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CABI Annual Report
Switzerland
2011

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KNOWLEDGE FOR LIFE

CABI improves people's lives worldwide

by providing information and applying scientific expertise to solve problems in agriculture and the environment

This annual report was prepared by the staff of CABI's centre in Switzerland and covers activities in 2011. Images are attributed to the photographers as far as is known and are by CABI staff unless specified.

Front cover photo – setting up a colony of cabbage seedpod weevil in a canola field (photo: T. Haye)

Inside front cover photo – Stefan Toepfer taking samples of entomopathogenic nematodes from application tanks on a maize-sowing machine for bioassay-based quality control in the CABI joint laboratory in southern Hungary (photo: F. Koncz)

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preface

It is a pleasure to take up Ulli Kuhlmann's request to contribute a preface to this report on behalf of the CABI Board. It is also fitting for we visited the centre for our June meeting in 2011 – a lovely time to be in the Jura and have a chance to meet many of the centre's staff and experience the summer buzz with students present.

We take time in each Board meeting to hear about projects and progress; it was a delight to be introduced to the range of activities through which the centre is making a difference to food security, farmer livelihoods, biodiversity and the environment in various parts of the world. We always are impressed at the combination of scientific depth, commercial thought and mission-driven enthusiasm. The Board thanks all who contributed to a great visit and even more so the impact you make.

Despite troubled global headlines and many uncertainties in our world, CABI had a good 2011, making progress in publishing, international development and CABI's foremost strategic programme, Plantwise, which contributed to good results and a firm financial base.

Plantwise, which is being led by our centre in Switzerland, made significant progress during the year with the roll-out of the plant clinic programme, release of a prototype of the knowledge bank and announcement of significant funding. The support of the Swiss Agency for Development and Cooperation (SDC) is a reflection on CABI's reputation in the field of plant health and an endorsement of its ability to deliver. Its backing has also brought in other major donors, allowing us to develop and expand Plantwise so as to achieve the wider goals of increased food security and improved livelihoods.

CABI is flourishing thanks to the individual and collective contributions of its member countries, staff, donors and partners. As it continues to use its distinctive combination of skills to put scientific knowledge to work for all of its customers and stakeholders, we look forward to continuing success. We are grateful for the part the team in Delémont has played and look forward to the coming years together.

John Ripley, Chair CABI Board

introduction

It is my pleasure to announce that 2011 has been another successful year for our centre in Switzerland. Despite the fragile global economy, we have been able to maintain steady project income within our research programmes and were even able to increase donor support for our development cooperation work in the field of integrated crop management (ICM). Overall, we achieved our highest annual project income to date and managed to break even for the third year in a row. This, of course, is good news for the centre, as it has been possible to invest in further renovations to the building and to improve our working conditions. In June 2011, the transformation of the old garages in the basement into plant and insect rearing rooms, an insect collection room and a workshop was completed. The conclusion of this work coincided with our hosting of a CABI Board meeting and so it was an honour to be able to invite the Chair of the Board, Mr John Ripley, to perform the official inauguration of the new basement rooms.

Our student placement programme continued to thrive this year, with nine MSc and 18 PhD students joining us at the centre at various times throughout the year to conduct their research, and 18 summer students residing here during the summer months to support our busy research programmes. The student placement programme has always been highly beneficial to students in giving them a unique opportunity to gain hands-on experience in applied classical biological control projects, as well as help them to shape their future aspirations and career paths. In return, the students contribute valuably to the centre's extraordinary productivity, while preserving the exceptional quality of its research outputs. In 2011, staff and students based at the centre in Switzerland accomplished an impressive 35 publications, of which 29 were in peer-reviewed journals.

An interesting initiative to strengthen the connection between CABI and the Canton Jura, the canton in which CABI is located, was further developed during 2011. A working group was set up by the Canton Jura's Minister of Education, Culture and Sport, with the intention to develop ideas for collaborative activities and re-inforce CABI's integration within the canton. A joint agreement was reached at the end of 2011 that will involve the Canton Jura providing funding to CABI for two years to develop educational training material for local schools in the field of sustainable agriculture and the environment. This activity will provide our centre with a new and exciting opportunity to broaden its expertise beyond research and consultancy and foster its capacity to provide training to the local community. These developments motivated the Canton Jura to initiate additional negotiations for CABI and the University of Neuchâtel to establish a joint higher education programme. This biological control and integrated pest management (IPM) course would be hosted by CABI and accredited by the University of Neuchâtel. Discussions will continue in 2012 with the desired outcome being the establishment, for the first time, of a higher education programme in this field within the Canton Jura.

Meanwhile, CABI, as an organization, focused for much of 2011 on developing its global programme, Plantwise, and in seeking donor support for its launch and implementation from 2012 onwards. Plantwise is unique for the organization, not only because it is its first global programme but also because it will involve staff based at all of CABI's locations around the world. It is therefore an extremely significant undertaking and one that requires an immense amount of coordination, management and organization. In September of 2011, I accepted the role of Plantwise Programme Executive, while remaining the Regional Director of CABI in Switzerland. This will undeniably be a challenging role for me, but I am pleased to have support from Wade Jenner, who has agreed to become the Programme Support Manager. In addition, André Gassmann and Emma Jenner will both take over more responsibilities in their existing roles as Assistant Directors. In July, I was also extremely pleased to welcome Gitta Grosskopf-Lachat back to the centre as Personal Assistant to the Regional Director. Gitta has already made a significant and positive impact on my capacity to both manage the centre and take on new management responsibilities within the Plantwise programme.

There have been a couple of other staff changes at the centre this year. Matthew Cock, who remains as CABI's Chief Scientist, relocated to CABI in the UK. We also regained two staff members, René Eschen and Ghislaine Cortat, both of whom returned to the Swiss centre, having spent the last three years working at CABI's centre in the UK. René is working primarily in our Risk Analysis & Invasion Ecology programme, while Ghislaine is continuing her work for the Weed Biological Control programme.

As you can see, the Swiss centre and the work its staff does are continuing to flourish. I attribute our success to the unrelenting dedication and motivation of the staff, as well as the deep commitment and support of our donors. For this I am extremely grateful, especially to the programme leaders. I am looking forward to continuing to support and lead the centre and its team into another exciting and fruitful year ahead.

Dr Ulli Kuhlmann, Regional Director


MINISTRY OF AGRICULTURE FORESTRY
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project highlights

twenty-four *Trichogramma* rearing facilities established in DPR Korea

A number of steps are required to successfully establish a rearing facility for the parasitic wasp *Trichogramma ostriniae*. These include choice of an appropriate location, development of a production design, assembly of rearing equipment, renovation of a suitable building and training the staff who will be involved in rearing – as well as the staff at cooperative farms who will be using the biological control agent.

During a Directorate-General for Development and Cooperation – EuropeAid (DG EuropeAid) funded project, which finished in November 2011, 24 facilities were established that mass-produce *Trichogramma*. The facilities were set up in 21 counties of four provinces in the Democratic People's Republic of Korea (DPR Korea). Together they produced 284 kg of *Trichogramma* in 2011. The parasitic wasps (over ten billion of them!) were released on 16,720 ha of maize to keep the Asian corn borer (*Ostrinia furnacalis*), the major pest of maize in the country, under control. As a result of the releases, the maize yield was increased by 12% – a total of more than 9000 tonnes – in 2011.

This success was achieved through numerous consultancy visits by CABI staff based in Switzerland and China, supported by Chinese *Trichogramma* rearing specialists from Hengshui and a strong network of partners in DPR Korea. Measures to improve the sustainability of operations (quality control procedures, owner agreements and a business plan) together with strong ownership of the County Farm Management Boards (CFMBs) in DPR Korea will assure production of *Trichogramma* at the 2011 level or even higher in the future.

Checking the production of the larval rearing host, *Sitotroga cerealella* (photo: D. Babendreier)

Participants at a training course on quality control for *Trichogramma* production (photo: D. Babendreier)

Staff of Jongju *Trichogramma* rearing facility with a mechanically driven egg-purifying device (photo: D. Babendreier)

Workshop on 'Novel information tools for problem oriented research' at AAS (photo: K. Holmes)

Workshop on 'Novel information tools for problem oriented research' at AAS (photo: K. Holmes)

the Academy of Agricultural Sciences, DPR Korea, goes online

As part of a DG EuropeAid funded Partnership Project (DCI-FOOD/2009/218-588), CABI staff based in Switzerland, in collaboration with the Academy of Agricultural Sciences (AAS), Pyongyang, DPR Korea, have been investigating how to improve the ability of AAS scientific staff to carry out problem-oriented research. We identified the need for AAS scientists to be able to access global scientific knowledge, information and resources. To facilitate this CABI and AAS, with the support of the CABI Liaison Officer, Mr Chae Chun Sik (Senior Officer of the AAS International Exchange of Science and Technology Centre – IESTC), established a Knowledge Management Room at AAS-IESTC.

The Knowledge Management Room was, after a long process of consultation at the ministerial level, approved to receive, and subsequently provided with, access to the Internet. This is the first time AAS has been able to provide its staff with access to international scientific resources. AAS has now established access to CABI online resources including CAB Direct (incorporating CAB Abstracts), CABI e-books and the CABI compendia, e.g. the Crop Protection Compendium.

CABI staff conducted a four-day participatory workshop attended by 20 scientists from AAS, from Pyongyang and nationwide, as well as representatives of Kim Il Sung University – Pyongyang Agriculture University (PAU). Participants were trained in the basics of how to use the Internet and the CABI online products, and given the opportunity to use them for their individual research interests. Following this training, a commitment was made by both AAS and PAU to develop training courses on Internet use for both university students and AAS staff, with AAS proposing selected staff be trained in practical hands-on use of the Internet. As a result of training and access to these resources, the ability of our project partners to conduct effective research will be strengthened and, in the future, their ability to contribute to alleviating food security problems enhanced.

from DPR Korea to the Greater Mekong – a new maize IPM Project in China, Myanmar and Lao PDR

After the successful development and scaling up of a *Trichogramma*-based integrated crop management (ICM) strategy in DPR Korea, a similar project in the Greater Mekong Subregion was awarded funding by DG EuropeAid. The three-year project, which starts in April 2012, aims to establish 21 locally adapted facilities for the production of biologically based plant protection agents and to train up to 10,500 smallholder farmers in maize IPM.

The project's approach will address the specific needs of low-income, smallholder maize farmers by combining traditional and modern practices to improve maize production and food security in each of the target countries. Through intra-regional partnerships the countries will gain access to the technology and training necessary to establish facilities for the mass-production of biological control agents. Village-level grassroots organizations will coordinate the plant protection activities and will be further helped to provide complementary agricultural inputs and services. The village-level approach will maximize benefits from the new technology, enabling farmers to produce more food in a healthier farm environment.

This project involves collaboration between the Institute of Plant Protection of the Chinese Academy of Agricultural Sciences (IPP-CAAS) and CABI, operating out of the Ministry of Agriculture (MoA) – CABI Joint Laboratory based in Beijing.

petitions for the first *Brassica* agents

Years of research yielded results with petitions for field release of two biocontrol agents being submitted to the Technical Advisory Group (TAG) in the USA in 2011.

In 2008, a petition for field release for the root-mining weevil *Ceutorhynchus scrobicollis* on garlic mustard (*Alliaria petiolata*) had elicited concerns from some reviewers, which led to additional tests being conducted by Dr Jeanie Katovich in quarantine at the University of Minnesota, USA, and at CABI. The results of the tests, which confirmed the narrow host range of *C. scrobicollis*, were summarized and a response to TAG was submitted at the beginning of September 2011.

Since 2003, we have been working with the gall-forming weevil *Ceutorhynchus cardariae* as a potential agent for hoary cress (*Lepidium draba*). Between 2003 and 2011, 106 plant species and varieties, over half native to North America, were exposed under no-choice conditions. Although adults developed on 14 plant species, the only North American plant that was consistently attacked under multiple-choice conditions was *Lepidium latipes*. In an open-field test conducted in 2011 we were able to show that *L. latipes* was only attacked when exposed in close proximity to *L. draba*. A combined impact and survival experiment revealed that (i) attack by *C. cardariae* does not negatively affect *L. latipes* even under no-choice conditions, and (ii) the plant is unable to sustain a population of the weevil. Based on these results, we judge the likelihood of non-target attack by *C. cardariae* as very low, and a petition for field release was submitted to TAG at the beginning of December 2011.

The root-mining weevil *Ceutorhynchus scrobicollis*, a potential biological control agent for garlic mustard (*Alliaria petiolata*) (photo: T. Haye)

an important opportunity for Plantwise planning

In 2011, CABI began the massive undertaking of scaling up its global Plantwise programme to build on previous achievements in countries where Plantwise is already active and to bring more countries into the programme. Prior to rolling out the full programme, much planning and preparation by CABI regional staff is needed. To facilitate this important phase, CABI was awarded an entry (bridging) phase project (April–December 2011) by the Global Programme Food Security of SDC. The funds provided (CHF715,000) were an extension of funding that had previously been allocated to the IPM Advisory Group programme. The objectives of the entry phase project were to (i) construct a strategy for global implementation of CABI's Plantwise programme, (ii) investigate ways of integrating successful approaches of current SDC projects into the Plantwise programme, (iii) establish a quality assurance standard for Plantwise plant clinic operation, (iv) identify preferred ownership models for the sustainable operation of plant clinics, (v) develop efficient data collection and sharing processes, and (vi) prepare Plantwise Regional teams for Implementation.

The gall-forming weevil *Ceutorhynchus cardariae*, a potential agent for controlling hoary cress (*Lepidium draba*) (photo: H.L. Hinz)

Participants at SDC Plantwise workshops in Engelberg, Switzerland, in late May 2011 (photo: CABI)

realizing the global vision for Plantwise

In late 2011, SDC's Global Programme Food Security awarded CABI funding (CHF3,050,000) for two years towards the global Plantwise programme. This major contribution from SDC will support the general implementation of the knowledge bank and plant clinic components of Plantwise in partner countries, along with other supporting services, such as BioNET and the Data and Diagnostics Services. In particular, SDC's support will enable CABI to strengthen its activities in three countries in which Plantwise is already active (Sierra Leone, Sri Lanka and Nicaragua) as well rolling out the programme to three new countries (probably Tanzania, Cambodia and Honduras). In the countries where Plantwise already operates, CABI's regional teams, with support from European resource team staff based in the UK and Switzerland, will work with national partners to build on previous achievements to further strengthen plant health systems. In countries where Plantwise is being introduced, CABI will formulate the necessary agreements with key partners to launch the first plant clinics, enhance partners' access to key plant health information through the Plantwise knowledge bank, and introduce the concept of a strengthened plant health system.

Plantwise planning meeting in Delémont, Switzerland, including Regional Directors and the Plantwise Programme Board members, shortly after SDC's pledge of support for 2012 and 2013 (photo: W. Jenner)

rational pesticide use training course developed for cooperative farms in DPR Korea

The availability of pesticide products in DPR Korea is rather limited due to restricted imports into the country and subsequent distribution to the cooperative farms. Furthermore, the few pesticides that are available for use are often highly toxic, broad-spectrum products that have been banned in many countries worldwide. It is therefore crucial to ensure that the limited available products are used appropriately, not only to avoid depletion of stocks but more importantly to mitigate unnecessary damage to human and environmental health. In 2010, partners of the SDC-funded maize ICM project in DPR Korea requested CABI's support for the development of an on-farm training course to teach pesticide sprayer operators about safe and appropriate handling, use and storage of pesticides. During a study tour to Beijing in China by representatives from AAS's Plant Protection Institute (AAS-PPI), PAU and nine project cooperative farms, CABI facilitated the transfer of theoretical and practical knowledge about different types of pesticides, their mode of action and toxicity, as well as appropriate timing and method of application. Information on how to calculate the correct dosage, select the most appropriate pesticide sprayer and nozzle, maintain pesticide sprayers in a good state of repair, and correctly store and dispose of pesticide containers was also covered. During two follow-up workshops, this knowledge was incorporated into two training curricula; one to be used for training trainers and the other for training pesticide sprayer operators. A series of hand-painted posters was developed as a visual training aid and a number of hands-on practical activities were designed to enhance the learning experience and effectiveness of the training. Implementation of the training, which started in the summer of 2011, includes an examination to test whether the required knowledge has been acquired satisfactorily by the trainees. Initial feedback from project partners indicates that pesticide sprayer operators are now much more knowledgeable about pesticides and their associated risks, and are applying products in a more competent manner.

Sprayer operators receiving rational pesticide use training at a cooperative farm in DPR Korea (photo: Kang S.I., AAS-PPI)

Albanian university embeds ICM in its new Master's programme

The University of Korçë in south-eastern Albania has incorporated a new ICM course into its recently launched Master's programme in Rural Development. The ICM course material was developed by CABI and handed over to the university through a SCOPES (Scientific Co-operation between Eastern Europe and Switzerland) project funded by the Swiss National Science Foundation (SNSF) and SDC. The university and CABI then jointly adapted the training content to fit with the existing undergraduate and graduate programmes. This new course is the first of its kind in the University of Korçë, providing students with an in-depth introduction to sustainable crop production based on modern knowledge and practices.

Students attending the ICM course implemented at Korçë University (photo: D. Babendreier)

Trainees and trainers attending hands-on training in biopesticide production at Andermatt Biocontrol AG, Grossdietwil, Switzerland (photo: Andermatt Biocontrol AG)

technical hands-on training of DPR Koreans in biopesticide production

CABI was successful in engaging two biocontrol companies to provide practical training of DPR Korean plant protection experts in the production of biopesticides. DPR Korea is not in a position to regularly produce synthetic plant protection products, and there is restricted importation and distribution of effective products. As DPR Korean scientists would benefit from opportunities to gain experience and skills to allow them to develop local biopesticide production, SDC sponsored 16 days of practical training at biocontrol companies in Switzerland and China for a DPR Korean delegation comprising plant protection experts from the Central Plant Protection Station (CPPS) of the Ministry of Agriculture (MoA), and AAS's PPI, Crop Cultivation Institute and PAU. The aim was to build the capacity of the nine participants in the practical skills needed for producing biopesticides. One week of hands-on training was carried out at the Andermatt Biocontrol Company in Grossdietwil, Switzerland. Andermatt Biocontrol is one of the most diverse producers of biological control products in Europe. Another week of training took place at the Lvbenyuan Biotec Company in Guangzhou, China. Lvbenyuan Biotec is a spin-off company of the Guangdong Entomological Institute and a producer of biocontrol agents for south-eastern China. Lvbenyuan Biotec has strong expertise in research and implementation of production of biopesticides, such as termite-killing bacteria and beneficial nematodes against soil pests. It was fortunate that the experts from the two biocontrol companies were willing and able to provide participatory and practical training that covered the entire production process, which enabled the trainees to acquire the skills giving them the potential to develop approaches for biopesticide production in their own institutions and for solving agricultural pest problems in DPR Korea.

Trainees and trainers attending hands-on training in biopesticides at Lvbenyuan Biotec, a company of the Guangdong Entomological Institute in Guangzhou, China (photo: Guangdong Entomological Institute)

DPR Korean plant protection experts being trained in producing biopesticides by CABI and Lvbenyuan Biotec in Guangzhou, China (photo: S. Toepfer)

CABI highlights

CABI Board meeting

A core part of CABI's overall governance structure is the CABI Board, which is tasked with guiding CABI management on operational and strategic issues. In order to fulfil this duty, the Board meets four times a year to oversee and advise on CABI's programmes and general operations. The Board itself is independent, comprised of eight external, international experts, with John Ripley, former Unilever Head of Corporate Development, acting as Chair since August 2010. CABI's CEO, Dr Trevor Nicholls, and Chief Financial Officer, Ian Barry, also sit on the Board. In June of this year, the Swiss centre had the pleasure of hosting the CABI Board for one of its meetings. In addition to its internal discussions, the Board took the opportunity to spend time learning more about the activities of the Swiss centre. Each programme leader gave a presentation to the Board members about work being conducted in their particular section, after which many questions were asked and lively discussions ensued. The Swiss centre took further advantage of the presence of the Board, and asked them to officially open the newly renovated basement containing climate-controlled rearing rooms, an insect collection room and workshop. Against a backdrop of beautiful weather, an abundance of 'nibbles' and wine, and a gathering of lively summer students, Mr John Ripley officially cut the red tape to inaugurate the new rooms.

John Ripley, Chair of the CABI Board, officially opens the newly renovated basement rooms (photo: D. Babendreier)

CABI Board members, representatives of the CABI Executive Management Team and CABI Head Office members. Left to right, sitting: Mr Philip Walters, Dr Vibha Dhawan, Prof. Emmanuel Owusu-Bennoah, Mr Robert Sloley; standing: Mr Roland Dietz, Dr Lutz-Peter Berg, Mr Andrew Bennett, Mr Martin White, Mr Gary Whitfield, Mr John Ripley, Mr Ian Barry, Mr Neil MacIntosh and Dr Trevor Nicholls (photo: D. Babendreier)

new roles under Plantwise

In 2011, Ulli Kuhlmann, Regional Director, CABI, Switzerland, accepted the position of Programme Executive to lead and coordinate CABI's global programme Plantwise. Ulli is also the Plantwise budget holder and the principal point of contact between CABI and the Plantwise Donor Forum.

At around the same time, Wade Jenner, ICM Advisor, was appointed to the role of Programme Support Manager for Plantwise. In this function, Wade will assist the Programme Executive and the Plantwise Programme Board in the day-to-day planning, monitoring and reporting of activities and lessons learned.

Ulli Kuhlmann (photo: D. Babendreier)

Wade Jenner (photo: E. Jenner)

Gitta Grosskopf-Lachat PA to Regional Director

In July 2011, Gitta Grosskopf-Lachat was appointed Personal Assistant to the Regional Director. Gitta took over various administrative tasks in order to help Ulli Kuhlmann manage the growing centre and support him with his new management responsibilities in the Plantwise programme.

Gitta Grosskopf-Lachat (photo: R. Lachat, Courroux)

After spending four and three years, respectively, in the UK, René Eschen and Ghislaine Cortat are back in Switzerland (photo: G. Grosskopf-Lachat)

Ghislaine Cortat and René Eschen are back home

Ghislaine Cortat and René Eschen, two former staff of our centre in Switzerland are back in Delémont. Ghislaine spent three years at CABI's centre in the UK, and René two years each at Royal Holloway, University of London, and CABI's centre in the UK. Ghislaine has taken over the weed biological control projects on hawkweed (p. 24), sulphur cinquefoil (p. 38) and field bindweed (p. 37) from Gitta Grosskopf-Lachat, who, as noted above, has assumed a new role.

René divides his time between the Risk Analysis & Invasion Ecology and the Ecosystems Management sections. In the Risk Analysis & Invasion Ecology section, he is mainly working on pathways of introductions of forest pests within the framework of the EU COST[1] Action PERMIT (Pathway Evaluation and pest Risk Management In Transport, p. 55) and the EC RTD[2] project ISEFOR (Increasing Sustainability of European FORests, p. 52).

We are very happy to have both of them back and wish them all the best for their continuing careers with CABI.

CABI's Chief Scientist, Dr Matthew Cock (photo: J. Cock)

CABI's Chief Scientist, Matthew Cock, relocates from Switzerland to Wales

At the end of June 2011, CABI's Chief Scientist, Matthew Cock, relocated from Switzerland to Wales in the UK, from where he will continue his global role in support of CABI's science. He can be contacted through CABI's centre in the UK and his email remains unchanged. Matthew spent 11 years at Delémont, the first ten as Regional Director, and then from 2010 taking on the new role of CABI's Chief Scientist. Matthew writes "I am proud of having had the opportunity of steering the Switzerland centre for nearly ten years, maintaining and growing the reputation of the centre and the quality of its scientific work and partnerships. This was possible thanks to the commitment and spirit of the excellent team of scientists and support staff at the centre, whose hard work made it all possible, and I very much appreciate having had this opportunity to work with them." The team in Switzerland marked Matthew's departure by organizing a farewell party in September 2011.

new Staff Council representative

Ghislaine Cortat, research scientist in the Weed Biological Control section, is the new representative for staff based in Switzerland on the CABI Staff Council. She took over the role from Gitta Grosskopf-Lachat in 2011. The Staff Council Annual Meeting was held in Malaysia in November 2011. Representatives from all of CABI's offices received a warm welcome from the local staff for two busy and productive days of meetings, discussions and training.

Annual meeting of the CABI Staff Council representatives, Malaysia, November 2011 (photo: Wang J.)

1. European Union Cooperation in Science and Technology framework.
2. European Commission Research, Technological development and Demonstration framework programmes

CABI hosts visiting scientist Dr Owen Olfert

Dr Owen Olfert, Agriculture and Agri-Food Canada (AAFC), Saskatoon, visited our centre from September 2010 until September 2011. He focused his collaboration primarily on bioclimatic modelling in support of CABI and AAFC's collaborative biological control programme. Bioclimatic modelling software, e.g. CLIMEX®, allows researchers to predict the potential areas where insects considered for classical biological control programmes may be successful against invasive pests. Furthermore, it facilitates the development of models that describe the potential distribution and relative abundance of a species based on climate.

An outcome of Owen's visit is a bioclimatic model that was developed to predict the potential range and relative abundance of the biological control agent *Peristenus digoneutis* and its hosts, *Lygus* spp., based on European data. The model will help researchers to better understand how climate affects the status of biological control efforts to manage *Lygus* populations using *P. digoneutis* in North America.

Owen Olfert (AAFC, Saskatoon) (photo: T. Haye)

training on CLIMEX®

In January 2011, staff based in Switzerland attended a one-week training course on CLIMEX® (see **www.climatemodel.com**), a software program to predict effects of climate on species. Climate is one of the major factors limiting the distribution of plants and insects. Using climate information and knowledge about the biology and distribution of a particular species in its original habitat, CLIMEX® enables a rapid, reliable assessment of the risks posed by the introduction of different organisms, and can be used to predict locations to which they could spread. CLIMEX® can also be used to identify possible collection and release sites for biological control agents. CLIMEX® is currently used by many governments, agencies, universities and schools worldwide to examine the distribution of insects, plants, pathogens and vertebrates for a variety of purposes, including biogeography, quarantine, biological control and impacts of changes in climate and climate variability.

The training, given by Ross Weiss and visiting scientist Dr Owen Olfert (AAFC, Saskatoon), was of particular benefit to our staff, because climatic analyses provide invaluable insights into the likely behaviour of biological control agents when introduced into a new environment.

Owen Olfert and Ross Weiss providing training on CLIMEX® to CABI staff based in Switzerland (photo: T. Haye)

training course on experimental design and statistics

In October 2011, Dirk Babendreier provided a week of training on experimental design and statistics for 12 CABI staff based in Pakistan. The training was characterized by brief lectures and extensive group work and comprised all the relevant aspects of experimental design (e.g. setting objectives, hypothesis, treatments, blocking, randomization) and useful statistical tools including a lot of information on how to interpret statistics. The participants agreed that this training course was very useful and would increase their capacity to conduct sound experiments in the fields of agriculture and horticulture, as well as to analyse data derived from these experiments. Based on the positive feedback, follow-up training will be given in 2012 to further strengthen the participants' understanding of the topics covered in this first training course.

Participants at the training course on experimental design and statistics for staff based in Pakistan (photo: D. Babendreier)

After working hours, scientists exchanged their dissecting binocular microscopes for paint brushes (photo: A. Gassmann)

John Ripley, Chair of the CABI Board, officially opens the basement facilities (photo: D. Babendreier)

transformation of garages into new rearing and laboratory facilities

Winter 2011 saw the continuation of the renovations to improve the use of space in our existing building, so we can accommodate the increasingly expanding activities of our centre. Three garages in the basement have been transformed into new rearing and laboratory facilities and an insect collection room. Following a now well-established tradition, a team of enthusiastic volunteers spent many after-work hours painting these newly insulated and panelled facilities, and building new shelves.

Philip Hoffman working in the new rearing room (photo: T. Haye)

student highlights

Angelos Katsanis’ PhD on *Harmonia axyridis*

In 2011, Angelos Katsanis successfully defended his PhD thesis entitled ‘Multitrophic interactions between the invasive coccinellid, *Harmonia axyridis*, and non-target insects’ at the University of Bern, Switzerland. This work was supervised by Dirk Babendreier and Marc Kenis at our centre in Switzerland and Prof. Wolfgang Nentwig from the University of Bern. The work conducted by Angelos substantially increased our understanding of the mechanisms behind the negative effects the invasive *H. axyridis* has on non-target species.


Angelos Katsanis (photo: CABI)

new PhD student for weed biological control

To complement the Weed Biological Control team with a young and enthusiastic scientist, we decided to create a PhD position within the framework of the recently launched oxeye daisy project. We were lucky to be able to choose from excellent applicants and finally offered the position to Sonja Stutz. Sonja did her MSc at the University of Bern on ‘The landscape context of aphid–ant–predator interactions on cherry trees’, under the supervision of Dr Martin Schmidt-Entling. Sonja’s PhD will focus on two central aspects of the biological control project against oxeye daisy: (i) characterizing the target weed itself (the distribution of the various taxa in North America and Europe, the area of origin of the invasive genotypes, and their relatedness to the ornamental Shasta daisy) and (ii) searching for specialist natural enemies in the native range and assessing their suitability for classical biological control of oxeye daisy. Sonja is enrolled at the University of Fribourg, Switzerland, where she is supervised by Prof. Heinz Müller-Schärer. We would like to welcome Sonja to the Weed Biological Control team and wish her a successful and enjoyable time at our centre.


Sonia Stutz
(photo: G. Grosskopf-Lachat)

Mike Wogin defends his MSc thesis

In 2011, Mike Wogin successfully defended his MSc thesis entitled ‘Competition between parasitoids of the cabbage seedpod weevil: effects on sex ratios and consequences for biological control’ at the Simon Fraser University, Burnaby, Canada. This work was supervised by Prof. Bernhard Roitberg, (Simon Fraser University, Burnaby), Dr Dave Gillespie (AAFC, Agassiz, Canada) and Tim Haye (CABI). Mike’s work helped to evaluate what makes the ideal biological control community for the cabbage seedpod weevil, *Ceutorhynchus obstrictus*, by looking at the effects of inter- and intra-specific competition between the two parasitoids *Trichomalus perfectus* and *Mesopolobus morys*.


Mike Wogin
(photo: G. Grosskopf-Lachat)

MSc student from Germany on the BACCARA project

Nadine Brinkmann, from the University of Freiburg, Germany, spent summer 2010 in the Risk Analysis & Invasion Ecology section conducting research for her MSc thesis entitled ‘Assessment of the impact of global climate warming on larch herbivores in Swiss alpine larch forests, using altitudinal gradients’: research she carried out within the framework of the EC RTD project BACCARA (Biodiversity and Climate Change, A Risk Analysis). Nadine’s MSc was supervised by Prof. Rainer Glawion, Prof. Michael Boppré (both University of Freiburg, Germany) and Marc Kenis (CABI). Her work involved intensive sampling and analysis of insect pest densities and damage on larch along altitudinal gradients in the Swiss Alps. The thesis was successfully defended in January 2012.


Nadine Brinkmann
(photo: N. Brinkmann)

Saidou Nacambo (photo: CABI)

new MSc student on the box tree caterpillar project

Saidou Nacambo, a student at the University of Neuchâtel, Switzerland, started research for an MSc thesis under the supervision of Prof. Bruno Betschart (University of Neuchâtel) and Marc Kenis (CABI) on the box tree caterpillar, *Cydalima perspectalis*, a newly invasive pest of box in Europe. During his studies, to be completed in autumn 2012, Saidou will investigate the natural enemy complex of the caterpillar and its ecological impact on natural box tree stands in Switzerland. He will also study parameters such as diapause induction and the influence of temperature on the development of immature stages, and integrate these data into a climatic model to map the risk posed by the caterpillar in Europe.

a new MSc student in the weed biological control programme

Alicia Leroux from the University of Manitoba, Winnipeg, Canada, has started a Master's degree on the biology and host range of the seed-feeding fly *Euphranta connexa*, a potential biological control agent for swallow-worts (*Vincetoxicum* spp.), at our centre in Switzerland. This study is being supervised by Prof. Neil J. Holliday (University of Manitoba) and at CABI by André Gassmann. Alicia's research is focusing on five main aspects: (i) investigating the timing of *E. connexa* emergence from the overwintering pupal stage, which is a major determinant of time to oviposition, (ii) determining the potential fecundity of *E. connexa* on its natural host and the target weeds, *V. rossicum* and *V. nigrum*, (iii) examining host preference among *V. hirundinaria*, *V. rossicum* and *V. nigrum*, (iv) examining the oviposition behaviour of *E. connexa*, with the aim of developing host-range testing methods, and (v) investigating the parasitoid community on *E. connexa*.

Alicia Leroux working at a scenic field site in the Alps (photo: L. Andreassen)

partnerships and meetings

24th IWGO Conference & 3rd International Conference of *Diabrotica* Genetics in Freiburg, Germany

The International Working Group on *Ostrinia* and other Maize Pests (IWGO) is an International Organization for Biological Control (IOBC) Global Working Group, dealing with IPM options for all maize insect pests and pesticide resistance problems. The working group convenors are Ulli Kuhlmann from CABI as well as Prof. C. Richard Edwards from Purdue University, USA, and Dr Wang Zhen-ying, IPP-CAAS, Beijing, China.

CABI, with the Regierungspräsidium, Freiburg and LTZ Augustenberg, Stuttgart in Germany, organized the 24th IWGO Conference & 3rd International Conference of *Diabrotica* Genetics held in Freiburg on 24–26 October 2011. The conferences were attended by 112 delegates from 17 countries, and included 11 sessions, each with four to six speakers, and a poster session. The sessions were designed to address the most interesting and currently relevant research topics in the field of maize insect pests, and in particular those with broad international application and appeal. CABI had a high profile involvement with sessions co-led by Stefan Toepfer on 'Population dynamics of maize pests and implications for pest management' and Dirk Babendreier on 'Corn borer control and *Trichogramma*: new research and implementation insights'. In addition, CABI facilitated the attendance and participation of a group of scientists from AAS, DPR Korea, supported by funding from a DG EuropeAid Partnership Project (DCI-FOOD/2009/218-588). The DPR Korean delegation was actively involved, giving two oral and two poster presentations.

For more information visit **www.iwgo.org**

IWGO convenor Ulli Kuhlmann (right) presenting an honorary gift to Prof. C. Richard Edwards (photo: KCS Convention Service, Delémont)

A delegation of scientists from DPR Korea presented two talks and two posters during the IWGO conference. From left to right: Yu Kwang Song (CABI Project Liaison Officer), Pyon Yong Chol (Researcher, AAS- PPI), Kim Kwang Guk (Lecturer, Department of Plant Protection, PAU) and Dr An Song Su (Researcher, AAS-PPI) (photo: KCS Convention Service, Delémont)

participation in the XIII ISBCW

The International Symposium on Biological Control of Weeds (ISBCW), which takes place every four years, is the key event in this subject area. This year it followed the International Bioherbicide Group (IBG) meeting on the Big Island of Hawaii and was attended by seven staff from our centres in Switzerland and the UK. The symposium was attended by about 200 delegates from nearly 30 countries and there were 58 oral presentations, around 150 posters, and five workshops. CABI staff members contributed five presentations, co-authored five additional presentations and 15 posters, and organized or co-organized two workshops as well as staffing a stand featuring CABI's publishing products and showcasing the Invasive Species Compendium. Apart from the educational aspects of the event, the symposium provided a unique opportunity to meet many of our collaborators and sponsors and to hold many formal and informal meetings as well as face-to-face discussions on current and potential projects. Overall, the impression most delegates will have taken back is that CABI remains an important player in biological control of weeds, producing high quality outputs from a dedicated team with an ability to work all over the world. The next ISBCW will be held in South Africa in January 2014.

Group picture of the participants of the XIIIth ISBCW (photo: D.E. Oishi, Hawaii Department of Agriculture)

collaboration CABI–Canton Jura

A working group has been set up by the Department of Education, Culture and Sports of the Canton Jura with a view to developing a service contract with CABI for collaboration with and specific services for various public and private actors. Following a series of meetings in 2011, a service contract will be ratified in January 2012 and implemented over two years from 2012. The contract includes several educational components worth a total of CHF130,000 over the two years, including CHF70,000 core funding. The Government of the Jura has also facilitated the establishment of a working group with a view to establishing a formal collaboration between CABI and the University of Neuchâtel which would be supported by the canton; a final report on this is due in June 2012 which should result in the implementation of a collaborative educational programme with the University of Neuchâtel starting in 2013.

new connections with Brazil

In April 2011, CABI opened a new office in Botucatu, Brazil. The office is hosted by UNESP (Universidade Estadual Paulista) and led by Dr Yelitza Colmenarez, who worked as temporary research assistant at our centre in Switzerland several years ago. Within this framework, CABI is developing collaborative research programmes with Brazil. In August 2011, Dr Luiz Alexandre Nogueira de Sá, an entomologist responsible for the EMBRAPA (Empresa Brasileira de Pesquisa Agropecuária) quarantine laboratory 'Costa Lima' in Jaguariúna, Sao Paulo, visited our centre in Switzerland to discuss potential collaborative projects. Then, in October, Marc Kenis travelled to Brazil to visit the new CABI office and the UNESP facilities in Botucatu as well as the EMBRAPA quarantine laboratory, and to discuss potential collaboration between our centre and the two organizations. Several ideas for collaborative projects were identified, particularly in the fields of forest protection, biological control and risk assessment. In 2012, an MSc student from UNESP will be posted to Delémont.

Dr Luiz Alexandre Nogueira de Sá with Ulli Kuhlmann in Delémont
(photo: L.A. Nogueria de Sá, EMBRAPA quarantine laboratory 'Costa Lima', Brazil)


BIG

introduction

In 2011, I had the pleasure of welcoming one new staff member and two new graduate students. On 1 February, Sonja Stutz, from Switzerland, started her PhD within the framework of the oxeye daisy project (see p. 36) under the supervision of Dr Urs Schaffner and myself. Sonja is enrolled at the University of Fribourg in Switzerland, where Prof. Heinz Müller-Schärer will be her main supervisor. Sonja has made a very good start in her new job and I hope that some of you will meet her in person over the coming years.

At the beginning of April, Alicia Leroux, a Canadian student from the University of Manitoba, started her MSc on the swallow-worts project (see p. 34). Alicia will concentrate on the biology and host specificity of a seed-feeding tephritid fly being investigated as a potential control agent. Alicia will spend half of her time at CABI, where she is being supervised by Dr André Gassmann and myself, and the other half at Manitoba, where Prof. Neil Holliday will be her main supervisor.

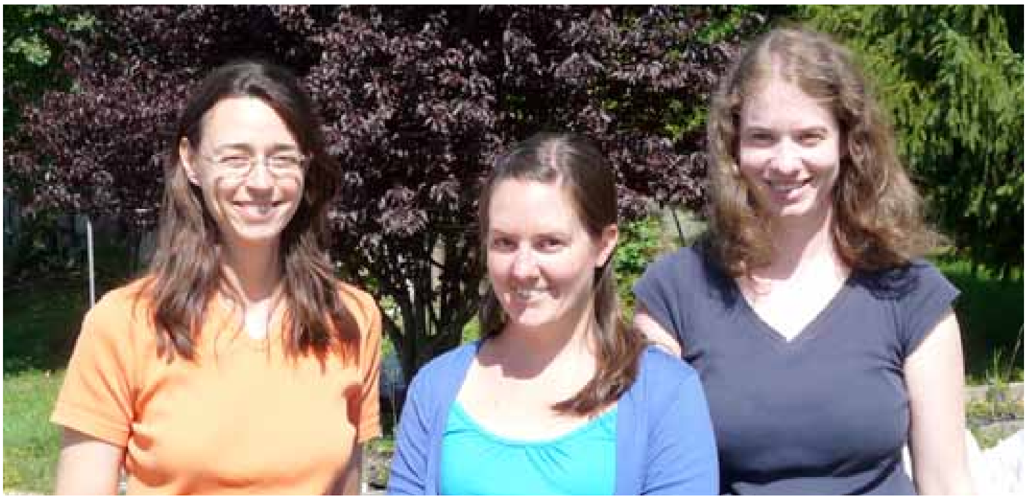
Finally, at the end of April we welcomed Ghislaine Cortat back to our team. Ghislaine worked in the Weed Biological Control programme in Switzerland for six years, first as a temporary, and then as our first (and so far only) permanent, technical assistant. In 2008 she switched to our centre in the UK, where she continued working in biological weed control and also familiarized herself with fungal pathogens. Ghislaine is currently taking over the projects on hawkweeds (p. 24), sulphur cinquefoil (p. 38) and field bindweed (p. 37).

From 7–10 April, we hosted Dr Kevin Delaney, a newly employed entomologist from the USDA-ARS (US Department of Agriculture – Agricultural Research Service) laboratory in Sidney, Montana, who visited us to get an overview of ongoing projects and to discuss closer collaboration between CABI and USDA-ARS. His main interests are in Russian olive (p. 35) and hoary cress (p. 27).

Participation in the XIII ISBCW was certainly one of the highlights in terms of meetings during 2011. Seven CABI staff members based in Switzerland or the UK participated. The symposium, held every four years, provided a unique opportunity to meet many of our collaborators and sponsors and to hold formal, informal, and one-to-one chats on current and future joint projects. The symposium was attended by about 200 delegates from nearly 30 countries and there were 58 oral presentations, nearly 150 posters, and five workshops. CABI staff contributed five presentations, 15 posters and organized or co-organized two workshops.

Finally, a summary of additional test results with the root-mining weevil *Ceutorhynchus scrobicollis* on garlic mustard (p. 26), prepared with the help of our North American partners, was submitted to TAG in September 2011. A petition for a second Brassicaceae agent, the gall-forming weevil *Ceutorhynchus cardariae* for hoary cress (page 27), was submitted to TAG at the beginning of December 2011.

Hariet L. Hinz, Head of Weed Biological Control (h.hinz@cabi.org)



From left to right: Ghislaine Cortat, Alicia Leroux and Sonja Stutz (photo: H.L. Hinz)

Milana Mitrović
(photo: A. Gassmann)

Oliver Krstić
(photo: A. Gassmann)

Jelena Jović
(photo: A. Gassmann)

biological control of toadflaxes, *Linaria genistifolia* and *L. vulgaris*

The western USA and Canada have been invaded by what appears to be three different morphological types of toadflax. These are yellow toadflax (*Linaria vulgaris*), Dalmatian toadflax (*L. dalmatica*), and a type that appears to be morphologically intermediate. From the eight agents of European origin that have been accidentally or deliberately introduced into North America for biological control of toadflaxes to date, one species only, the shoot-boring weevil *Mecinus janthinus* (now *M. janthiniformis*), has been reported to have a significant impact and this is on Dalmatian toadflax.

Morphological and molecular work has revealed the occurrence of cryptic speciation and a high degree of host plant specialization in the weevil genera *Rhinusa* and *Mecinus* associated with toadflaxes in Europe. Molecular work on toadflaxes is ongoing to determine the exact European origin of the invasive toadflaxes in North America.

Between 2006 and 2011, 111 plant species or populations (60 native to North America) were included in gall induction tests with the shoot-galling weevil *Rhinusa pilosa* from *L. vulgaris*. With the exception of *Nuttallanthus canadensis*, *Sairocarpus virga* and *S. nuttallianus*, no gall development was recorded on any native North American species. A petition for field release of *R. pilosa* against *L. vulgaris* in Canada and the USA will be submitted in early 2012. The shoot-galling weevil *Rhinusa brondelii* from *Linaria genistifolia* appears to be even more specific, since no oviposition and gall induction were recorded on *N. canadensis* and no larval development occurred on *S. virga*.

In 2011, additional no-choice larval development tests were conducted with the shoot-mining weevils *Mecinus heydeni* from *L. vulgaris* and *M. laeviceps* from *L. genistifolia*. In total, 68 and 73 plant species or populations, respectively, have been exposed so far, the majority native to North America. For *M. heydeni*, development to the adult stage has been found to occur on *Epixiphium wislizenii*, *Maurandella antirrhiniflora*, *N. canadensis* and *S. virga* and for *Mecinus laeviceps* on *N. canadensis* and *S. virga*.

A rearing colony of the two *Rhinusa* species has been established by Dr Rosemarie DeClerck-Floate at AAFC in Lethbridge, and *R. pilosa* was tested against different hybrids of *L. vulgaris* and *L. dalmatica* by Drs Sharlene Sing and David Weaver at Montana State University in the USA.

Work in 2012 will focus on completion of host-specificity tests with *R. brondelii* and on continuing studies with *Mecinus* spp. We plan to prepare and submit a petition for field release of *R. brondelii* in Canada and the USA in 2012/2013.

I. Toševski, **A. Gassmann** (a.gassmann@cabi.org), **M. Mitrović**, **O. Krstić** and **J. Jović**, in collaboration with **R. Caldara** (Milan, Italy) and **B. Emerson** (University of East Anglia, UK). Funded by: Wyoming Biological Control Steering Committee, USDA-APHIS-CPHST (Animal and Plant Health Inspection Service – Centre for Plant Health Science and Technology), USDA Forest Service and Montana Noxious Weed Trust Fund through Montana State University, USA; British Columbia Ministry of Forests, Lands and Natural Resource Operations, Canada.

Ivo Toševski looking for *Rhinusa* adults on small toadflax plants
(Photo: J. Jović, Institute for Plant Protection and Environment, Belgrade, Serbia)

is there still hope for biological control of houndstongue, *Cynoglossum officinale*, in the USA?

Houndstongue, *Cynoglossum officinale*, is a facultative biennial, native to Europe and Asia Minor. Introduced into North America in the mid-19th century, it now occurs in nearly all Canadian provinces and states of the adjacent USA. This rangeland weed hinders the establishment of forage species in new pastures. The barbed nutlets become attached to cattle causing irritation and potential market loss. A biological control programme was started in 1988 because chemical and cultural control methods against large infestations are often neither feasible nor economic.

To date, six insect species have been investigated as potential biological control agents at CABI. The root-mining weevil *Mogulones crucifer*, released in Canada in 1997, has successfully established and is showing impressive impact. However, doubts about its host specificity prevented its release in the USA, where many more native species in the same family as houndstongue (Boraginaceae) exist. Host-specificity tests for the root-mining flea beetle *Longitarsus quadriguttatus*, the root-mining weevil *Rabdorrhynchus varius*, the stem-mining weevil *Mogulones trisignatus*, and the root-mining hoverfly *Cheilosia pascuorum* have shown these species capable of attacking several indigenous North American species and they are no longer being considered as potential agents.

In the last few years, our work has concentrated on the seed-feeding weevil *Mogulones borraginis*, which is by far the most specific agent on houndstongue, with development restricted to the genus *Cynoglossum*. In 2011, we successfully maintained the rearing colony of *M. borraginis* at CABI and we are currently overwintering over 2000 individuals. Prof. Mark Schwarzländer (University of Idaho, USA) hand-carried weevils to the quarantine facility in Pullman, Washington twice during 2011, where PhD student IkJu Park will conduct tests on the visual and olfactory host-finding behaviour of *M. borraginis*.

In an overwintering experiment conducted in 2010/11 using six different temperatures, we found that weevils only successfully survived at temperatures at or above 0°C, but not at a constant –5°C or lower. An additional experiment was established in autumn 2011 with temperatures just below zero (–0.5°C, –1.0°C and –1.5°C) to determine more precisely the minimum temperature at which *M. borraginis* is able to overwinter successfully. Results will be available in spring 2012.

In addition, we established an oogenesis test with the native North American *Cynoglossum grande* in spring 2011. This test investigated whether female weevils can develop viable eggs when exclusively fed on the flowers of a given plant species. Results clearly confirmed that *M. borraginis* females are unable to develop mature eggs when only feeding on *C. grande*.

Results of all host-specificity tests conducted with *M. borraginis* between 1993 and 2011 have been summarized and a petition for field release will be submitted in 2012.

H.L. Hinz (h.hinz@cabi.org), **L. Blair** and C. Cloşca. Funded by: USDA-APHIS-CPHST, USA.

Mogulones borraginis adult on a houndstongue flower (photo: H.L. Hinz)

The native North American *Cynoglossum grande* in flower at CABI (photo: H.L. Hinz)

Célien Montavon checking *Cynoglossum officinale* inflorescences for emerging *Mogulones borraginis* larvae (photo: H.L. Hinz)

Aulacidea subterminalis female (photo: G. Cortat)

Aulacidea pilosellae galls on the midrib of *Pilosella officinarum* (photo: G. Cortat)

biological control of hawkweeds, *Pilosella* spp., for North America

European hawkweeds have been introduced into North America where several species have become invasive and declared noxious weeds. Meadow hawkweed, *Pilosella caespitosa* (= *Hieracium caespitosum*), and orange hawkweed, *P. aurantiaca* (= *H. aurantiacum*), invade roadsides, pastures, clear-cut areas and nature reserves. *Pilosella officinarum*, *P. piloselloides*, *P. glomerata* and *P. floribunda* are troublesome weeds in the north-western part of the USA and in British Columbia, Canada.

Since 2000, CABI has been researching the potential of natural enemies of *Pilosella* species in Europe to control invasive alien hawkweeds in North America. To date seven insect species have been investigated. Testing has been discontinued for four of these because of either lack of specificity, a preference for non-target *Pilosella* species or difficulties in obtaining conclusive results. A draft petition for a fifth species, the root-mining syrphid fly *Cheilosia urbana*, is being prepared and will be circulated for comments to our North American partners in early 2012.

In 2011, we continued to rear the gall wasp *Aulacidea subterminalis*, which attacks stolons of mouse-ear (P. officinarum) and orange hawkweed, and gall clusters were sent to the quarantine facility at Montana State University, Bozeman in the USA. First field releases of the wasp were made in the USA and Canada in 2011.

Finally, two populations of *Aulacidea pilosellae* that gall the midrib of leaves, stolons and flower stems of several *Pilosella* species are being investigated at CABI. The northern population (from eastern Germany, Poland and the Czech Republic) is univoltine and attacks *P. aurantiaca*, *P. caespitosa*, *P. glomerata* and *P. piloselloides*. The southern population (from southern Germany and Switzerland) is bivoltine and appears to prefer *P. officinarum*. In 2011, Chandra Moffat, an MSc student at the University of British Columbia, started to conduct molecular analyses on the two populations in collaboration with Drs Kevin Floate and Rosemarie DeClerck-Floate (AAFC). Her preliminary results indicate that the bivoltine *A. pilosellae* collected from *P. officinarum* is of a different lineage or biotype to the univoltine wasps collected from *P. caespitosa*, *P. glomerata* and *P. piloselloides*, independently of location.

Tests conducted with *A. pilosellae* between 2003 and 2011, on 38 test plant species for the univoltine population and 22 for the bivoltine population, revealed a restricted host range. Of the four native North American *Hieracium* species attacked by the univoltine population under no-choice conditions, only one, *H. scouleri*, received very limited attack in choice-tests. The bivoltine population has so far only attacked the native North American *H. umbellatum* outside the genus *Pilosella* under no-choice conditions. No-choice and multiple-choice tests will be continued in 2012.

G. Cortat (g.cortat@cabi.org), **G. Grosskopf-Lachat**, **C. Moffat**, **H.L. Hinz**, **A. Thuis** and **A. Tateno**.
Funded by: British Columbia Ministry of Forests, Lands and Natural Resource Operations and AAFC, Canada; Montana Weed Trust Fund through Montana State University and USDA-APHIS-CPHST, USA.

Collecting *Aulacidea pilosellae* galls on hawkweed during a field trip to eastern Europe (photo: G. Cortat)

controlling the noxious Russian knapweed, *Acroptilon repens*, in the USA and Canada

Russian knapweed, *Acroptilon repens*, is a herbaceous perennial that is native to Asia. The plant was accidentally introduced into North America in the late 19th century as a contaminant of alfalfa seed. To date, Russian knapweed is considered noxious in 16 western states and one Canadian province. First efforts in the 1970s to control Russian knapweed in the USA by biological means led to the release of a nematode species, *Subanguinea picridis*, but this agent did not prove to be effective under field conditions. Therefore, investigations on the biological control of Russian knapweed were resumed in 1997.

In spring 2011, field-collected galls of the gall wasp *Aulacidea acroptilonica* and the gall midge *Jaapiella ivannikovi* were sent to quarantine facilities in North America to maintain ongoing rearing programmes. Both biological control agents have established and successfully overwintered at various releases sites in the USA and Canada.

Together with colleagues from Mashhad University, Iran, and Dr Massimo Cristofaro, Biotechnology and Biological Control Agency (BBCA), Rome, Italy, an open-field test was conducted with the mite *Aceria* sp. near *acroptiloni* in 2011. As in previous years, signs of mite attack were only observed on Russian knapweed. However, when extracting mites from all test and control plants used in the open-field test conducted in 2010 in Iran, we found three different mite species on Russian knapweed and on at least one test plant species. More detailed morphological comparisons by Dr Philipp Chetverikov (Russian Academy of Sciences, St Petersburg) indicated that the original description of Aceria acroptiloni published by O. V. Kovalev and co-authors actually includes two distinct species. We will therefore need to reassess the taxonomy of *A. acroptiloni* and the other species associated with Russian knapweed by both morphological and molecular means.

Impact studies with *Aceria* sp. near *acroptiloni* were continued in 2011. As in 2010, strong evidence was found that this mite can significantly reduce above-ground biomass and almost completely prevent seed formation. The experiment will be continued in 2012 to assess mite impact over several years.

During field surveys in Uzbekistan, only a few larvae of the chrysomelid species *Galeruca* sp. were found. Therefore, continuation of no-choice host-range testing was postponed to 2012.

Work in 2012 will focus on shipping field-collected galls of the gall wasp *Aulacidea acroptilonica* and the gall midge *J. ivannikovi* to North America, on clarifying the taxonomy and revising host-range testing methods for the mite *Aceria* sp. near *acroptiloni*, and on assessing the host range of the chrysomelid species found in Uzbekistan.

U. Schaffner (u.schaffner@cabi.org) and **K. Dingle**, in collaboration with **M. Cristofaro** (BBCA), **R. Ghorbani** and **G. Asadi** (Mashhad University), **A. Khamraev** (Uzbek Academy of Sciences), **T. Rajabov** (University of Samarkant, Uzbekistan) and **J. Littlefield** (Montana State University, USA).
Funded by: Wyoming Biological Control Steering Committee, USDA-APHIS-CPHSTand Montana Weed Trust Fund through Montana State University, USA.

Root stock of *Acroptilon repens* with overwintering shoot buds infested with the mite *Aceria* sp. near *acroptiloni* (photo: G. Asadi, Mashhad University)

Students of Shirvan University dissecting mite-infested flowerheads of *Acroptilon repens* (photo: G. Asadi, Mashhad University)

Dr G. Asadi investigating artichoke plants that were inoculated with the mite *Aceria* sp. near *acroptiloni* (photo: U. Schaffner)

Set-up for single-choice tests with *Ceutorhynchus constrictus* on *Brassica juncea* (photo: E. Gerber)

Pod-bearing inflorescence of *Brassica juncea* (left) and *Alliaria petiolata* (right) in single-choice tests with *Ceutorhynchus constrictus* (photo: E. Gerber)

biological control of the environmental weed garlic mustard, *Alliaria petiolata*

Garlic mustard, *Alliaria petiolata*, is a biennial cruciferous plant of European origin considered as one of the most serious invaders in the north-eastern and mid-western USA and south-eastern Canada. This project to investigate the potential for biological control of the weed was started in April 1998 in collaboration with Prof. Bernd Blossey (Cornell University, USA). At present, we are concentrating on four weevil species: *Ceutorhynchus alliariae*, *C. constrictus*, *C. roberti* and *C. scrobicollis*.

For the root-mining weevil *C. scrobicollis*, a petition for field release had been submitted to TAG in 2008. To address the concerns expressed by reviewers, additional tests were conducted by Dr Jeanie Katovich in quarantine at the University of Minnesota, USA, and at CABI. Tests confirmed *C. scrobicollis* as a strong biological control candidate. The weevil was unable to complete development on any of the ten additional plant species tested, or on watercress (*Nasturtium officinale*) in water-saturated soils, i.e. under the conditions *N. officinale* is grown as a crop. Test results were summarized and a response to TAG was submitted at the beginning of September 2011.

No-choice tests conducted with the shoot miner *C. alliariae* in 2011 revealed that *Caulanthus inflatus*, a native North American plant species, might be within its fundamental host range. Single-choice tests established on *Lobularia maritima*, a species with limited adult development under no-choice conditions in 2010, revealed a surprisingly high level of acceptance for oviposition by *Ceutorhynchus alliariae*. We are planning to conduct an open-field test in 2012 with this species. Unfortunately none of the no-choice or single-choice tests established for *C. roberti* were valid.

Tests in 2011 endorsed results from the previous year suggesting that *Brassica juncea* might be attacked by *C. constrictus* although no complete development to adult was recorded. In single-choice arrangements, i.e. when *C. constrictus* was simultaneously offered test and *A. petiolata* plants, results varied according to test conditions. No eggs were laid in *B. juncea* when offered in a field cage, while a few eggs were found in the test plant species when weevils were released into a gauze bag that enclosed one inflorescence each of *B. juncea* and *A. petiolata*. However, *Ceutorhynchus obstrictus* (cabbage seedpod weevil) was observed on *B. juncea* plants in the greenhouse where plants had been kept prior to test set up. Eggs and larvae found in *B. juncea* might therefore originate from this oligophagous weevil. To clarify this, eggs and larvae have been sent for identification using molecular analyses.

In summary, work on garlic mustard progressed well in 2011. Work in 2012 will mainly concentrate on tests with *C. constrictus*. A first shipment of this species to the quarantine facility at the University of Minnesota is scheduled for spring 2012.

E. Gerber (e.gerber@cabi.org), **H.L. Hinz** and **D. Fife**. Funded by: USDA Forest Service, Minnesota Department of Natural Resources and USDA-APHIS-CPHST, USA.

Danielle Fife taking care of *Nasturtium officinale* plants exposed to *Ceutorhynchus scrobicollis* under water-saturated conditions (photo: E. Gerber)

biological control of whitetops, *Lepidium draba* and *L. appelianum*, for the USA

Whitetops or hoary cresses, *Lepidium draba* (= *Cardaria draba*) and *L. appelianum*, are deep-rooted, perennial mustards that are aggressive invaders of cropland, rangeland and riparian areas. In spring 2001, Prof. Mark Schwarzländer (University of Idaho, USA) established a consortium to investigate the scope for classical biological control of these weeds. During 2011, we concentrated our work on two potential biological control agents.

Collection of additional data on the phenology of the gall-forming weevil *Ceutorhynchus cardariae* showed that its life cycle is more plastic than previously assumed. Under favourable conditions, egg laying and larval development can occur even during winter, potentially increasing the chance of negatively affecting *L. draba* growth and vigour. Between 2003 and 2011, 106 plant species and varieties, over half native to North America, have been exposed under no-choice conditions. Galls developed to some extent on 18 species and adults emerged from 14. The only North American plant that was consistently attacked under multiple-choice conditions was *Lepidium latipes*. However, in an open-field test conducted in 2011 we were able to show that *L. latipes* was only attacked when exposed in close proximity to *L. draba*. A combined impact and survival experiment revealed that (i) attack by *C. cardariae* does not negatively affect *L. latipes* even under no-choice conditions, and (ii) the plant is unable to sustain a population of the weevil. Extensive data on the field host range of *C. cardariea* showed that only the closely related European Lepidium campestre can act as a secondary host of *C. cardariae* in its native range.

Based on the results above, we judge the likelihood of non-target attack by *C. cardariae* as very low, and a petition for field release was submitted to TAG at the beginning of December 2011.

Additional no-choice oviposition tests were conducted with the seed feeder *Ceutorhynchus turbatus* in 2011. Apart from *L. draba*, feeding was observed on nine of 11 test species exposed and one egg was found in the European Berteroa incana, confirming the narrow host range of *C. turbatus*.

In 2012, we are planning to conduct some additional tests with *C. cardariea* on test species not previously available, continue testing of *C. turbatus*, restart testing of the stem-mining weevil *C. merkli*, and start working on a specific clade of the root-galling weevil *C. assimilis* in cooperation with USDA-ARS.

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Leah Blair (background) and Cornelia Cloşca (foreground) covering plants for additional no-choice tests with *Ceutorhynchus cardariae* (photo: H.L. Hinz)

Ceutorhynchus cardariae marked with fluorescent powder for an open-field test (photo: A. Leroux)

Lepidium draba (control) and *L. latipes* (test plant) exposed during an open-field test with *Ceutorhynchus cardariae* (photo: H.L. Hinz)

Mining by *Melanobaris* sp. near *semistriata* (photo: M. Cristofaro, BBCA)

Dr Sergey Reznik releasing insects for the multiple-choice cage tests in southern Russia (photo: S. Grigoriev, Russia)

foreign exploration consortium for biological control of perennial pepperweed, *Lepidium latifolium*, in the USA

Perennial pepperweed, *Lepidium latifolium*, (PPW) is a highly invasive mustard of Eurasian origin. This project to investigate the potential for biological control of PPW was started in 2004 in collaboration with Prof. Mark Schwarzländer (University of Idaho, USA). In 2005, we joined forces with BBCA (Rome, Italy).

At present we are concentrating on five potential biological control organisms: the gall-forming weevil *Ceutorhynchus marginellus*, the shoot-mining flea beetle *Phyllotreta reitteri*, the root-mining weevil *Melanobaris* sp. near *semistriata*, the gall-forming eriophyid mite *Metaculus lepidifolii* and *Lasiosina deviata*, a chloropid stem-mining fly.

No-choice and single-choice tests conducted with *C. marginellus* in quarantine at CABI have so far revealed that ten other species support adult development. Several of these species were tested in multiple-choice cage tests in southern Russia and we found that four *Lepidium* species were attacked. Two of these, *L. crenatum* and *L. huberi*, were subsequently exposed in an open-field test and were not attacked. Tests to see if weevils reared from these two *Lepidium* species are able to sustain viable populations on them are currently being carried out.

No-choice larval transfer tests with *P. reitteri* advanced very well in 2011. Adults emerged from one additional species (*Lepidium fremontii*) resulting in a total of 17 plant species identified so far which can support development of this flea beetle. However, the species turned out to be very specific when tested in the field. Among the 14 test plants exposed in the field so far, only one single replicate of *Lepidium lasiocarpum* has been attacked, and only three dead larvae and no exit hole were found upon dissection. Based on these results we continue to consider *P. reitteri* as a potential agent.

An open-field test was carried out to investigate acceptance of nine critical test plant species by *Metaculus lepidifolii* and *Melanobaris* sp. near *semistriata* in central Turkey. Unfortunately, watering was stopped too early in the season and, when the plants were harvested, we could not reliably evaluate whether or not they had been attacked by the potential agents.

Host-specificity testing will continue in 2012, both in quarantine and in the field. Field tests in Turkey are essential at this point to decide if prioritized agents are host specific enough to be further considered. We will therefore continue our efforts to optimize collaboration with our local partners.

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Different degrees of deformation of PPW inflorescences due to attack by *Metaculus lepidifolii* compared to an unattacked shoot on the left (photo: E. Gerber)

giving dyer's woad, *Isatis tinctoria*, the blues

Dyer's woad, *Isatis tinctoria*, is of Eurasian origin and was introduced to North America by early colonists as a source of blue textile dye. Today, it is a declared noxious weed in ten western US states. In 2004, an initiative was started by Prof. Mark Schwarzländer (University of Idaho, USA) and Jim Hull (Weed Superintendent, Idaho) to investigate the potential for biological control of dyer's woad. Work is currently concentrating on three biological control candidates, i.e. the seed-feeding weevil *Ceutorhynchus peyerimhoffi*, the root crown-mining weevil *C. rusticus*, and the stem-mining flea beetle *Psylliodes isatidis*.

With *C. peyerimhoffi* we continued with no-choice oviposition tests on 13 test species, eight native to North America. Apart from dyer's woad, eggs were only found in four European test species. In subsequent larval development tests with three of these species, none of them supported development, confirming the narrow host range of *C. peyerimhoffi*. Our rearing colony performed extremely well in 2011 and nearly 3000 larvae emerged.

In autumn 2010, we established additional development tests with *C. rusticus* on 21 test plant species, 16 native to North America. Larvae (live or dead) were found in six test species, but adults of *C. rusticus* only emerged from dyer's woad in 2011. In autumn 2011 additional no-choice tests as well as an open-field test were established. In the latter, all dyer's woad control plants were heavily attacked (a mean of over 60 eggs and/or first instar larvae/plant), while only three plants of two test species were attacked, and to a limited degree (a mean of about one egg or first instar larva per plant).

Additional no-choice larval transfer tests with *P. isatidis* confirmed its relatively wide larval host range. However, in a joint open-field test with *C. rusticus*, one *P. isatidis* adult only emerged from the European *Barbarea vulgaris*, while no adults of either species emerged from any of the other test plants exposed. This confirms their narrow host range under natural field conditions. An impact experiment showed that larval mining of *P. isatidis* can significantly reduce shoot height of dyer's woad and tends to reduce seed production.

In 2008, we established an experiment in southern Germany to test the effect of *C. rusticus* and *P. isatidis* in combination with interspecific plant competition on dyer's woad under field conditions. In 2011, plants on plots not sprayed with insecticide (i.e. with herbivores) produced shorter and thinner shoots than plants on sprayed plots, and seed output was reduced by 72%. Since *C. rusticus* was the dominant herbivore, we assume that most of the impact was due to *C. rusticus* attack.

In 2012, host-range tests with the three prioritized agents will be continued.

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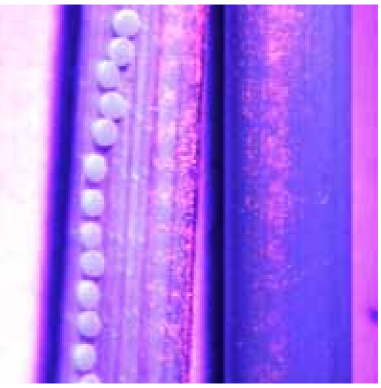
Leah Blair recording data at a dyer's wood site in southern Germany (photo: H.L. Hinz)

Leaf of dyer's woad showing feeding damage and adults of *Ceutorhynchus rusticus* (photo: H.L. Hinz)

Cornelia Cloşca (left) and Hariet L. Hinz (right) investigating dyer's woad plots established in southern Germany (photo: L. Blair)

Females of *Archanara geminipuncta* marked with fluorescent powder before release (photo: P. Häfliger)



Egg cluster of *Archanara geminipuncta* showing traces of pink under UV light (photo: R. Batallas)

protecting the USA's wetland areas from common reed, *Phragmites australis*

The perennial grass *Phragmites australis*, or common reed, is considered one of the most widespread plant species in the world. It can form large monocultures in wetlands and along river-banks and lakesides. Although reed-beds are seen in Europe as valuable and endangered ecosystems, *P. australis* is regarded to be invasive and reduce biodiversity in North America and Australia. Population studies using molecular techniques have shown that the dramatic spread of *P. australis* in recent decades in North America is due to an introduced population from Europe, which is displacing indigenous genotypes. Investigations to evaluate the potential for classical biological control of the invasive populations of common reed started in 1998. The native American populations of common reed were recently recognized as a distinct subspecies, *Phragmites australis americanus*.

We are currently concentrating on four shoot-mining noctuids, *Archanara geminipuncta*, *A. dissoluta*, *A. neurica* and *Arenostola phragmitidis*. Although all four moth species can develop on native North American reed under test conditions, we expect native *Phragmites* to escape attack in the field, because their leaf sheaths are less suitable for oviposition and eggs suffer higher mortality during winter.

Due to a population crash in our rearing colony in 2010, we were only able to ship 500 eggs of *Archanara geminipuncta* to the University of Rhode Island, USA, for host-specificity tests in 2011. The warm spring and early larval hatch had a strong negative impact on the rearing colonies of *A. geminipuncta* and *A. neurica* at the beginning of the 2011 season. Fortunately, we were able to restore them later in the season with field-collected larvae of both species. At CABI, additional no-choice larval transfer tests were established with *A. geminipuncta* using six test species. No living larvae were found on any of the test plants, dissected two weeks after the experiment was set up. We found two dead first instar larvae on *Spartina cynosuroides*, and some nibbling, but no larvae, on *Zizania aquatica* and *Schoenoplectus acutus*.

In addition, we carried out an open-field oviposition test in two common gardens in Delémont with native North American, introduced and European reed. Females of *A. geminipuncta* were marked with different colours of fluorescent powder and released in or between four plots of potted reed. Eggs were only found on European and introduced reed and could be assigned to individual females due to the residues of fluorescent powder found on leaf sheaths. However, only four eggs clusters with a total of 42 eggs were found. If we carry out additional tests in the future we will therefore try to release more females in order to obtain more reliable results with higher egg numbers.

P. Häfliger (p.haefliger@cabi.org) and **R. Batallas**. Funded by: Army Corporation of Engineers through Cornell University, USA.

Ronald Batallas releasing *Archanara geminipuncta* moths in an open-field oviposition test (photo: P. Häfliger)

searching for specific pathogens to control Canada thistle, *Cirsium arvense*, in the USA

Cirsium arvense, Canada thistle, is among the most important invasive plants in the world. To date, five biological control agents have been released against this weed in North America and several other natural enemies have been accidentally introduced. Thus far, however, none appears to have been able to halt the spread or reduce the impact of Canada thistle. Coevolved fungal pathogens can be more host specific than insects at the plant species level. Since host specificity is the main hurdle to introducing additional potential agents of *C. arvense* into North America, we are now focusing on the potential of pathogens.

We selected China as a survey area because a large number of *Cirsium* species are recorded from there, and some areas show a good eco-climatic match with infested areas in North America. Because CABI's fungal expertise lies with our staff in the UK, Drs Harry Evans and Carol Ellison are leading this project in cooperation with Drs Li Hongmei and Zhang Feng at the MoA–CABI Joint Laboratory for Bio-safety (hosted by IPP-CAAS) in Beijing.

A number of different pathogens were collected on *C. arvense* during the surveys in previous years, including the systemic rust *Puccinia* cf. *punctiformis*, the white blister 'rust' *Pustula* (*Albugo*) *tragopogonis*, and a number of leaf-attacking fungal pathogens: powdery mildews (probably two species), *Septoria* cf. *cirsii*, *Phoma* cf. *cirsii* and *Alternaria* sp. The white blister 'rust' *Pustula tragopogonis* was identified as the most promising pathogen. Varieties and physiological races of this fungus have been reported in the literature and field observations suggest that it could be highly specific and damaging to *C. arvense*.

From early August to mid-October 2011, six field surveys were conducted at five selected sites in Xinjiang and Gansu provinces in north-western China. Samples of the white blister 'rust' were collected and taken back to the laboratory in Beijing for study. Unfortunately, *P. tragopogonis* is proving to be a very difficult pathogen to work with and consequently Harry Evans visited China in October 2011 to provide technical training.

Studies are now ongoing to determine the conditions for successful germination of the spores (sporangia and oospores). Wan Huanhuan will be visiting the UK and Switzerland in April/May 2012 for training and will investigate germination of *Pustula* species, under the guidance of CABI pathologists.

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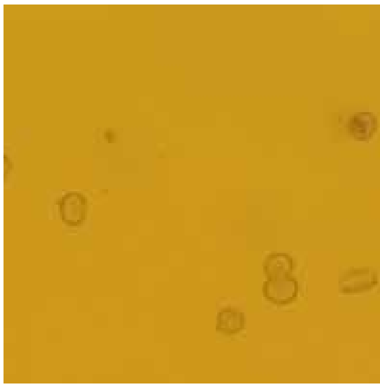
Making field collections of white blister 'rust' in Xinjiang Province (photo: Wan H.)

Pustules of the white blister 'rust' on a *Cirsium arvense* leaf (August 2011, Xinjiang Province) (photo: Wan H.)



Zoospores of the white blister 'rust' (photo: Wan H.)

Germination experiment
(photo: A. Gassmann)

Trichochermes walkeri adult
(photo: A. Gassmann)

controlling European buckthorn, *Rhamnus cathartica*, in the USA

Rhamnus cathartica is a shrub or small tree native to Europe and western Asia that has successfully invaded many habitats in North America, causing significant economic and environmental damage. In 2001, a biological control project was started by Dr Luke Skinner (Minnesota Department of Natural Resources, USA).

Work in 2011 focused mostly on the detection and characterization of a phytoplasma from *Rhamnus* and a psyllid that feeds on it, *Trichochermes walkeri*, and a study of plant–soil interactions using soil collected from two buckthorn sites in Switzerland.

In Europe, *R. cathartica* trees were found to be infected with '*Candidatus* Phytoplasma rhamni' ('Ca. Phytoplasma rhamni') at almost all surveyed localities, while it was not detected in three other *Rhamnus* species analysed. This suggests a very specific host association between this phytoplasma and *R. cathartica*, and also a very specific relationship between the insect vector of the pathogen and its host plant. 'Candidatus Phytoplasma rhamni' was not detected in 75 *R. cathartica* populations from North America suggesting either that the phytoplasma has not been introduced in the exotic range of its host plant, or that the absence of a suitable vector for phytoplasma propagation constrained its establishment in North America.

Trichochermes walkeri proved to be infected with '*Ca. Phytoplasma* rhamni' at a very high rate in almost all sampled localities. However, *T. walkeri* infection with phytoplasma only shows that this psyllid is acquiring the phytoplasma during feeding on infected plants, but not that it is capable of re-injecting the phytoplasma during feeding. The latter will be tested in transmission trials we started in 2011 and will complete in 2012. The presence of phytoplasma in two other psyllids that feed on *R. cathartica*, *Cacopsylla rhamnicola* and *Trioza rhamni*, is re-inforcing the need for elucidating the potential role of the psyllids in phytoplasma infection of *R. cathartica*.

We found no evidence for negative plant–soil feedback by mature *R. cathartica* on conspecifics to explain the low seedling numbers of *R. cathartica* in the native range. There was however a positive plant–soil interaction in terms of the rate of seedling emergence. A small difference in the number of days to seedling emergence probably explains most of the variation observed in seedling growth.

The currrent project phase ends on 30 June 2012. Pending completion of the transmission trials for *Ca*. Phytoplasma rhamni' with *Trichochermes walkeri*, *C. rhamnicolla* and *Trioza rhamni*, we recommend surveying in Europe for pathogens associated with *R. cathartica*. Based on literature records and herbarium records, at least three fungal pathogens found associated with *R. cathartica* have potential as classical biological control agents.

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Maja Penić and Meaghan Bennett collecting soil at a buckthorn site in Switzerland (photo: A. Gassmann)

tackling common tansy, *Tanacetum vulgare*, in North America

Common tansy, *Tanacetum vulgare*, is a Eurasian perennial plant, which was introduced to North America for medicinal purposes in the 17th century. To date, it is a declared noxious weed in five US states and three Canadian provinces. A biological control project was started in 2006. Work in 2011 concentrated on four potential agents: the root-feeding flea beetle *Longitarsus* sp., the stem-boring weevil *Microplontus millefolii*, the leaf-feeding beetle *Cassida stigmatica* and the flower-feeding moth *Isophrictis striatella*.

Molecular characterization indicates that all specimens of *Longitarsus* collected from *T. vulgare* in Russia and Ukraine belong to one species, *Longitarsus* sp. Sequences related to this species were not present in either the NCBI (National Center for Biotechnology Information) database or in BOLD (Barcode of Life Database). All specimens collected in Poland were identified as *L. noricus* and *L. succineus*. The larval host range of *Longitarsus* sp. appears to be quite broad. In larval transfer tests adults emerged from nine species in the tribe Anthemideae, three of which are native to North America. Our data supplemented with literature records for *L. succineus* suggest that all *Longitarsus* species that have been collected or reared from *T. vulgaris* are oligophagous in the Anthemideae. Therefore, *Longitarsus* sp. has been discarded as a potential biological control agent for *T. vulgare*.

Host-range testing with *M. millefolii* was further improved in 2011. Preliminary results indicate a narrow host range for this species. The native North American *Tanacetum camphoratum* appears to be a less well-accepted host for oviposition and also a less suitable host for larval development compared to *T. vulgare*.

So far, larval development of *C. stigmatica* has been recorded on the native North American species in the *Tanacetum huronense* – *T. camphoratum* complex, as well as on *T. parthenium* and *T. balsamita*. Little and inconsistent larval development was recorded on *Chamaemelum nobile* and one North American population of *Achillea millefolium*. All species suitable for larval development were accepted for oviposition in choice conditions.

Finally, the native North American *Achillea alpina* was found to be a suitable host plant for oviposition and larval development by *I. striatella*.

In 2012, we will focus work on host-range and biological studies with *M. millefolii.* An open-field test will be carried out in Russia with *M. millefolii* and *Cassida stigmatica*. Some additional studies are also planned with *I. striatella* from France. Since work with *Longitarsus* sp. has been discontinued, initial surveys will be carried out for the shoot tip-boring moth *Platyptilia ochrodactyla*.

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Meaghan Bennett (photo: A. Gassmann)

No-choice oviposition tests with *Microplontus millefolii* (photo: A. Gassmann)

Vera Wolf collecting *Tanacetum vulgare* shoots in Poland (photo: A. Gassmann)

Seeds of *Vincetoxicum hirundinaria* are consumed by *Euphranta connexa* larvae (photo: A. Leroux)

Exit hole of a *Euphranta connexa* larva on *Vincetoxicum hirundinaria* (photo: A. Leroux)

biological control of swallow-worts, *Vincetoxicum* spp.

Two European species of swallow-worts, *Vincetoxicum nigrum* (black swallow-wort) and *V. rossicum* (pale swallow-wort) were introduced into eastern North America around 1850 as ornamental vines and have since become naturalized in north-eastern North America. Both species are considered invaders of natural areas and abandoned pastures.

Since 2006, five potential insect biological control agents have been investigated, i.e. the leaf-feeding noctuids *Abrostola asclepiadis* and *Hypena opulenta*, the leaf-feeding chrysomelid *Chrysolina aurichalcea asclepiadis*, the root-feeding chrysomelid *Eumolpus asclepiadeus* and the seed-feeding tephritid *Euphranta connexa*.

Work in previous years at the University of Rhode Island, USA, has shown that *Eumolpus asclepiadeus* can complete larval development on the following North American non-target plants: *Asclepias fascicularis*, *A. incarnata*, *A. speciosa* and *A. tuberosa*. Results in 2010 and 2011 have confirmed that *A. incarnata*, *A. tuberosa* and another North American non-target plant, *A. syriaca*, are suitable hosts for larval development of *E. asclepiadeus*. Very occasionally larval development may also occur on two other North American plants, i.e. *Apocynum cannabinum* and *Cephalanthus occidentalis*. Females of *E. asclepiadeus* will occasionally oviposit in the vicinity of non-target plants even in the presence of *Vincetoxicum* resulting in occasional larval development on some non-target plants in the genus *Asclepias*. Although only a little adult feeding occurred on potted *Asclepias* spp. in choice or no-choice tests, naïve females of *E. asclepiadeus* were able to produce fertile eggs on *A. tuberosa* and to a lesser extent on *A. incarnata*. Adult *E. asclepiadeus* will feed and reproduce when provided with excised leaves of some non-target species.

Alicia Leroux from the University of Manitoba, Winnipeg, in Canada started her Master's research on the biology of *Euphranta connexa*. Post-diapause development time to adult emergence decreased linearly as the temperature increased from 15°C to 25°C. There was no emergence at 10°C, 30°C and 35°C. The dissection of one- to 20-day-old females showed that maturation of the first ovariole cycle takes about ten days. A study of the impact of the host *Vincetoxicum* species on the fecundity of *E. connexa* was set up in 2011. The fecundity of females emerging from larvae reared on different *Vincetoxicum* species will be assessed in 2012.

In 2012, work will focus on monitoring the emergence of *Eumolpus asclepiadeus* and on maintaining a colony of the beetle population from Ukraine. Studies on the biology of *Euphranta connexa* will be continued and methods will be developed for testing this candidate agent.

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Meaghan Bennett counting the number of flowers on *Vincetoxicum hirundinaria* (photo: A. Leroux)

stemming the spread of Russian olive, *Elaeagnus angustifolia*

Until the 1980s, Russian olive, *Elaeagnus angustifolia*, had been widely planted in North America for erosion control and reclamation purposes, as a shade tree and as a nectar source for honey bees. However, it has become an aggressive invader of riparian habitats where it displaces native vegetation and closes open areas. In 2007, an initiative was launched to study the potential for classical biological control of Russian olive. To avoid potential conflicts of interest, we are concentrating on biological control agents that attack Russian olive's reproductive capacity or seedlings so as to slow its spread without harming established trees.

In 2011, CABI and BBCA (Rome, Italy) continued with field studies in the native range of Russian olive. No-choice tests were continued with the shoot tip-attacking eriophyoid mite *Aceria angustifoliae* on 16 test plant species in CABI's quarantine facilities in Switzerland, including representatives of the North American genus *Shepherdia*. Mites were found on 50% of the control plants but none of the test plants. In collaboration with colleagues from Mashhad University, Iran, we also continued with open-field tests. After two field seasons, all except one Russian olive tree showed clear signs of mite attack. In contrast, none of the test plants were attacked.

In Mashhad, we started with an impact experiment using twenty 2- to 3-m-tall Russian olive trees. First signs of successful mite transfer have been observed, but mite populations need to build up more before impact can be measured. We also continued with comparative studies on the fruit set of mite-infested and healthy Russian olive trees in Turkey. In 2011, segments of branches that were infested by the mite did not produce any mature fruits.

In August 2011, field studies were initiated to assess the host range of the moth *Ananarsia eleagnella* under natural conditions. Together with a colleague from the University of Samarkant, Uzbekistan, we collected fruits of Russian olive and test plants, and any Lepidopteran larvae found in them were reared to adulthood. Attempts to rear the moth for release onto fruit-bearing branches of test and control trees failed, thus experimental releases had to be postponed until 2012.

In 2012, we will continue host-specificity and impact studies with *Aceria angustifoliae* and *Anacarsia eleagnella*. Depending on funding, we may also extend our surveys into China. In addition, together with colleagues from USDA-ARS Sidney, Montana, and other research institutions, we will organize a stakeholder meeting to present and discuss the current evidence for the economic and ecological impact of Russian olive in North America, and stakeholders' perceptions of the use of biological control agents to reduce seed production without killing established trees.

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Russian olive fruits infested by the moth *Ananarsia eleagnella* (photo: T. Rajabov, University of Samarkant)

Artificial inoculation of potted control and test plants with the mite *Aceria angustifoliae* under quarantine conditions: infested leaves were individually pinned to shoots of potted plants (photo: U. Schaffner)

Dr G. Asadi examining a Russian olive tree experimentally inoculated with the mite *Aceria angustifoliae* to assess its impact on fruit production (photo: U. Schaffner)

Larva of the root-mining tortricid moth *Dichrorampha aeratana* (photo: S. Stutz)

Adult of the root-feeding weevil *Cyphocleonus trisulcatus* (photo: S. Stutz)

prospects for the biological control of oxeye daisy, *Leucanthemum vulgare*

Oxeye daisy, *Leucanthemum vulgare*, a perennial herb of European origin, has naturalized throughout most of temperate North America, where it is now a regulated noxious weed in nine US states and four Canadian provinces. In 2008, CABI started to explore the prospects for biological control of oxeye daisy.

In 2011, no-choice larval development tests were established with the root-mining tortricid moth *Dichrorampha aeratana* using 29 test plant species and varieties. Most of the test plant species did not show any signs of larval attack. Larvae were found in the control and in all four Shasta daisy varieties which are in the genus *Leucanthemum* and cultivated as ornamentals. Whether attack on three additional test plant species was by *D. aeratana* or another contaminating *Dichrorampha* species remains to be verified.

In addition, a new impact experiment was established with *D. aeratana*. Fifteen larvae were transferred onto each of 40 oxeye daisy plants, while another set of 40 plants was not infested as a control. Half of the infested and control plants will be dissected in 2012 to assess impact after one year, while the other half of the infested plants will be re-infested to assess accumulated impact after two years.

We were able to establish small rearing colonies of the flowerhead-mining fly *Tephritis neesii* and a root-mining weevil, *Apion* sp. Another potential biological control candidate and root-feeding weevil, *Cyphocleonus trisulcatus*, appears to be very rare. Two sites with the most recent records in southern Germany were visited three times and we were able to collect a few larvae on one of the sites. Unfortunately, only one adult weevil emerged.

To clarify the taxonomy of invasive oxeye daisies, seeds and DNA samples from about 50 oxeye daisy populations in North America and about 80 populations in Europe have been collected. Ploidy analyses, which were conducted in collaboration with Prof. Heinz Müller-Schärer, University of Fribourg, Switzerland, revealed that invasive oxeye daisies are mainly represented by the diploid *L. vulgare*, whereas a tetraploid species, *L. ircutianum*, seems to be much less abundant. In collaboration with Dr John Gaskin, USDA-ARS Sidney, Montana, we continued to conduct molecular analyses in order to identify genetic variation in oxeye daisy in the native and introduced ranges and to elucidate its relationship with Shasta daisy.

In 2012, we will continue with studies on the host range and impact of *D. aeratana*, continue to rear *T. neesii* and *Apion* sp. and potentially conduct first host-specificity tests with them. We will also collect additional larvae or adults of *C. trisulcatus*, and finally try to establish a rearing colony of a second *Dichrorampha* species.

S. Stutz, **A. Tateno**, **H.L. Hinz** and **U. Schaffner** (u.schaffner@cabi.org). Funded by: British Columbia Ministry of Forests, Lands and Natural Resource Operations, Canada; Montana Weed Trust Fund, through Montana State University, and USDA Forest Service, USA.

Amber Tateno sweeping an oxeye daisy field site for herbivores (photo: S. Stutz)

revisiting biological control of field bindweed, *Convolvulus arvensis*

Field bindweed, *Convolvulus arvensis*, is a perennial vine of Eurasian origin that has been introduced into North America and Australia. In the 1970s, USDA initiated a programme for the biological control of field bindweed. Two biological control agents were released, the gall mite *Aceria malherbae* and the bindweed moth *Tyta luctuosa*. The gall mite became established but impact under field conditions varies, whereas establishment of the bindweed moth could not be confirmed. Therefore, the project is being revisited and investigations on three additional potential biological control agents started in 2009, i.e. the stem-mining agromyzid fly *Melanagromyza albocilia* and the root-mining flea beetles *Longitarsus pellucidus* and *L. rubiginosus*.

Melanagromyza albocilia has 2–3 generations per year. Attack rates on plants collected in the field in 2011 ranged between 18% and 27%, but only 11.5% of the plants contained viable pupae or larvae. Only about 10% of flies emerged from overwintered pupae in 2011 and the mean parasitism rate for 2009–11 was 67%. The relatively low attack rates in the field, combined with low adult emergence and high parasitism rates, demand sustained efforts in mass collection.

Attack by the agromyzid fly proved difficult to achieve in captivity. Several different methods were therefore tried in 2011. We observed greater fly activity in larger containers, and the addition of honey as a food source appeared to trigger mating and oviposition. Behavioural observations and oviposition tests were conducted on cut plant parts and potted plants. Preliminary no-choice and single-choice feeding and oviposition tests were conducted, which yielded valid results. One larva and two pupae were found in plants exposed to mated pairs, which is an encouraging first step towards establishing a rearing colony and conducting development tests in 2012.

In no-choice larval transfer tests established in 2010 and 2011 with *L. pellucidus* on 21 plant species (15 native to North America), adults developed on six test species (all native to North America). In a multiple-choice cage test exposing *C. arvensis* of various European and North American origins, the native North American *Convolvulus equitans* and four species of the closely related genus *Calystegia*, all plant species were attacked. An open-field test was established with the same plant species to determine if this result was a consequence of our test design. A site was chosen where both *L. pellucidus* and *L. rubiginosus* occur. Adults are expected to emerge in summer 2012 and the results will determine if we can continue to consider these two flea beetles as potential agents for biological control of field bindweed.

In 2012, we will continue improving methods for rearing and host-range testing of *M. albocilia* and conduct no-choice and single-choice feeding, oviposition, and development tests on critical North American test plants.

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Funded by: USDA-APHIS-CPHST, USA.

Longitarsus pellucidus (photo: G. Cortat)

Female of *Melanagromyza albocilia* (photo: G. Cortat)

Alicia Thuis collecting *Longitarsus* spp. on field bindweed in southern Germany (photo: G. Cortat)

Janetiella potentillogemmae larvae (photo: G. Cortat)

Janetiella potentillogemmae gall on *Potentilla recta* from Turkey (photo: G. Cortat)

biological control of sulphur cinquefoil, *Potentilla recta*

Sulphur cinquefoil, *Potentilla recta*, is a long-lived perennial native to Eurasia which was introduced into North America over a hundred years ago. It has invaded disturbed habitats, e.g. roadsides and pastureland, but also semi-natural habitats such as open forests. There is concern that *P. recta* may become a vector for pests of economically important plant species. A biological control project that had started in 1992 came to a premature end in 2002 owing to both the uncertainty of finding a host-specific candidate biological control agent and the funding situation. Following an expression of interest by British Columbia, Canada, a project for the biological control of sulphur cinquefoil was revived and in early 2008, a report summarizing data from previous research was prepared. Shortly before the project was halted in 2002, preliminary work had been conducted for three prioritized potential agents, i.e. two cynipid gall wasps, *Diastrophus* sp. near *mayri* from Turkey and *D. mayri* from Ukraine, and *Janetiella potentillogemmae*, a gall midge species from Turkey, which was recently described by Dr Marcela Skuhravá (Czech Republic). Work on these three species was restarted in 2008.

After several attempts to obtain galls in tests conducted in 2008 and 2009 with *Diastrophus mayri* from Ukraine, no galls were induced on *P. recta* and work was discontinued. Preliminary studies with *Diastrophus* sp. near mayri from Turkey conducted in 2000 revealed that the wasp could induce galls on *Potentilla gracilis*, *P. nivea* and *P. norvegica* under no-choice conditions. In an open-field test in Turkey, galls were only produced on the native North American *P. gracilis* and the wild *P. recta*, while potted *P. recta* did not develop galls. Since gall induction by *Diastrophus* has proven difficult to achieve, different methods were used in 2011 for the population from Turkey. Eggs were found on the North American natives *P. argentea*, *P. detomasii*, *P. taurica* and *P. sterilis*, and one gall was initiated on a *P. recta* plant. Although we made some progress with *Diastrophus* sp. near *mayri* in 2011, it remains extremely difficult to obtain conclusive host-specificity results and we therefore recommend discontinuing work with this species.

In 2008, few adults of *J. potentillogemmae* emerged and rearing was unsuccessful. Further field collections in Turkey were delayed until summer 2011, when over 200 galls were brought back to Delémont. Galls brought back on rooted plants were potted and are being kept in either an unheated glasshouse or a garden bed, while galls on cut shoots were placed in plastic containers with vermiculite and kept in a wooden shelter for overwintering. Adults emerging in 2012 will be used for host-specificity tests on a selected number of critical native North American *Potentilla* spp. and to establish a rearing colony.

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Ghislaine Cortat collecting galls of *Janetiella potentillogemmae* in Turkey (photo: H.L. Hinz)

introduction

The Arthropod Biological Control programme is led by Drs Ulli Kuhlmann and Tim Haye with additional CABI scientists based at CABI joint laboratories in Hungary (Dr Stefan Toepfer) and China (Drs Li Hongmei and Zhang Feng). In 2011, our team was joined by seven students from Canada and one from Albania who carried out research focused on the biological control of insect pests in Canadian canola (*Brassica napus* and *B. rapa*), such as cabbage seedpod weevil (*Ceutorhynchus obstrictus*), root maggot (*Delia radicum*) and swede midge (*Contarinia nasturtii*), and on finding new management solutions for controlling the western corn rootworm (*Diabrotica virgifera virgifera*) in Germany. Visiting scientist Dr Owen Olfert (AAFC, Saskatoon) joined our team from January to September to develop a bioclimatic model predicting the potential range and relative abundance of the biological control agent *Peristenus digoneutis* and its hosts *Lygus* spp. based on European data.

Our team researches natural enemies, such as insect parasitoids and predators, and their suitability as potential biological control agents of insect pests. Our expertise spans the exploration/search for natural enemies of designated target insect pests, as well as the characterization of their identity, life history parameters, ecology, behaviour and impact. We have significant experience in conducting field and laboratory studies to assess the effects of exotic biological control agents on non-target native species and also offer this service to biological control SMEs (small and medium-sized enterprises). We work in partnership with a wide range of organizations and have particularly close links with AAFC and Canadian universities.

The field season 2011 was highly productive. MSc student Paul Abram (Carleton University, Canada) finished his second field season investigating the potential for biological control of swede midge and will defend his thesis in January 2012. PhD student Lars Andreassen (University of Manitoba, Canada) finalized his research on biological control of *Delia* root maggots and his thesis defence will be in June 2012. In August, Mike Wogin successfully defended his MSc thesis entitled ‘Competition between parasitoids of the cabbage seedpod weevil: effects on sex ratios and consequences for biological control’ at the Simon Fraser University, Burnaby, Canada. For the cabbage seedpod weevil project, 2011 was one of the best years in a long time! Weevil and parasitoid densities in the home range were higher than ever before, which allowed us to complete host-range testing in Europe and ship parasitoids for additional tests to Canada for the first time.

As an outcome of our biological control research projects in 2011, several research manuscripts have been published jointly with our international partners in peer-reviewed international journals, including *Evolutionary Applications*, *Canadian Entomologist*, *Journal of Pest Science* and *Acta Phytopathologica et Entomologica Hungarica*. Since Paul Abram and Lars Andreassen will finish their degrees next year, more papers will follow in 2012. Furthermore, our research was presented at international meetings, such as the Joint Meeting of the Entomological Society of Canada and Acadian Entomological Society in Halifax, Canada, the 24th IWGO Conference and 3rd International Conference of *Diabrotica* Genetics in Freiburg, Germany, and the Austrian Working Group on Integrated Plant Protection in Ossiach, Austria.

Ulli Kuhlmann, Head of Arthropod Biological Control (u.kuhlmann@cabi.org)

Arthropod Biological Control team, 2011. Back row: Llewellyn Haines, Owen Olfert, Roberto Duarte, Tim Haye, Paul Abram, Dan Peach, Ulli Kuhlmann; front row: Lars Andreassen, Philip Hoffman, Lazjon Petri (missing: Danielle Fife) (photo: T. Haye)

Cabbage seedpod weevil, *Ceutorhynchus obstrictus* (photo: T. Haye)

Trichomalus perfectus, a parasitoid of the cabbage seedpod weevil (photo: T. Haye)

biological control of the cabbage seedpod weevil, *Ceutorhynchus obstrictus*

The cabbage seedpod weevil, *Ceutorhynchus obstrictus*, an invasive alien species of European origin, is an important pest of canola (*Brassica napus* and *B. rapa*) in North America. Accidentally introduced from Europe, the weevil was first discovered in British Columbia, Canada, about 80 years ago, and has since spread to other parts of western and eastern North America. Since its arrival in Canada, the weevil has caused substantial economic losses in canola crops in the prairie provinces of Saskatchewan and southern Alberta. Recent estimates suggest that the weevil costs the Canadian canola industry approximately CAN$5 million in losses annually. Significant damage to canola is caused mainly by the larvae, each consuming about five to six seeds and reducing yield of the pod by about 18%. To date the dominant management strategy for the cabbage seedpod weevil is the application of foliar insecticides. As the future availability of insecticides is uncertain and global warming may allow the weevil to establish in more northern canola-growing regions of Canada, there is a critical need for new control strategies.

In Europe, natural enemies provide control of the weevil, but the most important of these, the larval pteromalid ectoparasitoid *Trichomalus perfectus*, is absent in western Canada. This European parasitoid is considered to have great potential for incorporation into an IPM system for cabbage seedpod weevil in Canada. However, many weevils in the subfamily Ceutorhynchinae are already used as beneficial insects in weed biological control programmes in North America. Prior to importation of *T. perfectus* its host specificity has to be determined in its native cultivated and non-cultivated habitats to assess potential non-target risks, highlighting the potential conflicts with weed biological control programmes.

In laboratory host-specificity tests between 2008 and 2011, *T. perfectus* successfully developed on larvae of five non-target species, including the seed feeders *Ceutorhynchus constrictus*, *C. turbatus* and *C. typhae*, the gall-forming weevil *C. cadariae*, and the stem feeder *C. pallidactylus*. Ecological host-range studies in Europe confirmed the broad fundamental host range of *T. perfectus*. Apart from the main host, *C. obstrictus*, the ecological host range of *T. perfectus* in Europe comprises several other species, including *C. alliariae*, *C. roberti* and *C. constrictus* on garlic mustard, *C. erysimi* and *C. typhae* on shepherd's purse, and *C. cadariae* on hoary cress.

In 2012, host-range tests will be finalized. Furthermore, we are planning to map the distribution of T. perfectus in Europe and to investigate its temperature tolerance.

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Llewellyn Haines and Dan Peach sweeping for cabbage seedpod weevil parasitoids in a Swiss canola field (photo: T. Haye)

biological control of the swede midge, *Contarinia nasturtii*

The swede midge, *Contarinia nasturtii*
(photo: T. Haye)

The swede midge, *Contarinia nasturtii*, is an invasive pest of crucifer crops in North America. The midge is native to Europe and south-west Asia, where it is occasionally a serious pest of economically important crops such as broccoli, cabbage, cauliflower, kohlrabi, kale and Brussels sprout. Feeding by the midge larvae in the central growing tip of their host plant causes distortion and twisting of heart leaves, corky scarring and bacterial rot, thereby preventing proper inflorescence development and resulting in reduced marketability or, in severe cases, complete crop loss. Since its first official detection in Ontario, Canada, in 2000, surveys have confirmed the presence of swede midge in Québec, Nova Scotia, Manitoba and Saskatchewan and in the north-eastern USA.

Not long after its initial detection, the swede midge was causing up to 85% loss of broccoli crops southern Ontario. In subsequent years, the presence of the midge in some areas forced the abandonment of previously developed IPM programmes in favour of regular spraying schedules. There is concern that, if the swede midge becomes widespread in western Canada, it could become a pest of spring-planted canola (*Brassica napus* and *B. rapa*), an extremely valuable and widely cultivated crop.

Synopeas myles, a parasitoid of the swede midge (photo: P. Abram)

Surveys for natural enemies of the swede midge in Canada showed that indigenous natural enemies have only a little impact on the pest. Extensive surveys to identify potential classical biological control agents for introduction into North America were carried out in ten European countries between 2008 and 2011. Four species of larval endoparasitoids attacking the swede midge were identified: *Inostemma opacum*, *Macroglenes chalybeus*, *Synopeas myles* and *S. osaces*. Of these, *M. chalybeus* and *S. myles* were found throughout the surveyed range, and attacked every generation of the swede midge. Levels of attack, although sometimes 30–40%, were typically less than 10% and many generations of the swede midge were subject to very low levels of parasitism.

In 2011, additional collections were made from cultivated spring-planted canola and volunteer canola in southern Sweden and Denmark. As elsewhere in Europe, only *S. myles* and *M. chalybeus* emerged from the Swedish and Danish collections. Total parasitism rates were generally low, between 0% and 7.69%. Since swede midge could become a threat to Canadian canola production, we continued field experiments started in 2010 to investigate the susceptibility of different stages of summer canola to swede midge attack, the reliability of pheromone trap counts in predicting subsequent damage to plants, and the seasonal occurrence of the parasitoids in relation to host plant stage.

In 2012, a life table study will be initiated to determine what mortality factors are limiting to swede midge populations in Europe.

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Paul Abram and Danielle Fife taking a sample of volunteer canola plants infested with swede midge (photo: T. Haye)

Delia radicum laying eggs (photo: T. Haye)

Tribliographa rapae parasitizing *Delia radicum* larvae (photo: T. Haye)

biological control of root maggot, *Delia radicum*, in Canadian canola

The cabbage maggot, *Delia radicum*, was introduced from Europe into eastern North America in the 19th century and became a significant pest of canola (*Brassica napus* and *B. rapa*) in prairie Canada. Injury to canola is caused by *D. radicum* larvae feeding on and in roots of the host plant, disrupting the uptake of nutrients and water, resulting in fewer seeds per plant and reduced seed weight. As the area of canola across the Canadian prairie provinces of Alberta, Saskatchewan and Manitoba increased over the past 30 years, so did the levels of infestation by root maggots, and yield losses may increase further still as production continues to expand.

Since *D. radicum* is of European origin, the introduction of parasitoids from Europe to improve control has been suggested for integration with existing management strategies. The natural enemy under current consideration for introduction is a staphylinid beetle, *Aleochara bipustulata*, whose larva parasitizes *D. radicum* pupae and whose adult stage is believed to be an important predator of *D. radicum* eggs and larvae.

Research in 2011 focused on the role *A. bipustulata* may play in North American ecosystems if it is introduced as a classical biological control agent for *D. radicum.* A large-scale field cage experiment was set up to study the competitive interaction of *A. bipustulata*, *A. bilineata* and the larval parasitoid *Tribliographa rapae*. In addition, laboratory choice and no-choice tests were conducted to determine if *A. bipustulata* larvae would attack *Delia* puparia containing different developmental stages of *T. rapae*. Laboratory test results demonstrated that *A. bipustulata* larvae frequently attacked already parasitized puparia, but multi-parasitism usually resulted in the death of both parasitioids.

Since it is important to know from the perspective of pest control if a larger, more diverse, group of egg predators is likely to result in higher predation levels on Delia eggs, studies of egg consumption by *A. bipustulata*, *A. bilineata* and *Bembidion quadrimaculatum* and their inter- and intra-specific competition were started in 2010 and finalized in 2011. The analysis of results will be undertaken in 2012 and will help in evaluating if there is likely to be a benefit from introducing *A. bipustulata* to the existing egg predator community in Canada.

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Llewellyn Haines and Philip Hoffman setting up a field cage experiment for a parasitoid competition study (photo: T. Haye)

biological control product for western corn rootworm, *Diabrotica virgifera virgifera*, in Germany

The western corn rootworm, *Diabrotica virgifera virgifera*, is one of the most destructive pests of maize in North America. Over the last 20 years, it has moved into Europe causing major problems in maize.

During the last seven years, CABI, together with the University of Neuchâtel and the farmer association Landi REBA in Basel in Switzerland, the Plant Protection Directorate at Hodmezovasarhely in Hungary, Agroscope Reckenholz-Tänikon (ART) in Switzerland, and the nematode producer e-nema at Schwentinenthal in Germany, have developed a nematode-based biological control product for western corn rootworm larvae under a project funded by the Swiss Commission for Technology and Innovation (CTI) of the Federal Office for Professional Education and Technology, Switzerland. At the end of the project, the product was in the pipeline for implementation at e-nema. However, the recent arrival of the invasion front of *D. v. virgifera* in southern Germany and the banning of several insecticide seed coatings due to bee toxicity have generated a strong growth in interest in the biological control product.

Consequently, the state of Baden-Württemberg in southern Germany decided to fund a two-year project to further develop and launch the nematode product. In 2010 and 2011, LTZ (Landwirtschaftliches Technologiezentrum) in Stuttgart, Germany, AGES (Austrian Agency for Health and Food Safety) in Vienna, and CABI tested several application techniques for the beneficial nematodes in maize fields in Germany, Austria and Hungary to improve existing application technologies, aiming for the farmer-friendliest and least-costly method. Fluid and granular applications as well as seed coating with nematodes appeared technically possible, and all achieved some control of the larvae of the western corn rootworm. Finally, the nematode producer e-nema launched the nematode product for *D. v. virgifera* larvae in Germany, and it is likely to be used in 2012 if the state of Baden-Württemberg subsidizes the use of biological control in maize production.

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The red colour of the dead larva of the maize pest *Diabrotica virgifera virgifera* originates from the symbiotic bacteria of the nematode that killed the larva (photo: S. Toepfer)

Stefan Toepfer, together with summer students Natalia Sahin and Rajmond Stuber (University of Szeged, Hungary) and PhD student Mario Schuman (University of Göttingen, Germany), after assessing root damage by rootworms and yield losses in biological control trials for western corn rootworm in southern Hungary (photo: F. Koncz)

Nematode-based product for *Diabrotica virgifera virgifera* larvae launched on the webpage of the e-nema biological control company in Germany, www.e-nema.de/maiswurzelbohrer.php

understanding the dispersal behaviour of the western corn rootworm, *Diabrotica virgifera virgifera*, to improve guidelines for crop rotation in Bavaria, Germany

Over the last 20 years, the North American maize beetle pest *Diabrotica virgifera virgifera*, or western corn rootworm, has moved into Europe causing problems in maize production. It recently arrived in southern Germany, which troubles local farmers as they have to implement the binding EC decisions on eradicating or containing the new invader (i.e. obligatory rotation and pesticide applications). The German state of Bavaria therefore decided to fund a four-year multi-institutional project (2008–12) to seek new solutions for this pest and improve pest management strategies. CABI is tasked with providing the scientific basis for improving advice and guidelines for crop rotation in Bavaria.

Most yield loss attributed to this univoltine pest is due to larval feeding on maize roots, which ultimately causes plant lodging. The larvae are largely restricted to maize. Consequently, crop rotation is a powerful control strategy. Rootworm beetles are, however, very mobile flyers and tend to visit any nearby flowering crop or weed vegetation to feed. As they may also lay eggs into the soil of these food habitats, crop rotation may become less effective when a non-maize crop is succeeded by maize the following year. CABI is therefore investigating the dispersal and oviposition behaviour of adult *D. v. virgifera* in non-maize crops typically grown in Bavaria. The field experiments are being conducted near the Joint Laboratory of CABI and the Plant Protection Directorate in Hodmezovasarhely in southern Hungary because this location provides a combination of high pest populations, good conditions for field trials, and good local expertise on this pest. Results suggest that, despite dispersal and oviposition of at least 12% of a *D. v. virgifera* population from maize into non-maize crops, economic thresholds are not likely to be quickly exceeded. The final outcome of the studies will help to develop recommendations for crop rotation guidelines and standards in Bavaria for on-farm implementation.

S. Toepfer, **T. Haye** and **U. Kuhlmann** (u.kuhlmann@cabi.org), in collaboration with **M. Zellner** and **A. Kunert** (Bavarian State Research Centre for Agriculture, Freising, Germany), and the Plant Protection Directorate in Hodmezovasarhely, Hungary. Funded by: the state of Bavaria, Germany.

Where is the beetle? The maize pest western corn rootworm increases its egg-laying capacity by feeding on non-maize crops, such as young sugar beet (photo: S. Toepfer)

The 2011 *Diabrotica* team in Hungary: Stefan Toepfer (CABI), Mark Szalai (University of Godollo, Hungary), Ferenc Koncz (Hodmezovasarhely, Hungary) (absent: Nikolin Karapançi, Agrinet, Albania) (photo: S. Toepfer)

Rajmond Stuber and Stefan Toepfer explain to entomologists from the Julius Kühn-Institut, Braunschweig, and Bavarian State Research Centre for Agriculture, Freising, Germany, how to mass collect adult western corn rootworms for experimental releases in crop rotation trials in southern Hungary (photo: N. Karapançi, Agrinet, Albania)

post-introduction evolution of the western corn rootworm, *Diabrotica virgifera virgifera*, in Europe

The chrysomelid beetle *Diabrotica virgifera virgifera*, or western corn rootworm, has become a serious pest of maize since it successfully invaded Europe. As *D. v. virgifera* has been introduced to Europe on several occasions, independent populations are known to exist there. Therefore, *D. v. virgifera* represents a good model organism for studying adaptations and characteristics associated with successful invasions. Studies on environmentally induced phenotypic differences among invading populations in Europe and non-invading populations in the area of origin may help us to understand the role of phenotypic plasticity and local adaptations in this successful invasion. Variability in phenotypic traits, such as body or elytra size, may be indicators of genetic diversity, which is likely to be lower for invading populations, owing to genetic bottlenecks, than for the source populations. It may also reflect genetic changes in the insect due to selection pressure from the new environment.

Within a four-year multi-institutional research project (2007–11), CABI was, in collaboration with INRA (Institut Scientifique de Recherche Agronomique) Sophia Antipolis, France, responsible for comparing invasive European strains with a potential source population. Furthermore, independent European strains of low genetic diversity were compared to a crossed strain obtained from two disparate but spreading European populations that have started to overlap in their distribution and therefore cross naturally; i.e. beetles from Italy and from central and south-eastern Europe.

In the last project year, 2011, CABI finalized the analyses of the large amount of fitness data gathered for the different *D. v. virgifera* strains during three years' experimentation with regard to traits related to potentially increasing problems with this invader in Europe.

S. Toepfer (s.toepfer@cabi.org), **Li H.M.** and **U. Kuhlmann**, in collaboration with **T. Guillemaud**, INRA Sophia Antipolis, France. Funded by: Agence Nationale de la Recherche (ANR), France (ANR-06-BDIV-008).

Li Hongmei assessing fecundity of different western corn rootworm populations in the CABI quarantine laboratory at Delémont (photo: P. Turko, University of Manitoba, Canada)

Diabrotica female beetle of a specific distinct population in a rearing cage in the CABI quarantine laboratory at Delémont (photo: S. Toepfer)

Summer student Rajmond Stuber rearing families of a *Diabrotica virgifera virgifera* population for analysis of heritability of phenotypic traits (photo: S. Toepfer)

Diabrotica larvae feeding and destroying maize roots (photo: A. Varga)

PhD student Mario Schumann from the University of Göttingen assessing effects of attract-and-kill methods against the larvae of *Diabrotica* in field trials in southern Hungary (photo: S. Toepfer)

enhancement of soil insecticides against *Diabrotica virgifera virgifera* larvae through CO_2 emitting capsules

The western corn rootworm, *Diabrotica virgifera virgifera*, is one of the major maize pests in the world. Its three larval instars feed nearly exclusively on maize roots leading to a reduction in uptake of water and nutrients by the maize plant and a subsequent reduction in yield. Serious larval infestations may also cause plant lodging and a further loss in yield because plants are not harvestable. Larvae hatch in spring from eggs laid in the soil and orient towards the maize roots following CO_2 gradients originating from the roots. Consequently, CO_2 might be used as an attractant in combination with soil insecticides.

In this one-year study in 2011, scientists from CABI and the universities of Bielefeld and Göttingen in Germany investigated the efficacy of CO_2 capsule–soil insecticide combinations against *D. v. virgifera* larvae under field conditions in two artificially infested maize fields in southern Hungary. Results showed that CO2 can slightly increase the efficacy of pesticides; however, further studies using lower insecticide rates are needed to clarify the full potential of the strategy. There is potential for a reduction from standard concentrations of pesticides when combined with attractants.

S. Toepfer (s.toepfer@cabi.org) and **U. Kuhlmann**, in collaboration with **M. Schumann** and **S. Vidal** (Georg-August-University, Göttingen) and **A. Patel** (University of Applied Sciences, Bielefeld) in Germany. Funded by: Syngenta Crop Protection AG Switzerland.

Attract-and-kill field-scale trials for the larvae of *Diabrotica* in southern Hungary (photo: S. Toepfer)

biological control of plant bugs in Chinese cotton

The mirid *Apolygus lucorum* is a widely distributed species throughout Eurasia. In China, *A. lucorum* is one of the most important pests in cotton and Chinese date (*Ziziphus jujuba*) orchards. At high population density, it is known to cause considerable yield loss.

Historically, the cotton bollworm, *Helicoverpa armigera*, has been the most important pest of cotton in China. *Apolygus lucorum* was often regarded as a secondary pest and usually controlled by insecticide sprays targeted at the cotton bollworm. Since 1997, however, Chinese farmers have been increasingly adopting *Bt* cotton to combat the cotton bollworm, with resulting reductions in the amount of insecticides used in cotton production. This lowered pesticide use has meant that, in recent years, *A. lucorum* has become the key insect pest of *Bt* cotton in China. Currently, insecticide use is the sole pest management option available for most Chinese cotton farmers. As irrational pesticide use may have undesirable effects, environmentally sound and sustainable management alternatives are urgently needed.

Surveys for parasitoids native to China which started in 2009 were continued in 2011. Two nymphal braconid parasitoids, *Peristenus relictus* and *P. spretus*, were identified as potential biological control agents. Research in 2011 was focused on the functional response of *P. spretus* to different densities of *A. lucorum*, its preference for different nymphal instars, and the influence of temperature on the parasitoid's development. The laboratory experiments demonstrated that *P. spretus* responds positively to high densities of *A. lucorum* and that it prefers the third instar of its host. Data on the parasitoid's development at different temperatures will help to predict how many generations of the parasitoid there might be in the cotton growing areas of Yellow River and Changjiang River in China.

The focus in 2012 will be on continuing investigations on the biology and ecology of *P. spretus*, e.g. host specificity, parasitoid fitness and impact of the parasitoid under field conditions.

Luo S.P., **Li H.M.**, **Pan P.J.**, **Wang H.X.**, **T. Haye**, **Zhang F.** and **U. Kuhlmann** (u.kuhlmann@cabi.org), in collaboration with **Prof. Wu K.M.** and **Lu Y.H.** (IPP–CAAS, Beijing), **Li Y.F.** (Hebei Academy of Agricultural and Forestry Sciences), **Feng H.Q.** and **Li G.P.** (Henan Academy of Agricultural Sciences), **Wang F.Y.** (Agricultural Technology Extension), **Ma G.M.** (Liaocheng University, Shandong), **Hu B.J.** (Anhui Academy of Agricultural Sciences), **Wan P.** (Hubei Academy of Agricultural Sciences) and **Xiao L.B.** (Jiangsu Academy of Agricultural Sciences) in China. Funded by: MoA, China.

Peristenus spretus, a parasitoid of Apolygus lucorum in China (photo: T. Haye and Luo S.P.)

Apolygus lucorum, a common pest on cotton in China (photo: T. Haye)

Luo Shuping dissecting a nymph of *Apolygus lucorum* at the MoA–CABI Joint Laboratory in Beijing (photo: Luo S.P.)

Xu Haiyun collecting box tree caterpillars (photo: T. Haye)

Box tree caterpillar, *Cydalima perspectalis* (photo: T. Haye)

impact and biological control of the box tree caterpillar, *Cydalima perspectalis*

The box tree caterpillar, *Cydalima perspectalis*, an invasive alien species of Asian origin, was first reported from south-western Germany in 2006, from where it quickly spread into Switzerland, the Netherlands, France, Austria and the UK. Larvae feed on leaves, shoots and bark of box trees (*Buxus* spp.) and severe infestations can lead to almost complete defoliation of the plants. Imported box trees are commonly planted in European gardens for ornamental purposes, but native box trees (*Buxus sempervirens*) also grow in forests as understorey shrubs. The introduction of *C. perspectalis* in Europe represents a severe threat to nurseries, parks and gardens, and natural *Buxus* stands. A project has been developed at the CABI centre in Switzerland to assess the current and potential ecological impact of the caterpillar and to evaluate the potential for biological control.

A long-term study in natural box tree stands in north-western Switzerland has been initiated to assess the impact of the insect on the plant and on plant communities in general. A climatic model, using the CLIMEX® software, is presently being built to map the risk posed by the caterpillar in Europe.

Since the moth was probably introduced from China, the Chinese literature was reviewed to identify potential natural enemies and to locate areas for collections. Field surveys for potential biological control agents were conducted in Shandong, Zhejiang and Fujian provinces from May to October. In total, more than 1000 caterpillars were collected, and only a single parasitic wasp (*Chelonus* sp.) was found. In addition, surveys for natural enemies were also conducted in Switzerland and Germany. Parasitism was generally very low and the only natural enemy found was the tachinid fly, *Pseudoperichaeta nigrolineata*, a widely spread generalist parasitoid.

The low parasitism in Switzerland and Germany suggest that so far native European parasitoids have not adopted the new host and thus, *C. perspectalis* is a good target for classical biological control.

In 2012, impact assessments will continue in Switzerland and new field surveys for parasitoids will be carried out in China and Switzerland. In addition, biological parameters such as diapause induction and the influence of temperature on the development of immature stages of the moth will be investigated and integrated in the climate model.

T. Haye (t.haye@cabi.org), **S. Nacambo**, **Xu H.**, **L. Haines**, **M. Kenis**, **Wan H.**, **Li H.M.**, **Feng Q.Q.**, **Xiao B.**, **Ming Z.Y.** and **Zhang F.**, in collaboration with **Li Z.H.** (Shandong Agricultural University, China). Funded by: CABI.

Tim Haye inspecting defoliated box trees in the natural reserve at Grenzach-Whylen in Germany, one of the few natural box tree forests in Europe (photo: T. Haye)

introduction

The year started with an important change in the Risk Analysis & Invasion Ecology section. Dr Christelle Péré, who joined the team in 2005 to study for an MSc and continued with a PhD which she defended in 2009, left us in March 2011 to return to France. I would like to take this opportunity to thank Christelle for her crucial and substantial contribution to the section and for having been such a cheerful colleague during these last six years. I wish her much success for her future career. She has been replaced by Dr René Eschen, who worked in the section for a short period in 2006 before a long exile in the UK. René is working largely on two projects, ISEFOR, a project funded by the EC Seventh Framework Programme (FP7), and a new EU COST Action, PERMIT, in which our research activities are funded by the Swiss State Secretariat for Education and Research. In these two projects, we are investigating the introduction of alien forest pests in Europe and, in particular, the trade in woody plants for planting, a major pathway of invasion for forest pests.

In 2011, our small team was also involved in three other European projects: PRATIQUE (Enhancement of Pest Risk Analysis TechnIQUEs), BACCARA (Biodiversity and Climate Change, A Risk Analysis) and JATROPHABILITY (Investigating impacts of *Jatropha curcas* production). PRATIQUE ended in June with a final workshop in York, UK. The project is considered very successful. It produced a new, computerized version of the PRA (pest risk analysis) decision support scheme of the European and Mediterranean Plant Protection Organization (EPPO) and various other risk assessment tools.

The year 2011 was also the last year of Angelos Katsanis' PhD. Angelos successfully defended his thesis on 'Multitrophic interactions between the invasive coccinellid, *Harmonia axyridis*, and non-target insects' in May. Congratulations Angelos! The thesis is a great contribution to the understanding of the mechanisms behind the negative effects of the invasive harlequin ladybird on native species. With Angelos' departure, our work on the harlequin ladybird will be reduced, but monitoring of the decline of native ladybird species will continue for at least three more years thanks to a new grant obtained from the Swiss Federal Office for the Environment (FOEN).

Finally, I would like to mention that we have hosted five students, including two Master's students in our laboratory this summer. Among these, Nadine Brinkmann, from the University of Freiburg (Germany), investigated the effect of altitude on larch herbivores within the framework of the BACCARA project; and Saidou Nacambo, from the University of Neuchâtel (Switzerland), worked on a newly invasive species, the box tree caterpillar *Cydalima perspectalis*, which we are presently studying in collaboration with the Arthropod Biological Control section. Both MSc theses will be defended in 2012.

Dr Marc Kenis, Head of Risk Analysis & Invasion Ecology (m.kenis@cabi.org)

Risk Analysis & Invasion Ecology team, 2011. Saidou Nacambo, Xu Haiyun, Nadine Brinkmann, Marc Kenis, Greg Tomlinson and Chloé Swart (missing: René Eschen and Christelle Péré) (photo: N. Brinkmann)

Galls of *Mikiola fagi* on beech – one of the insects sampled along altitudinal gradients in the Jura (photo: C. Péré)

Epirrita autumnata, a looper sampled on larch along altitudinal gradients in the Alps (photo: N. Brinkmann)

Biodiversity And Climate Change, A Risk Analysis: BACCARA

BACCARA is an Integrated Project of the EC RTD FP7, involving 15 European teams and one Chinese team. The main objective of this project, which started in January 2009 and will run until December 2012, is to develop tools to allow forest managers and policy makers to evaluate the risks to European forest biodiversity and productivity loss due to climate change. The concept is to construct a three-dimensional risk assessment model linking climate change, functional diversity and forest productivity.

Climate change is expected to have serious effects on forest biodiversity. In particular, it may affect insect pest populations directly, through temperature increase, CO_2 increase and/or changes in precipitation patterns, and indirectly through changes via host–plant interactions and modification of natural enemy complexes. In the BACCARA project, our team is participating in an assessment of the effect of climate change on forest pest populations and the subsequent impact on forest productivity and biodiversity, using functional groups (i.e. species sharing common life traits) and altitudinal gradients as analogues for global warming.

In 2011, with the help of five students including a Master's student from the University of Freiburg, Germany, we assessed whether temperature, simulated using an elevation gradient, alters abundance of, and damage by, herbivorous insects feeding on larch (*Larix decidua*), spruce (*Picea abies*) and beech (*Fagus sylvatica*) trees. We sampled shoots and seeds and counted insects on leaves and bark along four altitudinal gradients in the Swiss Alps and two in the Swiss Jura. The species studied so far show a lot of divergence in their responses, even within similar functional groups.

We carried out reviews and analyses on the potential effects of climate change on insect pests and their natural enemies, and knock-on effects on pest outbreaks. In particular, we performed a meta-analysis, using published and unpublished data, of the effect of altitude on parasitism rate and parasitoid richness. This analysis showed that parasitism decreases with altitude, suggesting that parasitism of insect pests may increase with global warming. We are now carrying out a similar meta-analysis to assess the effect of altitude on forest insects.

In BACCARA, CABI is also coordinating dissemination activities to fulfil the project's outreach function.

M. Kenis (m.kenis@cabi.org), **C. Péré**, **N. Brinkmann**, **G. Tomlinson**, **S. Nacambo**, **Xu H.** and **C. Swart**, in collaboration with many partners in the BACCARA project. Funded by: EC RTD FP7 (**www.baccara-project.eu/**).

Greg Tomlinson and Marc Kenis during a field trip in the Alps (photo: N. Brinkmann)

ecological impact of the harlequin ladybird, *Harmonia axyridis*, in Switzerland

Harmonia axyridis feeding on aphids (photo: N. Kirichenko, V.N. Sukachev Institute of Forest, Krasnoyarsk, Russia)

Harmonia axyridis, the harlequin ladybird, is a polyphagous predatory coccinellid, native to Asia. It has been widely released as a biological control agent of aphids in the field and in greenhouses in both North America and Europe. Since its accidental establishment in North America in the 1980s and in Europe in the late 1990s, it has spread and its populations have increased dramatically so that it is now the dominant ladybird species in much of North America and Europe. Significant negative effects from the establishment of *H. axyridis* have been reported. Owing to its predatory and competitive abilities, *H. axyridis* can have strong negative effects on biodiversity, impacting on many non-target species, including native ladybirds and other aphidophagous insects but also non-pest aphids and other herbivorous insects. It may also affect humans directly by invading buildings in huge numbers to seek overwintering sites. Moreover, in North America, *H. axyridis* has been reported to damage fruit crops in late summer and to taint wine when inadvertently harvested and crushed with grapes.

The main objective of our research programme on *H. axyridis* is to assess the impact of the invasive ladybird on native ladybirds and other non-target organisms. Two approaches are used. Firstly, a long-term experiment based on 45 permanent field sites located in three habitats (broadleaved and coniferous woodlands and meadows) was set up in 2006 to observe changes in populations of native ladybirds during and after the invasion of the Asian species. In 2011, *H. axyridis* accounted for about 70% of all ladybirds found on broadleaved trees. Some native ladybird species living specifically on broadleaved trees have been severely affected, in particular the 2-spot ladybird, *Adalia bipunctata*, which has rarely been found at our sites since 2010 although it used to be the dominant species in these habitats. The same signs of decline have been found throughout Europe. *Harmonia axyridis* is also becoming the dominant species on pine, causing concern for ladybird species living in this habitat.

Secondly, we are trying to assess the risk posed to native ladybirds and butterflies through laboratory and field cage experiments. These have been carried out as part of the PhD research by Angelos Katsanis, who successfully defended his thesis in May 2011. Competitive interactions between the invasive species and twelve native ladybird species have been studied. *Harmonia axyridis* is an intraguild predator for many but not all European ladybirds. Coccinellids are not equally susceptible to predation by *H. axyridis*, with eggs and larvae of some ladybirds appearing to be chemically or mechanically protected. In particular, we have investigated the egg surface chemicals of *Calvia quatuordecimguttata*, which play an important protection role against predation by *H. axyridis*. Laboratory tests also showed that eggs of several butterfly species are preyed on by *H. axyridis* larvae and adults, while other species seem to be protected by egg surface chemicals.

A. Katsanis, **D. Babendreier** and **M. Kenis** (m.kenis@cabi.org), in collaboration with **F. Bigler** and **A. Aebi**, (Agroscope Reckenholz-Tänikon [ART], Zurich, Switzerland), **M. Hilker** (University of Berlin, Germany) and **A. Magro** (University of Toulouse, France). Funded by: SNSF and FOEN. A. Katsanis has been a PhD student at the University of Fribourg, Switzerland, co-supervised by Prof. W. Nentwig.

Marc Kenis sampling ladybirds in a meadow (photo: M. Kenis)

Increasing Sustainability of European FORests: ISEFOR

The trade in plants for planting is recognized as a key pathway for the spread of invasive forest pests and diseases. These plants are introduced into the environment and thus provide the invaders with an ideal starting point for establishment, from where they can spread. Despite precautionary regulations and phytosanitary border inspections to prevent the introduction of potential invasive species, the number of exotic forest pests and diseases in Europe continues to rise.

A rise in trade volume is associated with an increase in the risk of introduction of new forest pests. The more than 100% increase in trade volume over the past 15 years and changes in the identity and origin of the traded plants are factors that affect the risk of new, unknown forest pests and diseases becoming established in Europe. In addition, climate change may affect trees and their susceptibility to pests and diseases. An analysis of the trade in plants for planting and quarantine inspection procedures in Europe and elsewhere can assist quarantine authorities in tackling the risks associated with alien pests and pathogens.

The ISEFOR project addresses the threat to European forests from the combined forces of climate change and large increases in the numbers of alien invasive pests and pathogens. This is being achieved by defining the threats to European forest ecosystems based on current knowledge of potentially invasive pests and diseases, the development of molecular techniques to identify potentially invasive organisms at the port of entry to the EU, and a critical analysis of the nursery trade in order to develop a quantitative approach to pest risk assessment.

The ISEFOR consortium comprises 17 partners from the EU and China and the research project is funded under the EC's FP7. CABI's input focuses on defining the threats of invasive species to European forests based on current knowledge of pests and their host plants and contributing to a critical assessment of the nursery trade and phytosanitary inspection procedures, mainly in Europe and China.

In 2011, we started, in collaboration with teams from various European countries, a detailed assessment of the trade in plants for planting and the inspection procedures for their import into the EU. In the remainder of the project we will analyse pest distribution data from CABI's Crop Protection Compendium and the Plantwise knowledge bank in order to identify threats from potential new invasive species from outside the EU. In addition, we will work with project partners on the development of a database of alien forest insects and pathogens that pose an immediate threat to European forest ecosystems, based on work in the previous EU-funded projects PRATIQUE, ALARM and DAISIE. We will also develop a new method to help assess the risk of live plant imports through the establishment of test nurseries in China. The short-term output of this project will be diagnostic tools for the plant health surveillance community.

M. Kenis (m.kenis@cabi.org), **R. Eschen**, **C. Péré**, **S. Nacambo** and **Li H.M.**, in collaboration with partners in the ISEFOR project. Funded by: EU RTD FP7 (**www.isefor.com**).

Participants at the ISEFOR meeting in St Petersburg, Russia, visiting the Arboretum
(photo: C. Jones, Aberdeen University, UK)

investigating impacts of *Jatropha curcas* production: JATROPHABILITY

Jatropha curcas is a member of the Euphorbiaceae, native to Central America, yet cultivated pantropically. Its seeds contain 27–40% oil which is suitable for biodiesel. The plant is presently promoted as a biofuel crop in several regions worldwide, in particular in the three project countries: India, Mali and Mexico. However, so far, little is known about basic agronomy and ecological impacts across different agro-ecoregions. JATROPHABILITY, funded by various donors under the ERA-ARD (European Research Area – Agricultural Research for Development) programme of the EC RTD Sixth Framework Programme (FP6), started in June 2009. It involves nine partner teams from India, Mali, Mexico, Belgium, Spain, Switzerland and the UK. The project aims to assess profitability, and economic, social and environmental impacts, of the cultivation of *J. curcas* as a bioenergy crop. With data obtained by the project partners, it aims to identify the most suitable ecoregions for maximizing yields, taking into account the different pest and disease pressures and economies of scale of production (smallholder versus large-scale plantings), and the extent of economic, social and environmental production risks. It aims to identify current shortfalls in land tenure systems or law and support governments to develop legislation to ensure social sustainability and equity of bioenergy projects. Studies on *J. curcas* started in Mexico (Chiapas and Veracruz states) and India (northern India and Orissa and Tamil Nadu states) but, since 2010, are also being carried out in southern and central Mali while activities in India have been reduced because of security issues in the areas of investigation. We work along rainfall gradients in three ecoregions in each country.

Aphthona spp., a major pest of *Jatropha curcas* in Mali (photo: M. Kenis)

Leptoglossus occidentalis feeding in *Jatropha curcas* fruits in Mexico (photo: T. Haye)

CABI scientists based in Switzerland and UK, in addition to coordinating the project, are mainly involved in the environmental impact assessments. In Mexico, we are working with collaborators from INIFAP (Instituto Nacional de Investigaciones Forestales y Agropecuarias) to assess yield constraints, and energy and carbon balances, in each of the identified sites and along rainfall gradients. We are also studying the effects of the plant on soil properties. Data collected in 2011 showed that yields are lower than expected but reasons are still unclear and probably multiple. We are also continuing our experimental work on pests and diseases. While damage by true bugs and rusts, the major pests and pathogens in previous years, was lower, new pests and diseases were identified and will deserve more attention in 2012.

In September 2011, the annual meeting took place in Bamako, Mali, and the first surveys for pests and diseases were carried out in the different ecoregions with local collaborators – in Mali these were the Foundation Mali Biocarburant and the NGO Mali-Folkecenter. The two major pest problems encountered in Mali are termites and flea beetles. Termites are regularly cited by Malian farmers as a major constraint to *J. curcas* cultivation, hampering seedling establishment but also killing larger trees. These attacks generally occur at the end of the dry season and beginning of the rainy season, and during our surveys few new attacks were observed. In September, by far the most obvious insect damage was caused by flea beetles of the genus *Aphthona*. These beetles are also recognized as major pests of *J. curcas* plantations in other African countries. Plants of all ages were affected and it was clear that the beetles affected tree growth, even killing young seedlings. Surveys for pests and diseases will continue in 2012.

M. Kenis (m.kenis@cabi.org), **L. Norgrove**, **T. Haye**, **D. Fife**, **C.A. Ellison**, **S. Thomas** and **S. Edgington**, in collaboration with partners from Mexico, India, Mali, Spain and Belgium.
Swiss staff participation is funded by SDC.

Danielle Fife measuring *Jatropha curcas* trees in Mexico (photo: T. Haye)

Marc Kenis inspecting a branch with insect damage in a Russian botanical garden (photo: N. Kirichenko, V.N. Sukachev Institute of Forest)

enhancement of Pest Risk Analysis TechniQUEs: PRATIQUE

PRATIQUE (March 2008 – June 2011) is an EC RTD FP7 research project designed to address the major challenges for PRA in Europe. It has three main objectives: (i) to assemble the data sets required to construct PRA valid for the whole of the EU, (ii) to conduct multi-disciplinary research that enhances the techniques used in PRA, and (iii) to provide a decision-support scheme for PRA that is efficient and user-friendly. The research is being undertaken by scientists from 13 institutes in the EU and one each from Australia and New Zealand with subcontractors from institutes in China and Russia.

The final workshop took place in York, UK, in June 2011. The project gave rise to a totally new, computerized version of the PRA decision support scheme of EPPO and various other risk assessment tools.

In this project, CABI led the first workpackage, aimed at identifying and integrating key national and international data sets necessary for performing PRA in Europe. With the help of all PRATIQUE partners, over 600 electronic data sets and information sources were collected and stored in a database that is now directly accessible from the computerized EPPO PRA scheme. In collaboration with teams in France (INRA, Orléans), Russia (V. N. Sukachev Institute of Forest, Krasnoyarsk) and China (Institute of Zoology, Chinese Academy of Sciences [CAS], Beijing), we developed a new method to assess the impact of alien pests on European woody plants before they are introduced into Europe by monitoring European sentinel woody plants growing in Russian arboreta and planted in China. CABI also had a leading role in the development of techniques for measuring and estimating environmental impacts of alien pests. We developed an impact assessment protocol to help answer the questions related to environmental impact in the EPPO PRA scheme. This protocol has been integrated into the electronic version of the EPPO scheme. Two different versions were developed, one for plant pests and another for plants.

M. Kenis (m.kenis@cabi.org) and **U. Schaffner**, in collaboration with many partners in the PRATIQUE project. Funded by: EC RTD FP7. (**https://secure.fera.defra.gov.uk/pratique/index.cfm**).

Participants at the ISEFOR meeting in St Petersburg, Russia, visiting the Arboretum
(photo: C. Jones, Aberdeen University, UK)

PERMIT: Pathway Evaluation and pest Risk Management In Transport

Box, an ornamental plant commonly imported to Europe (photo: G. Grosskopf-Lachat)

The number of alien invasive organisms in European forests is steadily increasing. Plants for planting are recognized as a major pathway for the introduction of forest pests and diseases. The trade volume is very large, with many millions of plants for planting imported into Europe every year, and increasing. Phytosanitary inspections at the point of entry into Europe are an essential tool to minimize the number of introductions of harmful organisms, but the number of shipments, and the number of plants within each shipment, are so huge that only a fraction of the harmful organisms can be intercepted.

The identification of pathways for the international transfer of pests, including species identity, known hosts, origins and trade patterns, may enable the phytosanitary services to respond to the threat of current, known harmful species. It may also allow the development of generic procedures that could be applied to pathway management in a 'manage once, remove many' approach, which could also mitigate the threat of new, hitherto unknown pests.

The COST Action PERMIT focuses on reducing threats from exotic pests through promoting enhanced pathway management. The aims of the project are to analyse the plants for planting trade and its role in forest invasions, both in Europe and elsewhere, and to develop and propose new risk mitigation measures for the woody plants for planting pathway. In total there are 24 participating countries and eight non-COST participants. Research activities in Switzerland, carried out by CABI within the framework of this COST Action, are funded by a grant from the Swiss Department for Education and Science.

One of the working groups, co-chaired by Marc Kenis, is focusing on the identification of pathways for the movement of forest pests and diseases, evidence of movement of pests along the identified pathways, and an analysis of international trade patterns in relation to the movement of pests and diseases along the pathways. Other working groups are focusing on the development of mitigation measures to reduce the movement of pests along pathways and improve the level of education and awareness of risks associated with different pathways.

In 2011 we began an analysis of past interceptions of quarantine pests and diseases during European border inspections of plants for planting. We also started collating data for an analysis of the European plant trade. Both analyses are aimed at describing the potential pathways for the spread of forest pests and producing evidence for the movement of pests along these pathways. The results will be used in the project to develop measures aimed at reducing the movement of pests along the identified pathways.

M. Kenis (m.kenis@cabi.org), **R. Eschen** and **Li H.M.**, with many partners in the COST Action PERMIT. Funded by: Swiss Department for Education and Science and the EC.

Participants at the PERMIT meeting in Belgrade, Serbia (photo: M Glavendekić, University of Belgrade)

introduction

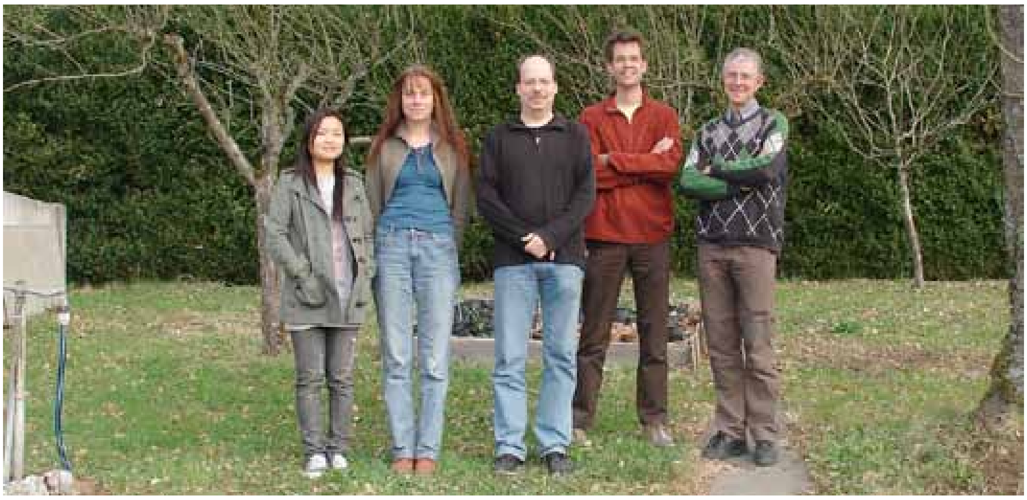
One of my personal highlights of this year's activities in the Ecosystems Management section was the publication of my first book, which I jointly edited with Prof. Otto Hegg, former director of the Institute of Botany, University of Bern. The book provides a historical overview of the long-term experiments set up on subalpine grasslands on the Schynige Platte in the Bernese Oberland, and a summary of the major scientific findings obtained between the late 1920s and today. The experiments, which were set up by a pioneer of vegetation science, Dr Werner Lüdi, are the longest-running replicated experiments in mountain ecosystems in Europe, and perhaps the world.

Dr Esther Gerber continued with her assessment of non-chemical management methods for invasive alien knotweeds, *Fallopia* spp. The main emphasis was on pursuing the scientific evaluation of a new method to destroy knotweed rhizomes. This consists of excavating and crushing soil containing the rhizomes, then storing the crushed material under a plastic foil cover to accelerate decomposition of the fragments. In first tests, up to 100% mortality of rhizome fragments was observed within a few months.

We also continued working on the biological control project for the native plant *Rumex obtusifolius*, a major weed of pastures and meadows throughout Europe, and on the Swiss NCCR (National Centre of Competence in Research) Project 'Plant Survival', which is funded by SNSF. Within the framework of the NCCR project, PhD student Sun Yan established a series of field and greenhouse experiments that are aimed to better understand the mechanisms underlying the ecosystem impact of invasive plant species. In March, we were fortunate to host Prof. Jane Molofsky, University of Vermont, USA, as a visitor to develop ideas for a future collaboration in the context of environmental impact of invasive plants.

Finally, two projects were completed in 2011 that aimed to promote the regulation and implementation of classical biological control in Switzerland and other European countries and were funded by FOEN. To inform national authorities and the general public about the history of classical biological control in Europe, a review was compiled summarizing all documented releases of exotic (non-European) invertebrate biological control agents (IBCAs) into the environment in Europe. The review is an update of the *Review of Biological Control in Western and Southern Europe* published by the late David Greathead (former director of the International Institute of Biological Control, now incorporated into CABI). The goal of the second project was to develop a guidance document that outlines the specific information that has to be included in petitions for field release of exotic organisms for their use in classical biological control projects in Switzerland. It is likely that Switzerland will become one of the very first European countries with clearly defined and transparent regulation of classical biological control.

Dr Urs Schaffner, Head of Ecosystems Management (u.schaffner@cabi.org)



Ecosystems Management team. Left to right: Sun Yan, Esther Gerber, Urs Schaffner, René Eschen and Patrick Häfliger (photo: P. Pardo)

Rumex root attacked by a larva of *Pyropteron chrysidiforme* in a field experiment (photo: K. Dingle)

Female *Pyropteron triannuliforme* (photo: P. Häfliger)

biological control of broad-leaved dock, *Rumex obtusifolius*

Broad-leaved dock, *Rumex obtusifolius*, is considered a weed of permanent pastures, meadows and arable crops throughout its native range in Europe. In Switzerland, it causes particular problems in organic and integrated farming systems. The only feasible control measure currently available for organic production in Europe is cutting the root at a depth of 10 cm below the soil surface. This is extremely laborious, and alternative solutions, such as biological control, would therefore be very welcome. However, all potential biological control agents investigated so far have turned out to be rather inefficient. In 2010, we obtained funding for a three-year project from CTI to develop a biological control product for docks on the basis of the native clearwing moth *Pyropteron chrysidiforme*. This project is being conducted in collaboration with ART, Andermatt Biocontrol AG and the University of Fribourg, Switzerland.

The main problem that emerged from impact experiments set up at four field sites in 2010 was that we found only very low establishment rates of *P. chrysidiforme* when digging up plants in spring 2011. We therefore collected additional larvae of *P. chrysidiforme* in southern France to set up new field experiments and to maintain a rearing colony. Various release designs were tested to elucidate the reasons for the low attack rates observed in the spring. We also started working with a Swiss population of *P. chrysidiforme* and a second closely related sesiid moth, *Pyropteron triannuliforme*, collected in Serbia. While the Swiss *P. chrysidiforme* population was successfully integrated into the various field experiments, mating of *P. triannuliforme* proved difficult to achieve; only three of 16 females were successfully mated.

We continued our study of the population dynamics of broad-leaved docks at nine sites using the permanent plots set up in 2008. In 2012, we will use the data to model the potential impact of *P. chrysidiforme* or *P. triannuliforme* on the population growth rate of the weed.

In 2012, particular emphasis will be put on investigating the biology of *P. chrysidiforme* at its natural field sites in Switzerland. With our increased knowledge we hope to find ways to improve the establishment rates of larvae in the roots, a prerequisite for a successful biological control product based on this root-feeding moth.

U. Schaffner (u.schaffner@cabi.org), **K. Dingle**, **C. Swart** and **P. Häfliger**. Funded by: CTI, Switzerland.

Field site in Switzerland with a large population of *Pyropteron chrysidiforme* (photo: P. Häfliger)

novel method for controlling exotic knotweeds and restoring contaminated soil

Exotic knotweeds (*Fallopia* spp.) are among the most damaging invasive weeds in Europe, inflicting high economic costs on construction and threatening native biodiversity in natural habitats. In 2009, CABI joined forces with Mireille Boyer (Concept.Cours.d'EAU, France) to test the efficacy of a newly developed method to locally eradicate exotic knotweeds. The method consists of excavating and crushing soil containing knotweed rhizomes, then storing the crushed material under a plastic foil cover to accelerate decomposition of the rhizome fragments. In first tests, up to 100% mortality of rhizome fragments was observed within a few months.

The rhizome crushing method is of considerable interest since it provides a technique to locally decontaminate soil infested with exotic knotweed, thereby avoiding the high costs incurred by transport of infested material and safe deposit. The method can also be applied in natural areas, in particular for rapid eradication of small and young infestations at the beginning of an invasion, thereby preventing further local spread of exotic knotweeds.

A series of tests was initiated in 2010, in collaboration with partners in France and Switzerland, to test the success of this method under different climatic conditions in Europe and to gather information on the recovery of native vegetation. A first knotweed infestation was treated in the Canton Jura in October 2010. In May 2011, several small sites along the river Vidourle in southern France were treated. Two additional sites in France will be treated in February 2012.

At the site in the Jura, the plastic cover was removed and the river-bank rebuilt in October 2011. A few *Fallopia* rhizomes, all of which were near the soil surface, had produced shoots under the plastic canvas. However, all except two were dead. The two rhizome fragments that contained some potentially viable material were set up in soil in a heated greenhouse, where one developed a new shoot. This result indicates that a few rhizome fragments can potentially resprout even after the rhizome crushing treatment. It is, however, questionable if this would have occurred under normal climatic conditions.

Samples from the top 15 cm of soil were taken before and after treatment in October 2011; subsequent germination tests indicated that the number of germinating native plants is greatly reduced after the soil has been treated. We will monitor colonization of the former *Fallopia* sites over the next two years. Results will indicate if re-establishment of plant cover occurs naturally or if it requires a seeding treatment.

E. Gerber (e.gerber@cabi.org) and **U. Schaffner**. Joint project with **M. Boyer** (Concept. Cours.d'EAU). Funded by: Office de l'Environnement, République et Canton du Jura, Switzerland; Syndicat Mixte d'Aménagement et de Gestion Equilibrée (SMAGE) des Gardons, Nîmes, Syndicat Interdépartemental d'Aménagement du Vidourle, Nîmes, and Syndicat Mixte d'Aménagement du Bassin de la Cèze, Saint Ambroix, France.

Fallopia rhizome crushing in the Swiss Jura (photo: E. Gerber)

Fallopia rhizome fragments after crushing (photo: E. Gerber)

Removing the plastic cover (photo: E. Gerber)

Former knotweed site in the Jura in autumn 2011 (photo: E. Gerber)

Greenhouse experiment on the competitive interactions between 15 'old' neighbours from the native range (Europe) or 15 'new' neighbours from the introduced range (North America) and European and North American tetraploid *Centaurea stoebe* (photo: Sun Y.)

A control subplot with *Centaurea stoebe* seedlings in the field experiment (photo: Sun Y.)

environmental impact of invasive plants

The goal of this project is to improve our understanding of the mechanisms underlying ecosystem impact by invasive plant species. We will try to achieve this by assessing whether the ecosystem impact of an invasive plant differs fundamentally between its native and its introduced ranges, and whether the ecosystem impact of invasive species differs from that of dominant native species.

In February 2010, a field experiment was set up in the garden of our centre, creating replicated artificial communities that varied in species richness. The experimental set-up is very similar to that of an ongoing experiment in Montana, USA, which will allow us to compare the environmental impact of *Centaurea stoebe* in its native (European) vs its introduced (North American) ranges. In May 2011, we invaded subplots with either dominant native European plant species, plant species invasive in Europe, or European tetraploid *C. stoebe*. In autumn 2012 we will compare these with artificial communities that we left undisturbed.

If we find *C. stoebe* has different impacts in the two ranges we will not know the underlying mechanism, since the experiments differ in a number of factors. We therefore set up greenhouse and mesocosm experiments to disentangle the role of the invasive species' genetics from differences in resident above- or below-ground communities as drivers of the expected ecosystem impacts. In 2011, a competition experiment was set up in a greenhouse to compare the competitive ability of 'old' neighbours from the native range and 'new' neighbours from the introduced range, in the presence of European and North American tetraploid *C. stoebe*. We found that neighbours from both ranges were similarly suppressed by *C. stoebe*. Interestingly, *C. stoebe* was also suppressed when grown in competition with European neighbours, but its growth rate was not affected when grown in competition with North American plants. Moreover, the level of impact of *C. stoebe* on European plant species was correlated with the size of *C. stoebe*, while its impact on North American plants was not. This suggests that the impact of *C. stoebe* is driven by biomass (or by competition for resources) at home but by direct interference in the invasive range.

We carried out a field survey in 2011 to assess whether the patterns emerging in the field experiment can also be found under natural conditions. We will repeat the survey in 2012.

Together with colleagues from Europe, New Zealand and North America, we conducted a meta-analysis on the impacts of alien plant taxa on native species, communities and ecosystems. Our analysis demonstrated that the magnitude of the impact declines with increasing levels of ecological complexity. Data-mining tools revealed that alien invasive plants exert consistent significant impacts on some outcomes (survival of resident biota, activity of resident animals, resident community productivity, mineral and nutrient content in plant tissues, and fire frequency and intensity), while for outcomes at the community level, such as species richness, diversity and soil resources, the significance of impacts is determined by interactions between species traits and the biome invaded.

U. Schaffner (u.schaffner@cabi.org) and **Sun Y.**, in collaboration with **H. Müller-Schärer**, **P. Mraz** and **R. Collins** (University of Fribourg) in Switzerland. Sun Yan is a PhD student at the University of Fribourg, co-supervised by Prof. H. Müller-Schärer. Funded by: SNSF, through the NCCR Programme 'Plant Survival' (lead institution: University of Neuchâtel, Switzerland).

Field experiment on the ecosystem impact of invasive and dominant native plant species along a diversity gradient (photo: Sun Y.)

classical biological control in Europe: review of arthropod introductions in Europe and implementation of regulations in Switzerland

Europe's primary experience with biological control lies in commercial forms of augmentative biological control, i.e. the repeated mass release of native or exotic biological control agents to control native (or exotic) arthropod pests. In contrast, the classical biological control approach, i.e. the deliberate release of exotic biological control agents to control exotic weeds or arthropod pests, has received less attention than in other parts of the world. It is therefore not surprising that the development and implementation of the regulations dealing with the complex questions related to the deliberate introduction of exotic organisms is still in its infancy in Europe.

To inform national authorities and the general public about the history of classical biological control in Europe, a review was compiled of all documented releases of exotic (non-European) IBCAs into the environment in Europe with a summary of key information on the target species and the biological control agent released. The review is largely based on BIOCAT, a database containing introductions of insect natural enemies for the control of insect pests worldwide, which covers the period from 1897, when the beetle *Rodolia cardinalis* was introduced to Portugal against the invasive cottony cushion scale, *Icerya purchasi*, until the end of 2009. Many of the IBCAs that were released in Europe in the past would not meet the standards of a modern environmental risk assessment, mainly because of their broad host range. On the other hand, successful classical biological control programmes suppressing economically or environmentally important target organisms have resulted in reduced pesticide usage, lowering acute and chronic impacts of chemical pesticides on humans and the environment, and have led to the protection of biodiversity and products harvested from natural systems. The key for sound regulation of the import and release of exotic IBCAs in Europe is accurate information provided by the petitioner for the candidate IBCA, and a careful weighing by the reviewers and regulators of the available pest control choices and their implications.

In Switzerland, the recent revision of the ordinance for the deliberate release of organisms has created the regulatory framework to implement comprehensive regulations on classical biological control. In this context, CABI was mandated by FOEN to produce, on the basis of the general guidelines set by the ordinance, a guidance document outlining specific information that has to be included in petitions for field release of exotic organisms for use in classical biological control projects. The document will be sent to stakeholders in Switzerland for review, and the final form made available to all interested persons. Switzerland will then become one of the first European countries to have clearly defined and transparent regulation of classical biological control in place.

U. Schaffner (u.schaffner@cabi.org), **E. Gerber**, **R. Eschen** and **U. Kuhlmann**. Funded by: the Swiss Agency for the Environment, Forest and Landscape.

Invasive plant species that are already targets of classical biological control projects in other European countries and that may become targets in Switzerland. Top right: *Impatiens glandulifera*; bottom right: *Ambrosia artemisiifolia*; and left: exotic *Fallopia* spp. (species pictured is *Fallopia* × *bohemica*). (photos: G. Grosskopf-Lachat and U. Schaffner)

integrated crop management

introduction

It has been another busy and exciting year for the ICM team during which we have been involved in implementing a number of projects across Asia, Africa and Europe. Four of the projects are funded by EuropeAid, whose support to our team has been building steadily over the past years. In 2011, we were part of a team that was successful in winning another project from EuropeAid; a maize IPM project to be implemented from 2012 onwards in the Greater Mekong Subregion, specifically the Lao People's Democratic Republic (Lao PDR), Myanmar and south-western China. We will support IPP–CAAS as a partner to implement this project. The project will complement the EuropeAid-funded rice IPM project which started at the beginning of this year and is being implemented in the same region and with the same partners (see p. 72). It will also draw on the experiences gained by the ICM team during a similar ICM project on maize in the DPR Korea, which was funded by SDC and EuropeAid and drew to a close this year (see p. 68).

This year marked the end of two major SDC-funded projects that the ICM team has been significantly involved with. Firstly, the two-year ICM project in DPR Korea (which was the last of four phases totalling ten years) (see p. 70) and secondly, the three-year IPM Advisory Group programme in Nicaragua, Tanzania and Albania (the second of two phases totalling six years) (see p. 65). This latter programme was a unique endeavour for CABI that involved staff based in the UK, Africa, the Caribbean, Latin America and Switzerland working together to ameliorate misuse of pesticides in the target countries. The ICM team was responsible for the coordination of this programme as well as its implementation in Albania. Despite these project closures, SDC continues to be extremely supportive of the work that the ICM team, and CABI as an organization, does. At the beginning of 2011, SDC made a strategic decision to merge all of its support to CABI and direct it towards the new Plantwise programme (see Highlights p. 7, 8, 11 and 'preparation for global roll-out of Plantwise', p. 66). Following the official launch of the Plantwise programme in 2012, the ICM team will become involved in its implementation through the provision of technical support to enable local partners to improve agricultural practices and conform to internationally recognized standards of production.

In 2011, the ICM team also initiated a new project with Philip Morris International (PMI) that will see our outreach expand once again to South America. During a trip to Brazil in May, I met with potential local partners and started to develop an IPM project on tobacco that will involve CABI, PMI Brazil and the University of Santa Cruz do Sul. It is anticipated that an agronomy programme will commence in 2012, once ideas have been further developed.

Due to the steady increase in the team's project activities, I was very pleased to welcome Urs Wittenwiler who will work as a part-time CABI Associate based in China. Urs will support ICM project implementation in the Greater Mekong Subregion (see p. 72).

I hope you enjoy reading about the ICM team's activities in 2011. It has been another year of change and, with that, the scope of our work has continued to expand. It is the constant discovery and capture of new opportunities that we strive towards year after year to ensure the diversification and sustainability of our project activities and support.

Dr Ulli Kuhlmann, Head of Integrated Crop Management (u.kuhlmann@cabi.org)

Integrated Crop Management team. From left to right, back row: Keith Holmes, Stefan Toepfer, Zhang Feng; middle row: Emma Jenner, Dirk Babendreier; front row: Wade Jenner, Ulli Kuhlmann, Manfred Grossrieder (missing: Urs Wittenwiler) (photo: KCS Convention Services, Delémont)

SCOPES Institutional Partnership project in Albania

Cow manure applied for fertilization of apple orchards (photo: D. Babendreier)

Albanian agricultural researchers suffer from a lack of resources and contact with the global scientific community, which leads to low international competitiveness. Furthermore, knowledge of modern and sustainable approaches in agriculture, such as ICM, is weak among Albanian governmental institutions, including the extension system. Funded by SNSF through SCOPES, this Institutional Partnership project aims to tackle these shortcomings by strengthening the capacity of four institutional partners in Albania (the Agrobusiness School Korçë, the University of Korçë, the Centre for Agricultural Technology Transfer (CATT) and the local NGO Agrinet).

After the development of ICM lectures (approximately 850 Microsoft PowerPoint slides) in 2010 and final approval for their use by the director of the University of Korçë and the Ministry of Education, this lecture series was given for the first time in March 2011. The lectures are an integral component of the new Master's course in Rural Development, which, for the first time, allows students at the University of Korçë to achieve postgraduate education in the field of agriculture. Based on experience gained at the University of Korçë, a refined and tailor-made version of the ICM lecture series was developed for the Agrobusiness School Korçë (64 hours of lessons in total) to be implemented in 2012. Linked to these lectures, examinations were developed to assess the students' comprehension of ICM concepts.

Researcher from the University of Korçë checking experiments in an apple orchard (photo: B. Skenderasi, University of Korçë)

A major achievement in 2011 was the development of informational handouts corresponding to the ICM lectures. These handouts contain all the key information from the ICM lectures in both English and Albanian and will be printed in early 2012, in time for undergraduate and graduate students starting in 2012. The new ICM lectures will better prepare students at the University of Korçë and Agrobusiness School for employment in the agriculture sector and will help to anchor the principles of sustainable agriculture among the future agricultural leaders of Albania.

To support CATT and farmers, a fertilization guideline for fruit growers in Albania was jointly developed with partners. Currently, fruit growers have a very poor understanding of fertilization, which results in yield losses, reduced fruit quality and even environmental degradation when nitrogen is over-applied. The fertilization guideline was developed using knowledge gained during study tours and workshops in Switzerland in 2010 and 2011. The final draft was prepared at the end of 2011 and will be printed in 2012. A series of farmer training events was conducted by Agrinet, with support from CATT. These training sessions focused on pest monitoring and rational pesticide use, but also included content from the fertilization guideline, such as how to take soil samples for analysis. It was through these training events that a strong link was maintained between this project and CABI's earlier ICM project for fruit growers in the Korçë region.

All partners were backstopped in conducting innovative research based on farmers' needs. In 2011, an experiment on the effect of the biological control product 'Madex' on a major apple pest was continued while other experiments were initiated (e.g. to assess the effects of pesticide spraying regimes on apple scab incidence, and of fertilizer use on apple quality and yield). Strong links were established between Agrinet, CATT and the Swiss SME Andermatt Biocontrol AG. The latter partner supported the Madex experiment by providing training and materials (e.g. pheromone traps). Finally, a young scientist from Albania, Lazjon Petri, received intensive three-month training on IPM and biological control at CABI in Switzerland through this SCOPES project. It is expected that anchoring the ICM philosophy at all levels of research, education, policy and practice will allow a more rapid transition to improved sustainable agriculture in Albania.

D. Babendreier (d.babendreier@cabi.org) and **U. Kuhlmann**, in collaboration with Agrinet, CATT, the Agriculture Faculty of the University of Korçë, and the Agrobusiness School Korçë in Albania. Funded by: SNSF and SDC.

Albanian delegation during a study tour to Switzerland (photo: D. Babendreier)

CABI IPM Advisory Group: strengthening advisory services for farmers in Albania, Nicaragua and Tanzania

The three-year SDC-supported IPM Advisory Group programme, which was initiated in April 2008, was completed at the end of March this year. This programme aimed to support the implementation of IPM in Tanzania, Nicaragua and Albania, where pesticide misuse is a chronic problem and farmers have limited knowledge of more sustainable pest management practices.

In Albania, the project worked closely with a local NGO, Agrinet, to support the establishment of an Apple Integrated Production Producer Club. A management structure and accompanying constitution were developed for the club. Technical Guidelines were also compiled defining the minimum production standards for members. A significant amount of technical support was provided by CABI to facilitate the development of guidance documents and training courses for the apple producers. By the end of the project the club had 110 paying members, with many more farmers interested in joining.

In Nicaragua, the project aimed to strengthen a plant health network (PHN) that CABI previously helped to establish. Nicaragua's PHN consists of, and is managed by, local partners, including farmer organizations, scientists, extensionists and other government agricultural services. The PHN offers advisory support to farmers through a variety of services, which the project helped to enhance in strength and sustainability. A monitoring strategy was developed and implemented to assess and improve the quality of service offered by plant clinics. 'Plant pharmacies' were established to increase farmer access to the alternative, biologically-based plant protection products being recommended to them by plant clinics. Public plant health campaigns, a rapid and inexpensive extension method for reaching remote rural locations, were also devised and implemented.

Work in Tanzania followed on from the previous IPM Advisory Group programme in which groups of farmers had been trained in IPM using a farmer field school approach. Since these farmers were already knowledgeable about sustainable agricultural practices, this project focused on transforming the farmer field school groups into vegetable producer clubs. Significant support was then provided to improve market access for the IPM tomatoes produced by the farmers and to enhance the sustainability of their farming business. A total of seven IPM vegetable producer clubs, each comprising 15–30 farmers, was established and registered at a national level during the project.

Results from all three countries were positive, with real differences in production and farmers' businesses being recorded. CABI will continue to support work in Tanzania and Nicaragua in 2012 through Plantwise, and it is anticipated that SDC may provide further funds to continue efforts in Albania.

U. Kuhlmann (u.kuhlmann@cabi.org), **D. Babendreier**, **E. Boa**, **Y. Colmenarez**, **R. Musebe**, **M. Kimani**, **S. Toepfer** and **E. Jenner** in collaboration with Agrinet, the Ministry of Agriculture, Korçë, CATT, the Agriculture Faculty of the University of Korçë, Korçë Agrobusiness School, and apple producers of Kosovo (Albania); PROMIPAC, an SDC-funded IPM programme managed by Zamorano, a leading agricultural university in Central America, and FUNICA, a private–public partnership funded by the Danish International Development Agency and the International Fund for Agricultural Development (Nicaragua); and HORTI Tengeru (Tanzania). Funded by: SDC.

A plant doctor offers advice to farmers at a plant clinic in Nicaragua (photo: Y. Colmenarez)

Members of the Apple Integrated Production Producer Club and Agrinet staff monitoring insect pests and diseases in an apple orchard in Albania (photo: E. Jenner)

A farmer belonging to an IPM vegetable producer club in northern Tanzania produces botanical pesticides on his tomato farm to combat whitefly and other pests (photo: S. Toepfer)

Phil Taylor shares results from a break-out discussion on quality assurance for field diagnoses made by plant doctors (photo: W. Jenner)

SDC Plantwise Workshop 2: participants discuss the advantages and constraints of working with different types of country partners for the establishment and regular operation of plant clinics (photo: W. Jenner)

preparation for global roll-out of Plantwise

For many members of CABI worldwide, 2011 was a year of intensive planning for the accelerated roll-out of Plantwise activities. To facilitate this process, CABI was awarded a bridging phase project funded by the SDC Global Programme Food Security. This entry phase project was a lead-in to the joint development of a larger credit proposal by CABI and SDC for 2012 and 2013.

A series of workshops was held in Switzerland in late spring to bring Regional Directors and representatives from all CABI centres together for Plantwise discussions. The purpose of the workshops was to build internal ownership and harmonization of objectives for the Plantwise programme. The first workshop included discussions on how the different CABI centres and programmes have conducted activities in the past to support various stakeholders in agricultural systems.

The second workshop was focused on plant clinic operation and quality assurance. Introductions to several country plant clinic schemes and a global review of plant clinics provided an effective introduction for CABI staff new to the programme. This second workshop concluded with agreements on (i) the expected responsibilities of country partners, at both the national and local implementation levels, (ii) a general process for plant clinic data collection and sharing, (iii) minimum requirements for entry into plant doctor training and clinic operation, (iv) a plant doctor code of conduct, (v) evolving processes for validation of diagnoses and recommendations made by plant doctors, (vi) an early concept for plant clinic accreditation processes, and (vii) ways in which the Plantwise knowledge bank could support plant clinics.

The third and final workshop of the series reviewed the current content of the four training modules associated with plant clinics. A number of required revisions to the modules were identified and agreements were made on the need for (i) examinations associated with Modules 1 and 2, (ii) a plant doctor manual for new trainees, and (iii) a training programme for future data managers in countries where Plantwise operates.

A fourth workshop was held in September at Naivasha in Kenya, during which 24 technical staff from CABI, representing all centres, were officially introduced to the Plantwise programme, the plant health system concept and all four plant clinic training modules. This important meeting was the start of the formation of regional teams for global implementation of Plantwise activities.

Over the course of the year, a programme-level strategy document and accompanying logical framework (logframe) have been developed for Plantwise. In October, the new Plantwise Programme Board met for the first time in Delémont to discuss the logframe and the types of activities that could be conducted in countries where Plantwise operates in 2012. This planning contributed to the credit proposal that was jointly prepared by CABI and the SDC Global Programme Food Security.

U. Kuhlmann (u.kuhlmann@cabi.org), **E. Jenner** and **W. Jenner**, in collaboration with several representatives from CABI centres/offices in Kenya, Trinidad and Tobago, Pakistan, India, Malaysia, China and the UK, as well as **C. Thoennissen** (SDC Global Programme Food Security, Bern, Switzerland). Funded by: SDC Global Programme Food Security.

The participants at the internal training on Modules 1–4 in Kenya, hold up their validated fact sheets – farmer-friendly extension messages targeting specific crop problems (photo: J. Bentley)

strengthening Sierra Leone's plant health system

Since the concept was introduced, Sierra Leone has established a number of plant clinics across the country, operated by field staff of the Ministry of Agriculture, Forestry and Food Security (MAFFS). On the agricultural front line, plant doctors operate their plant clinics as an accessible and face-to-face advisory service for farmers, providing quick diagnostic support and practical crop management advice. The plant clinic approach helps to overcome the barriers that inhibit information flow to farmers, thereby strengthening the interaction and cooperation between farmers and extension providers. At the same time, they are an effective mechanism for gathering information from the field on current plant health problems, making them a powerful resource for identifying emerging problems and developing responsive programmes. By improving information flow among the key stakeholders, plant clinics strengthen the linkages required for an effective national plant health system.

At the start of 2011, Sierra Leone had 12 operating plant clinic teams, one in each of the provincial districts. Through collaboration with the Italian NGO Cooperazione Internazionale (COOPI), CABI assisted MAFFS in establishing an additional 14 plant clinics in Kono District – one in each of the 14 chiefdoms of the district. CABI's primary involvement, supported by the CABI Development Fund, was to train new plant doctors and their support staff. This training (Plantwise Modules 1 and 2) builds on plant doctors' existing knowledge of making field diagnoses and giving crop management recommendations, and helps prepare them to run effective plant clinics. CABI also introduced its new version of the clinic register and data collection process to test how well the technology would work in Sierra Leone to simplify the data collation and sharing processes.

The new plant clinic teams in Kono District consist of combinations of MAFFS extension workers (plant doctors) and local volunteers (support staff). This partnership helps to build local ownership of the plant clinics and also demonstrates how the plant clinic system is becoming more deeply rooted in MAFFS at the policy level.

By the end of 2011, all of Sierra Leone's 26 plant clinics were running in their assigned regions. In addition to further clinic establishment, the next steps for 2012 will include further development of the use of clinic data in Sierra Leone and integration of the Plantwise knowledge bank as a responsive information resource for agricultural advisors and planners within the plant health system.

W. Jenner (w.jenner@cabi.org), in collaboration with **P. Taylor**, **E. Boa**, MAFFS and COOPI.
Funded by: the CABI Development Fund.

Plant doctor trainees engage in mock scenarios to practise providing locally feasible crop management advice (Module 2; photo: W. Jenner)

Plant doctor trainees examine plant samples and practise describing symptoms of damage caused by biotic and abiotic factors (Module 1; photo: W. Jenner)

Maize stem destroyed by stem borer larvae (photo: W. Jenner)

Training of facility personnel on *Trichogramma* host rearing at the AAS–PPI training centre (photo: Zhang F.)

Onchon CTRF manager showing *Trichogramma* production records (photo: Zhang F.)

A maize cooperative farm in Hwangju County, North Hwanghae Province, DPR Korea (photo: Zhang F.)

large-scale dissemination of maize ICM in DPR Korea

Chronic difficulties in agriculture, brought on by economic problems and accentuated by unfavourable climatic conditions, have accumulated over many years, and continue to seriously undermine domestic food production in DPR Korea. Maize production, in particular, is facing extensive problems due to damage inflicted by agricultural pests including the Asian corn borer (*Ostrinia furnacalis*), which causes yield losses in the range of 10–30%, depending on the year and location.

In order to improve maize yields, CABI and its Pyongyang-based Korean partners, AAS-PPI and the MoA's CPPS, have been working since 2009 with CFMBs and County Plant Protection Stations on scaling up the implementation of an IPM strategy that was developed during earlier CABI projects. The key element of this maize IPM strategy is the mass release of a parasitic wasp, *Trichogramma*, which attacks and kills the egg stage of the pest and thus protects the crop from the pest damage.

With financial support from DG EuropeAid, CABI and local partners have implemented the maize IPM strategy in North Pyongan, South Pyongan and Hwanghae provinces and in Pyongyang City District. In total, 24 County *Trichogramma* Rearing Facilities (CTRFs) have been established in 21 counties with production output covering about 20,000 ha of maize fields in 320 cooperative farms in the project areas. Seven rearing facilities are responsible for stock culture rearing. In order to make the rearing facilities self-sustainable and economically viable, owner agreements including a business plan have been finalized with each CTRF and signed off by the CFMBs in their function as the owners of the CTRFs. Calculations in the business plans show that the established facilities can be operated efficiently and at low cost which has been achieved through adaptations to local conditions in the design of the facilities as well as through the inclusion of a barter system between producing facility and cooperative farms using the *Trichogramma*. One hectare of maize can now be protected at a cost of 1825 Won, while the benefit of this protection in terms of yield increase is predicted to be 360 kg/ha or 7200 Won/ha in monetary terms. The 2011 results indicate a yield increase of as much as 540 kg/ha. The break-even point of the facility is reached as soon as the application of the product increases the yield by only 2.03% (the increase is usually around 10%).

In November 2011, a final project review workshop was conducted by CABI and project partners in Pyongyang. During this workshop, positive aspects, difficulties and lessons learnt from the project implementation between 2009 and 2011 were discussed and shared by all the partners. With the finalization of the project, a strong base for nationwide implementation of maize IPM by local partners is now available in DPR Korea.

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Pakchon CTRF manager explaining Trichogramma production (photo: Zhang F.)

increasing food production in DPR Korea by sustainably reducing the impact of soil-borne insect pests

Monster grubs in DPR Korea to be controlled by beneficial entomopathogenic nematodes (photo: S. Toepfer)

Over recent years, food crops in DPR Korea have come under increasing threat from soil-borne insects, with yield losses of up to 30% not unusual. Currently farmers lack feasible and sustainable methods for controlling these pests.

Funding has been provided from DG EuropeAid (2011 to 2014) to improve pest management practices targeting soil-borne insects, by making low-cost biological control agents, i.e. beneficial entomopathogenic nematodes, locally available. Self-reliant nematode production facilities will be established to provide a readily available product to local areas. Support units called County Competence Centres will be created to offer technical support and training in the production and application of the nematodes. As the proposed technology is new to DPR Korea, national and provincial agricultural centres will also gain experience by operating their own nematode production facilities. The national-, provincial- and county-level facilities will all play a key role in the widespread dissemination of the technology.

Given the novelty of the technology to DPR Korea and the numerous stakeholders involved in its implementation, significant capacity building is required. Working with nematode production specialists from China and Switzerland, CABI has successfully started to transfer knowledge and expertise to project partners, including AAS-PPI, as well as to the MoA's CPPS, DPR Korea. This includes materials explaining in-vitro and in-vivo production systems for beneficial nematodes. This knowledge transfer has been facilitated through in-country hands-on training, and has led to the collaborative development of production manuals.

Preparation of a bioassay of beneficial entomopathogenic nematodes against soil pests in DPR Korea (photo: S. Toepfer)

In parallel to the above activities, it was necessary to survey and isolate indigenous entomopathogenic nematodes, which may be better adapted to the environmental conditions and target pests in DPR Korea. To support this activity, training was provided and manuals developed to explain the process of surveying, baiting, purifying and storing the nematodes. Using these resources and acquired knowledge, field surveys are now being carried out.

CABI staff and associates from China and Switzerland with expertise in nematode production will continue to support the development of a locally adapted production system that works effectively under the conditions in DPR Korea. In collaboration with AAS-PPI and CPPS, we will facilitate the transfer of production and application knowledge and skills to county and cooperative farm levels. It is envisaged that this project will contribute to a reduction in the volatility in the nation's food production and will consequently address impending food insecurity.

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Planning soil pest surveys in agricultural flatlands of DPR Korea in 2011, facilitated by Stefan Toepfer from CABI and a senior scientist from AAS-PPI, Pyongyang (photo: Pak)

Mr Chae Gwang (left), the director of the newly established Plant Protection Department, MoA, with Mr Ri Chol Hun of the International Cooperation Office, MoA (photo: M. Grossrieder)

Preventative measure to avoid crop damage: trapping insect pests (photo: M. Grossrieder)

Workshop with farm engineers at a cooperative farm: feedback on IPM guidelines (photo: M. Grossrieder)

ICM to improve cabbage and maize production in DPR Korea

In DPR Korea, CABI has been working on SDC-funded projects since 2002 with the aim of introducing the principles and concepts of ICM. CABI has been supporting local scientists to develop and test crop-specific IPM approaches in cabbage and maize and to integrate crop rotation ideas within an overall ICM approach towards stabilizing food production and provision to the population. With MoA and AAS partners, large-scale implementation and dissemination of the approach to cooperative farms, including appropriate knowledge transfer, were important, along with activities to improve the availability of plant protection products (biological control agents *Bt* and *Trichogramma*). Another measure to strengthen ICM in DPR Korea was to embed the IPM concept and understanding of sustainable agriculture in general in the national higher education system (agricultural universities, colleges). Over the years of collaboration with DPR Korean institutions, activities began to shift away from a research focus towards knowledge transfer and institutional capacity building. A strong focus has been placed on the further establishment and improvement of inter-institutional linkages to ensure sound and functioning foundations at policy, educational and scientific levels upon which future actions towards rendering DPR Korea's agriculture more sustainable can be built.

The last phase of the Miru Hills project (2010–11) was designed to capitalize on past activities and to consolidate achievements from them to ensure the sustainability of the ICM initiatives in DPR Korea. A focus in 2011 was on further supporting the Integrated Crop Management – Technical Advisory Group (ICM-TAG) following its establishment in 2010. This group will become instrumental in the future implementation of ICM in DPR Korea by advising the government on ICM issues and by further planning, steering and coordinating of ICM projects in the country. The overall compilation and structuring of available materials for training farmers and farm group leaders, as well as extension specialists at the farm, county and national levels, was an interesting exercise for trainers and master trainers that had been involved in ICM knowledge transfer activities. The extensive collection of information materials as well as methodological documents like training curricula will allow trainers to capitalize on past activities.

Besides the actual direct benefit for the DPR Korean population in terms of increased food production through the implementation of the SDC Miru Hills project (40% increase in cabbage and 20–40% increase in maize production), one of the most important indirect achievements of the long-term engagement in DPR Korea has been that the profile of sustainable approaches to agriculture has been raised markedly, which is reflected in the fact that the former Plant Protection Section of the Agro-production Department has now been raised to department status within the MoA.

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PAU students on a practical IPM course (photo: S. Toepfer)

ensuring future food security through the strengthening of research capacity in DPR Korea

In order for DPR Korea to address plant protection and food security issues, a strong, applied research community is required. Currently, a significant proportion of the DPR Korean research community lacks the necessary skills and resources for experimentation and communication with stakeholders which would allow them to realize their full potential in conducting problem-oriented scientific studies.

This DG EuropeAid-funded partnership project aims to strengthen the knowledge and in-house applied research capacity of AAS to provide solutions for agricultural problems. Through participatory learning, project partners will gain experience in problem identification, experimental design and data analysis, and in presentation of results. In addition, they will develop skills in, and an appreciation for, frequent communication of research-related experiences and knowledge with their peers.

A major achievement of the project to date has been to enable the scientific staff of AAS to access the Internet and online resources to support the development and implementation of their research. Access to international and current research is essential to effective delivery of sustainable solutions to agricultural problems. This capacity to access information has also been enhanced by provision of access to CABI online products including CAB Direct (CAB Abstracts), CABI eBooks and the CABI compendia (see Highlights, p. 6).

To enhance the ability of AAS staff to design, carry out and analyse their research, a workshop was held on 'Experimental Design and Statistical Analysis'. The workshop successfully introduced staff to these topics and how they can be applied to their own research area and topics. PAU, with support from CABI, adopted this workshop and developed it as a component of its curriculum. To enhance the new course they used the workshop content to produce a course manual which was published through funding from SDC, with 1500 copies being made available to students. It is planned to further disseminate the course at the farm level, with cooperative farm engineers being trained in 2012. In addition, AAS will adopt the course for training of its institute's staff in 2012.

Training was also provided in communication of scientific information through preparation and presentation of posters, hand-outs and oral presentations. These newly developed skills were then used to develop posters and presentations for an international conference, the 24th IWGO Conference (see Highlights, p. 17) in October 2011 in Freiburg, Germany, where the students gave two poster and two oral presentations.

In addition to providing direct support to knowledge transfer and information provision CABI, in collaboration with AAS, has enhanced the ability of AAS to provide training to its own staff, with this project supporting the partial renovation of the AAS Training Facility accommodation block. The improved facility enhances the ability of AAS to host scientists and agricultural staff from outside Pyongyang, thus improving its ability to train and disseminate knowledge nationally. As a result of this project, improved efficiency at the research and development level will result in sustainable increases in agricultural productivity, which, in turn, will enhance food security in DPR Korea.

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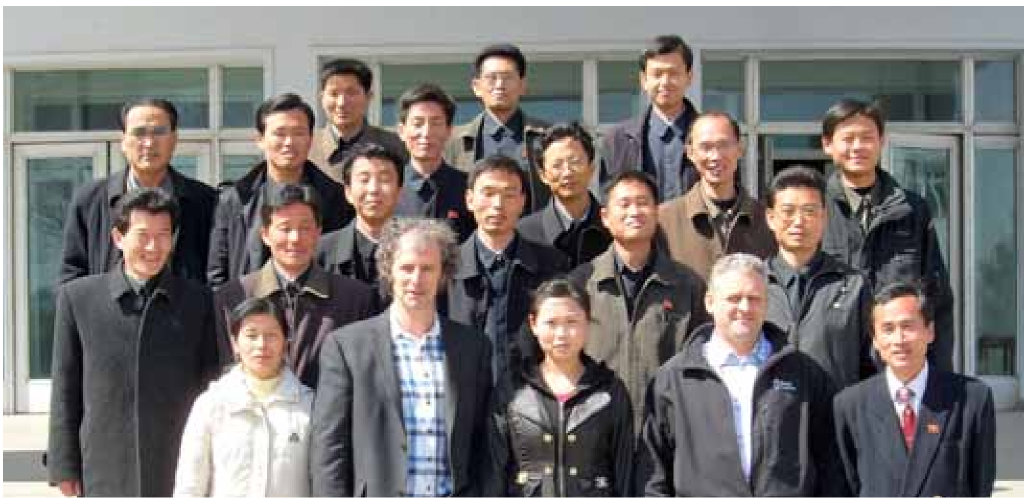
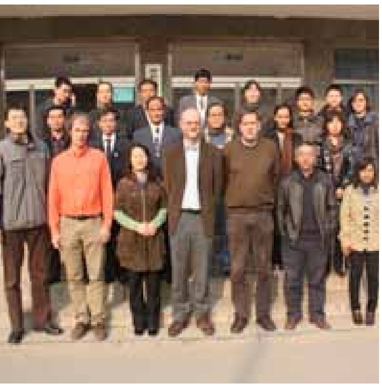
Supporting learning in the workshop (photo: K. Holmes)

Participants take the end of workshop examination (photo: K. Holmes)



Participants from the 'Experimental Design and Statistical Analysis' workshop (photo: K. Holmes)



Participants of one of the multi-stakeholder workshops (photo: Hou M., IPP-CAAS)

Project staff inspecting rice fields (photo: D. Babendreier)

improved food security for smallholder rice farmers in the Greater Mekong Subregion

Rice is the most important crop in the Greater Mekong Subregion; it is not only the most important source of food for the people in the region but also provides work and income for 80% of the population. Rice production furthermore generates a substantial part of the GDP of the countries in the Greater Mekong Subregion. Despite significant improvement of rice production in the subregion in the past 15 years, productivity is still low with, for example Laotian farmers produce about 4.5 tonnes/ha per year. Rice production is threatened by pests, diseases and weeds and millions of tonnes of rice are lost annually due to these problems. Intensive use of broad-spectrum pesticides leads to different problems like insecticide resistance and frequent outbreaks of secondary pests (e.g. plant hoppers). Last but not least, chemical pesticides are a constant threat to the health of smallholder farmers and consumers as well as to the environment. Knowledge on more advanced rice production technologies and ICM is fairly new to the region and access to more benign pest control methods limited for smallholder farmers. Overall, increased productivity in rice is crucial for both achieving food security and meeting the targets laid out in the Millennium Development Goals by the United Nations.

This multi-stakeholder project started in February 2011 and aims to improve the livelihoods of smallholder rice farmers in the Greater Mekong Subregion through the introduction of a biologically based pest management approach to sustainably increase rice production. During several multi-stakeholder meetings, comprehensive planning and management documents were jointly developed to allow smooth implementation of this big project involving a large number of partners and associates. In order to better understand the specific needs and problems of poor smallholder rice farmers, project staff visited 11 villages in the region and spent three days with farmers of each village. Local staff were trained in participatory rural appraisals to ensure participation of smallholder farmers in project planning and implementation. In addition, literature and field surveys were conducted to assess which pests are dominating in the target countries and to find out about pest management and pest monitoring approaches currently applied. The findings of these surveys will help the project to develop tailor-made biological pest management approaches. Extensive field surveys in rice fields of Myanmar, Lao PDR and two provinces in south-western China (Yunnan and Guangxi) were conducted to search for promising natural enemies that have the potential to fight the most damaging rice pests. *Trichogramma* species/strains that were collected have been identified and laboratory tests started to assess life history, compatibility with insecticides and searching ability on the target hosts, i.e. stem borers and leaf rollers.

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Myanmar delegation during a technical meeting in Dehong (photo: D. Babendreier)

implementation of tobacco IPM in Turkey

In September 2009, CABI began working on an IPM programme together with PMI and six Oriental tobacco leaf supplier companies in Turkey. This initiative is special for Turkey's tobacco industry because it is one of the first occasions that the leaf supplier companies have collaborated in such a large programme. The joint action was stimulated by an increasing occurrence of pesticide misuse, which can lead to residues on the harvested tobacco leaves. The overall objective is to reduce inappropriate use of pesticides, while sustaining or improving crop yields, thereby leading to enhanced tobacco quality, grower safety and protection of the agro-ecosystem.

The core activity of the programme is the implementation of an IPM farmer training programme targeting 40,000 Oriental tobacco farmers in the Aegean, Black Sea and South East regions of Turkey. Some 5475 farmers were invited to three training sessions in 2010, with each training session addressing topics relevant to production activities at the time the training was held. Average farmer participation at these sessions was an impressive 75%. In 2011, farmer training was hosted on 'model farms' established and managed by the leaf supplier companies. Various agronomic practices, including a new seed sowing method and seedling clipping technique, were demonstrated to farmers, and posters were used to facilitate the transfer of theoretical knowledge. During the training, farmers received documents developed by programme partners to support the correct identification and appropriate management of key insect pests and diseases. Record sheets and monitoring booklets, in which farmers should record their on-farm activities, as well as seedling clippers and personal protective clothing for pesticide applications, were also distributed. A total of 9295 farmers were invited for training in 2011 and the participation rate was an average of 60%.

In order to be able to monitor the impact of the IPM programme and determine changes in farmer behaviour, an internal farm inspection system is being developed. During 2011, two farm inspection protocols, or 'checklists', were finalized to verify implementation of IPM techniques by farmers during the seedbed and field stages. In 2011, 23 IPM inspectors were selected and trained in how to conduct farm inspections. Preliminary inspections were carried out on 416 farms (224 belonging to farmers who attended training in 2010 and 192 belonging to untrained farmers). Initial results indicate positive effects of the training in terms of safer pesticide handling, application and storage. However, topics such as the documentation of pesticide applications and monitoring for pests and diseases are still problematic, and farmers may require further support to implement these in the future.

CABI will continue to support the programme in 2012, with activities focusing on continuing the implementation of farm inspections as well as supporting the implementation of scientific agronomic trials to identify new techniques to boost yield.

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Farmers receive training on how to scout for pests and diseases in the tobacco field (photo: Ö. Korkmaz, TTL Tütün San. ve Dış Tic. A.Ş.)

Leaf experts learn how to inspect farms and assess whether farmers are implementing IPM practices (photo: W. Jenner)

A group of Oriental tobacco farmers thin out seedlings in a seedbed (photo: K. Boz, Özge foto rafçılık)

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Häfliger Patrick, DnatSc, IT
Grosskopf-Lachat Gitta, DnatSc, Assistant to Regional Director (from July)


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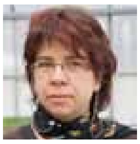
Schaffner Urs, DnatSc, Ecosystems Management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Marc Kenis


Ulrich Kuhlmann


Urs Schaffner

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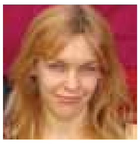

Lindsey Norgrove

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about CABI

what does CABI do?

CABI is a not-for-profit, science-based development and information organization governed by 47 member countries from all parts of the world. We create, communicate, and apply knowledge in the fields of agriculture and the environment, working for and with universities, national research and extension institutions, development agencies, the private sector, governments, charities and foundations, farmers, and NGOs. CABI has over 400 staff operating from bases in ten countries and working in more than 70. Our activities include:

publishing

We produce key scientific publications including CAB Abstracts, the world-leading database covering agriculture and the environment, and Global Health, the definitive bibliographic database for public health information. We also publish multimedia compendia, books, eBooks and full text electronic resources which support the practical application of the results of research.

international development

Our staff research and find solutions to agricultural and environmental problems. We use science, information and communication tools to help solve issues of global concern. Our work is arranged around four core themes:

Commodities: we work to enable smallholder commodity farmers to compete in global markets. We diagnose and control plant pests and diseases, and help farmers get a better price for their crops. We work on crops such as coffee, cocoa, wheat, rice and cotton.

Invasive Species: we are helping to reduce the spread and impact of invasive weeds such as Japanese knotweed and water hyacinth and insects such as coffee berry borer and cocoa pod borer. We also advise countries at a policy level about agriculture, trade and the environment.

Knowledge for Development: we work with farmers, extension workers, researchers and governments to deliver agricultural knowledge and develop communication strategies and systems. We provide information and support for community-style telecentres, and facilitate the establishment of plant clinics around the world to help farmers identify pests and diseases affecting their crops.

Knowledge Management: we use information and communication technologies to provide farmers, researchers and policy makers with the information they need to make informed decisions and to lift people out of poverty. We produce interactive databases and encyclopaedic compendia that give access to detailed and easy-to-search information on subjects like crop protection and animal health.

For more information about CABI please visit the website **www.cabi.org**

CABI in Switzerland

One of the unique advantages that CABI has in carrying out its mission is its global network of Regional Centres; one of these is in Switzerland, in Delémont, the capital of the Canton Jura. By being present in Switzerland, CABI has been able to develop numerous relationships with national institutions, such as the Swiss Agency for Development and Cooperation (SDC), and the plant protection industry, including Andermatt Biocontrol AG and e-nema GmbH. Productive scientific collaborations have also been established with national universities (e.g. Fribourg, Neuchâtel, Bern and Basel), the Federal Office for the Environment (FOEN) and the Agroscope research stations of the Federal Office for Agriculture (FOAG). These valuable links have all been strengthened further by Switzerland's accession to CABI as a member country in 2000. Close ties are also constantly evolving between CABI and Canton Jura.

Established in 1948, CABI's centre in Switzerland has for many years been a leading international research-based institution in the management of invasive weeds and insect pests through the promotion of biological control. Biological control is the use of natural enemies (parasitoids, predators and diseases) to control pests and weeds. Many of the most damaging pests and weeds are alien species that have been accidentally introduced through trade and travel. Alien pests often arrive in a new area without their natural enemies, which normally keep them in check in their region of origin. Hence, much of the centre's work has been based on so-called classical biological control, i.e. the control of introduced pests in one area by the introduction of natural enemies from the pest's area of origin. Naturally, this approach depends upon a careful study and evaluation of the risks before any natural enemy can be introduced, and this is a major focus of the centre's work.

Because of the centre's substantial activities in biological control, it is not surprising that its staff play an active role in CABI's contribution to aspects of biological control policy, linking with organizations such as FAO (Food and Agriculture Organization of the United Nations), OECD (Organisation for Economic Co-operation and Development), EPPO (European and Mediterranean Plant Protection Organization), IOBC (International Organization for Biological Control) and national authorities such as FOAG and FOEN, to provide inputs to protocols and guidance documents required for regulation, as well as cutting edge research on the development of methods to assess risks associated with potential biological control agents.

The centre's research also contributes to methods to assess the risks and impacts of invasive alien insects. We are developing inventories of invasive alien insects and have contributed to the establishment of a 'Black List' of alien animal species that require particular attention and regulation due to their current or potential environmental impact. By doing this, the centre contributes to the development of regional and national strategies for prevention and management of invasive species in Europe.

In order to support a better understanding of how biodiversity can be conserved, the centre's research places emphasis on assessing multi-trophic interactions below- and above-ground, as well as nutrient cycling in the context of biological invasions, land-use change and climate change. In the context of climate change, the centre is studying interactions between global warming and biological invasions, and assessing the possible impacts of climate change on agricultural production and ecosystems through their effect on pests and insect–plant interactions.

A large proportion of the centre's work is less research-based and more focused on providing technical support and facilitating activities to improve agricultural practices in a number of developing, transitional and developed countries around the world. This work is in response to the strong current global movement towards agricultural development and the need to tackle environmental issues, alleviate poverty and enable food security. It also addresses the requirement of farmers around the world to adopt good agricultural practices (GAP) and elevate standards of food production due to market globalization and growing consumer concerns about food safety and environmental health. Our centre's Integrated Crop Management team is therefore conducting a number of consultancy-based projects in which it is promoting the appropriate use of natural resources and supporting the implementation of integrated pest management (IPM) in order to reduce unnecessary use of pesticides. These projects are funded by a number of different donors including SDC, EuropeAid and Philip Morris, and are being implemented in countries such as DPR Korea, China, Albania, Turkey, Argentina, Lao People's Democratic Republic and Myanmar. Towards the end of 2011, the ICM Team also became involved with the implementation of CABI's global programme, Plantwise, with the aim being to provide technical support to local partners in the 24 target countries.

CABI staff based in Switzerland annually host international student placements whereby biology and agriculture students receive hands-on training in practical aspects of applied biological control research, working in project teams with high-impact outcomes. There is also a graduate student programme, with links to universities around the world. As a result, this is a truly international centre, normally with staff and students from more than a dozen countries working together each summer.

acronyms

AAFC	Agriculture and Agri-Food Canada
AAS	Academy of Agricultural Sciences (DPR Korea)
AGES	Austrian Agency for Health and Food Safety
ALARM	Assessing LArge-scale environmental Risks with tested Methods (EC RTD FP6, Integrated Project)
ANR	Agence Nationale de la Recherche (France)
APHIS	USDA Animal and Plant Health Inspection Service
ARS	USDA Agricultural Research Service
ART	Agroscope Reckenholz-Tänikon, Zurich (Switzerland)
BACCARA	Biodiversity and Climate Change, A Risk Analysis (EC RTD FP7 project)
BBCA	Biotechnology and Biological Control Agency, Rome (Italy)
BLM	USDI Bureau of Land Management
BOLD	Barcode of Life Database
Bt	*Bacillus thuringiensis*
CAAS	Chinese Academy of Agricultural Sciences (part of MoA)
CAS	Chinese Academy of Sciences
CATT	Centre for Agricultural Technology Transfer (Albania)
CATT	Centre for Agricultural Technology Transfer (DPR Korea)
CFMB	County Farm Management Board (DPR Korea)
COOPI	'Cooperazione Internazionale' (Italy/Sierra Leone)
COST	EU Cooperation in Science and Technology programme
CPHST	USDA-APHIS Center for Plant Health Science and Technology
CPPS	Central Plant Protection Station, MoA (DPR Korea)
CTI	Swiss Commission for Technology and Innovation
CTRF	County *Trichogramma* Rearing Facility (DPR Korea)
DAISIE	Delivering Alien Invasive Species Inventories for Europe (EC RTD FP6 project)
DPR Korea	Democratic People's Republic of Korea
DG EuropeAid	Directorate-General for Development and Cooperation – EuropeAid
EC	European Commission
EMBRAPA	Empresa Brasileira de Pesquisa Agropecuária/Brazilian Enterprise for Agricultural Research
EPPO	European and Mediterranean Plant Protection Organization
ERA-ARD	European Research Area – Agricultural Research for Development (EC RTD FP6)
EU	European Union
FOEN	Federal Office for the Environment (Switzerland)
FP6	RTD Sixth Framework Programme (EC)
FP7	RTD Seventh Framework Programme (EC)
FUNICA	Fundación para el Desarrollo Tecnológico Agropecuario y Forestal de Nicaragua
GDP	gross domestic product
HBERC	Hubei Biopesticides Engineering Research Center (China)
HORTI	National Horticultural Training Institute, Tengeru (Tanzania)
IBCA	invertebrate biological control agent
IBG	International Bioherbicide Group
ICM	integrated crop management

ICM-TAG	Integrated Crop Management Technical Advisory Group (DPR Korea)
IESTC	International Exchange of Science and Technology Centre (AAS, DPR Korea)
INIFAP	Instituto Nacional de Investigaciones Forestales y Agropecuarias (Mexico)
INRA	Institut Scientifique de Recherche Agronomique (France)
IOBC	International Organization for Biological Control
IP	integrated production
IPM	integrated pest management
IPP	Institute of Plant Protection, CAAS (China)
IRRI	International Rice Research Institute
ISBCW	International Symposium on Biological Control of Weeds
ISEFOR	Increasing Sustainability of European FORests: modelling for security against invasive pests and pathogens under climate change (EC RTD FP7 project)
IWGO	International Working Group on Ostrinia and other Maize Pests (IOBC)
JATROPHABILITY	Investigating impacts of *Jatropha curcas* production
Lao PDR	Lao People's Democratic Republic
LTZ	Landwirtschaftliche Technologiezentrum (Germany)
MAFFS	Ministry of Agriculture, Forestry and Food Security (Sierra Leone)
MoA	Ministry of Agriculture (China or DPR Korea depending on context)
NCBI	National Center for Biotechnology Information (USA)
NCCR	National Centres of Competence in Research (Switzerland)
NGO	non-governmental organization
NSERC	Natural Sciences and Engineering Research Council (Canada)
PAU	Kim Il Sung University – Pyongyang Agricultural University (DPR Korea)
PERMIT	Pathway Evaluation and pest Risk Management In Transport (EU COST Action)
PHN	plant health network
PMI	Philip Morris International
PPI	Plant Protection Institute, AAS, (DPR Korea)
PPW	perennial pepperweed, *Lepidium latifolium*
PRA	pest risk analysis
PRATIQUE	Enhancement of Pest Risk Analysis TechniQUEs (EC RTD FP7 project)
PROMIPAC	*Programa de Manejo Integrado de Plagas en América Central/Central American Program for Integrated Pest Management*
RTD	EC Research, Technological development and Demonstration framework programmes
SCOPES	Scientific Co-operation between Eastern Europe and Switzerland
SDC	Swiss Agency for Development and Cooperation
SMAGE	Syndicat Mixte d'Aménagement et de Gestion Equilibrée (France)
SME	small and medium-sized enterprise
SNSF	Swiss National Science Foundation
TAG	USDA-APHIS Technical Advisory Group
UNESP	Universidade Estadual Paulista (Brazil)
USDA	United States Department of Agriculture
USDI	US Department of the Interior
USDI	US Department of the Interior

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