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General News

Oriental Fruit Fly Biocontrol in French Polynesia

The ten years' data analysed in a paper in *Biological Control* by Roger Vargas and co-authors[1] were collected during a programme on the biological control of oriental fruit fly (*Bactrocera dorsalis*) in French Polynesia. As well as providing an account of "the most successful example of classical biological control of fruit flies in the Pacific outside of Hawaii", the authors report on investigations on interspecific competition and displacement among *B. dorsalis* and two other invasive *Bactrocera* species that had been accidentally introduced and established in French Polynesia some years earlier: *B. kirki* (introduced in 1928), and *B. tryoni* (in 1970). During surveys of five of the Society Islands of French Polynesia (Tahiti, Moorea, Raiatea, Tahaa and Huahine) *B. dorsalis* was found on 29 host plants. It is commonly reared from *Mango indica* (mango), *Terminalia catappa* (tropical almond), *Inocarpus fagifer* (Polynesian chestnut) and *Psidium guajava* (common guava) fruits collected from trees along roadsides (and these thus became the subject of a monitoring programme on Tahiti), but more significantly from wild *P. guajava*, which is invasive in the interior. In Hawaii, *P. guajava* and *P. cattleianum* (strawberry guava) have proved to be the key hosts; these are invasive and often dominate the wild vegetation of the interior, although the pest is of more economic importance on tree fruits along major roadways, where there are more residential gardens and commercial orchards.

During the programme in French Polynesia, which began in 2002, three biocontrol agents that had been introduced to Hawaii during the successful campaign against *B. dorsalis* (1947–53) were considered for introduction: *Fopius arisanus, Diachasmimorpha longicaudata* and *F. vandenboschi*. Given its contribution to control in Hawaii, *F. arisanus* was the primary candidate for French Polynesia and was introduced from Hawaii in 2002, with *D. longicaudata* following in 2007; *F. vandenboschi* was eventually rejected for introduction because it is now rare in Hawaii, having been largely displaced by *F. arisanus*.

This new publication follows an earlier paper in 2007[2] in which the successful establishment of *F. arisanus* in French Polynesia (on Tahiti, Moorea, Raiatea, Tahaa and Huahine) was described, together with data indicating the early success of the introduction: by 2006 *F. arisanus* was parasitizing 51.9% of the invasive *Bactrocera* spp. infesting common guava, Polynesian chestnut and tropical almond on Tahiti and was providing significant control; for example, it had reduced numbers of flies emerging from guava fruits by 75.6%, 79.3% and 97.9% for *B. dorsalis*, *B. tryoni*, and *B. kirki*, respectively, compared with 2003 (pre-establishment) levels. The data in the new paper indicate that *F. arisanus* is having a growing impact. By 2009 mean parasitism had reached 65% on the same three host plants. If *M. indica* (a seasonal fruit) is included, mean parasitism increased from 47.7% in 2006 to 59.7% in 2009. Fruit fly numbers were also still falling: by 2009, numbers of *B. dorsalis*, *B. tryoni* and *B. kirki* emerging from guava fruits had declined 92.3%, 96.8%, and 99.6%, respectively, from 2003 levels.

Following its introduction to Tahiti in 2007, *D. longicaudata* was found to be established in early 2008. It is now widespread on the island but numbers remain low. Sampling rarely found parasitism levels on an area or host-plant basis exceeding 5%, and it was often lower (mean 2.4% for the 11 host plants from which it has been recovered, cf. 43.4% for *F. arisanus* from the same plants), and *D. longicaudata* accounts for less than 10% of the parasitoid guild on *Bactrocera* spp. on Tahiti. Nonetheless, the new introduction has increased total mortality by parasitoids and these are early days; with time its populations may increase further.

The observed decreases in numbers of the three *Bactrocera* species in absolute terms and relative to each other are concluded to be the combination of the action of the biocontrol agents and competitive interaction between the fruit fly species. The fruit flies use different host plants to differing extents, but all use common guava, Polynesian chestnut and tropical almond, which were extensively sampled on Tahiti during the biocontrol programme. *Bactrocera dorsalis* now predominates in mango, common guava and tropical almond. While in mango *B. dorsalis* may have found an 'empty' niche – or one not exploited by *B. kirki* in particular – it has steadily displaced *B. tryoni* and *B. kirki* on common guava and tropical almond to become the predominant species. It has thus probably become the dominant fruit fly on many of the fruit tree species in French Polynesia.

The authors end by saying that the results add weight to arguments for the use of *F. arisanus* against *B. dorsalis* on other islands of French Polynesia and elsewhere in the Pacific, and further afield against related invasive *Bactrocera* spp. in Indian Ocean island countries, Africa and South America.

[1]Vargas, R. I., Leblanc, L., Putoa, R. and Piñero, J.C. (2012) Population dynamics of three *Bactrocera* spp. fruit flies (Diptera: Tephritidae) and two introduced natural enemies, *Fopius arisanus* (Sonan) and *Diachasmimorpha longicaudata* (Ashmead) (Hymenoptera: Braconidae), after an invasion by *Bactrocera dorsalis* (Hendel) in Tahiti. *Biological Control* 60(2), 199–206.

[2]Vargas, R.I., Leblanc, L., Putoa, R. and Eitam, A. (2007) Impact of introduction of *Bactrocera dorsalis* (Diptera: Tephritidae) and classical biological control releases of *Fopius arisanus* (Hymenoptera: Braco-

nidae) on economically important fruit flies in French Polynesia. *Journal of Economic Entomology* 100, 670–679.

Contact: Roger I. Vargas, USDA-ARS, US Pacific Basin Agricultural Research Center, Hilo, Hawaii.
Email: roger.vargas@ars.usda.gov

Puccinia abrupta var. *partheniicola*: a biocontrol agent of *Parthenium hysterophorus* new to Nepal

Puccinia abrupta var. *partheniicola*, also called parthenium winter rust, is one of two fungal pathogens that have been used as biocontrol agents against the noxious invasive weed *Parthenium hysterophorus*. *Parthenium*, a native of Central and South America, is an invasive weed of global significance which has been rapidly expanding in urban, agricultural and grazing lands of Australia, Asia, Africa and the Pacific causing serious environmental, economic, human and animal health problems. Though *Parthenium* was first encountered in Nepal in 1967, the population explosion of this weed has been occurring since the 1990s throughout the southern part of the country; along the road networks, it has been expanding to higher elevations in the Mid Hills of Nepal.

Winter rust is naturally found in Argentina, Bolivia, Brazil, Central America and Mexico. As a part of a biocontrol programme, rust collected from Mexico was first introduced into Australia between 1991 and 1995. In other parts of the world, the rust has not been introduced intentionally, but it has been reported from a number of countries including China, India, Ethiopia, Kenya, Mauritius and South Africa[1]. In Nepal *Parthenium* infected by winter rust was observed in May 2011 on the campus of Tribhuvan University at Kirtipur (27° 40' 42.6" N, 85° 17' 7.2" E, 1324 m above mean sea level) in Kathmandu valley, and at a few other sites in the valley. This is the first report of the winter rust from Nepal. Its identification was confirmed by Dr Marion K. Seier and Dr Harry C. Evans at CABI at Egham in the UK. Herbarium specimens of *Parthenium* with leaves infected by this rust have been deposited in the Herbarium at the Royal Botanic Gardens, Kew (IMI No. 501023). This rust is the second biocontrol agent of *Parthenium* to be reported from Nepal; the Mexican beetle *Zygogramma bicolorata* is already established and has caused significant damage to *Parthenium* in a few places[2].

Rust-infected *Parthenium* growing along roadsides grew to normal heights and flowered with abundant heads (capitula). Therefore, the impact of winter rust on growth and seed production of *Parthenium* is likely to be marginal at best. By the end of June (the first month of the rainy season), the rust had disappeared from the stands. Throughout the rainy season, which lasts for 3–4 months, no rust-infected *Parthenium* was found. Earlier research had shown that spore germination and infection is optimum when the temperature is 15°C and the leaves are wet[1]. The minimum temperature of Kathmandu valley is above 18°C in the rainy months (June–September) when *Parthenium* grows most luxuriantly. During April and May the night temperature is very close (13–14°C) to the optimum temperature required for winter rust spore germination and infection. But during these months the environment is relatively dry. Therefore it appears that the climatic conditions of Kathmandu valley are not conducive for winter rust to inflict significant damage to *Parthenium*. To date, it is not clear how widespread the rust is in other *Parthenium*-infested areas of the country. Given the heterogeneous climatic conditions across Nepal, some areas may be more suitable for winter rust than Kathmandu valley.

[1]Dhileepan, K. and Strathie, L. (2009) *Parthenium hysterophorus*. In: Muniappan, R., Reddy, D.V.P. and Raman, A. (eds) *Weed Biological Control with Arthropods in the Tropics: Towards Sustainability*. Cambridge University Press, Cambridge, UK, pp. 272–316.

[2]Shrestha, B.B., Poudel, A., Khatri-Chhetri, J., Karki, D., Gautam R.D. and Jha, P.K. (2010) Fortuitous biological control of *Parthenium hysterophorus* by *Zygogramma bicolorata* in Nepal. *Journal of Natural History Museum* 25, 332–337.

By: Bharat Babu Shrestha, PhD,
Central Department of Botany, Tribhuvan University, Kathmandu, Nepal.
Email: shresthabb@gmail.com

Australia Releases First Biocontrol Agent against Madeira Vine

The release of a chrysomelid leaf-feeding beetle in the Australian state of Queensland in May 2011 marked the first release worldwide of a biocontrol agent against the weed *Anredera cordifolia*, or Madeira vine. Native to South America, Madeira vine was introduced as an ornamental and has become a serious environmental weed in several countries, including South Africa and Australia. It spreads rapidly via tubers produced on its stems and its vigorous mat-like growth smothers native vegetation, including trees, especially in moist and riparian areas. As weedy vines are notoriously difficult to control by mechanical or chemical means, a biological control programme was launched against it by South Africa's ARC-PPRI (Agricultural Research Council – Plant Protection Research Institute), funded by the Department of Water Affairs' 'Working for Water' programme, in collaboration with Australian institutions and the US Department of Agriculture – Agricultural Research Service (USDA-ARS) South American Biological Control Laboratory in Argentina.

Exploratory surveys by South African (ARC-PPRI) and Argentinian (USDA-ARS) scientists led to the identification of two potential chrysomelid biocontrol agents, *Phenrica* sp. from Brazil and *Plectonycha correntina* from Argentina and Brazil. Adults and larvae of both species feed extensively on leaves and new growth of *A. cordifolia*, resulting in leaf and above-ground biomass reductions. Laboratory host range and biology studies of *Phenrica* sp. were conducted in South Africa but unfortunately the culture was lost and re-collection has not yet been possible. Host-specificity testing has, however, continued on *Plectonycha correntina* in both Argentina and South Africa. Despite some feeding on other non-indigenous species of Basellaceae, Portulacaceae and Talinaceae, normal insect development was restricted to the target weed, *A. cordifolia*. The evaluation of *P. correntina* can now be finalized with the inclusion of the newly acquired African native, *Basella paniculata*, in the host-specificity testing.

Both insect species were also supplied by South Africa to Queensland's Department of Employment, Economic Development and Innovation (DEEDI) to progress research leading to the insects' release in Australia through funding from local councils, and the New South Wales and Queensland state governments. Madeira vine damages native vegetation in riparian, rainforest and other natural areas along Australia's eastern seaboard. It is, however, the only naturalized plant in the family Basellaceae in Australia, which eased the host-specificity issue for potential agents, although one other exotic member of the family, Ceylon spinach or *Basella alba*, is cultivated as a non-commercial garden vegetable in south-eastern Queensland.

The Australians were also unable to maintain a colony of *Phenrica* sp. in quarantine, but *Plectonycha correntina* was successfully established in culture and host-specificity testing commenced in 2008. Of 37 plant species tested, the beetle could complete its life cycle only on Madeira vine or *B. alba* – and the latter proved an ultimately inadequate host, with four attempts to establish a culture on it failing before the end of the second generation. Experimental evidence suggests that although *B. alba* might be fed on should it be grown near Madeira vine infested with *P. correntina*, damage would be of little consequence.

The release of *P. correntina* for the biological control of Madeira vine was recommended in a report submitted to the Commonwealth Department of Agriculture, Fisheries and Forestry (DAFF) and the Commonwealth Department of Sustainability, Environment, Water, Population and Communities (then called the Department of the Environment, Water, Heritage and the Arts) in December 2009. The case for this insect was the first to be processed through DAFF's new protocols for biological control agents. The release was approved by both Commonwealth agencies in early 2011.

Early indications following the first releases are of severe damage to leaves on Madeira vine and egg batches being laid. The insect has also successfully overwintered. Further releases are being made in Queensland, and beetles have been sent to New South Wales to start a breeding programme there. The ultimate aim is to release beetles in batches of 100–500 throughout the whole area infested with Madeira vine. Biosecurity Queensland will monitor the beetle's effectiveness over several years.

Sources: Biosecurity Queensland, 'Biological control of Madeira vine'
Web: www.dpi.qld.gov.au/4790_13771.htm

Cagnotti, C., McKay, F. and Gandolfo, D. (2007) Biology and host specificity of *Plectonycha correntina* Lacordaire (Chrysomelidae) a candidate for the biological control of *Anredera cordifolia* (Tenore) Steenis (Basellaceae) *African Entomology* 15(2), 300–309.

Palmer, W.A. (2012) Australia's current approval procedures for biological control with particular reference to its *Biological Control Act*. In: *Proceedings of the Thirteenth International Symposium on the Biological Control of Weeds.* (In press)

Palmer, W.A. (2012) *Anredera cordifolia* (Ten.) Steenis – Madeira vine. In: Julien, M. *et al. Biological Control of Weeds in Australia.* CSIRO Publishing, Melbourne, Australia. (In press)

van der Westhuizen, L. (2011) Initiation of a biological control programme against Madeira vine, *Anredera cordifolia* (Ten.) Steenis (Basellaceae), in South Africa. *African Entomology* 19(2), 217–222.

Contact: Bill Palmer,
Biosecurity Queensland, DEEDI.
Email: bill.palmer@deedi.qld.gov.au

Beetle Set to Get to Root of Moth Plant Invasion in New Zealand

The release of the first biocontrol agent against moth plant (*Araujia hortorum*) in New Zealand was approved by the Environmental Protection Authority (EPA; formerly ERMA – Environmental Risk Management Authority) in December 2011 following an application by Waikato Regional Council in September. Adults of the chrysomelid beetle *Colaspis argentinensis* feed on moth plant's leaves, but the females lay eggs around the base of the plant stem and larvae hatch and burrow down to feed in the root zone – which is where the real damage is caused.

Moth plant is a fast-growing evergreen vine from South America, which scrambles over trees and shrubs and smothers them. Each fruit pod contains hundreds of wind-borne seeds. It is an environmental weed, especially in the North Island of New Zealand (and also in parts of Australia). It is hoped the biocontrol agent will reduce moth plant's impact on New Zealand's native forests.

Under the biocontrol project, funded by the National Biocontrol Collective, surveys were undertaken by Dr Diego Carpintero of the Universidad Nacional de La Plata in Argentina where *C. argentinensis* was found to be one of the most common natural enemies of moth plant – and furthermore only ever observed on this host. As other species in the genus are significant root pests, it was prioritized as a potential agent. Little was known about *C. argentinensis*, however, so a good deal of effort had to be put into learning how to rear and host test it. Experience gained from this suggests females of the long-lived adults may lay several hundred eggs over a lifetime, and the beetle may complete two generations a year when released in New Zealand.

The decision to allow the beetle to be released followed host specificity (starvation) tests on larvae in 2010 and adult oviposition (choice and no-choice) tests in 2011, which confirmed that *C. argentinensis* is specific to plants in the subtribe Oxypetalinae, family Apocynaceae, to which moth plant belongs. The only species that the beetle is likely to attack in New Zealand is tweedia (*Oxypetalum caeruleum*), an old-fashioned ornamental plant. Testing ruled out it attacking another close relative, swan plant (*Gomphocarpus* spp.) – the favourite host of monarch butterfly (*Danaus plexippus* – and any native plants. Unfortunately, the colony of *C. argentinensis* in New Zealand has died out in containment, so there will be a delay to the first release while new material is obtained from Argentina and a new colony established for mass rearing.

Meanwhile, other potential biocontrol agents from Argentina are under investigation. A tephritid fruit fly (*Toxotrypana australis*) attacks the fruit pods, laying eggs inside them. Feeding by the developing larvae destroys pod contents and prevents seeds from being formed, which makes the fruit fly a promising candidate. Little is yet known about this fly, so once again efforts are being made to develop rearing and host-testing methods – with the added challenge to get all the test plants to produce pods at the right time.

Progress with a third potential agent, the rust fungus *Puccinia araujiae*, has been hampered by difficulties with maintaining the colony and quarantine restrictions on acquiring seeds of test plants. However, these obstacles have been overcome and testing in Argentina is expected to start soon.

Source: Anon. (2011) A beetle for moth plant. *Biological Control of Weeds* No. 58, p. 2. Landcare Research New Zealand Ltd 2011.

Contact: Hugh Gourlay,
Landcare Research, Lincoln, New Zealand.
Email: gourlayh@landcareresearch.co.nz

Road Map for HIPVs in Agriculture

A review in *Biological Control*[1] examines the potential for using herbivore-induced plant volatiles (HIPVs) to enhance biological control in agriculture. Insofar as arthropod biological control is based on the (re-)establishment of a balance between natural enemies and pests, the problem, particularly with annual crops is, as author Ian Kaplan says, the "enemies are always one-step behind the pest." A good deal of research has gone into ways of manipulating biocontrol agent populations and behaviour to overcome this, and HIPVs are a potentially exciting tool. Yet despite plenty of laboratory evidence indicating the central role of HIPVs in attracting arthropods, attraction to and repulsion by chemical signals is complex and at present not fully understood, especially in a field setting. Noting that most current reviews "are replete with warnings of the potential dangers" of interfering with these chemical signals, Kaplan sets out to "highlight major gaps in our understanding of how to exploit HIPVs in biocontrol and thus serve as a roadmap for future research efforts in this field." Although his review concentrates on synthetic compounds deployed as slow-release lures, a lot of the questions and concerns he raises are more widely relevant.

After discussing choice of compounds and release rates, the author goes on to highlight the importance of field research that looks at the 'bigger picture': investigations that move on, from focusing on what HIPVs and application criteria increase attraction of entomophagous insects into a crop, to look at whether the intervention increases their density on plants, and increases the frequency of predation or parasitism on pests. Encouragingly, he identifies a trend towards more such evaluations in recent years, "a clear indication that investigations are shifting toward larger-scale tests that are ultimately needed to assess the utility of HIPVs in biocontrol and counter-balance those aimed at optimizing attraction." Later, he raises the importance of assessing spatial elements for answering the "robbing Peter to pay Paul" conundrum: whether the predator and parasitoid populations in a system are source limited, and whether using HIPVs is merely re-arranging a finite number of natural enemies – again highlighting how counting natural enemy numbers is less useful than measuring pest impact on a larger scale.

Kaplan also tackles the issue of non-target effects: HIPVs, unlike attractants such as sex pheromones, are not target-specific. He points out two potential non-target pathways yet to be subjected to scrutiny: fourth trophic level consumers (which if attracted could disrupt the third trophic level and relax pest suppression) and pollinators (on which impact could be positive or negative).

The author deals with a host of other issues, including uncertainties about the underlying mechanisms by which HIPVs attract arthropods, possible reasons for variability in results between studies, and whether HIPVs would provide a sustainable means of attracting natural enemies. As final food for thought, he suggests that while HIPVs have largely been researched as a tool for attracting local natural enemies into crops as part of a conservation biological control strategy, the same compounds could be used to advantage as arrestants in augmentation biological control, where a major limitation is the released natural enemies dispersing out of the crop.

[1]Kaplan, I. (2012) Attracting carnivorous arthropods with plant volatiles: The future of biocontrol or playing with fire? *Biological Control* 60(2), 77–89.

Contact: Ian Kaplan, Department of Entomology, Purdue University, USA.
Email: ikaplan@purdue.edu

TWAS Prize for Push–Pull Pioneer

In November 2011, Dr Zeyaur Rahman Khan from ICIPE (International Centre of Insect Physiology and Ecology, Nairobi, Kenya) was announced as joint winner of the 2011 TWAS (Academy of Sciences for the Developing World) Prize in Agricultural Sciences in Trieste, Italy, for his role in leading the development and wide-scale implementation of Push-Pull Technology. This technology has been developed over the past two decades by ICIPE in collaboration with a team at Rothamsted Research (UK) led by Prof. John Pickett, and national partners in eastern Africa. It has been adopted by more than 47,000 smallholder farmers in the region to control parasitic striga weed and stemborer insect pests, and they have seen average annual maize yields increase from 1.5 t/ha to 3.5 t.

Research and outreach activities continue to improve and encourage further adoption of the technology. One of the most destructive maize pests in eastern Africa is the introduced spotted stem borer, *Chilo partellus*, which reduces yields by up to 88%. In November 2011, the team published research revealing how maize landraces from South America, in the crop's area of origin, produce herbivore induced plant volatiles (HIPVs) that attract parasitic wasps as soon as *C. partellus* lays its eggs[1]. Their results suggest that release of these chemical attractants is absent from commercial hybrid maize varieties, possibly lost through conventional crop breeding; introducing them could be a valuable avenue for future breeding activities.

The ICIPE and Rothamsted team are also intent on reaching farmers further afield. An on-going project in north-eastern Brazil aims to transfer the Push-Pull Technology from Africa to family-run farms there. The plan is to develop and encourage the technology for protecting cotton crops in Brazil, and back in Africa. The First Workshop on Developing a Push-Pull Approach for Management of Cotton Pests in Africa and Northeast Brazil was held on 22–25 October 2011 in Campina Grande, Brazil.

[1]Tamiru, A., Bruce, T.J.A., Woodcock, C.M., Caulfield, J.C., Midega, C.A.O., Ogol, C.K.P.O., Mayon, P., Birkett, M.A., Pickett, J.A and Khan, Z.R. (2011) Maize landraces recruit egg and larval parasitoids in response to egg deposition by a herbivore. *Ecology Letters* 14(11), 1075–1083.

Further information:
www.push-pull.net/news.shtml

Trap Crops in Strawberry Fields

A short article in a recent newsletter of the IOBC-NRS (International Organization for Biological Control – Nearctic Regional Section)[1] highlights how biological control of *Lygus* bugs by an introduced parasitoid in California can be boosted by a trap crop. Charlie Picket, CDFA (California Department of Food and Agriculture) Biological Control Program, writing with Sean Swezey, Diego Nieto and Janet Bryer of the University of California, Santa Cruz, and James Hagler, USDA-ARS (US Department of Agriculture – Agricultural Research Service), Maricopa, Arizona, describe how strips of alfalfa [lucerne] in strawberry fields are being used to manipulate the spatial distribution of *Lygus* bugs, a key pest of strawberries. The alfalfa trap crop attracts the pest out of the strawberries, which reduces the number of bugs feeding on strawberries and makes their removal (via vacuum) more efficient. In addition, the resulting high spatial concentrations of *Lygus* in the trap crop can also benefit the introduced parasitoid *Peristenus relictus* which, as a host-specific parasitoid, exhibits a density-dependent response to host numbers; the pockets of high host densities in the alfalfa help elevate parasitism rates and hence numbers of parasitoid adults – and these spill out from the alfalfa strips and attack the already depleted densities of *Lygus* bugs in adjacent rows of strawberries.

[1]Pickett, C., Swezey, S., Nieto, D. and Bryer, J. (2011) Strawberries, trap crops, and parasitoids. *IOBC-NRS Newsletter* 33(3) (Fall 2011), p. 5.
Web: www.iobcnrs.com/index.php/newsletter

Contact: Charlie Pickett
Email: charlie.pickett@cdfa.ca.gov

Getting an Insect-based Delivery System for EPNs Taped

Collaboration between USDA-ARS (US Department of Agriculture – Agricultural Research Service) and a commercial partner, Southeastern Insectaries, Inc., of Perry, Georgia, in the USA has led to the development of a patented automated system that allows entomopathogenic nematodes (EPN) to be stored and applied in the cadavers in which they were reared. Although previously observed to be better than other formulations in terms of performance of the EPN, a literal sticking point in the use of insect cadavers commercially has been that the insect hosts commonly used to mass produce EPN (the wax moth *Galleria mellonella*) tend to rupture and stick together during storage, transport and application.

A solution was found through collaboration between David Shapiro-Ilan (ARS Southeastern Fruit and Tree Nut Research Laboratory, Byron, Georgia) with Southeastern Insectaries, Inc., and entomologists Juan Morales-Ramos and Guadalupe Rojas at the ARS Biological Control of Pests Research Unit, Stoneville, Mississippi. An article in the November/December issue of the ARS magazine *Agricultural Research* describes the development of the system from original concept, through patenting in 2010, to commercial machine.

A key early decision was to switch from using the fragile caterpillar hosts to beetle larvae, specifically mealworms (*Tenebrio molitor*), which have a harder exoskeleton and are more suitable for taping. The team developed an automated system that selects a uniform size of host for infection, then after the infection process is complete, picks up the nematode-infected insect cadavers and sandwiches them individually between two strips of masking tape at a rate of a cadaver every two seconds. The double roll of taped EPN that this process forms allows for easy storage, transport and application to pest-infested soils.

Trials demonstrated that infective juvenile EPN yield was not negatively affected by the tape formulation. Laboratory and glasshouse experiments also indicated that EPN from taped mealworms were as effective as those supplied by other formulations.

Source and more information: Suszkiw, J. and Durham, S. (2011) Coming to a field near you: taped field cadavers. *Agricultural Research*, November/December 2011, pp. 12–13.
Web: www.ars.usda.gov/is/AR/

IOBC Short Course Takes Students to the Tropics to Learn about Advances in Biological Control

In September 2011, IOBC-NRS and IOBC-NTRS (International Organization for Biological Control – Nearctic Regional Section and Neotropical Regional Section, respectively) co-organized a week-long workshop on 'Biodiversity and Biological Control' in Colombia. The course was held at the International Center for Tropical Agriculture (CIAT) and the Yotoco Nature Reserve (Universidad Nacional) in Cali, Colombia. The workshop was organized by Jonathan Lundgren, Tatyana Rand (US Department of Agriculture – Agricultural Research Service), and Kris Wyckhuys (CIAT), with local support from Maria Manzano, Inge Armbrecht and Takumasa Kondo. Workshop participants attended a diversity of lectures on novel diagnostic tools for analysis of trophic interactions, landscape perspectives of biological control, role of insect systematics in biological control, and its tremendous potential in the developing world. Lectures were paired with hands-on activities, in which students ran ELISA-based gut content analysis, used anthrone analysis to determine body sugar content, examined effects of floral architecture on parasitoid feeding behaviour, examined distance-to-edge relationships of predation and predator diversity, and looked at predation on clay models. For several students, the course meant their first contact with the developing world. The lush tropical setting, broad variety of lecture topics and location of the workshop at one of the world's leading centres for agricultural development all helped exemplify the tremendous potential for biological control in this part of globe, and motivate a new generation of scientists to actively contribute to its promotion.

By: Kris Wyckhuys.

Review of Likely Impact of Climate Change on Food and Agriculture Considers Biocontrol Agents

One of the pathways through which food security and agricultural production will be influenced by climate change is via its impact on invertebrates. A document prepared for the Secretariat of the FAO (Food and Agriculture Organization of the United Nations) Commission on Genetic Resources for Food and Agriculture, as a contribution to the cross-sectoral theme 'Consideration of scoping study on climate change and genetic resources for food and agriculture' which the Commission will consider at its Thirteenth Regular Session, focuses on soil invertebrates, biological control agents (BCAs) and pollinators[1].

How climate change will influence the effects of invertebrates on crop productivity is not straightforward. Complex and non-linear responses are expected among the interactions between invertebrates, plants and ecological processes. The authors used 31 case studies to help explore possible interactions and impacts. They found many gaps in knowledge, and identified priority actions to remedy them.

[1]Cock, M.J.W., Biesmeijer, J.C., Cannon, R.J.C., Gerard, P.J., Gillespie, D., Jiménez, J.J., Lavelle, P.M. and Raina, S.K. (2011) Climate Change and Invertebrate Genetic Resources for Food and Agriculture: State of Knowledge, Risks and Opportunities. *Commission on Genetic Resources for Food and Agriculture, Background Study Paper* No. 54, 105 pp.

Web: www.fao.org/docrep/meeting/022/mb390e.pdf

Good Reads

Paul Pratt and Ted Center (*BioControl* Online First™, 20 October 2011, doi: 10.1007/s10526-011-9412-4) draw on the *Melaleuca* biocontrol programme to illustrate unintended spread of weed biocontrol agents, describing amazing distances, unknown pathways, and possible links with trade and tourism.

Roy Van Driesche (*BioControl* Online First™, 22 December 2011, doi: 10.1007/s10526-011-9432-0), arguing that classical biological control in wild lands is a form of planned, beneficial invasion, advocates greater cooperation between conservation biologists and biological control scientists to define ecological goals for projects and to investigate and judge the potential safety of proposed biocontrol agents.

Conference Reports

Tuta absoluta: Tackling a Threat to Tomato Production

The EPPO/IOBC/FAO/NEPPO* Joint International Symposium on Management of *Tuta absoluta* was held in Agadir, Morocco, on 16–18 November 2011. It was attended by more than 240 participants from 40 countries, companies and organizations around the world.

The lepidopteran tomato pest *Tuta absoluta* was first introduced from South America into Europe, to

Spain, in 2006 and has since spread rapidly through the Mediterranean Basin and Near East. It also threatens glasshouse production in northern Europe. The pest can cause total yield loss, with consequent adverse effects on trade. Its impact is attributed at least in part to its high reproductive capacity, while a host range that includes other solanaceous plants such as potato, eggplant [aubergine] and the weed *Solanum nigrum* facilitates its persistence between tomato cropping seasons.

The pest is challenging to control but presentations at the meeting gave reason for optimism. The consensus emerging was that by pulling together all available control options into an IPM (integrated pest management) strategy, the pest can be managed so that tomatoes can still be produced sustainably. Biological control was highlighted as a key tool.

Although newly invaded countries consistently report the pest's devastating impact, in many countries where it has been present only a few years longer, the initial devastation has declined to some extent, largely through the implementation of effective IPM schemes, aided by the adaptation of native biological control agents to the new pest.

Presentations and posters on biological control at the conference covered the identification of the natural enemy complex on *T. absoluta* in its new range, and the potential for augmenting and conserving useful biocontrol agents, together with searches for more effective egg parasitoids. A researcher from Spain, speaking on the potential for biological control of *T. absoluta,* described the diversity of natural enemies found on the pest in its invaded range in Mediterranean Europe, and said that predators are currently the most widely augmented. Her statements were corroborated by subsequent oral and poster presentations. The presence of the mirid *Nesidiocoris tenuis* preying on *T. absoluta* was widely reported. It was cited as the most efficient predator so far in several presentations and posters which reported on studies across the invaded range, including Spain, Morocco, Algeria and Israel, in open field and glasshouse production. Further polyphagous mirids, in the genus *Macrolophus,* are among other predators identified on the pest in many locations. *Macrolophus* spp. have been evaluated with some promising results in many countries .

Of parasitoids, the eulophid *Necremnus artynes* reported from North Africa and Europe seems to be engaging most interest, although a poster from France highlighted some difficulties in separating species of this genus. More native species being investigated from *T. absoluta*, such as *Bracon nigricans* and other *Necremnus* spp. in Italy, and the description of rather different natural enemy complexes in different parts of the invaded range – Europe, North Africa, Iran – illustrate that, with the invasion in its early stages, the potential for finding further useful natural enemies is high. French research has achieved good, although expensive, results by combining the mirid *M. pygmaeus* and the egg parasitoid *Trichogramma achaeae*; their efforts are now focused on identifying additional and more effective *Trichogramma* species/strains.

The use of microbials is also being explored, notably in North Africa and Iran, and cases of success were reported, particularly with *Beauveria bassiana* and where the microbial product was used as part of an IPM strategy.

*European and Mediterranean Plant Protection Organization/International Organization for Biological Control/Food and Agriculture Organization of the United Nations/Near East Plant Protection Organization.

Full details of the conference, including the programme and abstracts, links to presentations, and a summary report can be found at:

EPPO: http://archives.eppo.org/MEETINGS/2011_conferences/tuta_absoluta.htm
IOBC: www.iobc-wprs.org/expert_groups/c_ip_north-africa.html

For more information on the conference, please contact the local organizer: Prof. Mohammed Besri, Convenor of the IOBC-WPRS [Western Palaearctic Regional Section] Integrated Production, Protection and Biocontrol Commission for North African Countries.
Email: mohammed besri@gmail.com; m.besri@iav.ac.ma

Further information on *Tuta absoluta*: www.tutaabsoluta.com/

IOBC Symposium Highlights Untapped Potential for Biological Control

During the 2011 Annual ESA (Entomological Society of America) meeting in Reno, Nevada, IOBC-NRS (International Organization for Biological Control – Nearctic Regional Section) organized a symposium entitled 'Biodiversity and Biological Control'. The short symposium highlighted how biodiversity – from the landscape level to the microbial diversity within an insect – contributes to the outcomes of biological control programmes. A total of four speakers addressed key developments in this topic, including how landscape structure affects biological control (Mary Gardiner), whether diversity is a source or a sink for biological control programmes (Deb Finke), how food diversity influences biological control (Jonathan Lundgren), and efforts to harness biodiversity within tropical systems to contribute to biological control of pests (Kris Wyckhuys). The symposium was organized by Jonathan Lundgren (US Department of Agriculture – Agricultural Research Service) and Kris Wyckhuys (CIAT [International Center for Tropical Agriculture], Cali, Colombia).

By: Kris Wyckhuys.

BIOCICON 2011

The Third Biopesticides International Conference (BIOCICON 2011) held on 28–30 November 2011 at St Xavier's College, Palayamkottai, India, attracted over 210 delegates from ten countries; 116 research papers including 12 invited lectures were presented in oral and poster sessions. In the inaugural address Dr G. J. Samathanam advocated the importance of biopesticides in crop pest management. Introducing the theme of the conference, K. Sahayaraj, the Organizing Secretary, outlined the overall scenario of the chemical and biopesticide market and the importance of biopesticides research.

In the botanicals session, R. Sundararaj, (Bangalore) suggested neem oil and neem oil-based formulations for forest pest management. More than 11 plant extracts and azadirachtin were proposed for cotton, coconut and groundnut pest management. Insecticidal activity was reported for *Caulerpa scalpelliformis, Ulva fasciata* and *U. lactuca* (Asha and Sahayaraj, Palayamkottai), *Corynebacterium* spp. toxic proteins (Dhinakaran, Parangipettai) and *Avecenia marina* (Rajaram, Tiruchirappalli). Stem injection of azadirachtin and *Beauveria bassiana* was recommended for *Odoiporus longicollis* (Irulandi, Petchiparai). Hans E. Hummel (Germany) reported that in *Epilachna varivestis,* marrangin is up to six times as active as azadirachtin. A methanol extract of *Tectona* that suppressed *Echinochloa* spp. monocot weeds was also reported (Jana, West Bengal).

In the storage pest management session, vegetable oils against *Sitophilus oryzae*; Decaleside-II for *Rhizopertha dominica, Sitophilus oryzae, Tribolium castaneum* and *Callosobruchus chinensis*; and *B. bassiana* for *Callosobruchus maculatus* were recommended for management of storage pests. Toxicity and persistence of botanicals were enhanced when combined with vegetable oils (Disna, Sri Lanka). In addition, *Dinarmus* sp. was recorded as a parasitoid of *C. maculatus* (Soundararajan, Coimbatore).

In the microbes session, R. Srinivasan (Taiwan) emphasized IPM strategies for brassica, eggplant [aubergine], vegetable legume and tomato pests in tropical Asia. For the most effective and environmental pest management, *Beauveria bassiana* against *Dysdercus cingulatus, Aulacophora foveicollis, Phenacoccus solenopsis* and *Holotrichia serrata*; *Isaria fumosorosea* and SlNPV against *Spodoptera litura*; *Pseudomonas fluorescens* and *B. bassiana* against *Earias vittella*; *Metarhizium anisopliae* against *Holotrichia serrata*; *Lecanicillium lecanii* NRCB–VL-7 against *Pentalonia nigronervosa*; *Pseudomonas fluorescens* + *B. bassiana* against *Pempherulus affinis*; *Bacillus thuringiensis*, *Beauveria bassiana* and *M. anisopliae* against *Hyblaea puera*; and *B. bassiana*, *Pseudomonas fluorescens*, Spinosad, and fish oil rosin soap for aubergine [brinjal] pests were all suggested by the presenters. Wheat bran, xylose and molasses were recommended for mass production of *Trichoderma* spp., *Colletotrichum gloeosporioides* and *B. bassiana*, respectively.

In the entomopathogenic nematodes (EPN) session, *Pasteuria penetrans* was reported as a parasite of *Meloidogyne incognita*, *Heterodera cajani*, *Radopholus similis*, *Helicotylenchus multicinctus*, *Pratylenchus coffeae* and *Hoplolaimus* spp. *Citrullus colocynthis* fruit extract was reported to reduce *M. incognita* populations, while *Nepeta cataria, Couroupita guianensis* and *Pentanema indicum* reduced egg hatching. After storing the EPN at room temperature for 2–11 days, they can be used for the management of sunn pest, *Eurygaster* (Hussein, Egypt.).

In the vector management session, a combination of *Acalypha alnifolia* extract + *Metarhizium anisopliae* or *Momordica charantia* + *Bacillus thuringiensis* were reported to show larvicidal and pupicidal activity against filarial or malarial vectors; further, *Vinca rosea* and *Prosopis spicigera* extracts can be used for cockroach management (Arunjunairajan, Sivakasi).

Classical biological control of *Paracoccus marginatus* was highlighted by Jonathan (Coimbatore). Thomas (Calicut) demonstrated the potential of weaver ants against *Luprops tristis*. Nine native spiders dwelling in the rice ecosystem were proposed for rice pest management. Presence of celidoniol, dodicamethyl, dodecanoicacid and dotriacontane in cotton pests induced *Rhynocoris longifrons* feeding (Kalidhas and Sahayaraj, Palayamkottai). *Micromus igorotus* was presented as a bioagent for *Ceratovacuna lanigera.* Venkatesan (Bangalore) described the biology, feeding potential and mass multiplication of *Spalgis epius.*

In the biotechnology session, synthesis of biocidal bio-silver nanoparticles using marine algal seaweeds and terrestrial plants was described. Organic nanofibers charged with sex pheromones were reported to disrupt mating of *Lobesia botrana* and *Eupoecilia ambiguella* (Hummel, Germany). The potential of juvenile hormone epoxide hydrolase for integration in IPM was described (El-Sheikh, Egypt). Christopher J. Geden (USA) proposed salivary gland hypertrophy virus (MdSGHV) for fly management. Hristina Kutinkova (Bulgaria) stressed that Surround®WP, Neem Azal T/S and Pyrethrum FS EC are very effective for apple aphid management.

The recommendations of the conference were: that pests could be managed with a combination of botanical extracts and their nanoparticles (terrestrial or marine), and with microbial species used alone or in combinations; agro-wastes could be utilized for microbe mass production, and *Pseudomonas* for induction of systematic resistance; bio-safety evaluation is crucial in biopesticides research and existing registration formalities could be modified for biopesticide registration; finally, the crop protection research centre of St Xavier's College could be promoted as centre of excellence for biopesticides.

By: Dr K. Sahayaraj, Organizing Secretary, Third Biopesticide International Conference, St Xavier's College, Palayamkottai 627 002, Tamil Nadu, India.