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General News

Model Cassava Mealybug Biocontrol Programme for Thailand

A carefully crafted emergency campaign against cassava mealybug (*Phenacoccus manihoti)* in Thailand got underway in July 2010 with the release of a quarter of a million *Anagyrus lopezi* wasps by Thailand's Department of Agriculture in the northeastern province of Khon Kaen. This followed two small-scale releases to assess the biocontrol agent's environmental impact. Widespread releases of this neotropical parasitoid in the mealybug-infested cassava growing regions of sub-Saharan Africa saved the crop there in the 1980s and staved off a major food security catastrophe.

Thailand's cassava industry alone accounts for more than 60% of global exports of this tropical root crop, which is critical for food security and economic growth in many developing countries. About five million growers across Southeast Asia supply cassava to domestic and foreign processing industries, which convert the roots to animal feed and biofuels and also extract starch from them for use in a wide variety of food and other products.

The spread of cassava mealybug to about 200,000 ha has been confirmed in eastern and northeastern Thailand, where the pest is causing yield losses as high as 50%. Since the country's cassava industry generates more than US$1.5 billion of income each year – and the overall Thai cassava industry is worth US$3 billion – reductions of that magnitude could translate into hundreds of millions of dollars in economic losses, especially if the pest is allowed to spread further.

In mounting the emergency campaign, Thai scientists consulted with the International Institute of Tropical Agriculture (IITA) in Benin and the Colombia-based International Center for Tropical Agriculture (CIAT), who were both involved in the Africa-wide programme that curbed cassava mealybug in Africa. Ruben Echeverria, director general of CIAT, said "Thailand's rapid response to stop the cassava mealybug plague shows international agricultural research at its best."

The critical step of confirming the identity of the pest proved initially complicated, according to a Thai Department of Agriculture senior entomologist, Amporn Winotai, because it closely resembled another mealybug, *P. madeirensis*, which, although probably also from South America, poses no threat to cassava. Within a year of confirming the presence of *P. manihoti*, the Department of Agriculture had arranged for importation of *A. lopezi*, following strict quarantine procedures and then carried out controlled testing and mass multiplication ready for a possible release. IITA entomologist Georg Goergen hand-carried a colony of the 500 wasps from Benin to Thailand last year to start the testing and mass rearing process.

CIAT scientists are investigating reports that that the cassava mealybug has already spread to Cambodia, Burma, Laos and Vietnam. Tony Bellotti, a CIAT entomologist who has spent 35 years investigating cassava pests, expects that it will soon reach other parts of Southeast Asia, including southern China, and eventually spread to Indonesia and the Philippines. If the pest is confirmed in these countries, biological control can be implemented in line with the procedures followed by the Thai Department of Agriculture. According to Bellotti, however, in the long term scientists will also need to develop cassava crops with genetic resistance to mealybugs as part of integrated pest management strategies. To be most effective, biological control must be combined with more resilient cassava varieties and better crop management.

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Source: IITA (www.iita.org)
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Arthropod Invasions: Seeking Commonalities

Writing in the September 2010 issue of *Biological Invasions* (vol. 12, no. 9), James D. Harwood & Megha N. Parajulee argue that the success of future efforts to reduce the impact of invasive non-native arthropods "is likely to rest on our ability to identify any commonality that exists among such invasions and define options for biological control." Their paper, 'Global impact of biological invasions: transformation in pest management approaches', introduces five further papers, which were originally presented at a Program Symposium at the Annual Meeting of the Entomological Society of America, held in Reno, Nevada, in November 2008. Harwood and Parajulee say that this series of papers "forms the basis of developing a sound framework of transforming pest management approaches and minimizing the effects of biological invasions by non-native arthropods."

The papers are: 'Eating their way to the top? Mechanisms underlying the success of invasive insect generalist predators' (D. W. Crowder & W. E. Snyder); 'Bioeconomic management of invasive vector-borne diseases' (E. P. Fenichel, R. D. Horan & G. J. Hickling); 'Micro-managing arthropod invasions: eradication and control of invasive arthropods with microbes' (A, E. Hajek & P. C. Tobin); 'European buckthorn and Asian soybean aphid as components of an extensive invasional meltdown in North America' (G. E. Heimpel, L. E. Frelich, D. A. Landis, K. R. Hopper, K. A. Hoelmer, *et al.*); and 'Habitat

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manipulation to mitigate the impacts of invasive arthropod pests' (M. Jonsson, S. D. Wratten, D. A. Landis, J.-M. L. Tompkins & R. Cullen).

Web: www.springerlink.com/content/1387-3547/12/9/

More Insect Biodiversity Research in Africa

Two papers published in *BioControl* concerning two different groups of insect pests and their natural enemies in Africa argue that more research is needed on the indigenous insect fauna before developing biological control programmes.

In the first[1], Robert Musundire and co-authors assembled information about agromyzid and parasitoid diversity in different habitats in Africa from references scattered in the literature, with the aim of being able to discuss the future needs from the perspective of biological control. They found comparatively low parasitoid diversity, which they suggest reflects "poor sampling effort and lack of taxonomic expertise for parasitoid species in this area". The number of records suggested that comparatively more studies had been carried out in eastern/southern Africa than in West/Central Africa. Efforts appear to have been concentrated on economically important agromyzid species, but studies in other regions suggest natural habitats are a rich source of native agromyzids and their natural enemies. The polyphagous nature of agromyzid parasitoids makes native species potentially useful in conservation biological control. The authors suggest more research on African native parasitoids and associated agromyzids is needed before extensive biological control programmes are embarked upon.

In the second paper[2], Jean-François Vayssières and co-authors, from the International Institute of Tropical Agriculture-coordinated regional programme on fruit fly control strategies in West Africa, provide an inventory of parasitoids associated with fruit flies in mangoes, guavas, cashew, pepper and major wild fruit crops from surveys carried out in northern-central Benin in 2005, 2006, and 2008. The aim was to determine the overall parasitism rate and the pest control potential of these parasitoids to provide baseline data for future biological control efforts. They found that the efficacy of the parasitoid assemblage in controlling tephritid pests was low, as indicated by the high infestation rate with low parasitism rate; parasitism was highest in wild fruit crop habitats. The recently introduced pest *Bactrocera invadens* was rarely parasitized and then only by the pteromalid *Pachycrepoideus vindemmiae* – and not at all by the otherwise (easily) most abundant and widely distributed parasitoid, the braconid *Fopius caudatus*. Although the authors say the very low rate of parasitism of *B. invadens* may justify the introduction of a non-native (such as *F. arisanus* which has proved effective elsewhere against many fruit flies), they underline the importance of inventorying the native parasitoid fauna before carrying out exotic parasitoid introductions.

[1]Musundire, R., Chabi-Olaye, A., Löhr, B. & Krüger, K. (2010) Diversity of agromyzidae and associated hymenopteran parasitoid species in the afrotropical region: implications for biological control. *BioControl* Online First, DOI: 10.1007/s10526-010-9312-z.

[2]Vayssières, J.-F., Wharton, R., Adandonon, A. & Sinzogan, A. (2010) Preliminary inventory of parasitoids associated with fruit flies in mangoes, guavas, cashew pepper and wild fruit crops in Benin. *BioControl* Online First, DOI: 10.1007/s10526-010-9313-y.

Thai Beetle Hope for Skunk Vine Biocontrol

A newly described species of an aleocharine beetle, *Himalusa thailandensis*, is a promising candidate for biological control of skunk vine, *Paederia foetida* and potentially for the related sewer vine, *P. cruddasiana*[1]. The discovery of this beetle marks a number of 'firsts'.

Skunk vine is a noxious weed in the southeastern USA and has the potential to spread further in mainland USA; as far as the northeastern states. It is also a weed occurring in Hawaii, Mauritius, Reunion, and possibly Sri Lanka and New Guinea. As a weed of natural areas it smothers and displaces trees and other native vegetation. On Hawaii it is a serious problem in nurseries producing ornamental foliage plants. It was initially introduced to the USA as a potential fibre crop in central Florida in the nineteenth century, and had been identified as a weed by 1916. Sewer vine is a more localized weed in parts of Florida but also has the potential to spread further.

Efforts to find natural enemies in the weed's native range in Asia uncovered a potential classical biological control agent. The insect was found feeding on a closely-related *Paederia* species, *P. pilifera,* during exploration in Thailand by entomologists from the USDA-ARS (US Department of Agriculture – Agricultural Research Service), Invasive Plants Research Laboratory (IPRL) in Ft. Lauderdale, Florida, and the ARS Australian Biological Control Laboratory (ABCL) in Brisbane, Australia, with a cooperator with the Thailand Department of Agriculture. Subsequent study by research leader Ted Center and entomologist Paul Pratt, both with IPRL, and Canadian and Italian cooperators showed it to be a new *Himalusa* species. *Himalusa thailandensis* represents the first record of the genus for Thailand; it previously contained a single species, *H. annapurnensis,* from the Himalayan region of Nepal.

Himalusa species have been placed in a newly erected tribe, the Himalusini. The only two known species of *Himalusa* are unusual amongst aleocharines in being plant feeders; most members of this staphylinid subfamily are scavengers or predators. The 2.5-mm-long adult beetles feed near the leaf mid-vein of the skunk vine plant, gnawing holes the size of their bodies. They also scrape nearby leaf tissues from this refuge, which blacken and decay, producing significant levels of foliar damage. The larvae burrow into and feed within the leaf petioles. As they grow, the petioles swell until they split and the larvae drop out to pupate in the soil.

Himalusa thailandensis has been prioritized as a biological control candidate, and Ted Center and his team are currently defining the insect's host range and further studying its biology. Preliminary results show that the beetle is specific to skunk vine. There are no native *Paederia* species in the USA, so *H. thailandensis* could be a promising biocontrol agent for this invasive weed.

[1]Klimaszewski, J., Pace, R., Center, T.D. & Couture, J. (2010) A remarkable new species of *Himalusa* Pace from Thailand (Coleoptera, Staphylinidae, Aleocharinae): phytophagous aleocharine beetle with potential for bio-control of skunkvine-related weeds in the United States. *ZooKeys* **35**, 1–12.

Other sources:
ARS News Service, (www.ars.usda.gov/is);
Bugwood (http://wiki.bugwood.org);
Centre for Aquatic and Invasive Plants, University of Florida (http://plants.ifas.ufl.edu)

Protecting Natural Ecosystems

A supplement to the August 2010 issue of *Biological Control* (vol. 54, supplement 1) focuses on 'Classical biological control for the protection of natural ecosystems'. The body of the supplement is a review paper[1], authored by 48 leading figures in the classical biological control community, which assesses 70 classical biological control projects that have protecting nature as at least part of the objective. The senior author, Roy Van Driesche, explains in the preface that their aim was to illustrate the benefits of using classical biological control to protect natural areas and their component species when they are threatened by invasive plants and insects. That this is a relatively new but active field is illustrated by the finding that nearly half of the projects reviewed are ongoing. Of all projects considered, about twice as many were against invasive plants compared with insects. Complete success against insects was apparently higher than against plants but this may reflect the role of weed biocontrol agents in weakening rather than killing host plants. Protection of biodiversity was the most frequent benefit; protection of natural products also benefited as in one case did ecosystem services.

A report on a recent meeting on this same topic is in the Conference Reports section, this issue.

[1]Van Driesche, R.G., Carruthers, R.I., Center, T., Hoddle, M.S., Hough-Goldstein, J., Morin, L., Smith, L., Wagner, D.L., *et al.*, (2010) Classical biological control for the protection of natural ecosystems. *Biological Control* **54**, Supplement 1, S2-S33.

Weed Biocontrol in South Africa: Ecosystem and Economic Impacts

Economic and ecosystem assessments of weed biological control impacts are scarce. The authors of a new paper in *Biological Invasions*[1] describe their study as "a first attempt at a holistic economic evaluation of South African endeavours to manage invasive alien plants using biological control", noting that they have focused on, "the delivery of ecosystem services from habitats that are invaded by groups of weeds, rather than by each individual weed species." They established the present cost of weed biological control efforts, and compared these to the estimated value of ecosystem services protected by biological control to derive cost:benefit ratios. They identified four major functional groups of invasive alien plants, which they assessed separately for their impacts on water resources, grazing and biodiversity. They also estimated the land area in South Africa that remained uninfested owing to *all* control efforts, and the proportion of this that could be attributed to biological control since it began in 1913. Results indicated that although an estimated 6.5 billion South African rands (ZAR; 1 ZAR = ~ US$7) were lost annually to invasive alien weeds, an additional ZAR 41.7 billion would have been lost in the absence of any control, and 5–75% of this protection was from biological control. Benefit:cost ratios varied from 50:1 (invasive subtropical shrubs) to 3726:1 (invasive Australian trees). The authors conclude that biological control has brought about a considerable level of protection of ecosystem services, and that this remained true even when they substantially reduced estimates of the key variables in a sensitivity analysis.

[1]de Lange, W.J. & van Wilgen, B.W. (2010) An economic assessment of the contribution of biological control to the management of invasive alien plants and to the protection of ecosystem services in South Africa. *Biological Invasions* Online First, DOI: 10.1007/s10530-010-9811-y.

Ticking Off Time for Livestock?

In a review two years ago[1] some of the constraints to tick control using fungi such as *Metarhizium anisopliae* were discussed. Entomopathogenic fungi (EPF – the term is used even when referring to fungi that kill ticks, which are not insects) are clearly pathogenic to ticks under laboratory conditions and pasture applications have also shown promise; topical applications have a long way to go before realistic control is imminent. However, research in a number of countries has produced promising results which suggest that mycoacaricides could have a valuable role to play in integrated pest management of ticks.

Ticks are serious parasites of terrestrial vertebrates, taking blood meals in all of their feeding stages. The feeding alone causes production losses, and also hide damage, thus reducing income to farmers, but it is the diseases that ticks spread that cause most losses. With climate change, ticks are likely to become much more important in many new areas. And ticks are very difficult to control. Until the middle of the 20th century, arsenic-based acaricides were a mainstay; there were some obvious issues with these. More-modern acaricides have also suffered problems such as the accumulation of toxic residues and negative environmental effects as well the development of resistance to the chemicals.

The development of effective acaricides based on EPF would be a major achievement; at worst these biological products would slow down the rate of resistance developing to chemical acaricides by reducing the number of times they are used. Even more exciting would be products that could completely replace the chemicals.

Problems associated with biological pesticides can be broadly grouped as either a general lack of quality in products or a more specific lack of adaptation to the particular requirements for control. Fortunately, for the fungal species generally researched for tick control such as *M. anisopliae* and *Beauveria bassiana*, most generic problems have been resolved. We do know how to mass-produce them to a high level of quality, store them, giving them a good shelf life, often extending to years, and, increasingly, there is understanding of the importance of formulation and application techniques. The more specific problems relate to the peculiar ecosystems in which fungal spores would need to operate in order to control ticks

These specific issues are again divisible into two; tick control on pastures and on the animals. The first of these is essentially applications to vegetation to cause infections of the ticks off-animal. With the right isolate, formulation and application strategy, this can be very effective at reducing tick numbers. However, pasture control, especially where stocking densities are very low, implies treatments over vast areas. The economic compromise would appear to be to apply to hot-spots of tick infestations, such as areas where the animals regularly overnight. Control of ticks on the animals presents very different challenges. The fungus has to tolerate mammalian body temperatures, moisture from sweat and urine, and an array of chemical secretions. Ticks may only be attached to the animals for a very short time and/or protected by being in folds of skin, so application can be a serious problem. None of these aspects mean that the use of fungi for tick control is impossible, but significant research is going to be required, so the news from Australia (see article below) is to be welcomed.

[1]Polar, P., Moore, D., Kairo, M.T.K. & Ramsubhag (2008) Topically applied myco-acaricides for the control of cattle ticks: overcoming the challenges. In: Bruin, J. & Geest, L. van der (eds) *Diseases of Mites and Ticks.* Springer, The Netherlands, pp. 119–148.

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A Fungal Biopesticide for Cattle Tick Control?

The cattle tick, *Rhipicephalus (Boophilus) microplus*, is a serious external parasite of cattle in Australia and many other parts of the world. This tick is responsible for a range of problems in cattle that all result in economic losses, estimated to cost the Australian cattle and dairy industries A$146 million annually. Problems include lowered milk and meat production, hide damage, acute anaemia from excessive blood loss and increased morbidity and mortality due to a range of diseases termed tick fever, for which the ticks are vectors.

The Australian beef and dairy industries were founded on British breeds which evolved in cattle tick-free areas and hence have little inherent resistance to this tick. When exposed to large numbers of *R. microplus* larvae, these cattle breeds are unable to prevent excessive numbers feeding on them. Cattle are now exposed to *R. microplus* in a region extending across the northern portions of Australia and down the eastern half of Queensland. The current control strategies rely heavily on veterinary chemicals. Tick control uses a range of acaricides applied as either spray formulations or pour-ons. However ticks have developed resistance to most of the classes of chemicals used in acaricides.

Fungal biopesticides could provide an alternative to chemical control of cattle ticks with the added benefit of avoiding problems associated with acaricide resistance and residues. A fungal biopesticide for tick control would consist of formulated fungal spores applied to cattle in a manner similar to that used for some conventional acaricides.

Agri-Science Queensland scientists have been conducting research into the feasibility of using local isolates of the insect-killing fungus *Metarhizium anisopliae* to control cattle ticks. The characteristics of a range of *M. anisopliae* isolates taken from the soil or dead insects throughout Queensland have been studied. Some isolates were found to be extremely virulent to ticks. In laboratory assays the fungus killed 100% of engorged adult female ticks within 48 hours. Pathogenesis studies revealed that the spores germinate on the exterior, then invade and destroy parts of the tick cuticle before killing the tick. This mechanism could be significant in relation to precluding tick resistance.

In 2003–04 three outdoor pen trials were conducted to assess the efficacy of a *Metarhizium*-based formulation in killing ticks on animals. Different formulations were sprayed onto dairy heifers which had been artificially infested with tick larvae. Surface temperatures of selected animals were monitored, as were the ambient temperature and relative humidity. Unengorged ticks sampled from each animal immediately after treatment were incubated under laboratory conditions to assess the efficacy of the formulation and application. Egg production by engorged ticks collected in the first three days after treatment was reduced significantly. Side counts of standard adult female ticks (i.e. all adult ticks 4.5–8 mm long on the same side of each animal) were conducted daily, before and after treatment, to assess the performance of the fungus against all tick stages on the animals. At each trial the formulation caused 100% mortality in unengorged ticks that were removed from cattle and cultured under laboratory conditions.

The trials showed that while lethal doses of the fungal biopesticide can be applied to ticks on cattle, high temperature on the skin surface during mid summer may be a limitation. The third trial, conducted in extreme summer heat, was aborted when tick numbers on all animals, including the controls, declined drastically. One trial in which the product appeared to be quite effective took place under cooler ambient temperatures; further research is needed in this area.

Meat and Livestock Australia are co-funding a project that aims to conduct further investigations to develop the best possible *Metarhizium* formulation for ease of storage, application and rapid tick death and define the temperature limits of this formulation against ticks. A trial with artificially infested cattle in moated tick pens is currently underway to evaluate the efficacy of the new formulation against all tick stages on cattle.

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Comparing Models of Biopesticide Development

A paper in *Plant Disease*[1] discusses different models for biopesticide development for plant-based agriculture in operation in various parts of the developing and developed worlds, looking at how production, distribution and methods of use have evolved in diverse ways. The paper, which arose out of the X *Trichoderma* and *Gliocladium* Conference in San José, Costa Rica, on 21–23 May 2008, with additional perspectives obtained through the 'Expert Consultation on Biopesticides and BioFertilizers in Sustainable Agriculture' (organized by the Association of Asian Pacific Agricultural Research Institutions Taichung, Chinese Taipei, by the senior author) deals principally but not exclusively with biocontrol based on *Trichoderma* strains.

The authors begin by outlining how chemical and topical and endophytic biopesticides differ. They describe four general models for the use of biopesticides, and identify the advantages and disadvantages of each: (1) full registration and marketing, (2) inoculants, plant strengthening agents and biofertilizers, (3) local production, and (4) governmental monopolies or state-supported production; they also say more systems are needed. They emphasize the need for effective screening and selection systems to provide the most effective strains, without which none of the models will be successful. They highlight the importance of modern taxonomy in defining species that may be of concern because of the toxins or other metabolites they might produce or because of their biological propensities; for example, the potentially harmful strains of *Trichoderma* have now been largely localized in a few well-defined species.

[1]Harman, G.E., Obregón, M.A., Samuels, G.J. & Lorito, M. (2010) Changing models for commercialization and implementation of biocontrol in the developing and the developed world. *Plant Disease* **94**(8), 928–939.

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Bridal Creeper Biocontrol Adds Up

A paper in *Biological Control*[1] describes how interactions between a pathogen and an insect biological control agent produced a result that was more than the sum of the parts. The authors note that how biological control agents interact and impact on invasive plant hosts has received little research attention. Their study evaluated the separate and combined effects of the rust fungus *Puccinia myrsiphylli* and an undescribed leafhopper in the tribe Erythroneurini (formerly referred to as *Zygina* sp.) in greenhouse and field experiments. Both agents have been introduced to southern Australia for the control of bridal creeper (*Asparagus asparagoides*) where it is a major bushland weed. It forms a thick mat of underground tubers and rhizomes which impedes the root growth of other plants and can prevent seedling establishment, while its climbing stems and foliage smother native plants. Although leafhopper damage decreased as rust infection increased, the combined impact of the agents was greater on belowground parameters than for the individual agents.

[1]Turner, P.J., Morin, L. Williams, D.G. & Kriticos, D.J. (2010) Interactions between a leafhopper and rust fungus on the invasive plant *Asparagus asparagoides* in Australia: A case of two agents being better than one for biological control. *Biological Control* **54**(3), 322–330.

Charting Progress of Cat's Claw Creeper Biocontrol Agent

Since the first biocontrol agent for cat's claw creeper, *Macfadyena unguis-cati*, was approved for introduction to Australia, more than half a million of the tingid bug *Carvalhotingis visenda* have been released at 72 sites in Queensland and New South Wales, and in addition, community groups have deployed some 11,000 tingid-infested plants at 63 sites in Queensland. A paper in *Biological Control*[1] charts the progress of the biological control programme from the commencement of mass-rearing and field releases in May 2007. It reports evidence of establishment of the agent three years after release at 80% of release sites, and that it has established on the two morphologically distinct 'long-pod' and 'short-pod' cat's claw creeper varieties present in Australia. Establishment was positively correlated with number of releases and number of tingids released. In the field, the tingid has spread slowly (5.4 m per year), and the maximum distance that it has been found from initial release sites ranged from 6 m to some 1 km.

[1]Dhileepan, K., Treviño, M., Bayliss, D., Saunders, M., Shortus, M., McCarthy, J., Snow, E.L. & Walter, G.H. (2010) Introduction and establishment of *Carvalhotingis visenda* (Hemiptera: Tingidae) as a biological control agent for cat's claw creeper *Macfadyena unguis-cati* (Bignoniaceae) in Australia. *Biological Control* **55**(1), 58–62.

Invasive Mite Has Silver Lining in Broom Biocontrol

A study reported in *Journal of Applied Ecology*[1] suggests that the adverse impact of *Varroa destructor* mites on honeybees may just have a beneficial side-effect. The seed-feeding beetle *Bruchidius villosus*, which was released in New Zealand to control European broom, *Cytisus scoparius*, in 1988, was subsequently found unable to suppress the invasive weed populations because it did not destroy sufficient seed. Paynter and co-authors looked at whether honeybee decline, caused by the invasive mite, had led to pollinator limitation, and, in which case, whether the impact of *B. villosus* on broom seed production might now reach thresholds for population suppression. From a combination of manipulative pollination treatments and broad-scale surveys of pollination, seed rain and seed destruction by *B. villosus,* together with modelling studies, they showed that broom extinction could indeed occur at many sites, and where broom persisted it could become easier to control by conventional means. On the other hand, the presence of commercial beehives (treated for *Varroa*) would allow broom to persist in many places, which the authors consider in the light of an integrated broom management programme.

[1]Paynter, Q., Main, A., Gourlay, A.H., Peterson, P.G., Fowler, S.V. & Buckley, Y.M. (2010) Disruption of an exotic mutualism can improve management of an invasive plant: varroa mite, honeybees and biological control of Scotch broom *Cytisus scoparius* in New Zealand. *Journal of Applied Ecology* **47**(2), 309–317.

Conference Reports

Joint IOBC Nearctic and Neotropic Regional Sections Biocontrol Conference

The Nearctic and Neotropical Regional Sections of IOBC (International Organization for Biological Control) co-organized and co-convened a joint meeting on 'Biological Control in the Americas – Past, Present and Future' on 11–13 May 2010 in Niagara Falls, Ontario, Canada. With the rapid movement of invasive pests worldwide and especially on a North–South axis, we thought a meeting of biocontrol researchers, integrated pest management practitioners and biocontrol producers would be timely and build on the collaboration that is already occurring within the Americas. With 136 participants from 17 countries, the conference proved to be an important event where all major players presented the current situation regarding biological control in their countries.

The keynote speaker for the meeting was Dr Jacques Brodeur, President of IOBC Global, who provided an update on the IOBC Commission on 'Biological Control and Access and Benefit Sharing'. The scientific programme covered a wide range of biocontrol topics on arthropod, plant pathogen and weed pests. Ten symposia were organized with 47 presentations; symposia topics covered Invasive pests, Risks and benefits of exploration for biocontrol agents in the Americas, Ecosystem landscapes and habitat management for IPM, Challenges and successes for commercialization and implementation of biocontrol agents, Microbial biological control, Weed biocontrol, Biological control with egg parasitoids, and more. In addition, 39 posters were displayed. The local arrangements committee organized a diverse and interesting tour one afternoon which included some of the different biocontrol activities undertaken in the Niagara region and also some of the local sights. The tour ended with a banquet at one of the premier wineries in the area. A social mixer and poster viewing was held the first evening.

The Association of Natural Biocontrol Producers (ANBP) organized a symposium on 'Challenges and Successes in Augmentation Biological Control for North America' and assisted in the organization of the meeting. ANBP also sponsored two student poster awards which were awarded to Wendy Romero (Masters student at the University of Guelph, Canada) and Doo-Hyun Lee (PhD student at Cornell University, USA). In addition, ANBP held its annual meeting on 13 May. The IOBC Global Working Groups 'Benefits and Risks Associated with Exotic Biological Control Agents' and 'Egg Parasitoids' organized a symposium each at the meeting.

Feedback from the participants indicated that the meeting was a big success due to the dedication and hard work from the organizing committee and all the sponsors that contributed to the meeting. PDF versions of some of the oral presentations are available on the NRS web site (www.iobcnrs.com). A recommendation was made that the next joint NRS/NTRS meeting be convened in 3–4 years and held in Central/South America.

By: Vanda Bueno (President, NTRS) & Les Shipp (Agriculture and Agri-Food Canada).

Classical Biological Control for Protection of Nature

Invasive species are second only to habitat destruction as factors driving population declines of native species and causing dysfunction and degradation of natural ecosystems. Management strategies for invasive species in wilderness areas are varied and range from doing nothing, to active management through the establishment of quarantine zones, implementation of eradication programmes, or the development of impact reduction programmes (e.g. herbicide applications or trapping). One management tool that is gaining greater significance in the management of invasive pests of conservation importance is classical biological control. This approach is potentially very well suited for reducing damaging population densities of invasive weeds and insects because biological control agents can spread over vast, and often sensitive, areas that would be impossible to manage with traditional approaches. The use of natural enemies in support of the conservation of nature is an extension of technology developed for the management of invasive agricultural pests. Initial efforts were pioneered by weed biocontrol specialists and now programmes targeting arthropod pests are being developed with increasing frequency as well.

To increase awareness and better document the diversity of biological control programmes being developed for the management of invasive species of conservation concern, a conference showcasing recently completed and ongoing programmes was organized by Roy Van Driesche (Department of Plant, Soil, and Insect Sciences [PSIS], University of Massachusetts, Amherst, USA) and Mark Hoddle (Department of Entomology, University of California, Riverside, USA). Sponsorship for the conference was provided by the USDA (US Department of Agriculture)-Forest Service, USDA-Agriculture Research Service, the National Park Service, the Mid-Atlantic Exotic Pest Plant Council, the US Fish and Wildlife Service, the Northeastern Regional Association of State Agricultural Experiment Station Directors, the University of Massachusetts, Amherst, and the University of California, Riverside Center for Invasive Species Research.

The conference was held over 3–7 October 2010 in Northampton, Massachusetts. It was attended by 140 people from ten countries (Australia, Canada, China, French Polynesia, Mexico, New Zealand, Republic of Georgia, South Africa, the UK and the USA). The meeting started on the evening of Sunday 3 October 2010 with registration and a mixer where participants shared bottles of wine and other beverages sourced from their home areas. The plenary address on Monday morning, 'Preserving the Fynbos' was delivered by Dr Cliff Moran (University of Cape Town, South Africa). This highly informative presentation opened the meeting for the remaining 13 sessions (Integrated ecosystem management: how important are invasive plants and biological control in natural areas?; Ecological ramifications of the biological control of fire-connected invasive species; Nutrient loading and biological control of aquatic plants – what are the interactions?; Recent biological control for invasive species management on islands; Role of molecular genetics in identifying 'fined tuned' natural enemies of invasive weeds; Recent successes in biological control of forest pests; Biological control of invasive ants; Preserving native forests from invasive wood borers; Pathogens - successes, prospects and barriers to their wider use as classical biological control agents; Invasive plant, invasive butterfly, invasive parasitoid: multiple woes for a native pierid in the northeast USA; Review of non-target ecological effects and unwanted agent spread from classical biological control agents; Host range determination and risk assessment; Flow-on effects of biological control in native food webs; How do we measure the environmental effects of biological control in natural systems?) in which a total of 63 oral presentations were made and 30 posters were displayed.

In the evening of Tuesday 5 October, at the annual meeting of the northeast USA Regional Project on Biological Control, progress for various ongoing projects was informally and briefly discussed. Two highly engaging and entertaining panel discussions were held on Wednesday evening where panelists discussed and debated 'What are we not doing well?' and 'What happened in the saltcedar biocontrol program and what are its implications?'

A field trip was taken on the Wednesday to visit local ecosystems with invasive species problems. The tour included stops to view locally important invasive species (e.g. hemlock woolly adelgid, swallow wort, garlic mustard, purple loosestrife, beech scale and Japanese knotweed) together with some cultural and landscape-viewing stops.

From the oral presentations, some 20 were chosen to be developed more fully for a special issue of *BioControl*. A retreat was held after the meeting at Lake Sunapee in New Hampshire to complete the development of an outline for writing a book encapsulating the major themes and accomplishments of biological control projects for conservation.

Selected presentations from this conference will available as PDF's on the web at:
www.biocontrolfornature.org

A review of this same topic has appeared in a supplement to *Biological Control*; see 'Protecting natural ecosystems', General News, this issue.

By: Mark S. Hoddle[a] & Roy G. Van Driesche[b]

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Ecology of Aphidophaga 11

The 11th meeting of the official IOBC (International Organization for Biological Control) Working Group 'Ecology of Aphidophaga', which was held on 19–24 September 2010 in Perugia in the historic and scenic Umbria region of central Italy, was attended by just over 100 participants from 30 different countries. Participation by seven IOBC student members was made possible by travel grants from IOBC. The meeting was chaired by Dr J.P. Michaud of Kansas State University, USA, and the local organizing committee was headed by Prof. Carlo Ricci, University of Perugia.

In addition to hearing stimulating presentations on recent research developments concerning aphid-feeding arthropods and engaging in animated discussions on their favourite topics, participants were treated to exquisitely catered food services, wine tastings, live entertainment, and a lavish banquet on the Thursday evening. Wednesday was a day designated for local touristic activities and included a guided tour of the historic village of Assisi, followed by a tour of a local winery. By all accounts, a good time was had by all and members are looking forward to the next meeting scheduled to be held in Belgrade, Serbia in the autumn of 2013.

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Conference Announcements

International Bioherbicide Group Workshop

The X International Bioherbicide Group (IBG) Workshop will be held on 10 September 2010, as a one-day, pre-symposium workshop to the XIII International Symposium on Biological Control of Weeds (ISBCW), which is on 11–16 September in Hawaii. The meeting is sponsored by Novozymes Biologicals Inc. The tentative programme includes invited presentations on: The biopesticide innovation chain: how can we structure biopesticide development from a research perspective?; Are biopesticides a growing industry?; The development of bioherbicides by industry; and Using genomics and metabolomics to advance biopesticide development. The call for speakers, abstracts and papers will come in January 2011.

Contact: Karen Bailey (Karen.Bailey@agr.gc.ca)
Web:
http://uhhconferencecenter.com/xiii_isbcw.html

European Whitefly Symposium

The 4th European Whitefly Symposium is being held in Jerusalem, Rehovot, Israel on 11–16 September 2011, with the themes: Trends in whitefly evolution, The plant–whitefly relationship, Whitefly biology, Whitefly–virus interactions, Whiteflies and their symbionts, and Whitefly control.

Contact: D. Gerling (DANGE@tauex.tau.ac.il)
Web: Http://Tinyurl.Com/2epg5nc

Publications

Bailey, A.; **Chandler, D.; Grant, W. P,; Greaves, J.; Prince, G.** Biopesticides: pest management and regulation. CABI (due Oct 2010) 240 pp.
ISBN 9781845935597
Price: £75.00, $145.00, €105.00.
Email: orders@cabi.org
Web: http://bookshop.cabi.org

Ehlers, R.-U. (Ed) Regulation of biological control agents in Europe. Springer (due January 2011) 330pp.
ISBN 9789048136636
Price: £135.00, $209.00, €160.45.
Email: orders-ny@springer.com / orders-hd-individuals@springer.com
Web: www.springer.com

Consoli, F. L.; Parra, J. R. P.; Zucchi, R. A. (Eds.) Egg parasitoids in agroecosystems with emphasis on *Trichogramma* (Progress in Biological Control Vol. 9). Springer (2010) 479 pp.
ISBN: 9781402091094
Price: £136.50, $179.00, €137.10.
Email: orders-ny@springer.com / orders-hd-individuals@springer.com
Web: www.springer.com

Williams, I. H. (Ed) Biocontrol-based integrated management of oilseed rape pests. Springer (2010) 500 pp. ISBN 9789048139828
Price: £153.00, $239.00, €179.30.
Email: orders-ny@springer.com / orders-hd-individuals@springer.com
Web: www.springer.com

Becker. N.; Petric, **D.; Zgomba, M.; Boase, C.; Madon, M.; Dahl, C.; Kaiser, A. (Eds)** Mosquitoes and their control, 2nd Ed. Springer (2010) 577 pp.
ISBN: 9783540928737
Price: £153.00, $229.00, €181.85.
Email: orders-ny@springer.com / orders-hd-individuals@springer.com
Web: www.springer.com

Booth, B. D.; Murphy, S. D.; Swanton, C. J. Invasive plant ecology in natural and agricultural systems, 2nd Ed.(previous Ed: Weed ecology) CABI (2010) 224 pp. ISBN 9781845936051
Price: £37.50, $72.50, €52.50.
Email: orders@cabi.org
Web: http://bookshop.cabi.org/