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General News

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Revisited Taxonomy Provides New Option for *Cactoblastis* Control in North America

A taxonomic study in Argentina coinciding with a renewal of efforts to contain the cactus moth, *Cactoblastis cactorum*, in North America have led to a parasitoid from *C. cactorum*'s home range being considered as part of a new collaborative programme to mitigate the impacts of the moth in North America.

Cactoblastis cactorum, a 'poster child' from the early era of classical biological control, originates from southern South America; its caterpillars feed gregariously inside the pads (the modified stems, or cladodes) of prickly pear cactus (*Opuntia* spp.), hollowing them out, and completely destroying plants by direct herbivory and associated pathogenic decay. Long after its first, spectacular success in Australia, the moth was introduced to the island of Nevis in the Caribbean in 1957 to manage weedy native cactus species. Unforeseen at that time was its spread to other Caribbean islands and eventually North America. It is easy to be wise in hindsight, but at the time of release the insect was thought to be a poor flyer and the risk of the moth spreading in the Caribbean, let alone North America, was considered low. *Cactoblastis cactorum* was found attacking rare and endangered *Opuntia* species in the Florida Keys in 1989, the first time it had been detected on the North American continent.

Over the next 15 years the moth spread at rates of up to 100 miles (160 km) per year along the US Atlantic and Gulf coasts, north to South Carolina and west into Alabama. The westward spread took it towards the centre of *Opuntia* biodiversity. *Opuntia* cacti are dominant key components of many arid areas in the southwestern USA and throughout Mexico, minimizing erosion and providing food and habitat for a wide variety of vertebrates and invertebrates. Thirty-one species of *Opuntia* are at risk of attack in the southwestern USA, including nine endemic and six designated rare or endangered species. Mexico is the centre of endemism for *Opuntia* and has 54 species at risk, 38 of which are endemic. In addition, *Opuntia* has commercial and cultural value in Mexico. Clamours of concern including publications from expert scientists highlighting the immediacy of the threat from the rapidly spreading moth helped to raise awareness and in 2006 a collaborative control programme* was initiated with the aim of containing the moth.

This programme employed sanitary measures, comprising removal of infested plants and restriction of plant movements, developed the sterile insect technique (SIT) and researched pheromone disruption approaches. Although the cactus moth continued to creep westwards, reaching Louisiana in 2009, programme measures reduced established populations on Mississippi and Alabama barrier islands, in Louisiana bayous, and along the northwest Gulf coast of Florida, considerably slowing the moth's western progress. In addition, the only incursion so far in Mexico – on the offshore islands of Mujeres and Contoy, potentially hurricane-related – were eradicated. SIT has a proven track record of containing pests, but only when implemented on an area-wide basis, which is expensive. SIT is not self-sustaining, and funding levels for cactus moth were insufficient to carry out such a programme indefinitely. With SIT cancelled, the only operational management tactic was the removal of infested cactus pads or whole plants.

However, development of pheromone-based control tactics was continued by the United States Department of Agriculture – Agricultural Research Service (USDA-ARS) and supported by USDA-APHIS (Animal and Plant Health Inspection Service). In reviewing the cactus moth programme, the teams involved looked at what other complementary measures were available to allow them to develop sustainable control tactics to minimize long-term impacts of the moth on native desert ecosystems and in commercial cactus production areas.

One control option being reconsidered in collaboration with Argentine colleagues was the potential for a classical biological control programme. Although a braconid has commonly been recorded attacking *C. cactorum* in its home range, long-standing taxonomic work dating back to 1953 had established that the parasitoid was associated with many cactus-feeding moth species, ruling it out as a biocontrol agent. From 2008, work re-evaluating parasitoids was undertaken by scientists from USDA-ARS, in collaboration with the Fundación para el Estudio de Especies Invasivas (FuEDEI) near Buenos Aires, Argentina, and funded by USDA-ARS and USDA-APHIS. As a result, in 2012, Martínez and coauthors published a revision of *Apanteles* parasitoids of cactus-feeding moths based on material collected during five years' extensive sampling of these moths and their parasitoids in central and northern Argentina. Both morphological and molecular evidence allowed them to split the apparently polyphagous species *A. alexanderi* into two species, and they described a new species, *A. opuntiarum*, which they recorded only from *C. cactorum*. This specificity held for *C. cactorum* material collected from six other *Opuntia* species. Subsequent field studies in Argentina found that when another cactus-feeding species and *C. cactorum* were feeding on the same *Opuntia* plant, *A. opuntiarum* parasitized only *C. cactorum*. The newly described species thus provides an option that had been previously lacking: a common and, on the basis of field records, host-specific, coevolved natural enemy of *C. cactorum* from its area of origin.

The refocused *C. cactorum* programme started in 2013, again as a regional collaborative venture

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involving largely the same teams as before. It includes biological control and pheromome approaches with the aim of developing a coordinated strategy for mitigating *C. cactorum*. The primary tactics under development are biological control with *A. opuntiarum* and the disruption of both adult and larval pheromone communication systems. The hope is that the introduced natural enemy will permanently limit *C. cactorum*'s population growth, which is particularly valuable for protecting *Opuntia* in natural areas, while the pheromone-based management tactics will provide a cost-effective means of minimizing damage in commercial cactus plantations.

Preliminary field trials with an adult female sex pheromone identified and developed under the previous programme had indicated its promise for use in mating disruption. Additional pheromone improvement and testing in 2010–11, in collaboration with a Mexican colleague, led to field trials in Argentina in 2013, which showed that a synthetic adult attractant reduced both mating and oviposition in plantation settings. Dispensers and release methods have been investigated to determine optimum deployment parameters, with the strategy tested giving active mating disruption throughout a moth flight period (4–6 weeks). In 2015, trials are being carried out in two large plantations in Argentina to assess the impact of mating disruption over several generations. Successful mating disruption will reduce the number of fertile eggs laid. To complement this, development of a larval trail-following pheromone could help disrupt larval aggregation and reduce (even prevent) the number of larvae that become established in pads. Larval mandibular secretions were identified to function as a larval trail-following pheromone and, while still in the very early stages of development, showed promise as a potential management tool for commercial and urban settings. Research on how these or analogues that are simpler to manufacture might be utilized for aggregation disruption is continuing under the new programme with the aim of producing an affordable product to deter larvae from infesting pads.

The classical biological control component began in March 2013 when *A. opuntiarum* material was received by Florida Department of Agriculture and Consumer Services, Division of Plant Industry (FDACS-DPI) quarantine laboratory in Gainesville from FuEDEI, to allow host-specificity testing of the parasitoid on non-target native North American cactus-feeding moths. This work was given a flying start by the expertise acquired on rearing *C. cactorum* during SIT development: 2000–3000 *C. cactorum* per week can be produced on artificial medium to maintain the parasitoid colony and for host-range testing. Nevertheless, testing *A. opuntiarum* has come up against some hurdles. The health of the Florida quarantine parasitoid colony and its sex ratio have been causes for concern. Modifying the rearing procedures has helped to restore a sex ratio closer to 1:1, while regular integration of new stock from Argentina has allowed a viable colony to be maintained and with increased genetic diversity.

Bringing stability to the parasitoid colony has allowed host-range studies to assess the safety of the parasitoid for the complex of cactus-feeding moths in North America to proceed, but this is also proving a little tricky. *Cactoblastis cactorum*'s gregarious habit is not shared by most of the native cactus moths, so collecting sufficient material during survey trips has proved a challenge. In addition, handing the native moth larvae in quarantine is not straightforward as, once removed from the cactus pads they bored into when they hatched, the larvae are not so keen to bore again, so a good deal of effort has gone into developing rearing and testing protocols/methods. At this stage, the efforts are looking worthwhile with extremely promising test results suggesting that the parasitoid will not attack North American cactus-feeding moths, nor other non-target moths tested so far. Further collecting trips, including to areas yet to be surveyed, are planned for 2015 and testing is expected to continue into 2016. In addition, more field collections of cactus-feeding caterpillars will be made in Argentina to acquire as much information as possible on the field host range of *A. opuntiarum*. Also, splitting a species into two throws up questions about historical records of host associations, so a museum study of larval hosts documented as parasitized by *A. alexanderi* needs to be conducted. If all the results confirm the specificity of *A. opuntiarum*, a request for field release could be made in 2016 and field releases as early as 2017. Similar to *C. cactorum*'s spread to the USA from the Caribbean islands (where it was welcome as a biocontrol agent), the risk and implications of *A. opuntiarum* spreading to the Caribbean islands will be addressed in the petition for release.

**From its inception in 2006, the cactus moth management programme has been a cooperative effort between USDA-APHIS, USDA-ARS, Gulf Coast state departments of agriculture, including Florida, Alabama, Mississippi, Louisiana and Texas, and Mexico's Secretaría de Agricultura, Ganadería, Desarrollo Rural, Pesca y Alimentación (SAGARPA). USDA-APHIS developed regulations to prohibit shipments of cactus nursery stock from states and countries that have the cactus moth to minimize the spread of this insect in the USA. In the new programme, pheromone trials are being carried out in collaboration with the State University of New York, Cortland (larval control) and FuEDEI (mating disruption), and biological control research with FuEDEI and FDACS-DPI.*

Prepared from programme documents with input from Trevor Smith, FDACS-DPI
(trevor.smith@freshfromflorida.com),
Stephen Hight USDA-ARS
(stephen.hight@ars.usda.gov) and
Ken Bloem, USDA-APHIS
(Kenneth.Bloem@aphis.usda.gov)

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The Mistflower White Smut Fungus in Australia: a Star Biocontrol Agent

The white smut fungus *Entyloma ageratina* (ex Jamaica) was released in Hawai'i in the 1970s for the biological control of mistflower (*Ageratina riparia*), a perennial herbaceous alien plant. Its impact on the weed population was spectacular and control of mistflower has been maintained to this day. The fungus was later introduced from Hawai'i to South Africa (in 1989) and New Zealand (in 1998). A field study in New Zealand demonstrated similar highly effective control of mistflower by the fungus and a subsequent increase in plant diversity. On 21 October 2010, the mistflower white smut fungus was found in southeast Queensland (QLD), Australia. The pathway of introduction is unknown.

In Australia, mistflower primarily invades wet habitats, particularly riparian areas and moist cliff faces of the eastern coast. In subtropical habitats it grows through most of the year, setting abundant white composite flowers in late-winter. In Australia and elsewhere, it is primarily a problem in mid-high elevation rainforest areas where it creates a canopy over headwater streams and displaces native riparian plant species. It can also be a problem in wet meadows where it reduces forage quality for livestock.

Field surveys performed in the nine months following the first detection of the fungus revealed that it was widespread in southeast QLD and North Coast and Mid-North Coast of New South Wales (NSW), but not present further north and south. This widespread distribution indicated that the fungus had possibly been in Australia for a while prior to the first record and had had the opportunity to naturally spread to other mistflower-infected sites. Nonetheless, we cannot rule out the possibility of human-mediated movement of infected material across this wide region soon after its accidental or deliberate illegal introduction to Australia.

Host-specificity testing of the fungus, primarily on plant species closely related to mistflower that had not been tested before by researchers in other countries, including the two Australian native *Adenostemma* spp., was undertaken. Of the 17 species tested, only the congener Crofton weed (*Ageratina adenophora*) developed disease symptoms, albeit to a much lesser extent than mistflower. Once confirmation was obtained that there were no intra-state restrictions to the movement of this fungus in NSW, eight strategic releases of the fungus to non-infected mistflower sites were made in May 2011.

The direct impact of the fungus on mistflower and the flow-on impact on associated plant communities were monitored at eight sites in NSW and three in QLD until July 2012. There was more than 60% decrease in percentage cover of mistflower across sites, with a corresponding increase, by also more than 60%, of the percentage cover of other plant species. Within a very short timeframe, the fungus showed its great potential as a highly effective and self-sustaining control method for mistflower across its range. Since then the fungus has developed recurrent severe epidemics on mistflower in regions that have not been affected by drought. For example, in Kangaroo Valley, south of the Sydney region, entire mistflower infestations have disappeared and have been replaced by native plant communities.

The research, in collaboration with Dr Shon Schooler (ex CSIRO), was supported by the NSW Government through its Environmental Trust and seed funding from the Lake Baroon Catchment Care Group and the Sunshine Coast Regional Council to support activities in Queensland.

By: Louise Morin, CSIRO Biosecurity Flagship, Canberra ACT, Australia.
Email: Louise.Morin@csiro.au

Salute to Fortitude: White Admiral Released against Japanese Honeysuckle in New Zealand

The endemic Honshu white admiral butterfly (*Limenitis glorifica*) from Japan, released against Japanese honeysuckle (*Lonicera japonica*) in New Zealand in October 2014, is the first biocontrol agent to be released against the invasive vine anywhere in the world. An application for the release of a second agent, the longhorn beetle *Oberea shirahatai*, was lodged in early 2015.

Native to Japan, China and the Korean peninsula, Japanese honeysuckle was introduced to New Zealand as an ornamental in the nineteenth century. The hardy, perennial, rapidly-growing vine spreads by rhizomes, above-ground runners, and also seeds. Its twining stems allow the plant to form thick, tangled curtains that completely overgrow small trees and shrubs and can cause canopy collapse, while runners allow it to spread across open ground. Uncontrolled infestations ultimately lead to reduced biodiversity with native seedlings unable to establish beneath the dense growth. First reported as naturalized in New Zealand in 1926, in the last decade it has become a weed of concern, particularly in North Island where it is increasingly troublesome in many habitats including shrubland, woodland, forest margins and wetlands/riparian areas, and it grows rampantly in urban situations and along hedgerows and roadsides. The existing widespread but often isolated infestations frequently have their origin in dumped garden refuse; plant fragments, which may also be carried by animals or on machinery, easily take root. A recent apparent upsurge in new infestations may be associated with an increase in bird-aided seed dispersal. In the past the plant has set relatively few seeds in New Zealand. Japanese honeysuckle is an obligate outcrosser, which means it cannot self-pollinate and only sets seed if it is pollinated by an unrelated plant. When Japanese honeysuckle was less common, unrelated plants had a low chance of pollinating each other, as bumblebees (the main pollinator in New Zealand) did not fly the long distances between plants, and so this climber rarely set seed. However, now that Japanese honeysuckle is more common, pollinators are more frequently encountering unrelated plants and pollination success has increased. This means that the lag phase for Japanese honeysuckle is well and truly over and it is expected to start spreading much more quickly.

A classical biological control programme was initiated by Landcare Research in 2004–05 and surveys in Japan to investigate candidate biocontrol agents began in 2007 with considerable logistical assistance from scientists at the National Institute of Agro Environmental Sciences at Tsukuba. It was recognized that a suite of agents would be necessary; requirements were for natural enemies to remove a significant proportion of foliage annually to lessen shading impacts and to reduce productivity and thus limit expansion of infestations. Existing literature indicated that two white admiral butterflies (*Limenitis camilla* and *L. glorifica*) feed on *Lonicera japonica* in Japan; both have narrow host-ranges, but *Limenitis camilla*, which is widespread in Eurasia, is reported to have a broader host-range than *L. glorifica*, which is endemic but widely distributed in the island of Honshu, where it is considered to be a specialist defoliator of *Lonicera japonica*. Host-range studies were planned by Landcare Research to investigate this further, and *Limenitis glorifica* was imported into containment in New Zealand, but here the project hit its first hurdle because – not unusually – it proved impossible, even with a spacious butterfly rearing house and international expert help, to persuade the butterflies to mate in captivity; butterflies tend to have complex mating, host plant selection and oviposition behaviours.

Two natural disasters then intervened. In September 2010, the first earthquake of a sequence that destroyed much of Christchurch, caused system failures in Landcare Research's containment facility at Lincoln and colonies of the butterfly, along with the second candidate beetle agent, were lost owing to overheating. Six months later came the earthquake and tsunami that overwhelmed the northeastern coast of Honshu in March 2011. While Japan confronted this tragedy, the project was put on hold; the collecting area was still suffering aftershocks and there was an unstable nuclear situation, and access to many sites had been destroyed and some sites obliterated.

Work resumed in 2012. To circumvent the unresolved rearing problems, Landcare Research scientists Quentin Paynter and Hugh Gourlay travelled to Japan where they conducted no-choice tests with field-collected *L. glorifica* eggs and larvae on test plants imported from New Zealand; in some cases this later entailed transporting larvae that had begun development in Japan back to New Zealand at the end of their stay, so the larvae completed their life cycle in containment in Lincoln. This complicated process fortunately produced clear results and showed that development to adult by *L. glorifica* was restricted to two subfamilies in the Caprifoliaceae. There are no native species in this family in New Zealand. Some are grown as ornamentals but the most popular species (*Lonicera nitida*) was not attacked, although it was acknowledged that some other untested (soft-foliaged) *Lonicera* species grown in New Zealand may turn out to be suitable hosts. Development to adult occurred for a small proportion of larvae on a few ornamental Caprifoliaceae grown in New Zealand other than *L. japonica* – including Himalayan honeysuckle (*Leycesteria formosa*), which is also an invasive weed in New Zealand – but development times and pupal size indicated that these plants were suboptimal hosts. Richard Hill & Associates, acting for Greater Wellington Regional Council as the lead applicant for the National Biocontrol Collective (comprising 13 regional councils and the Department of Conservation), submitted an application to the Environmental Protection Authority in May 2013 for permission to release the butterfly and, after the public consultation process, this was granted in August 2013.

There was a final set of hurdles to overcome. As it was not possibly to rear the biocontrol agent through its entire life cycle in New Zealand, releases were to be made of material reared in New Zealand from butterflies field-collected (thus hopefully already mated) in Japan, once the butterflies had been verified as the correct species and the resulting larvae as disease-free. For this to work, the seasonal differences between the northern and southern hemispheres had to be reconciled within one life cycle; developing larvae had to be prevented from entering (northern hemisphere) winter diapause, instead pupating so adults emerged in the New Zealand spring. The collecting trip to Japan was made as late in their season as possible (September). The captured butterflies began to lay fertile eggs and, to optimize this, care was taken to keep them healthy by providing good light levels and good food (a well-known Japanese sports drink, on recommendation of Japanese colleagues). To allow any diseased larval lines to be culled, eggs from each female were kept separately. Fortified by all the care, the butterflies survived the trip to New Zealand and continued to lay eggs in containment. Hatching larvae were kept in long-day, cool conditions to prevent diapause and to slow development, respectively. Diapause was averted but the larvae developed quickly despite the low temperature, and the first butterflies emerged in mid-October. First releases were made at two sites in late October, with the hope that they would mate post-release. When fertile eggs were found in December, that hope was fulfilled, and optimism was further boosted by the sight of second-generation adults at one of the sites in January followed by third-generation adults in March. It is of course far too early to predict the outcome, but it is hoped that the butterfly will establish at both sites and it will soon be possible to collect and re-distribute the biocontrol agent to other infested sites.

Meanwhile, following the re-establishment of the containment colony, the less obstacle-strewn testing of the second prospective biocontrol agent, *O. shirahatai*, was completed. Larvae of this stem-boring cerambycid, which appears to be restricted to northern Honshu, cause severe dieback. The beetle could thus be a good complement to the defoliating butterfly. Adult beetles feed on the foliage, and lay eggs in the stems. The larvae, which may take several years to complete development, can cause the death of entire branches and could potentially limit the production of fast-growing runners and also reduce plant vigour and seed production. Testing again indicated a very restricted host range: although adult feeding occurred on species in several Caprifoliaceae subfamilies, egg laying was more restricted, and larvae survived to six months only in *Lonicera japonica.*

An application for release of *O. shirahatai* was made by Richard Hill & Associates, acting for the lead organization Hawke's Bay Regional Council, to the Environmental Protection Authority in February 2015 and the public consultation has been underway.

Sources: www.landcareresearch.co.nz/publications/newsletters/biological-control-of-weeds and www.epa.govt.nz

Contact: Quentin Paynter, Landcare Research.
Email: PaynterQ@landcareresearch.co.nz

New Biocontrol Agent for Crofton weed (*Ageratina adenophora*) Released in Australia

The release of a new biocontrol agent for Crofton weed (*Ageratina adenophora*) brings hope for improve management of this invasive plant in Australia. The agent, commonly referred to as Crofton weed rust (*Baeodromus eupatorii*), originates from Mexico, the native range of Crofton weed. It infects young leaves and stems of Crofton weed and has great potential to reduce competitiveness, reproduction and spread of the weed.

Crofton weed has been running rampant in eastern coastal Australia since it 'escaped' from gardens in the early 1900s. It produces copious quantities of windborne seeds, spreads rapidly and once established at a site reduces its agricultural or ecological value. Crofton weed is declared as a class 4 noxious weed in several local government areas along the New South Wales (NSW) coast. This means that its growth must be managed in a manner that continuously inhibits its ability to spread. While Crofton weed can be managed by manual removal and herbicide applications, the extent of current infestations and their inaccessibility in some instances make control with traditional methods uneconomical and impractical. Biological control is the only sustainable method to manage Crofton weed at the landscape scale and reduce spread and infestation of new sites.

In the 1950s, two biocontrol agents were introduced for Crofton weed in Australia: the fly – *Procecidochares utilis* that causes galls on stems, and the leaf spot fungus – *Passalora ageratinae* (previously known as *Phaeoramularia eupatorii-odorati*) that causes necrotic lesions on old leaves. While these agents cause some damage on plants, their impacts on populations of the weed have been negligible. It is hoped that the Crofton weed rust will bring a welcome boost to biological control of this widespread weed in eastern Australia.

The rust fungus was thoroughly tested to demonstrate that it would not pose a threat to economic and native plant species before it was approved for release in Australia in May 2014. During winter 2014, the fungus was released at five sites within national parks and conservation areas on the NSW South Coast and north of Sydney. These initial experimental releases demonstrated that the fungus can establish readily in the field providing that the material used for release survives for several days and that conditions are conducive for infection at some stage during that period.

This new biocontrol agent is now available for widespread release in NSW. The CSIRO Biosecurity Flagship, with support from the NSW Weeds Action Program administered by the NSW Department of Primary Industries, is undertaking a release programme in partnership with the community in 2015 to facilitate releases of the fungus at several strategic locations across the range of Crofton weed in NSW (more detail at www.csiro.au/en/Research/Farming-food/Invasive-pests/Biological-control-of-weeds/Managing-Crofton-Weed). A few strategic releases will also be undertaken in southeast Queensland with support from Queensland Parks and Wildlife Service.

Research on Crofton weed rust was supported by the Australian Government through the Rural Industries Research & Development Corporation, the Lord Howe Island Board and the Office of Environment and Heritage NSW. Fritz Heystek, Stefan Neser and Alan Wood (Plant Protection Research Institute, South Africa) sourced the rust fungus in Mexico during one of their field surveys on this target weed and assisted with its importation to Australia.

By: Louise Morin, CSIRO Biosecurity Flagship, Canberra ACT, Australia.
Email: Louise.Morin@csiro.au

Virus-based Bioherbicide to Complement Classical Biological Control for Tropical Soda Apple

BioProdex, Inc., a spin-off company of the University of Florida – Institute of Food and Agricultural Sciences (UF-IFAS) in the USA, has developed and registered a bioherbicide for tropical soda apple (TSA; *Solanum viarum*). TSA is a prickly shrub originating from South America. First reported from Florida in 1988, its prolific seed production facilitated rapid spread. It quickly became a serious invasive in pasture and conservation land in the southeastern USA, particularly in Florida, and also serves as a reservoir for solanaceous pests. An economic assessment of TSA in Florida in 2006 found that control using mowing and chemical herbicides was costing the state's ranchers US$6.5 million to $16 million annually. The new product registered for use against TSA, SolviNix® LC, is the first bioherbicide to be based on a plant virus, and is based on a locally collected tobacco mild green mosaic tobamovirus (TMGMV) strain U2.[1]

The herbicidal activity of TMGMV U2 derives from its unusual ability to elicit a localized resistance response followed by a systemic necrosis that kills the TSA plant. Upon inoculation, TMGMV U2 triggers necrotic local lesions in infected leaves but unlike in a typical resistance response wherein the virus is confined to the lesions, in TSA the virus multiplies and spreads beyond the lesions and throughout the plant, eliciting a delayed host response resulting in plant wilting and death. This ability of TMGMV U2 to kill TSA was researched and patented by Dr R. 'Charu' Charudattan, Dr Ernest Hiebert and associates in the Department of Plant Pathology, UF-IFAS. BioProdex, Inc. licensed the technology from the University of Florida Research Foundation, developed an industrial process to mass-produce the virus, assembled safety and efficacy data based on extensive research and testing, and successfully registered the bioherbicide with the US Environmental Protection Agency in December 2014. Small Business Innovation Research (SBIR) grants from the US Department of Agriculture – National Institute of Food and Agriculture (NIFA) enabled BioProdex to develop the mass-production technology. The IR-4 Biopesticide and Organic Support Program, Princeton, New Jersey, undertook and steered the registration effort for BioProdex.

SolviNix® LC is the second biocontrol tool to be made available for TSA. Substantial biological control of TSA in central and south Florida has been achieved following the introduction in 2003 of the leaf-feeding beetle, *Gratiana boliviana*.[2,3] The beetle, which has 7–8 generations per year between March and November, can completely defoliate plants, leading to reduced growth and fruit production. Success has been attributed to coordinated efforts of federal, state and county agencies in the multi-agency biological control programme, which supported the rearing, distribution and release of a quarter of a million beetles throughout Florida by the end of 2011. Of key importance to raising awareness and effective technology transfer was collaboration between property owners, extension agents, scientists and government officials, which facilitated widespread distribution of the beetle. Post-release evaluations indicate the beetle is causing significant defoliation, decreasing plant density within 2–3 years of its release (in some places within a few months), and reducing reproduction.

Although a follow-up in 2010 to the 2006 assessment found that *G. boliviana* had reduced TSA control costs in Florida by some 50%, an integrated control approach is still necessary, particularly where the beetle has had less impact, north of latitude 29°N. Elsewhere in the southeastern USA, the beetle has not established successfully in southern Georgia and Alabama despite the large numbers released; it did establish in one Texas county where good control is now reported. While further research would be needed to find cold-tolerant biocontrol agents, mowing and herbicides remain important to TSA management, and there is a market for alternatives to broad-spectrum synthetic herbicides. The registration of the viral herbicide SolviNix® LC thus heralds a ground-breaking additional biological control tool against TSA.

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[2]Medal, J., Gaskalla, R., Hibbard, *et al.* (2014) Biological control of *Solanum viarum* in Florida, USA: a successful project. In: Impson, F.A.C., Kleinjan, C.A. and Hoffmann, J.H. (eds) *Proceedings of the XIV International Symposium on Biological Control of Weeds*, Kruger National Park, South Africa, 2–7 March 2014. University of Cape Town, South Africa, pp. 77–81.

[3]Diaz, R., Manrique, V., Hibbard, K., *et al.* (2014) Successful biological control of tropical soda apple (Solanales: Solanaceae) in Florida: a review of key program components. *Florida Entomologist* 97, 179–190.

Contact: (Bioherbicide) Raghavan Charudattan,
Emeritus Professor, University of Florida,
Gainesville.
Email: rcharudattan@bioprodex.com
Web: www.bioprodex.com/

(Classical biocontrol agent) Julio Medal,
University of Florida, Gainesville.
Email: medal@ufl.edu

Bacterial Consortium Needed for Chytrid Disease of Amphibians

A global panzootic lineage of chytrid fungus (*Batrachochytrium dendrobatidis* GPL) is thought to be behind the decline or extinction of at least 200 species of frogs. It is also one of the reasons why 31% of amphibian species are currently listed as threatened by the International Union for the Conservation of Nature. Not all species are affected by the disease, however, and beneficial bacteria, or microbiomes, present on the skin have been implicated in disease immunity. Introducing these bacteria onto the skin of susceptible species to boost their immunity is being researched as a 'probiotic' approach to control.[1] A study by scientists at the University of Manchester and the Zoological Society of London's Institute of Zoology in the UK, published in *Applied and Environmental Microbiology*[2] concludes that this is not likely to be simple. Isolates of *B. dendrobatidis* GPL exhibit significant variation in virulence, even within a single host species exposed under laboratory conditions, and the enormous and unpredictable genetic variability of the disease together with its ability to evolve rapidly presents a 'moving target' in the natural world. Most studies so far have looked at single disease isolates although amphibian communities may host several genotypes, any or all of which may be lethal in the amphibians present. The objectives of the new study were to determine (i) whether bacterial isolates from immune frog species (i.e. that have not succumbed to the disease in c. 45 years of exposure in the wild) could inhibit specific disease variants, and (ii) whether bacterial taxonomy, derived from 16S rRNA sequencing, could explain variation in capacity to inhibit the disease.

In preliminary *in-vitro* screening, 15 of 56 bacterial isolates, obtained from wild populations of two species of *Agalychnis* frogs in Belize, inhibited one or both of two variants of *B. dendrobatidis* GPL. The team selected 15 isolates that had inhibited one, both or neither of these variants for quantitative testing against three previously unassessed disease isolates, collected from a British newt, a Panamanian frog and a Spanish toad. These results showed inconsistency and variability in how bacterial isolates performed against disease variants. For example, only three bacterial isolates consistently inhibited all three disease variants, and only one of these also inhibited the two variants used for the preliminary screening. In addition, while two of the disease variants were fairly consistently inhibited, the other was rarely so. While some bacterial genera performed better in general than others, genetic sequencing did not explain variation between bacterial isolates. For example, of three bacterial isolates from the same amphibian that were typed as a single species by sequencing, only one inhibited all three disease variants. This finding suggests that developing a strategy for mining amphibian microbiomes for target probiotics will be complex. The team still believe that probiotic bacteria could be usefully deployed as a protection measure, but suggest that a 'consortium' approach is needed and also propose that candidates should exhibit inhibitory activity against a range of disease genotypes, with a focus on the hypervirulent *B. dendrobatidis* GPL.

[1]Bletz, M.C., Loudon, A.H., Becker, M.H., *et al.* (2013) Mitigating amphibian chytridiomycosis with bioaugmentation: characteristics of effective probiotics and strategies for their selection and use. *Ecology Letters* 16, 807–820.

[2]Antwis, R.E., Preziosi, R.F., Harrison, X.A. and Garner, T.W.J. (2015) Amphibian symbiotic bacteria do not show universal ability to inhibit growth of the global pandemic lineage of *Batrachochytrium dendrobatidis*. *Applied and Environmental Microbiology* online 27 March 2015. doi:10.1128/AEM.00010-15

Contact: Rachael Antwis, North-West University, South Africa, and the Institute of Zoology, London, UK.
Email: rachael.antwis@gmail.com

Amber Light for Acacia Biocontrol Agent in Europe

The first deliberate release of a classical biocontrol agent against a weed in mainland Europe is one step closer following an assessment by the European Food Safety Authority (EFSA).

The Australian species *Acacia longifolia* was introduced to Portugal in the nineteenth century to curb sand erosion, but its fast growth and enormous seed production allowed it to invade the sand-dune ecosystem and it is now a threat to Portugal's coastal biodiversity. It is not amenable to control by existing measures: a large accumulated seed bank means it recolonizes quickly after clearance, and fire can promote seed germination. In 1982, South Africa introduced an Australian bud-galling pteromalid wasp, *Trichilogaster acaciaelongifoliae*, against invasive *A. longifolia*. The gall wasp inflicted gall and seed set reductions of, initially, up to 95% and has contributed to substantial biological control of the invader. Drawing on South African expertise including research on host specificity, Portugal considered the possibility of introducing the same wasp and informed the European Commission of its plan. *Trichilogaster acaciaelongifoliae* is currently neither a regulated harmful organism nor present in the European Union (EU), but it was considered likely to be injurious to plants in the EU and thus subject to plant health regulation. Following discussion at the Standing Committee on Plant Health, the Member States and the Commission agreed to seek an advice from EFSA's Panel on Plant Health on the risks to plant health from the proposed introduction.

The Panel considered the environmental impacts of the wasp in Europe, including potential negative impacts, for example on ornamental *Acacia* species, and also the positive impacts of reducing *A. longifolia* populations. The Panel's deliberations are contained in an EFSA Opinion, published on 23 April 2015.[1] It concluded that, given the presence of a known host plant and environmental conditions, the wasp is likely to establish in Portugal (although dependent on re-phasing the wasp's southern-hemisphere phenology), where it would have a 'massive' effect on *A. longifolia* populations and reduce its negative impacts in the target area. Spread outside that area is possible, through trade in ornamental *A. longifolia* and the closely related *A. floribunda*, which is also a host. These are less commonly grown than other *Acacia* species as ornamentals elsewhere in the EU, and although temporary 'spill-over' feeding might occur on other acacias there would be little impact on their populations. However, the Panel indicated that two species, the European native *Cytisus striatus* (broom) and one non-native ornamental species, *Acacia retinodes*, need to be further investigated because the currently available data on their host status for the wasp are inconclusive.

[1]EFSA Panel on Plant Health (2015) Risk to plant health in the EU territory of the intentional release of the bud-galling wasp *Trichilogaster acaciaelongifoliae* for the control of the invasive alien plant *Acacia longifolia*. *EFSA Journal* 13(4) 4079, 48 pp. doi:10.2903/j.efsa.2015.4079
Web: www.efsa.europa.eu/en/efsajournal/pub/4079.htm

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