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General News

High Hopes for Water Hyacinth Hoppers in South Africa

The Agricultural Research Council – Plant Protection Research Institute (ARC-PPRI) in South Africa is soon to release a new insect biocontrol agent against the invasive aquatic weed, water hyacinth (*Eichhornia crassipes*).

Cornops aquaticum is a semi-aquatic grasshopper that has been under consideration for release in South Africa since 1995; a year prior to the last release of a new biocontrol agent for water hyacinth, the mirid *Eccritotarsus catarinensis*. The laboratory colony of *C. aquaticum* at PPRI, Pretoria was initiated from grasshoppers collected in Brazil, Trinidad, Venezuela and Mexico between 1995 and 1997 and host-range testing was completed in 2001. Although *C. aquaticum* has long been recognized as a very damaging natural enemy of water hyacinth, it has not been considered as a biocontrol agent elsewhere in the world and would be only the second grasshopper to be used in a biological control programme against an invasive weed (the first being *Paulinia acuminata* on *Salvinia molesta*, another major aquatic weed in South Africa and other parts of the world).

Water hyacinth in South Africa is already attacked by a suite of five introduced arthropod biocontrol agents but certain environmental conditions have caused variable and mostly unsatisfactory levels of control through the classical approach. The two major factors affecting field damage levels of the agents are enhanced plant growth rates through nutrient enrichment of water bodies and climate incompatibility. Reports on damage to water hyacinth by grasshopper populations in the native range, its distribution to frost-infected areas in Argentina and its specificity to water hyacinth made *C. aquaticum* a priority agent for South Africa. However, its release following completion of the host-range studies was delayed while its worth as a new agent was assessed, particularly in terms of its impact on the plant under eutrophic nutrient conditions and its interaction with the *Neochetina* weevils, the most damaging of all the agents already present on water hyacinth in South Africa. The weevils are also valuable biocontrol agents for water hyacinth in other parts of Africa and any disruption to their impacts through interspecific competition by *C. aquaticum* would have diminished prospects for introducing the grasshopper.

Quarantine laboratory studies showed that *C. aquaticum* herbivory had a significant impact on water hyacinth growth and productivity. The performance of the grasshopper in terms of fecundity and survival was also positively associated with high levels of nitrates and phosphates in the water. Interaction studies showed that a combination of the grasshopper and the *Neochetina* weevils is particularly effective in reducing plant growth. All aspects of the water hyacinth project and the candidate agent were weighed up by the biocontrol community in South Africa, and it was decided in August 2010 to proceed with a release.

The first releases of the grasshopper are due to take place early in 2011. Post-release research will initially be conducted by ARC-PPRI researchers (Angela Bownes, Anthony King and Ayanda Nongogo), in collaboration with the funding and implementation agency, Working for Water (of the Department of Water Affairs, South Africa). Although, in recent years, control of water hyacinth has been more successful with the development of integrated control programmes using biological and chemical methods, water hyacinth is still South Africa's nemesis aquatic weed. It is hoped that the introduction of the grasshopper will improve the success of classical biological control and that the apparent synergism between the *Neochetina* weevils and *C. aquaticum* will manifest in the field, reducing the overall negative impacts of the weed in South Africa.

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Current Status of Releases of *Puccinia spegazzinii* for *Mikania micrantha* Control

Mikania micrantha (mile-a-minute weed) is a major invasive alien weed in many countries of Asia and the Pacific, and is still invading new regions, such as northern Australia. This neotropical vine is able to smother plants in agricultural ecosystems and agroforestry, seriously affecting livelihoods, by decreasing productivity and increasing the time farmers and plantation workers need to spend weeding. However, it is also a serious weed of native habitats, affecting biodiversity – sometimes in a headline-grabbing fashion, e.g. by affecting the habitat of the rare one-horned rhino in India and Nepal (http://news.bbc.co.uk/1/hi/sci/tech/8576646.stm).

The UK Department for International Development (through Natural Resources International) funded a research project to look at the impacts of this weed in India (Kerala and Assam) and to develop a biological control approach for its management. A rust fungus *Puccinia spegazzinii* was selected, screened for specificity to the target weed at CABI Europe – UK (E-UK) and then released in India in 2005–7 by Assam Agricultural University and Kerala Forest Research Institute. Unfortunately, the rust apparently failed to establish persistent populations in the field, and the project is no longer active in India[1].

Nevertheless, the potential of the rust was recognized by scientists at the Chinese Academy of Agricultural Sciences (CAAS) and Taiwan National

University. A project to release the rust in mainland China was funded by the UK Department for Environment, Food and Rural Affairs (through the Darwin Initiative) and, since the weed is a problem in Guangdong Province, brought in the expertise of Guangdong Entomological Institute. Following extensive additional host-specificity testing by CAAS, targeting plants of relevance to China, the rust was released in 2006. Although there was initial spread at the release site, the current status of the rust in the field is unknown. In Taiwan, a similar programme was undertaken, funded by the Taiwan Forest Bureau (TFB). Again, extensive host-specificity testing was undertaken and the rust was released in 2008. In 2010, S.S. Tzean (TFB) was able to report successful establishment, spread of the rust and between-season survival.

Most recently, the rust has been released in Papua New Guinea (PNG) and Fiji in 2009, under an Australian Centre for International Agricultural Research-funded project (through Queensland's Department of Employment, Economic Development & Innovation – DEEDI)[2]. In PNG, the releases have involved a number of partner organizations, led by the National Agricultural Research Institute, Kerevat, East New Britain. The rust has been mass reared on living plants and widely released in over 500 sites in 15 provinces. This has involved placing potted, rust-infected plants in amongst infestations of young mikania weed in the field. To date, over 3700 pots have been distributed. So far, the rust has established in nearly 100 sites in seven provinces, but many of the remote sites have not yet been monitored. Initial monitoring found the rust to have moved 400 metres in six months at some sites, and after 12 months, the rust has spread over 7 km. However, at one site (visited in October 2010), the rust was found to have spread 37 km after 18 months. In Fiji, the rust has been released at over 80 sites on four of the main islands of Viti Levu, Vanua Levu, Taveuni and Ovalau, and has established at 20 sites on Viti Levu and Vanua Levu. Comparative growth studies and field monitoring in PNG show that the rust can significantly reduce the growth and density of mikania and offers great potential for the control of this weed[3].

There are a number of key issues that come to the fore regarding the successful establishment and spread of the rust; these concern the climate and release strategy. The rust must be applied at high doses (large numbers of infected plants placed in the field) in order to establish. This has been demonstrated by the successes in Taiwan and PNG. The range of sites where the rust has been released also shows that the rust does not establish well in the drier areas; it is clearly adapted to the wet tropics. Future work could focus on screening other biocontrol agents of *M. micrantha* that are adapted to drier areas in the native range.

Addendum: In December 2010, a predicted non-target effect was observed in the field in PNG: the rust was found infecting a native species of mikania, *M. cordata* found in Asia. Glasshouse screening results at CABI E-UK had identified this as a likely possibility.

[1]Sankaran, K.V., Puzari, K.C., Ellison, C.A., *et al.* (2008) Field release of the rust fungus *Puccinia spegazzinii* to control *Mikania micrantha* in India: protocols and awareness raising. In: Julien, M.H., *et al.* (eds) *Proceedings of the XII International Symposium on Biological Control of Weeds.* CABI, Wallingford, UK, pp. 384–389.

[2]Pene S., Orapa, W. & Day, M. (2007) First fungal pathogen to be utilized for weed biocontrol in Fiji and Papua New Guinea. *Biocontrol News and Information* **28**(3), 55N–56N.

[3]Day, M.D., Kawi, A., Tunabuna, A., *et al.* (2010) Biological control of *Mikania micrantha* Kunth (Asteraceae) in Papua New Guinea and Fiji using the rust fungus *Puccinia spegazzinii* de Toni (*Pucciniales: Pucciniaceae*). In: *8th IOBC International Workshop on Biological Control and Management of Chromolaena odorata and Other Eupatorieae*, Nairobi, Kenya, 1–5 November 2010, pp. 6–7. (Abstract)

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Role Reversal for EBCL as Europe Warms to Classical Weed Biocontrol

Europe has long been a source of natural enemies against invasive weeds of European origin in North America, and over the past 90 years the USDA-ARS (US Department of Agriculture – Agricultural Research Service) European Biological Control Laboratory (EBCL) at Montpellier in the south of France has become one of the key facilities for screening potential biocontrol agents from Europe, as well as Asia and Africa, for the USA. The launch of a new classical biological control project against silverleaf nightshade, *Solanum elaeagnifolium*, is a departure from tradition, however, because *S. elaeagnifolium* is a New World species that has become an invasive weed in many parts of the world – including southern Europe. In its introduced range, *S. elaeagnifolium* can outcompete native plants, reduce crop yields and diminish pasture productivity, while its berries are toxic to livestock.

Work under a cooperative project involving USDA-ARS, EBCL and the Benaki Phytopathological Institute in Greece's capital city, Athens, marks the first time that natural enemies from North America are being considered for a target weed introduced to Europe[1]. In a reverse of its traditional role, EBCL will serve as a receiving point for candidate organisms from North America, which could open the door to biological control of *S. elaeagnifolium* in Greece and other countries in the Mediterranean basin.

S. elaeagnifolium has been a target for classical biological control in other countries, notably South Africa and Australia[2]. It is native to north-eastern Mexico and the south-western USA, but has spread through North America and is now widespread and causes weed problems in all but the Great Lakes and New England regions. It is also considered native to Argentina although, based on its insect fauna there, this distribution is thought to be secondary. Biocontrol agents introduced to South Africa include two *Leptinotarsa* leaf-feeding beetles, one of which (*L. texana*) causes considerable damage, while a leaf-galling nematode (*Ditylenchus phyllobius*) has been deployed with some success in the USA.

The new project's early stages include genetic analysis of silverleaf nightshade populations from the south-western USA, Argentina, Greece, France and Australia, with the aim of determining the European weed population's origin and tracing the route of its invasion. In addition, the distribution and density of the weed in Greece is being mapped with the aid of satellite imaging.

EBCL's former Director Walker Jones, who helped established the project, says that it provides an ideal opportunity to use EBCL's experience, location, and facilities to establish a biocontrol project that could benefit Europe, "sort of as thanks for the biocontrol agents we've acquired and sent to the United States for the past 90 years." He adds that this could lead to similar projects in North African countries where *S. elaeagnifolium* is a major weed.

Source: Suszkiw, J. (2010) ARS overseas lab sets the stage for reuniting a weed and its enemies. *ARS Magazine*, November/December 2010, p.29.
Web: ars.usda.gov/ar

EPPO (2007) Data sheets on quarantine pests. *Solanum elaeagnifolium*. *EPPO Bulletin* **37**, 236–245.

Managing Witches' Broom of Cocoa

Cocoa production in Brazil's main cocoa-producing state of Bahia fell into decline after the outbreak of witches' broom disease (*Moniliophthora perniciosa*) in the late 1980s, and several thousand hectares of once productive cocoa was abandoned. It is a similar story in many other Latin American countries (in some of which the related and equally destructive frosty pod rot, *M. roreri*, has compounded the damage). Initial efforts to contain witches' broom in Bahia failed for a number of reasons but most importantly through a lack of resistant cocoa material. More recently, deployment of disease-tolerant cultivars, better understanding of disease epidemiology and development of crop management strategies have led to some improvement in total production. The integrated pest management (IPM) method currently recommended by the Brazilian cocoa research and extension agency CEPLAC (Comissão Executiva do Plano da Lavoura Cacaueira) includes 4-–6 applications of copper fungicides plus 2–4 phytosanitary broom removals per year and also application of the fungal biocontrol agent *Trichoderma stromaticum*. However, the high cost of copper fungicides and the labour-intensive and therefore costly nature of broom removal put this approach out of the reach of many farmers and uptake has been low.

A paper in *Crop Protection*[1] describes a three-year field study designed to identify a cost-effective, integrated method that could be recommended to cocoa farmers in Bahia. Treatments, which were applied alone or in combination, included applications of *T. stromaticum* and copper hydroxide fungicide, and broom removal.

Results demonstrated that higher pod yields and consistently lower pod losses were obtained by alternating applications of the fungicide and the biocontrol agent. Application of *T. stromaticum* alone was not able to reduce witches' broom on pods, probably because *Trichoderma* species, as saprophytes, colonize better the dead tissue (dry brooms) than fresh tissue (pod and leaf surfaces). *T. stromaticum* did reduce broom formation and increase the number of pod-forming flower cushions. Similar observations were made previously when *T. asperellum,* a mycoparasite of *Phytophthora megakarya,* was applied for black pod disease control in Cameroon. Mycoparasites such as *Trichoderma* seem to 'clean up' the flower cushions resulting in more pods being formed.

Total pod production per tree was consistently low, however, whenever broom removal was used as a management strategy, although actual pod losses were reduced. Why broom removal reduces yield is unclear at present, but may possibly be related to energy being diverted from pod production to vegetative growth.

Medeiros *et al.* propose that the best IPM strategy for witches' broom disease in cocoa in Bahia consists of alternating applications of copper hydroxide and *T. stromaticum*, and omitting phytosanitary broom removal. Results of an economic assessment indicate that this reduces the cost of IPM and gives better yields and thus better net economic returns than current IPM recommendations. There is one further element: the authors note that the increases in pod yields they found are dependent on adequate fertilizer application.

[1]Medeiros, F.H.V., Pomella, A.W.V., de Souza, J.T., Niella, G.R., Valle, R., Bateman, R.P., Fravel, D., Vinyard, B. & Hebbar, P.K. (2010) A novel, integrated method for management of witches' broom disease in cacao in Bahia, Brazil. *Crop Protection* **29**, 704–711.

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How Many Times Do You Have to Prove that Biocontrol Does Not Work?

Few plant pathologists will ever face the challenge of combating a disease that claims between 80% and 100% of potential yield. But this is exactly what frosty pod rot (FPR, caused by *Moniliophthora roreri*) of cocoa does. The trials of Ulrike Krauss and her team in Costa Rica were no exception[1]. Their FPR control strategy needed to be rigorously pragmatic to stand any chance of success. As long-term trials are obligatory in research with perennial crops, rationing of resources was just one pragmatic tenet.

In order to economize on field trials, the team applied a strict 'fail once and you're out' rule: only the most promising treatments from each season's trial were repeated in the following one. Although this was incompatible with a neat factorial arrangement with multi-season replication of treatments, the approach allowed for additional replication – and thus higher confidence – of the more promising treatments. Initially the resulting unbalanced design with unequal replication challenged referees' paradigms. However, tools for the analysis of such experiments are available on any professional statistics software and need no longer be of concern *if* there are convincing scientific and/or logistic reasons to select such designs.

The researchers resorted to a whole arsenal of appropriate analyses in order to extract as much information from their data as reasonably possible – after all, that's what tools are for! Eighteen treatments, consisting of biological and chemical agents, stickers and their combination in time, were field tested in Costa Rica over three growing seasons. Eight to 11 treatments could be evaluated in each year. Initial ANOVAs were decision-making aids only, guiding the formulation of interim hypotheses and prioritization of treatments to pinpoint specific hypotheses for subsequent testing using orthogonal contrasts. All conclusions drawn from the trials were based on orthogonal contrasts applied to data derived from two to three replicated field seasons. The iterative approach identified eight treatments that increased yield significantly and consistently.

The paper is the first report of an endophytic fungus being used as a classical biocontrol agent against a plant disease under field conditions. Copper hydroxide could partly be replaced with two systemic agents, the coevolved endophyte *Trichoderma ovalisporum* and the oxathiin fungicide flutolanil. While the former should be applied in water, the latter two were best formulated with a sticker. If this formulation rule was observed, a switch from systemic agent to the contact fungicide in mid season was beneficial. Such relatively complex conclusions could only be reached because experimental treatments were eliminated after a single year of poor performance, which is a resource-efficient common sense approach, as a treatment that is not *consistently* beneficial is of little use to growers – and one unsuccessful season is enough to be sure of that.

[1]Krauss, U., Hidalgo, E., Bateman, R., Adonijah, V., Arroyo, C., García, J., Crozier, J., Brown, N.A., ten Hoopen, M. & Holmes, K.A. (2010) Improving the formulation and timing of application of endophytic biocontrol and chemical agents against frosty pod rot (*Moniliophthora roreri*) in cocoa (*Theobroma cacao*). *Biological Control* **54**, 230–240.

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Michael Way: 1922 – 2011

Professor Michael Way, who died on 18 January 2011 and was internationally recognized for his work on insect pest management, made some significant contributions to biological control.

A former student and research assistant of Sir Vincent Wigglesworth at Cambridge, in 1950 he was seconded from Rothamsted, UK, where he was researching insecticide selectivity, to Zanzibar to work on cloves. He was, however, soon studying damage caused by coreid bugs, then referred to as *Theraptus* spp., which were reducing coconut yields, and the weaver ant *Oecophylla longinoda*. His work provided the basis of practical biological control of key pests of coconuts – and pioneered the scientific study of weaver ants in biological control (an approach currently enjoying a revival; see Van Mele (2008) *BNI* 29(1), pp. 4N-5N, and the next article, this issue). This research was followed by a taxonomic study of the coreid bugs by Eric Brown who named the coconut pest *Pseudotheraptus wayi* in recognition of Michael's work.

Returning to Rothamsted, Michael began research on how to forecast when insecticides should be applied to aphids. This work continued on his appointment as a Reader (1961) and then Professor of Applied Zoology (1969) at Imperial College London. During the early 1960s, Michael was responsible (with Prof. Manfred Mackauer of Simon Fraser University, Vancouver) in running a massive international effort on the biological control of the aphid *Myzus persicae*, one of about five programmes on arthropod biological control supported financially by the International Biological Programme of that era. He made two exceptional conceptual contributions to the world of applied entomology. The first was elegant experimental work demonstrating (with aphids) that intraspecific competition starts its impact on population regulation remarkably early in the exponential of population growth. Secondly he pointed out, during the debate in the 1970s on ecosystem diversity and stability, that for any pest problem, the introduction of just one element of new diversity would usually be all that was needed to improve control.

At Imperial College's world-famous field station, Silwood Park (Ascot), Prof. Way transformed the well-established Diploma of Applied Entomology course into an internationally recognized Masters course under the aegis of the University of London in 1966. The course, still running, is now the only such course in the UK. In 1979 he was appointed Director of Silwood Park and in this role brought together wide-ranging expertise on insects, nematodes, plant pathogens and weeds to form the Silwood Centre of Pest Management, and encouraged CABI to re-locate UK staff of the Commonwealth Institute of Biological Control (CIBC) to Silwood, thus forging closer links with applied ecological research programmes in the tropics. (CIBC later became the International Organization of Biological Control, IIBC; the Silwood group subsequently became part of CABI Europe – UK.)

As a member of the Panel of Experts on Pest Management to FAO (UN Food and Agriculture Organization), he was instrumental in helping to develop the draft Code of Conduct for the Import and Release of Exotic Biological Control Agents, which became International Standards for Phytosanitary Measures No. 3 (ISPM3). He visited Sri Lanka with Mike Cammell of Imperial College to work on the ecology and integrated control of the coconut caterpillar, *Opisina arenosella*, under a Commission of the European Communities grant working on possible causes of caterpillar outbreaks and the role of ants. He also studied ant populations in cocoa in Malaysia with K. C. Khoo with whom he reviewed the role of ants in pest management in the *Annual Review of Entomology* in 1992. Among many professional and learned society commitments, he was Vice President of West Palaearctic Regional Section of the International Organization for Biological Control (IOBC/WPRS) (1974–81), President of IOBC (1981–1985) and a Consultant Director to CIBC/IIBC (1981–85).

During an active retirement, he was at the International Rice Research Institute (IRRI) as a visiting scientist for three months a year over a five-year period with K. L. Heong. This enabled him to review the role of biodiversity in IPM which now forms the foundation of IRRI's ecological engineering approach to pest management. Being much happier in the field and using an empirical approach to solving problems, he was able to do pioneering research to document the role of ants in the rice ecosystem. His contributions to rice pest management will remain classics.

Source: Imperial College London.

DANIDA Funds Ant Farming Project

Weaver ants are an ancient method of pest control whereby farmers collect ant nests from the wild to hang in fruit trees to control pests. Interest in the use of weaver ants has been growing in recent years, and a project funded by the Danish International Development Agency (DANIDA) aims to build on this by developing methods for establishing and managing weaver ant farms. This technology would ensure a larger and more stable production of ants in orchards, while protecting wild populations. The method will be adapted for cashew and mango farmers in Benin and Tanzania to help them reduce losses from pests in mango and cashew orchards and, by eliminating pesticide use, market their produce as organic.

Scientists from the Faculty of Agricultural Sciences, Aarhus University, Denmark, are researching how the ants reproduce and developing methods for collecting semen from drones and artificially inseminating queens. Their partners in the project include the University of Abomey Calavi in Benin, Skione University of Agriculture in Tanzania and Charles Darwin University in Australia. Experience from Australia has indicated that it is cheaper to control pests in cashew and mango orchards with ants than with insecticides. However, farmers' fear of ants needs to be overcome, and they need information on how to manage weaver ants, for example so fruit can be harvested without pickers being attacked by ants. To share available knowledge with the farmers, project partners will prepare easy-to-understand manuals, and farm advisors will be trained to teach fruit farmers how to use the ants for pest control. In addition, six African PhD students will be involved in adapting the method to local climate conditions, and also investigating how efficient the ants are at controlling the local pests and whether other complementary methods of control are necessary.

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Non-Native Species Costing the UK

A report published in December 2010[1] assessed the economic cost of invasive non-native species (INNS) to the British economy at UK£1.7 billion every year. The research, carried out by CABI for the Scottish Government, Defra (UK Department of the Environment, Food and Rural Affairs) and the Welsh Assembly Government, looked in detail at the impacts of INNS on different sectors of the British economy, and summed up the costs as follows: £1.3 billion/year to the English economy, £251 million to the Scottish economy, and £133 million to the Welsh economy. The report indicated that the economic cost of INNS can be wide ranging and impact on crops, ecosystems and livelihoods. The cost to the agriculture and horticulture sector alone is estimated to be £1 billion across Britain.

During the study, the effect of the extent of invasion on control costs was investigated in five case studies: Asian long-horned beetle (*Anoplophora glabripennis*), carpet sea squirt (*Didemnum vexillum*), water primrose (*Ludwigia* spp.), grey squirrel (*Sciurus carolinensis*) and coypu (*Myocastor coypus*). In all examples, early action provided a significant economic benefit compared to the cost of management if the species were to become more widely established. For example, with water primrose, a group of South American aquatic weeds which grow rapidly and can block waterways, it is estimated that the current timely eradication will cost £73,000 which is far less than the estimated £242 million that it would cost if the plant were to become widely established as it has in countries like France and Belgium.

Responses of government ministers indicated the message had gone home that not only are INNS a huge problem in Britain, but that urgent action is needed to prevent problems and control costs escalating; to paraphrase two of them: what may seem like an expense now saves enormously in the long run because INNS are more difficult to control as they become established, and the report will help to prioritize and target actions.

[1] *The Economic Cost of Invasive Non-Native Species to the British Economy*. CABI 2010.
Web: https://secure.fera.defra.gov.uk/nonnativespecies/index.cfm?sectionid=59

Arguments against Killifish for Mosquito Control in Africa

A multi-author letter to the editor of the journal *Parasites and Vectors*[1] sets out a series of arguments, backed up by published literature, against the use of the annual killifish species *Nothobranchius guentheri* to control mosquito larvae in temporary freshwater bodies across Africa. The authors say that in their opinion it would be "largely ineffective and pose a significant threat to natural ecosystems." The letter is in response to an earlier article in the same journal[2] in which the results of semi-natural experiments in a field laboratory in the Philippines were used to support the use of *N. guentheri* in Africa.

Reichard *et al.* point to (1) expected low success of annual fish introductions, based on the failure of previous attempts, (2) low success of mosquito control in the field, (3) serious ecological threats from translocation of *N. guentheri* both within and outside its native range, and (4) ethical issues. They argue against the next proposed step of field trials in Tanzania.

[1]Reichard, M., Watters, B. R., Wildekamp, R. H., Sonnenberg, R., Nagy, B., Polačik, M., Valdesalici, S., Cellerino, A., Cooper, B. J., Hengstler, H., Rosenstock, J. & Sainthouse, I. (2010) Potential negative impacts and low effectiveness in the use of African annual killifish in the biocontrol of aquatic mosquito larvae in temporary water bodies. *Parasites & Vectors* **3**:89, 6 pp.

[2]Matias, J.R. & Adrias, A.Q. (2010) The use of annual killifish in the biocontrol of the aquatic stages of mosquitoes in temporary bodies of fresh water; a potential new tool in vector control. *Parasites & Vectors* **3**:46, 9 pp.

Web: www.parasitesandvectors.com

EMAPi10 in Biological Invasions

A special issue of the journal *Biological Invasions* (12[12], December 2010) entitled 'Plant invasions: theoretical and practical challenges', includes 15 papers from the 10th International Conference on Ecology and Management of Alien Plant Invasions (EMAPi), which was held in Stellenbosch, South Africa in August 2009).

EMAPi11 takes place this August in Hungary.
Web: www.emapi2011.org

Bioherbicide Website

Maurizio Vurro has redesigned the International Bioherbicide Group (IBG) website at http://ibg.ba.cnr.it. It contains all previous issues of the *IBG Newsletter*, most proceedings of past IBG workshops, and useful information on the group. All documents can be downloaded as pdf files, and most can be read online.

Comments, corrections and suggestions for the website's improvement are welcome. Equally, contributions for future newsletters are encouraged. Some pages 'in progress' could contain pictures of previous meetings, events, equipments, agents, etc. If you wish to contribute, please send your pictures with a short legend, and these will be included with an acknowledgement. Equally, if you have pdf files of abstracts of missing workshops and newsletters, please email them to Maurizio.

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Conference Reports

IOBC Workshops Highlight Threat of Invasive Alien Plants to East Africa

The Eighth IOBC (International Organization for Biological Control) Workshop on Biological Control and Management of *Chromolaena odorata* and other Eupatorieae and the First IOBC Workshop on Biological Control and Management of *Parthenium hysterophorus* were held in combination in Nairobi, Kenya on 1–5 November 2010. The IOBC chromolaena workshops have been held every 3–4 years since 1988, while this was the first IOBC parthenium workshop to be held since the inception of the IOBC Parthenium Working Group in 2009. Both *C. odorata* and *P. hysterophorus* have invaded East Africa, and the combined workshops were held in Kenya to encourage early awareness and mitigating action. The parthenium workshop was also held in conjunction with an annual meeting of project partners of the USAID- (US Agency for International Development-) funded IPM-CRSP (Integrated Pest Management Collaborative Research Support Program) project on parthenium in East Africa.

Organized partly by the ARC (Agricultural Research Council) in South Africa and locally hosted by CABI Africa, IUCN (International Union for Conservation of Nature) and GISP (Global Invasive Species Programme), the combined workshops were attended by a total of 45 participants from 16 countries (Australia, Bangladesh, Ethiopia, Ghana, India, Jamaica, Kenya, Mauritius, Nigeria, Pakistan, Papua New Guinea, South Africa, Tanzania, Thailand, Uganda, USA). A keynote address by Dr Arne Witt of CABI Africa highlighted the threat of invasive alien plants in Africa and prospects for their control. During the first workshop, the distribution, spread, impacts, ecology and control of *C. odorata* and the closely related weeds *Mikania micrantha*, *Ageratina adenophora* and *Campuloclinium macrocephalum* were discussed. The parthenium workshop, which addressed similar topics of distribution, impacts and various control options for parthenium, was held on 4–5 November. During an inter-leading day between the workshops, delegates visited Nairobi National Park to view encroaching invasive alien plants, including parthenium, a rapidly increasing threat in East African savanna habitats.

Each workshop ended with the promulgation of a set of technical recommendations. Recommendations arising from the chromolaena and other Eupatorieae workshop included that governments and agencies be made aware of the imminent threat of chromolaena to East Africa, and be encouraged to take action to contain it; that the introduction of the biocontrol agents *Pareuchaetes pseudoinsulata* and *Cecidochares connexa*, where they are not present, be encouraged; that the distribution and efficacy of these two agents in West Africa be assessed; and that, for *M. micrantha*, the rust fungus *Puccinia spegazzinii* be considered for introduction as a biocontrol agent where it is not yet present. The workshop also recommended that impacts of invasive Eupatorieae on biodiversity and socioeconomics be further studied.

The parthenium workshop recommendations included that, as several agents in addition to *Zygogramma bicolorata* have been successful in Australia, they should be considered for introduction elsewhere; that increased coordination between the various international projects and workshops on parthenium be considered; that countries where parthenium has not yet been recorded but which are at risk (particularly in West Africa, Indochina and the Pacific) be on the lookout for it, while countries in which it has recently arrived take up strong management strategies, including possibly biocontrol, to contain it; and that development agencies that may inadvertently be spreading parthenium take appropriate remedial actions to prevent further spread.

From both logistical and technical perspectives, it was useful to combine the workshops of these two IOBC working groups. In many countries, more than one of the weed species is either present or a potential invader, and many issues raised were common to both workshops. The intention is thus to consider a similar combination of workshops in future, when appropriate.

Apart from ARC and CABI Africa, both IUCN and GISP in Nairobi are thanked for assistance with organization and sponsorship, and the IOBC, USAID IPM-CRSP, CTA (Centre Technique de Coopération Agricole et Rurale) and AusAID (Australian Agency for International Development) are gratefully acknowledged for their financial support.

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Waging Biological War Against the Killer Weed Parthenium

Parthenium hysterophorus is one of the world's most serious invasive alien species (IAS) because of its impacts on human health, livestock and biodiversity. Much effort has been put into containing the weed, and this article is a report on the Third International Conference on Parthenium (ICP-2010) and its outcomes. ICP-2010 was held in New Delhi, India, on 8–10 December 2010. India has previously witnessed two international conferences on parthenium, the first at Dharwad (1997), and the second at Bangalore (2005). The third in the series had as its theme: 'Sustainable conservation of biodiversity in ecosystem vis-à-vis parthenium'. The conference comprised five theme-based sessions: (1) Global views on parthenium spread, (2) Management strategies, (3) Associated human and animal health hazards, diagnosis and management, (4) Utility aspects of parthenium, and (5) Awareness and interactive – plenary session.

Professor Steve W. Adkins (Australia), in a wide-ranging presentation, discussed important facts about the weed, reasons for its highly invasive nature, management strategies, and work going on around the world. No single method has proven effective in management of parthenium. Management strategies are based on preventing seed spread and reducing population size in heavily infested areas, and are built around biological control using both natural enemies and suppressive plants.

A complete session was devoted to the clinical aspect of parthenium allergy, comprising talks from eminent medico-professionals. The severity and seriousness of the weed in medical terms was evident to any layperson attending the session.

In other sessions, Professor B. B. Shrestha (Tribhuvan University, Nepal) detailed the invasion of parthenium in Nepal, and said that the biocontrol agent *Zygogramma bicolorata* is contributing to control. In a paper from CABI South Asia – India on 'Footprints of CABI in managing invasive alien species globally', emphasis was placed on the economic and political impacts and consequences of IAS on biosafety and the environment. The paper listed the management options for IAS including biocontrol agents and competitive plants, and suggested these should be aimed at managing, rather than eradicating, IAS.

The conference accommodated more than 100 presentations, of which 20% were on biological control. The role of biocontrol agents in managing parthenium was widely acknowledged. The integrated weed management programme (IWMP), the Programme on Parthenium Elimination (PROPEL), which was based on using the competitive plant *Cassia sericea* together with *Z. bicolorata* and was implemented in Tamil Nadu in 1986–88 with great success, led to a local modification of the strategy (i.e. replacing *C. sericea* with *Kochia indica*) being implemented with equal success in Delhi and NCR (National Capital Region) in 2008 as the Pusa Protocol for Parthenium Management. The path of success, from PROPEL to the Pusa Protocol, should encourage similar initiatives to be developed in other parts of the world.

A slide show session in lieu of poster presentations was included, in which four high school students gave a remarkable presentation on their understanding of the use of *Z. bicolorata* to control parthenium.

Two publications from the conference, comprising the scientific presentations (198 pp.) and a Souvenir booklet (20 pp.) are obtainable free from the Organizing Secretary (see below).

Amongst many recommendations of the Conference, some pertinent to biological control are outlined below.

1. A legislative recommendation was to include parthenium as an obnoxious weed under Agricultural Pest & Diseases Act and the Destructive Insect Pest Act (India). Similar legislations may be enacted in other countries.

2. Appropriate administrative set-ups, in the form of state-, national- and international-level working groups, management authorities and boards coupled with cooperation from non-governmental organizations at a global scale are urgently needed.

3. Recommended research issues were: other biocontrol agents and botanicals; preparation of a road-map for the integrated management of parthenium; conducting benchmark surveys of parthenium spread and severity, along with its natural-enemies; and use of biotechnological tools.

4. The need for documentation of success stories, their effective dissemination, and campaigning for public awareness was given priority in the interactive and plenary session.

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Conference Announcements

IOBC/NTRS and SISA Joint Meeting

The International Organization for Biological Control/Neotropical Regional Section (IOBC/NTRS) Joint Meeting with the International Seminar for Animal and Plant Health (SISA 2011) 'Exchanges of experiences in the production and use of biological control' will be held on 3–6 May 2011 in La Habana, Cuba, hosted by the National Animal and Plant Health Center (CENSA) in cooperation with the Agrarian University (UNAH), Institute of Plant Protection (INISAV), National Center of Plant Protection (CNSV) and Agricultural Minister (MINAG). The objective of the meeting is to address the goal of moving from scientific research to industrial production and to farmer use of natural enemies. The meeting will focus on all issues related to mass rearing biological control agents, including principles and practices of quality assurance and release methods integrated with other sustainable agricultural practices.

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Third International Biopesticide Conference

Registration is open for the Third International Biopesticide Conference (BIOCICON 2011), which will be held at St Xavier's College, Palayamkottai in Tamil Nadu, India, on 28–30 November 2011 in collaboration with the Centre for Plant Protection Studies, Tamil Nadu Agricultural University, Coimbatore. Topics to be covered include: Botanicals (including plant-based biopesticides); Microbial insecticides; Biosafety and registration of biopesticides; Biotechnology (including semiochemicals); and Economics, investment and partnerships.

The deadline for submission of abstracts is 30 June 2011; see website or contact the Organizing Secretary for further details. In addition to oral and poster presentations, participants unable to attend may submit 'virtual papers' for exhibition on an online platform for virtual participants.

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