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www.cabi.org/BNI

General News

Azolla is the Business

During the summer months of 2011, CABI's AzollaControl (www.azollacontrol.com) supplied more than 30,000 weevils of the North American species *Stenopelmus rufinasus* for control of azolla (*Azolla filiculoides*) to national and local authorities, businesses and individuals in the UK; this year the number is likely to exceed 50,000, with both the largest individual order and largest number of orders for a season received in 2012 by the end of July. Interest in the weevil appears to be spreading too, with countries in mainland Europe now investigating the potential of azolla biocontrol using *S. rufinasus* in collaboration with CABI.

The history of azolla in the UK is one common to many aquatic weeds: it was introduced from the New World as an ornamental in the mid-nineteenth century, escaped into the wild and invaded natural waterbodies. It is now widely distributed in lowland areas across Great Britain as far north as Falkirk in Scotland. Its fast, mat-forming growth means it blocks out light and kills native aquatic flora, reduces oxygen availability to aquatic fauna, and impedes flood defences and water-based recreation. The dense mats may be mistaken for land by livestock, with drownings sometimes occurring, while anecdotes of people attempting and failing to walk across mats of azolla having mistaken them for solid earth are not uncommon. Attempts to remove the weed mats by physical or mechanical methods inevitably result in fronds breaking up, and new mats are quick to form from the fragments left in the water after such operations. Azolla's enormous annual spore production means that it may re-infest waterbodies year after year. Despite its weed status, supported by a ban on it at Royal Horticultural Society shows, it continues to be sold by certain unscrupulous garden centres and online, often incorrectly described as *Azolla caroliniana*.

Interest in biological control of aquatic weeds has been heightened in Europe as a whole because the Water Framework Directive (2000/60/EC) obliges European Union member states to ensure waterbodies reach good ecological status by 2015. Chemical control options for aquatic weeds are very limited with only the non-selective herbicide glyphosate likely to remain licensed for use on or near water in the UK after 2013, and any herbicide use banned or taboo throughout the majority of Europe. Removal measures tend to be inadequate for the kinds of reasons outlined above, with the plant prone to fragmentation and rapid regrowth. Manual removal is also practically and financially demanding and on a large scale may be impossible.

CABI began investigating the potential for inundative releases of *S. rufinasus* against azolla in the UK in 2002. The weevil already had a track record of success as a classical biological control agent of *A. filiculoides* in South Africa, where it was successfully introduced after extensive host-specificity testing. At the time, no planned introduction of an exotic weed biological control agent had been made in the UK, but the weevil was already present (first recorded in 1921), probably having been accidentally introduced on commercially imported azolla. Because of its long occupancy, it was (and continues to be) considered by Defra (the UK Department for Environment, Food and Rural Affairs) as ordinarily resident, so there were no licensing restrictions.

From field observations and laboratory experimentation it became apparent that weevils present in the UK were very efficient at controlling UK azolla populations. They cause considerable damage to the weed, including local eradication in some instances, and even large infestations can be brought under control within a growing season. CABI began supplying *S. rufinasus* commercially in 2003. The new venture was publicized during UK National Insect Week in 2010 when footage from a microscope-mounted webcam (dubbed 'WeevilCam') streamed live images of the weevils demolishing azolla in a Petri dish. It has since been doing the same on a larger scale for customers around England, Wales and Scotland.

The azolla team at CABI is continuing to increase capacity for supplying weevils on demand, as well as liaising with potential European partners. The team is also conducting research to improve understanding of the weevil's distribution, mobility, population development and survival requirements in the UK.

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Codling Moth Parasitoid for New Zealand

New Zealand's Environmental Protection Agency has approved the release of a new biocontrol agent against codling moth (*Cydia pomonella*). Pipfruit New Zealand, on behalf of apple and pear growers, applied for permission to release *Mastrus ridens* against the pest.

Pipfruit is New Zealand's third-largest horticultural sector with an export market worth NZ$325 million annually. Codling moth, which was accidentally introduced in the 1860s, is one of the most serious pests of apples grown for both domestic and export consumption; it also attacks various other fruits and walnuts. The pest has a suite of natural enemies in New Zealand: classical biological control agents were introduced in the first half of the twentieth century. Although these agents established successfully on the high populations of codling moth on neglected apple trees, they have made only a minor contribution to control in commercial orchards. Until the 1970s, codling moth control in orchards relied on broad-spectrum insecticides, but in recent decades an integrated pest management (IPM) programme based on mating disruption and granulosis virus has been developed. Although this is largely successful in both conventional and organic orchards, low numbers of moths and larvae in apples at harvest remain a problem: a single moth at harvest can close (and has closed) export markets.

The effectiveness of the IPM programme on commercial orchards is undermined by uncontrolled codling moth in home gardens and abandoned orchards and walnut trees. These trees host large populations of the pest that typically destroy over 80% of their crop. Female moths fly from these refuges into commercial orchards and start new populations. It has previously been shown that even a small reduction in immigrant female moths would help to reduce the codling moth threat significantly.

Mastrus ridens, which attacks late-instar codling moth larvae, was first collected in Kazakhstan in the 1990s. Released in the USA in California in 1995–2000, it is now established in several states and contributes to control of codling moth. It is hoped that establishing permanent populations of *M. ridens* in New Zealand will improve IPM of codling moth by providing long-term control of codling moth in commercial orchards and in home-gardens and abandoned trees.

Sources: Environmental Protection Agency
www.epa.govt.nz
Biological Control Agents Introduced to New Zealand database
http://b3.net.nz/bcanz

Crassula Biocontrol for the UK

Crassula helmsii, or Australian swamp stonecrop, is an invasive semi-aquatic plant that has been present in the UK since its introduction as a pond plant in 1911. Native to Australia and New Zealand, the plant has since spread throughout the UK and is considered one of western Europe's most troublesome water weeds.

It has the ability to dominate slow-moving waterbodies and bank sides, threatening native species and, once established, it is almost impossible to eradicate completely with chemical control restricted and mechanical control effectively spreading the infestation. Therefore in 2011, the UK Government (Department for Environment, Food and Rural Affairs – Defra) funded CABI to investigate the potential for classical biological control of this weed. It had previously been suggested that there were no natural enemies in the native range; however, a scoping study revealed that a range of insects and fungi do indeed exist and cause significant damage to the plant, which warranted further investigation.

Preliminary genetic studies had already indicated that *Crassula* in the UK is likely to have originated from Australia rather than New Zealand, therefore more wide-ranging surveys have since taken place in Victoria and Tasmania, Australia. Potential biocontrol agents have been imported to CABI's quarantine facilities, with several insects and plant pathogens under analysis and identification. CABI's plant pathologists have identified potentially two *Collitotrichum* species and a *Cercospora*-like fungus which have been observed causing significant damage to the leaves and stem in the field. Infection parameters are currently being determined and life-cycle studies carried out in order for host-specificity studies to commence.

A stem-mining fly, a *Hydrellia* species, has also been imported to the UK where a culture has been established and host-specificity tests are taking place. A stem-mining weevil, a *Steriphus* sp., had also been under investigation but was found to feed and develop on non-target plants and has since been rejected from further study.

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Cautious Optimism: *Opuntia* Surviving *Cactoblastis* in Florida

The accidental arrival of the 'poster child' cactus biocontrol agent *Cactoblastis cactorum* in continental North America in Florida in 1989 sparked concerns that the moth, which is native to southern South America, could be catastrophic to the region's opuntioids; *C. cactorum*, which has a wide host range within the genera *Opuntia*, *Consolea* and *Nopalea*, has since spread along the US Atlantic and Gulf coasts. At least 31 species in the USA are likely to be attacked and 56 species in Mexico. As well as threatening wild cactus species, there are over 250,000 ha of *Opuntia* plantations in Mexico that support a thriving agricultural industry, mostly centred on harvesting fruits or pads (cladodes). A study published in *Biological Invasions*[1] notes that the effects of invasive species are known to vary spatially and temporally, and *C. cactorum*'s efficacy as a biological control agent varies considerably from region to region, so its long-term effects in its North American range are uncertain.

In the south-eastern USA, the moth is feared to threaten the biological and physical integrity of desert, scrub and coastal habitats. Data collected from 580 *O. stricta* and *O. humifusa* plants over a six-year period indicated that although *Cactoblastis*-attacked plants were more likely to die than unattacked plants, they were nonetheless more likely to survive than die: some 78% of the *Opuntia* plants were attacked by *Cactoblastis* over the six years, but almost 76% of these survived. *Opuntia stricta* was more likely than *O. humifusa* to be attacked, and was attacked more frequently, suggesting that *O. stricta* is the preferred of these two hosts. *Opuntia humifusa* was also more likely to survive after an attack. Taken as a whole, these results suggest that there could be inter- and intra-species variation for resistance and tolerance to *Cactoblastis* attack, although explicit tests are needed before such a conclusion could be drawn. Thus, the impact of *Cactoblastis* on opuntioid communities across North America is likely to vary dramatically. Plants with more cladodes initially (i.e. larger plants) were more likely to be attacked and (in contrast to a previous study in Nevis[2]) larger plants lost proportionally more cladodes than smaller plants. Initial cladode number was not, however, related to survival. Interestingly, the proportional increase in number of cladodes showed a significant positive relationship to frequency of attack, regardless of initial plant size – something that bears further investigation.

The authors do not suggest that North American opuntioids are not under threat from *Cactoblastis*. In an earlier laboratory study[3], other North American species were identified as preferred for oviposition (e.g. *O. engelmannii*) and as better hosts for larval development (e.g. *Consolea rubescens* and *O. streptacantha*). They stress that *Cactoblastis cactorum* remains a threat, particularly for rare opuntioids, but suggest that plants able to survive moth attack may possess traits that render them more tolerant of *C. cactorum* damage. Discussing their results in the context of published work on *Opuntia* in the wake of *Cactoblastis* introductions in Australia, South Africa and St Kitts and Nevis leads them to emphasize the importance of not automatically extrapolating from results elsewhere and of assessing invasions over time before drawing conclusions. They argue that "an assumption of severe negative effects of an invasive species, based on its effects in other regions or over short periods of time, may not always be justified."

[1]Jezorek, H., Baker, A.J. and Stiling, P. (2012) Effects of *Cactoblastis cactorum* on the survival and growth of North American *Opuntia*. *Biological Invasions* Online First. DOI: 10.1007/s10530-012-0234-9.

[2]Jezorek, H.A., Stiling, P.D. and Carpenter, J.E. (2010) Targets of an invasive species: oviposition preference and larval performance of *Cactoblastis cactorum* (Lepidoptera: Pyralidae) on 14 North American opuntioid cacti. *Environmental Entomology* 39, 1884–1892.

[3]Pemberton, R.W. and Liu, H. (2007) Control and persistence of native *Opuntia* on Nevis and St. Kitts 50 years after the introduction of *Cactoblastis cactorum*. *Biological Control* 41, 272–282.

Harmonia Has the Edge

In several parts of the world, the propensity of invasive coccinellids, notably *Harmonia axyridis*, to replace native species is being viewed with alarm. Interactions with native species often influence whether alien species become invasive. A study reported in *Biological Control*[1] investigated whether the failure of two invasive alien coccinellids, *Coccinella septempunctata* and *H. axyridis*, to establish fully in some parts of western North America is due to intraguild predation by the native, locally abundant, predatory bugs *Nabis alternatus* and *Geocoris bullatus*. In a series of predation trials, the authors compared the likelihood of the invasive beetles and two native species (*Hippodamia convergens* and *Coccinella transversoguttata*) falling prey to the generalist predators, and the likelihood of the coccinellids consuming the two native bug species. They found that *C. septempunctata* and the native ladybirds were similar in both respects, so the predatory bugs confer neither advantage nor disadvantage on the alien species. In contrast, *Harmonia axyridis* was least susceptible to predation and most likely to consume the bugs, which – all else being equal – would tend to favour it replacing the native coccinellids.

[1]Takizawa, T. and Snyder, W.E. (2012) Alien vs. predator: could biotic resistance by native generalist predators slow lady beetle invasions? *Biological Control*, online 1 August 2012. DOI: 10.1016/j.biocontrol.2012.07.011.

Award for Cane Toad Researcher

The Australian Research Council (ARC) has conferred an Australian Laureate Fellowship on the University of Sydney's Professor Rick Shine whose team researches cane toads. Professor Shine will use his fellowship to follow up results from his recent research, also funded by the ARC. He explains that, in particular, his work has shown that invasive species such as cane toads evolve so rapidly, due to the new challenges they face, that we can actually study evolution in real time.

Source: *Feral Flyer*, Invasive Animals CRC.

The most recent publication from Shine's group[1] shows that some native invertebrate predators that consume tadpoles are unaffected by the cane toad's toxins and prefer cane tadpoles to native species. These predators are abundant and voracious, and may reduce cane toad recruitment in some tropical waterbodies – which future research could explore further.

[1]Cabrera-Guzmán, E., Crossland, M.R. and Shine, R. (2012) Predation on the eggs and larvae of invasive cane toads (*Rhinella marina*) by native aquatic invertebrates in tropical Australia. *Biological Conservation* 153, 1–9.

Take Ants into Account

Predation on biocontrol agents can have a significant effect on their ability to establish, let alone inflict damage on their target. A paper in *Biological Control*[1] reports on a study investigating factors that could be involved in the patchy establishment of the boneseed leafroller moth, *Tortrix* s.l. sp. '*chyrsanthemoides*', which was introduced to New Zealand from South Africa against boneseed, *Chrysanthemoides monilifera* ssp. *monilifera*. From results of field surveys and manipulative experiments, the authors ruled out climate as a factor, and instead found indications that establishment failure was associated with predation, notably by invasive ants of South

American and Australian origin, which were attracted to invasive honeydew-secreting scale insects also found on boneseed. The results of an exclusion experiment showed that the leafroller larvae did not survive to maturity on boneseed plants infested with scales unless invertebrate predators (mainly invasive ants and *Vespula* and *Polistes* wasps) were excluded. The authors say this highlights the importance of prioritizing biocontrol agents where externally feeding insect agents would be subject to predation on a target plant that also hosts ant-attended Homoptera.

[1]Paynter, Q., Forgie, S.A., Winks, C.J., Peterson, P.G., Ward, D.F., Nicholson, L. and Van Zoelen, R. (2012) Biotic resistance: facilitation between invasive Homoptera and invasive ants limits the establishment of an introduced weed biocontrol agent in New Zealand. *Biological Control*, online 31 July 2012. DOI: 10.1016/j.biocontrol.2012.07.010.

Putting Practitioners' Needs to Ecologists

A free-access paper from weed biocontrol scientists in New Zealand, which appeared in the April issue of *Journal of Applied Ecology*[1], considers the question, 'How can ecologists help practitioners minimize non-target effects in weed biocontrol?' The authors start from the premise that although many ecologists show little enthusiasm for biological control, practitioners believe it offers a cost-effective answer to many invasive weed problems – practitioners, moreover, who are under pressure to implement effective weed biocontrol more quickly, cheaply and safely. In a 'Practitioner's perspective', the authors focus on two key areas, direct effects on non-target plants (assessed by host-range testing) and indirect non-target effects (i.e. impact on food webs, pollinators, mutualistic relationships). The authors use examples from New Zealand to illustrate gaps where "advances in ecological research could progress [...] stakeholder-driven aims and minimize potential negative outcomes of biocontrol that concern ecologists and practitioners." To entice the research ecologists, Simon Fowler points out that while biocontrol practitioners are often constrained from studying the ecological systems associated with their biocontrol agent releases, such systems offer a wealth of experimental opportunities for ecologists including food webs, predator–prey interactions, interspecific plant competition and modelling parasitic relationships.

[1]Fowler, S.V., Paynter, Q., Dodd, S. and Groenteman, R. (2012) How can ecologists help practitioners minimize non-target effects in weed biocontrol? *Journal of Applied Ecology* 49(2), 307–310.

Additional source: *What's New in Biological Control of Weeds* No. 60, pp. 6–7. Landcare Research New Zealand 2012.

Communicating Risk

It is harder to import entomophagous biocontrol agents than it used to be – national import regulations have become increasingly stringent as concerns about irreversible non-target impacts have grown. While this is a good thing if it prevents another '*Harmonia*' fiasco, a forum paper in *BioControl*[1] says that "there is a divergence of opinions among regulators, researchers, environmentalists, and the general public on ways to appropriately manage associated risks". The authors say that a comprehensive and effective risk communication process could narrow these gaps. The paper reports the results of a survey conducted in the USA to identify communication habits of stakeholders in the biological control sector, and identify what is essential for an efficient process. It also reviews risk communication practices for this group of biocontrol agents in several countries to help identify what tools are used in an effective risk communication framework. The authors identify barriers to efficient risk communication, which together indicate a lack of focus, inadequate information sources and failure to engage effectively with the public. They suggest that a more effective process would include using more methods of disseminating messages and doing so more effectively to increase "coverage, understanding, and guidance". This includes exploiting the various media and opportunities for engaging with stakeholders, characterizing stakeholder groups so risk messages can be targeted, implementing participatory decision making to increase stakeholder involvement and trust, and creating a clear framework for incorporating public comments in the decision making process. Finally, consistency of messages disseminated by the different agencies is key.

[1]Paraiso, O., Kairo, M.T.K., Hight, S.D., Leppla, N.C., Cuda, J.P., Owens, M. and Olexa, M.T. (2012) Opportunities for improving risk communication during the permitting process for entomophagous biological control agents: a review of current systems. *BioControl* Online First™. DOI: 10.1007/s10526-012-9464-0.

Adding Microbials to Arthropod Biocontrol Agents

Biological control in crops often requires multiple biocontrol agents, and combinations of microbial and arthropod agents are common. How such agents interact is an active area of research. In a study reported in *Biological Control*[1], authors looked at whether using bees for vectoring *Beauveria bassiana* to control insect pests in greenhouses would have adverse effects on natural enemies already in use as biocontrol agents in this system. In greenhouse trials in which the commercial pollinator *Bombus impatiens* was used to vector the microbial control agent to tomatoes and sweet peppers, over 95% of flower and leaf samples contained detectable levels of *Beauveria* spores. Parasitism and predation levels were unaffected by the pathogen for all biocontrol agents tested (*Encarsia formosa, Eretmocerus eremicus, Aphidius colemani, Orius insidiosus* and *Amblyseius* *swirskii*), and survivorship was unaffected for four of them although it was decreased for *O. insidiosus*. In addition, bee mortality was unaffected. The authors suggest that bee-vectoring of *B. bassiana* can be integrated with greenhouse biological control programmes.

In a paper in the *Journal of Applied Entomology*[2], authors report on a study in which they assessed the combined use of a eulophid ectoparasitoid (*Euplectrus plathypenae*) and *Spodoptera exigua* multiple nucleopolyhedrovirus (SeMNPV) in larvae of *S. exigua*. Parasitoids did not complete development in hosts infected prior to parasitism, but when fourth-instar *S. exigua* larvae were infected with the virus 48 hours after parasitism, there were no significant effects on parasitoid survival or development times for virus-infected cf. healthy *S. exigua* hosts. The authors conclude that so long as application is timed appropriately, the use of the virus is unlikely to interfere with control exerted by *E. plathypenae* in biological pest control programmes against *S. exigua*.

[1]Shipp, L., Kapongo, J.P., Park, H.-H. and Kevan, P. (2012) Effect of bee-vectored *Beauveria bassiana* on greenhouse beneficials under greenhouse cage conditions. *Biological Control*, online 23 July 2012. DOI: 10.1016/j.biocontrol.2012.07.008.

[2]Stoianova, E., Williams, T., Cisneros, J., Muñoz, D., Murillo, R., Tasheva, E. and Caballero, P. (2012) Interactions between an ectoparasitoid and a nucleopolyhedrovirus when simultaneously attacking *Spodoptera exigua* (Lepidoptera: Noctuidae). *Journal of Applied Entomology* 136(8), 596–604.

Biocontrol by Soil Bacteria Reviewed

Members of the bacterial genera *Bacillus* and *Pseudomonas* are deployed as biocontrol agents against plant pathogens. A review in *Biocontrol Science and Technology*[1] brings together pioneering and more recent research. It discusses the mechanisms in *Bacillus* and *Pseudomonas* that can be exploited in their use as biocontrol and plant-growth promoting agents, discussing their mode of action by comparing the two genera.

[1]Santoyo, G., Orozco-Mosqueda, M.D.C. and Govindappa, M. (2012) Mechanisms of biocontrol and plant growth-promoting activity in soil bacterial species of *Bacillus* and *Pseudomonas*: a review. *Biocontrol Science and Technology* 22(8), 855–872.

Disease Needs Controlling in Biocontrol Agent Mass Production

Pathogen infections may inflict mortality in insect mass-rearing colonies, but can also have more subtle effects, and thus hygiene is a major issue in mass production. A study in Brazil, reported in Biological Control[1], investigated the impact of *Nosema* infection on the performance of *Cotesia flavipes*, which is deployed on over three million hectares of sugar cane annually in Brazil against the borer *Diatraea saccharalis*. For the experiments reported, infection was achieved by presenting parasitoids with fifth-instar *D. saccharalis* larvae that had been infected as third instars. Heavily infected larvae did not support parasitism, while lesser infection increased the duration of life stages and had adverse impacts on adult size, longevity and fecundity. Infection was also shown to have effects on behaviour that could compromise biological control: uninfected *C. flavipes* can distinguish both uninfested from infested plants, and *Nosema*-infected and uninfected larvae, but these capabilities were absent in *Nosema*-infected parasitoids thus interfering with their ability to locate hosts. *Nosema* is transmitted both from host to parasitoids and from parasitoids to hosts. The authors say that the severity of the effects of infection justifies disease management efforts, especially given the importance of *C. flavipes* as a control agent in sugarcane in Brazil.

[1]Simões, R.A., Reis, L.G., Bento, J.M.S., Solter, L.F., Delalibera, I. Jr. (2012) Biological and behavioral parameters of the parasitoid *Cotesia flavipes* (Hymenoptera: Braconidae) are altered by the pathogen *Nosema* sp. (Microsporidia: Nosematidae). *Biological Control*, online 30 June 2012. DOI: 10.1016/j.biocontrol.2012.06.012.

Another study in Brazil, also published in *Biological Control*[2], reports on *C. flavipes* host densities in mass production and gives economic costs for rearing the biological control agent.

[2]Vacari, A.M., De Bortoli, S.A., Borba, D.F. and Martins, M.I.E.G. (2012) Quality of *Cotesia flavipes* (Hymenoptera: Braconidae) reared at different host densities and the estimated cost of its commercial production. *Biological Control*, online 29 June 2012. DOI: 10.1016/j.biocontrol.2012.06.009.

Special Issues

The August 2012 issue of *Biological Invasions* (14[8]) includes a selection of papers presented at the First International Congress on Biological Invasions, which was held in Fuzhou, China, in November 2009 with the theme 'Biological invasions under climate change'. How climate change may affect natural enemies of invasive species was among aspects considered and is reported in several papers.

The August 2012 issue of the *EPPO Bulletin* (42[2]) includes a report on the recent joint international symposium on *Tuta absoluta* (also see *BNI* 33[1], 6N) together with 23 papers on the pest, several of which deal with its natural enemies and biological control.

A special issue of *BioControl* (April 2012, 57[2]) includes 17 papers on the theme, 'Conserving nature with biological control'. Following an introductory paper discussing the role of biological control in wildlands, papers deal with biological control in South Africa's fynbos, and of *Icerya purchasi* in Galapagos, *Eichhornia crassipes* in South Africa, *Miconia calvescens* in Tahiti, *Melaleuca* in Florida's everglades, *Agrilus planipennis* and *Persicaria perfoliata* in other parts of the USA, and the potential for biological control of *Agrilus auroguttatus* in California. For methods, papers cover use of molecular genetics in the US *Schinus terebinthifolius* programme, and host range determination of *Colletotrichum gloeosporioides* f. sp. *salsolae*, a potential biocontrol agent for *Salsola tragus*. The risks of biological control are reviewed, with specific papers also covering benefits and harm from releasing *Compsilura concinnata* in North America, the predictability of pathogen host range in classical biological control of weeds, and the unintended spread of introduced weed biological control agents. Lastly, two papers look at perception and conflict, one considering how to optimize public engagement about biocontrol for nature, and the other describing how riparian restoration can resolve conflict in the US *Tamarix* programme.

International Bioherbicide Group

The XI International Bioherbicide Group (IBG) workshop will be held in Nanjing, China, on 23–24 August 2013, hosted by Dr Shen Qiang from the Nanjing Agricultural University, just before the 10th International Congress on Plant Pathology (25–31 August 2013) takes place in Beijing. Dr Qiang is planning a two-day meeting to include presentations, a university tour and a bioherbicide field trip.

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More information on this, together with other bioherbicide news, is posted on the IBG website, including the latest newsletter. This contains articles on a potential leaf-spot pathogen for Japanese knotweed (*Fallopia japonica*), biological control of *Crassula helmsii* for the UK (also see p.18N, this issue) and stump-sprouting species with *Chondrostereum purpureum* in New Zealand, a fact sheet from New South Wales, Australia, on use of an indigenous fungus for control of *Sporobolus fertilis*, as well as news of recent meetings and publications.

Web: http://bioherbicidegroup.jimdo.com

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International Symposium for Biological Control of Arthropods

The Fourth International Symposium for Biological Control of Arthropods is being held on 4–18 March 2013 in Pucón, Chile. The goal of this symposium series is to create a forum where biological control researchers and practitioners can meet and exchange information, to promote discussions of up to date issues affecting biological control, particularly pertaining to the use of parasitoids and predators as biological control agents. It encompasses all approaches to biological control: conservation, augmentation, and importation of natural enemy species for the control of arthropod targets, as well as cross-cutting issues. The aim of the meetings is to stimulate ideas by presenting new information. Presentations should therefore present original data from projects dealing with predators and parasitoids, avoiding overviews, summaries or well-known material.

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Budget Cuts Hit Biological Control in the USA

A US$38.6 million cut in the budget for the US Department of Agriculture – Agricultural Research Service (ARS) for 2012 has led to the closure of 12 laboratories at ten locations, with voluntary redundancy offered and continuing employees re-assigned; ARS now has just under 100 locations. The cuts mean that a number of projects involving biological control are being discontinued, including: Integrated pest management for high latitude agriculture (Fairbanks, Alaska); Integrated management of cotton pests: plant genetics, biological control and novel pest estimation (Shafter, California); Organic and reduced input fresh market specialty crop production systems for the southern Great Plains (Lane, Oklahoma); Biological control of invasive pests of orchard and vegetable crops in the subtropical South (Weslaco, Texas); Biological control strategies for invasive weeds of south-western US watersheds (Weslaco); IPM strategies for managing pests of subtropical row crops (Weslaco); Development of quarantine alternatives for subtropical fruit and vegetable pests (Weslaco); Integrated water, nutrient and pest management strategies for subtropical crops (Weslaco); and Termites: chemical and biological control for integrated pest management of invasive species (New Orleans, Louisiana).

In addition, *AgAlert*, a weekly newspaper for Californian agriculture, said in July that the California Department for Agriculture is halting its stand-alone biological control activities supporting weed and olive fruit fly biocontrol (representing $701,000 in funding), although it will continue with biocontrol activities incorporated into specific programmes, such as the Asian citrus psyllid programme.

BNI adds its voice to the many who wish affected biocontrol colleagues well in coping with changes and settling into new places and roles.

Sources: *IOBC-NRS Newsletter* 34(1), Spring 2012; *AgAlert* (http://agalert.com).

Europe Legislating on Invasives

In January–April this year, the European Commission (EC), through the Directorate-General for the Environment, undertook a consultation on a dedicated legislative instrument on invasive alien species, one of the final steps in a process to draw up this instrument. This and the European Union (EU) 'Biodiversity Strategy to 2020', which was launched in 2011, could create opportunities for biological control in Europe.

Although current EU legal instruments deal with other major causes of biodiversity loss – habitat change, climate change, overexploitation and pollution – there has been no such instrument specifically for invasives. The Biodiversity Strategy 2020 calls for such an instrument by 2012, and includes a target that "by 2020, invasive alien species (IAS) and their pathways are identified and prioritised, priority species are controlled or eradicated, and pathways are managed to prevent the introduction and establishment of new IAS".

The EC has been addressing the lack of a specific instrument for invasives through a process based on working groups and public consultations. In 2008 the first working group representing member states and stakeholder organizations produced a discussion paper, 'Developing an EU Framework for Invasive Alien Species', followed by a public consultation. In 2010–11, three working groups derived from member states and stakeholder organizations and representing a broad range of interests, considered and reported on (i) prevention, (ii) early warning and rapid response, and (iii) eradication, control/management and restoration of damaged ecosystems. The latest public consultation focuses on the policy measures being considered, which are based on the input and feedback collected since 2008.

Web: http://ec.europa.eu/environment/consultations/invasive_aliens.htm

Global Initiative for *Tuta absoluta* and *Drosophila suzukii*

ASCII (Ameliorating the Sustainable Control of Invasive Insects), funded under the European Commission's Framework Programme Seven (FP7) International Research Staff Exchange, brings together 12 partners from Italy, France, UK, USA, Argentina, Brazil and China, coordinated by Emilio Guerrieri of the National Research Council, Italy – Institute for Plant Protection. The new project, which starts in February 2013, has grown out of the ENDURE European Network of Excellence. ASCII will focus on the development of integrated pest management (IPM) of two new and serious invasive pests. *Tuta absoluta*, which first appeared in Spain in 2007, has been spreading worldwide and represents a major problem for tomato growers. *Drosophila suzukii,* which attacks a range of fruits, is native to South-east Asia and has been spreading in North America and recently appeared in Europe. ASCII aims to further the integration of new practices derived from basic research in biology, genetics and biological control to promote lasting management approaches to these pests. One specific area to be tackled and integrated into IPM programmes is monitoring, detection and characterizing of pest and natural enemy populations.

Source: *ENDURE News*, No 15 (June 2012).

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Plantwise Knowledge Bank

The Plantwise Knowledge Bank, an open-access information resource from CABI covering crop pests and diseases, which was launched worldwide in July 2012, is available to all but is particularly aimed at extension workers, government organizations, researchers and farmers in developing countries. It provides clear, up-to-date information that can be put immediately into action to diagnose, treat and prevent plant pests and diseases.

Web: www.plantwise.org/KnowledgeBank

Plantwise is a global programme to improve food security, alleviate poverty and improve livelihoods. The programme helps developing countries establish a network of plant clinics run by CABI-trained 'plant doctors', where farmers can bring crops afflicted by pests or disease.

The Knowledge Bank is central to the Plantwise programme and was designed to support those involved in plant health in developing countries, especially plant doctors. It contains a range of features which ensure the information it provides is useful, relevant and applicable. For example, the diagnostic tool enables users to diagnose plant problems based on pictures of symptoms; country specific homepages mean the information shown is tailored to the user's location; and a range of factsheets provide information about easily applicable treatments. New ways of delivering the Knowledge Bank's information are constantly being explored, with printed Knowledge Bank factsheets already being distributed in areas where specific plant pest or diseases are particularly prevalent and Internet access is unavailable.

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CAB Abstracts

As a regular user of CABI's abstracts database, I'm pleased to share the news that the over nine million records on CAB Direct (www.cabdirect.org) have been re-indexed to bring them into line with the controlled vocabulary of the updated 2011 CAB Thesaurus. This re-indexing standardizes indexing and searching across all of CABI's database records from 1910 to date, adding new and updated vocabulary and enabling seamless searching for concepts and organisms which may have changed indexing term or taxonomic name over time. While they were doing this, my colleagues took the opportunity to re-check all the records for the availability of DOIs (digital object identifiers) which led to the addition of over 415,000 new DOIs to the database – where one is available you can click through to the original publisher record and often to full text; interestingly, the DOIs added include many old records, as far back as 1915.

Conference Report

Biological Control at the Sixth International Weed Science Congress

The Sixth International Weed Science Congress was held in Hangzhou, China, on 17–22 June 2012 where over 600 scientists from 50 countries attended to present and discuss current research in the field of invasive plant species. The thematic sessions included a diverse array of topics reflecting the strapline of the conference – Dynamic Weeds, Diverse Solutions – where both theoretical and applied scientific aspects were presented and discussed. There was a wide scope of topics that ranged from aquatic weed management using both herbicides and biological control methods, through herbicide application and formulation, to integrated weed management in rice. The diversity of talks reflected the diversity of participants and their interests and visions for future weed management.

Biological control of weeds was represented by two sessions which highlighted the need to incorporate this sustainable weed management method for the control of invasive plant species, in both agricultural and natural ecosystems. The majority of the discussions focused on invasive weeds in China, although global initiatives were also presented; for example, *Ambrosia artemisiifolia*, where a recent European Union COST action focusing on this species has established a global network of scientists working on its management. A number of presentations dealt with the classical biological control approach, detailing the effectiveness of arthropod biological control agents for the suppression of non-native weeds like *A. artemisiifolia* and *Alternanthera philoxeroides* in China. The use of plant pathogens as classical biological control agents was illustrated by a presentation on the utilization of the rust pathogen *Puccinia spegazzinii* against *Mikania micrantha* at a regional Asian–Pacific scale. *Puccinia spegazzinii* was first released in Asia seven years ago and the presentation highlighted the success of this pathogen in controlling *M. micrantha* when large-scale release programmes were implemented.

Another presentation detailed how prioritizing weed targets in China may help to focus efforts and limited resources on those species where classical biological control may have significant tangible impacts. Based on a recently developed weed classical biological control prioritization tool for Australia, over 250 non-native invasive plant species in China were ranked in order of feasibility for this approach and a 'top ten' list of weed targets was presented to the conference.

It was interesting to hear talks on the ecological interactions of classical biological control agents and their hosts, and agent efficacy, under different environmental conditions. The flea beetle, *Agasicles hygrophila* was released in China in 1986 to control *Alternanthera philoxeroides*, although success was found to vary between aquatic and terrestrial habitats. The authors of a presentation entitled 'Biological control: the importance of plant tolerance of herbivory' showed, through garden and greenhouse experimentation, that plants in terrestrial habitats compensated for herbivory through increased below-ground growth. However, this was not seen in aquatic populations.

Recent developments in biopesticide research were highlighted by a number of talks and posters. These particularly focused on the impact of formulation and application on efficacy, in both agricultural and environmental habitats. Although yet to be commercialized, field evaluation of a powder formulation of *Helminthosporium gramineum* for barnyard grass (*Echinochloa crus-galli*) control in rice paddies in China demonstrated that it gave higher weed control rates than found in herbicide-treated plots, with no adverse effects on rice yield. Research into plant pathogens with potential as mycoherbicides for weed control in citrus orchards in China was presented. The authors detailed a number of promising plant pathogens – *Alternaria* sp., *Fusarium* sp. and *Botryotinia fuckeliana* – which are undergoing research into their pathogenicity and efficacy against a number of target weeds. A keynote presentation entitled 'Strategies for advancing bioherbicides', by Susan M. Boyetchko (Agriculture and Agri-Food Canada), stressed the need to move the focus from single weed target products to the development of broad-spectrum products that can be integrated into weed management systems.

It was encouraging to see so many oral and poster presentations on biological control, both the classical and bioherbicidal approach, at the Sixth International Weed Science Congress. Since there has not been a scientific breakthrough in the discovery of a new chemical herbicide with a novel mode of action in the last 30 years, coupled with restrictions in chemical herbicide use in areas of high conservation status, biological control offers a tried and tested, environmentally safe, management tool for invasive plant species.

By: Rob Tanner and Carol Ellison, CABI.