

Compiled by Lesley Henderson largely from papers in *African Entomology* 19 (2)

The first biological control project against an invasive alien plant was that against the drooping prickly-pear, *Opuntia monacantha* (**photo 1**), previously known as *O. vulgaris*, that had formed extensive infestations along the coast from Cape Town to KwaZulu-Natal. A cochineal insect species was introduced in 1913 which caused widespread destruction of the pest plants and today, almost 100 years on, this continues to be an example of a completely successful biocontrol project. One of the most spectacularly successful projects was that against the sweet prickly pear, *Opuntia ficus-indica* (**photo 2**), which started in the 1920s. Impenetrable forests of this cactus which extended over about 1 million hectares in the Eastern Cape were reduced to 10% of their former abundance through a biocontrol programme using the prickly pear moth and cochineal.



The biocontrol of red water fern, *Azolla filiculoides* (**photos 3a & 3b**), using the frond-feeding weevil, *Stenopelmus rufinasus,* starting at the end of 1997, exceeded all expectations, with the dramatic collapse of dense mats and local extinctions of the weed from the majority of sites. Today red water fern is no longer a significant problem and where it occurs, the biocontrol agent is usually present. Biocontrol of red water fern is now widely regarded as the most successful biocontrol programme against an invasive alien plant in South Africa.

South Africa is rated amongst the world leaders in the biological control of invasive alien plants and this work is **reviewed in a special edition of *African Entomology*, 19(2), published in August 2011.** This volume comprises 29 papers, 24 of which provide accounts of recent (emphasising the period from 1999–2010) biocontrol projects against individual IAPs or against taxonomically– or functionally-related groups of species. The remaining 5 papers deal with an introduction; regulations and risk assessment; mapping (SAPIA project); cost-benefit analyses; and a catalogue of all the target plants, and of the insects, mites and pathogens implicated since 1913.

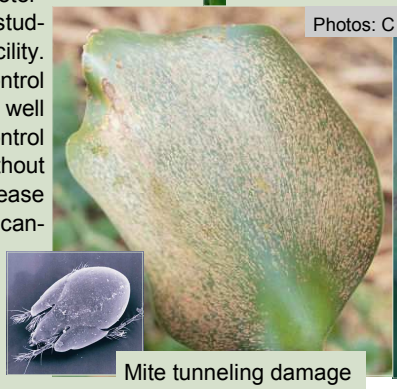
How does biocontrol work and is it safe?

Biological weed control is the **use of natural enemies** to reduce the vigour or reproductive potential of an invasive alien plant. The principle is that plants often become invasive when they are introduced to a new region without any of their natural enemies. The alien plants therefore gain a competitive advantage over the indigenous vegetation, because all indigenous plants have their own natural enemies that feed on them or cause them to develop diseases. Biological control is an attempt to introduce the alien plant's natural enemies to its new habitat, with the assumption that these natural enemies will remove the plant's competitive advantage until its vigour is reduced to a level comparable to that of the natural vegetation.

Insect feeding damage on Water Hyacinth

Photos: C J Cilliers

The **potential risk** posed by a candidate biocontrol agent is determined by biocontrol researchers through extensive host range studies (specificity tests) that are carried out in a quarantine facility. These trials determine the range of plants that a potential biocontrol agent is able to use as host plants throughout its life cycle, as well as its host plant preferences. Permission to release a biocontrol agent will be sought only if the host-specificity tests prove without doubt that the potential agent is sufficiently host-specific for release in this country. To be regarded as sufficiently host-specific, the candidate agent must be either monophagous (i.e. the insect feeds on only one plant species, the target weed in this case) or it could have a slightly wider host range, provided that none of the additional host plants occur in South Africa or surrounding countries, either as indigenous or introduced crop plants.



Mite tunneling damage

Pathogen damage

Biological Control of IAPs: Achievements and Progress

Species under complete biocontrol (no other control measures are needed to reduce the weed to acceptable levels, *at least in areas where the agents are established)*:

the floating aquatics—red water fern, *Azolla filiculoides* (**photo 1***),* water lettuce, *Pistia stratiotes* (**photo 2**)*,* salvinia, *Salvinia molesta* (**photo 3**)*;* creeping crofton weed, *Ageratina riparia;* queen of the night cacti, *Cereus jamacaru* (**photo 4**) and *C. hildmannianus;* chainfruit cholla, *Cylindropuntia fulgida* var. *fulgida* (**photo 5**)*;* pencil cactus, *Cylindropuntia leptocaulis;* moon cactus, *Harrisia martinii* (**photo 6**)*;* St John's Wort, *Hypericum perforatum* (**photo 7**)*;* and red sesbania, *Sesbania punicea* (**photo 8**).


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Photo: C J Cilliers


3
Photo: C J Cilliers


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stem-sucking mealybug deforms growth tips, prevents flowering and eventually kills the plant

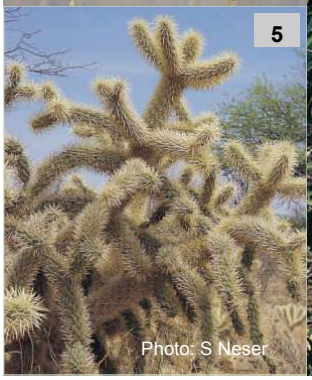
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Photo: S Neser


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Photo: S Neser


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Photo: S Neser


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Species under substantial control (other methods are needed to reduce the weed to acceptable levels, but less effort is required i.e. less frequent herbicide applications or less herbicide needed per unit area) include, amongst others:

the Australian acacias—red eye/rooikrans, *A. cyclops;* long-leaved wattle, *A. longifolia*; blackwood, *A. melanoxylon;* golden wattle, *A. pycnantha* (**photo 9**) and Port Jackson, *A. saligna;* the aquatics—water hyacinth, *Eichhornia crassipes* (**photo 10**) and parrot's feather, *Myriophyllum aquaticum;* silky hakea, *Hakea sericea* (**photo 11**)*;* silver-leaf bitter apple/satansbos, *S. elaeagnifolium* (**photo 12**)*;* the cacti—jointed cactus, *Opuntia aurantiaca;* imbricate prickly pear, *Cylindropuntia imbricata;* Australian pest pear, *Opuntia stricta* (**photo 13**); sweet prickly pear, *O. ficus-indica;* drooping prickly pear, *O. monacantha;* small round-leaved prickly pear, *O. engelmannii;* and some varieties of lantana, '*Lantana camara'* hybrid complex.


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A gall wasp induces formation of galls instead of flowers and pods


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Photo: C J Cilliers


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Biological control of IAPs contin.

Species under negligible control (in spite of damage inflicted by the agents, control of the weed remains entirely reliant on other control measures) include amongst others:

bugweed, *Solanum mauritianum* (**photo 14**)*;* pereskia, *Pereskia aculeata* (**photo 15**)*;* Mauritius thorn, *Caesalpinia decapetala* (**photo 16**)*;* cat's claw creeper, *Macfadyena unguis-cati* (**photo 17**)*;* mesquite, *Prosopis* spp; some varieties of lantana, '*Lantana camara'* hybrid complex (**photo 18**); green wattle, *Acacia decurrens;* Australian myrtle, *Leptospermum laevigatum.*


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Photo: G R Nichols


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Species for which control has not been determined (either the release of agents has been too recent for meaningful evaluation or the programme has not been evaluated) include amongst others:

black wattle, *Acacia mearnsii* (**photo 19**)*;* silver wattle, *Acacia dealbata* (**photo 20**)*;* pearl acacia, *Acacia podalyriifolia;* chromolaena, *Chromolaena odorata* (**photo 21**)*;* parthenium, *Parthenium hysterophorus* (**photo 22**)*;* yellow bells, *Tecoma stans* (**photo 23**)*;*


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Photo: L Fish


23

New investigations (biocontrol agents are still being evaluated for host-specificity; no releases have yet been made) include amongst others:

pompom weed, *Campuloclinium macrocephalum* (**photo 24**)*;* yellow and red Mexican sunflowers, *Tithonia diversifolia* (**photo 25**) *& T. rotundifolia* (**photo 26**)*;* balloon vine, *Cardiospermum grandiflorum* (photo **27**)*;* Madeira vine, *Anredera cordifolia* (photo **28**)*;* hydrilla, *Hydrilla verticillata;* pepper tree wattle, *Acacia elata.*


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Photo: H Klein


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Photo: S Neser

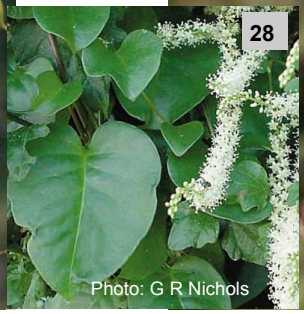
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Photo: G R Nichols

Integration of Biological Control with other Control Methods.

Biological control is often perceived as an alternative to mechanical and/or chemical control (clearing operations), and that either one or the other should be employed to control IAPs in any particular area. However, as this edition of SAPIA News has illustrated, biocontrol to date can provide complete control for only 10 IAPs, and the remainder depend on additional methods of control to reduce the weeds to acceptable levels. The integration of biological, mechanical and chemical control methods should be a logical choice yet there are few cases where an integrated management approach has been adopted in South Africa. This topic is discussed in the May/June edition of *Environmental Management* by Alan Wood of ARC-PPRI. (**Wood, A. 2011. Integrated control of alien invasive weeds. Clearing operations and biological methods. *Environmental Management* 6(4): 17–18.**).

Important points made by Wood (2011):

- Integration uses the benefits of each method in an additive or synergistic way to achieve sustained effective control with lower costs.
- Biocontrol agents should be established in a weed stand **before** well-managed clearing operations are implemented
- Where biocontrol reduces weed density (by damage to vegetative structures), the cost of initial clearing will be reduced; where biocontrol reduces the seed bank (by damage to the reproductive structures), the follow-up operations are cheaper and more effective
- Even biocontrol agents that appear to do little damage on their own provide a significant benefit in an integrated operation

Selected references from *African Entomology* 19(2):

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Henderson, L. 2011. Mapping of invasive alien plants: The contribution of the Southern African Plant Invaders Atlas (SAPIA) to biological weed control. *African Entomology* 19(2): 498–503.

Impson, F.A.C., Kleinjan, C.A., Hoffmann, J.H., Post, J.A. & Wood, A.R. 2011. Biological control of Australian *Acacia* species and *Paraserianthes lophantha* (Willd.) Nielsen (Mimosaceae) in South Africa. *African Entomology* 19(2): 186–207.

Klein, H. 2011. A catalogue of insects, mites and pathogens that have been used or rejected, or are under consideration, for the biological control of invasive alien plants in South Africa. *African Entomology* 19(2): 515–549.

McConnachie, A.J., Retief, E., Henderson, L. & Mc Kay, F. 2011. The initiation of a biological control programme against pompom weed, *Campuloclinium macrocephalum* (Less.) DC. (Asteraceae), in South Africa. *African Entomology* 19(2): 258–268.

Moran, V.C., Hoffmann, J.H. & Hill, M.P. 2011. A context for the 2011 compilation of reviews on the biological control of invasive alien plants in South Africa. *African Entomology* 19(2): 177–185.

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Urban, A.J., Simelane, D.O., Retief, E. Heystek, F., Williams, H.E. & Madire, L.G. 2011. The invasive '*Lantana camara* L.' hybrid complex (Verbenaceae): a review of research into its identity and biological control in South Africa. *African Entomology* 19(2): 315–348.

Zachariades, C., Strathie, L.W., Retief, E. & Dube, N. 2011. Progress towards the biological control of *Chromolaena odorata* (L.) R.M.King & H.Rob. (Asteraceae) in South Africa. *African Entomology* 19(2): 282–302.

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The Weeds Research Programme of the ARC-Plant Protection Research Institute is responsible for research on the ecology and control of invasive alien plants in South Africa. .

- Biological control
- Chemical control
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