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CABI Annual Report Switzerland 2014

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CABI improves people's lives worldwide

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

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This annual report was prepared by the staff of CABI's centre in Switzerland and covers activities in 2014. Images are attributed to the photographers as far as is known and are by CABI staff unless specified.

Front cover photo – Transplanting rice in Phattana village, Lao PDR (photo: D. Babendreier).

Inside front cover photo – Stefan Toepfer checking banana plants at the request of a commercial small holder farmer (photo: M. Matimelo, Zambia Agricultural Research Institute, Zambia).

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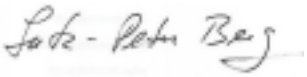
preface

Firstly, I would like to express my thanks to the team at CABI in Switzerland for inviting me to contribute to this edition of their Annual Report. It was with pleasure that I accepted, especially following the warm welcome with which I and the CABI Board members had been received during our visit to the centre in July 2014. This was the second time that the CABI Board had chosen to hold their meeting at the CABI centre in Delémont, the first time being in June 2011. I have been invited to participate in the meetings of the CABI Board for some time now, initially as an elected observer and currently as Chair of the CABI Executive Council, and I was particularly happy to join this one and have the opportunity to meet the staff of the Swiss centre and learn more about their work. I speak for both myself and the entire CABI Board when I say how impressed we were with the level of professionalism and expertise demonstrated by the staff and students at the centre in managing and implementing their project work. There is another aspect of the CABI centre which I remember very vividly – the special "buzz" that the presence of the international summer students brings to Delémont. It was a privilege to see their enthusiasm and their interest in CABI. For me, Delémont in the summer really brings CABI's international nature as a member organization and a global player in food security to life.

CABI's Executive Council is comprised of the representatives from each of CABI's 48 member countries, of which Switzerland has been one since 2000, and has the responsibility of approving CABI's annual accounts and budgets, the admission of new members and key policy decisions. It meets once a year and communicates regularly outside of these meetings in order to monitor CABI's affairs and implement resolutions that come out of CABI's Review Conferences. I have been Switzerland's representative on the Executive Council since 2003, chairing it for the last four years, and have been impressed with how CABI has continued to grow and expand its expertise over the years in order to meet its mission and goals in the area of food security. Plantwise, which commenced during my early years on the CABI Board, is CABI's first global programme and is now its flagship programme following its success and impact in strengthening plant health systems and agricultural production in 34 target countries. I was happy to meet the team that coordinates the programme out of the Swiss centre during my visit in July.

One of the things that impresses me most about CABI is its continual motivation to innovate and branch out into new territory. One example of this, which I came across during my visit to the Swiss centre, is the current collaborative effort between CABI, the University of Neuchâtel and the Canton Jura to develop a new Masters of Advanced Science programme in Integrated Crop Management, which will be implemented for the first time in 2015. This exploration into higher education is new to CABI, however, it is perfectly suited to both the existing expertise and mission of the organization. The knowledge that the students will absorb through undertaking the programme will be taken back and put to use where it is needed the most; right at the heart of the plant health systems of the students' native countries. I wish this programme every success and am looking forward to seeing its results and impact over the coming years.

Once again, I express my thanks to the Swiss team for inviting me to contribute to their Annual Report and I congratulate them on their successful and high impact work.



Dr Lutz-Peter Berg
Science & Technology Attaché,
Swiss Embassy London, UK

introduction

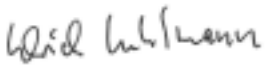
I am pleased to present another edition of the Switzerland Centre Annual Report after a year that has seen a number of noteworthy events taking place. In particular, we succeeded in securing two major research for development (R4D) projects within the Swiss Programme for Research on Global Issues for Development. This programme is part of a new funding scheme for development-related research on global issues, financed by the Swiss Agency for Development and Cooperation (SDC) and the Swiss National Science Foundation (SNSF). It is a remarkable achievement that we have been awarded two projects, one addressing woody invasive species in East Africa, led by Dr Urs Schaffner, and the other addressing insects as feed in West Africa, managed by Dr Marc Kenis. Both projects will start in 2015 and run for six years.

As Lutz-Peter Berg mentioned in the preface, our centre was requested to host a CABI Board meeting in early July this year. We were of course delighted to do so, especially following the success of the last meeting that took place here in June 2011 and the great opportunity it presented to staff and students to meet and interact with CABI management. The CABI Board is comprised of nine members and is tasked with overseeing CABI's programmes and guiding CABI's Executive Management Team on operational and strategic issues. The meeting went very well again this year and all Board members were pleased to be given the opportunity to interact with our staff and students and to receive first-hand information about the programmes that operate out of the centre.

Continuing the trend of past years, the centre's publication record was again very high this year, totalling 24 peer-reviewed publications and four non peer-reviewed publications. One of the most noteworthy of these publications was the fifth edition of 'A World Catalogue of Agents and their Target Weeds'. Both Dr Hariet Hinz and Dr Matthew Cock are co-authors on this 838 page landmark catalogue, which is the updated version of Mic Julien's original catalogue. In addition to these publications, our staff also gave 39 talks and three posters at various conferences, and generated 17 project reports. Furthermore, two PhDs and two MScs were successfully completed.

CABI's global programme Plantwise continued to be steered out of the Switzerland centre in 2014. Plantwise, which has been operating since 2011, has been growing year on year and attracting support from a number of big donors, including SDC, EuropeAid, DfID and Irish Aid. There have now been two external evaluations of Plantwise, the second of which took place this year, funded by the European Commission, focussing on six countries in sub-Saharan Africa. The conclusions of the evaluation were very positive, stating that Plantwise is a highly relevant and timely initiative and approach, and merits full donor support. Of course, this is encouraging news for CABI as an organization, and a sign of approval that the coordination team in Switzerland is doing a good job.

Finally, I would like to mention that 2015 will be my last year as Regional Director of the Switzerland centre. We will be seeking a new Country Director to take over leadership of the centre, starting 1 April 2015 with a 6-month handing over phase. Following this phase, I will remain based at the centre in my role as Regional Director for Europe & the Americas but will no longer have any direct involvement in the centre operations except for line management of the new Country Director. I have very much enjoyed the last five years of managing the centre. I feel that very positive progress has been made in many areas, particularly in terms of income generation to the centre, which has grown year upon year. This reflects the dedication and expertise of the staff, as well as their motivation to continually seek new opportunities in increasingly diverse areas of research and development cooperation. As a result of increasing income we have been able to make a number of renovations and reorganizations within the building, which has created a refreshed and more pleasant working environment for our staff. I will continue to oversee the centre's activities with great interest as part of my new role and will work together with the incoming Country Director to encourage further business development and cross-centre collaborations in order to enable the centre to further flourish as part of CABI.



Dr Ulrich Kuhlmann
Regional Director CABI Switzerland &
Plantwise Programme Executive

Dieter Schroeder: 1935–2014

Dr Dieter Schroeder, former Director and Head of Weed Biological Control of the CABI centre in Switzerland, passed away on 28 March 2014. Dieter led a rich and fulfilled life and his sudden death caught all of us at CABI by surprise since we had never seen him sick and he did not appear to age, even after his retirement.

Dieter was born in Magdeburg, Germany, on 12 September 1935 and spent his youth in the eastern sector of Germany after the Second World War. His wish to study biology could not be realized under the new socialist conditions in which he was living, but since he was a trained lumberjack he was ordered to study forestry. Three months before his final examinations he was forced to leave the eastern sector of Germany prior to the construction of the wall separating East and West Germany. Arriving in West Germany with little more than his briefcase, he finished his Diploma studies in Göttingen. In 1960 he accepted an offer to become junior entomologist at what was known back then as the European Station of the Commonwealth Institute of Biological Control, at Delémont in Switzerland, working on biological control of forest pests, which also became the subject of his PhD thesis in 1965.

In 1969 he joined Helmut Zwölfer, the leader of the Weeds Section at that time, in his work on biological control of invasive plants. In October 1969, however, he took a temporary posting to Ghana where he set up the new West African Sub-station of CIBC at Kumasi and instigated work on pests of maize, rice, cocoa and water weeds, before returning to Delémont in August 1970. He took over responsibility for the Weeds Section in 1973, and from the late 1970s concentrated on weed biological control, which developed into a major programme at CABI in Switzerland, involving six research scientists and several Diploma and PhD students. With the support of Peter Harris, another pioneer of weed biological control, affiliated with what is now Agriculture and Agri-Food Canada, Dieter put a lot of effort into encouraging Canadian and US scientists and sponsors to join forces and form funding consortia to enable projects to be carried out in the area of biological control of invasive weeds. The consortia approach continues today, with 14 different donors currently providing financial support to the Weeds Section at CABI in Switzerland.

Soon after taking over as Weeds Section leader, Dieter established close cooperation with the USDA-ARS (US Department of Agriculture – Agricultural Research Service), the EBCL (European Biological Control Laboratory and its forerunners) and the CSIRO (Commonwealth Scientific and Industrial Research Organisation, Australia) European Laboratory in France. Together with Paul Dunn of the EBCL, he initiated annual meetings of the three groups to exchange information and prevent duplication of work. These regular 'tripartite meetings' between CABI, USDA-ARS and CSIRO continue to this day.

From 1996 until 2000, Dieter was the Director of CABI in Switzerland during which time he helped the centre to grow by pushing through the construction of an extension to the building that increased the available space by 50%. Under his leadership, the weed biocontrol programme made important contributions to biological control of leafy spurge (*Euphorbia esula*), spotted and diffuse knapweeds (*Centaurea* spp.), purple loosestrife (*Lythrum salicaria*) and Dalmatian toadflax (*Linaria dalmatica*). After four successful years of steering the centre, Dieter retired in 2000.

Apart from his weed work, Dieter travelled the world, teaching on CABI's international training courses in biological control held in India, Trinidad, Pakistan and Kenya, and providing expert input to projects and organizations. He participated in many symposia in numerous countries, and was proud to have attended every International Symposium on Biological Control of Weeds from the first, which he co-organized in 1969, until he retired, after being an honouree at the X Symposium in Montana in 1999. He was founder and chairman of the Biological Weed Control working group of the European Weed Research Society from 1983 to 1989. He wrote and co-authored over 120 publications that have greatly stimulated ecological thinking in the area of biological control.

Dieter will be remembered by all of us not only for his strong opinions and his strong will, but also for his inexhaustible enthusiasm and humour, his worldly wisdom, his charisma and last but not least, his great story telling. Dieter was a real character and the kind of person that left a deep impression on most people he met. There is rarely a meeting in North America we go to where somebody does not ask about Dieter. The many students that he introduced to biological control and that he mentored, including some of us, are some of his most indelible footprints.

We have lost a great man and one of the last pioneers of weed biological control.

The following messages are among those that reached us from colleagues all over the world. They speak for themselves.

Cliff Moran (retired, University of Cape Town, South Africa)

"I had, and have, the greatest respect and admiration for Dieter as a role-model scientist and as a man of utmost integrity."

John Hoffmann (University of Cape Town, South Africa)

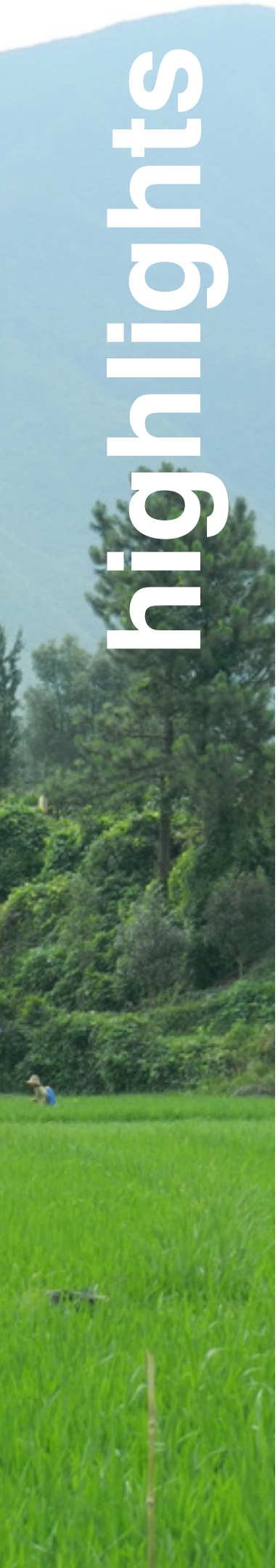
"He will long be remembered as a larger than life gentleman and a scholar of the highest order. I feel especially privileged to have known him and to have interacted with him. He will be sorely missed by many of his associates. His life stories were legendary."

Heinz Müller-Schärer (University of Fribourg, Switzerland)

"He was my great ideal for my scientific work, he introduced me to entomology and biological control, to weeds and to ecology. More importantly, I learnt so much from him for my life, and his thoughts, ideas and views, and his great mission, enthusiasm and good mood will hopefully continue through us who had the great luck to pass some time with him. I will surely miss him a lot."

Andy Sheppard (CSIRO, Australia)

"Dieter affected all our lives in such a profound way. The passion, the wit, the honesty, the story telling, the open armed nature of his welcome, the pure character and charisma. I have many Dieter stories that still make me laugh and you knew there was never a dull moment with Dieter in the room. Dieter was one of the people who made my first few years as a biocontrol scientist a special time when I felt privileged to be working in such a collaborative international scientific fraternity. I will sorely miss him as he was one of a kind."



highlights

CABI joins prestigious Marie Skłodowska-Curie Innovative Training Network

In September 2014, the Marie Skłodowska-Curie Innovative Training Network BINGO (Breeding Invertebrates for Next Generation BioControl) was granted by the EU. CABI will participate in this network, which develops innovative research training to improve the production and performance of natural enemies in biological control by the use of genetic variation for rearing, monitoring and performance. The programme combines integrated training workshops and internship opportunities across the network, with career opportunities in academia, public or the private sectors. BINGO is funded by the EU Horizon 2020 programme and involves 12 partners from academia, non-profit organizations and industry located in the Netherlands, Germany, France, Spain, Czech Republic, Austria, Switzerland, Greece and Portugal.

Participants of the BINGO kick-off meeting at Wageningen (photo: M. Meijer zu Schlochtern, Wageningen University)

CABI Switzerland increases its involvement in research on insects as feed

The Risk Analysis and Invasion Ecology section has been involved since 2013 in research on insects used as animal feed through its participation in the EU-FP7 project PROteINSECT (Enabling the exploitation of insects as a sustainable source of protein for animal feed and human nutrition) in which we are exploring the use of fly larvae as an alternative source of protein for animal nutrition in Europe, China and West Africa. This year, we gained another large research project, IFWA (Insects as feed in West Africa), which will last for six years. The project is funded by SDC and the Swiss National Science Foundation. It is coordinated by the CABI centre in Switzerland and involves seven other partners from Ghana, Benin, Burkina Faso and Switzerland. IFWA focuses on the use of fly larvae and termites in smallholder farms in West Africa. The two projects are generating much interest in a quickly developing field and it is likely that studies on the use of insects as animal feed as well as human food will gain in importance at CABI in the near future.

Saidou Nacambo presenting the results of PROteINSECT at the international congress “Insects to Feed the World” in the Netherlands, May 2014 (photo: G. Melzer, Eutema GmbH, Vienna, Austria)

Plantwise, the International Plant Protection Convention and the FAO work together to lead successful workshops for coordinated plant protection in Africa

From Rwanda, Uganda, Kenya and Tanzania, key representatives of agricultural institutions gathered in Nairobi in February of 2014 for the first ever joint workshop led by CABI's Plantwise programme and the International Plant Protection Convention (IPPC) Secretariat. This pilot workshop was convened in an effort to exchange national experiences in plant protection and pave the way for renewed strategies to share plant pest information from the region. Participants included representatives from each country's National Plant Protection Organisation (NPPO), agricultural extension organizations, research and universities and members of the Plantwise team. The IPPC Secretariat provided an overview of the IPPC, the functions of NPPOs and their national reporting obligations (NROs). CABI gave an overview of the Plantwise programme, explained plant clinic data management and introduced tools available through the Plantwise knowledge bank that could be useful to NPPOs. Various participants presented their NPPO functions and national frameworks for the implementation of Plantwise, including activities relating to validation and using plant clinic data. The country teams worked through case studies and exercises that served as an opportunity for them to plan together how to respond to emerging problems such as the detection of a new pest. The workshop concluded with the national teams developing action plans that should enable Plantwise to assist their countries in fulfilling their obligations under the IPPC. A video from the workshop in Nairobi is available online through the Plantwise blog: http://blog.plantwise.org/2014/02/28/ippc-and-plantwise-lead-successful-workshop-for-coordinated-plant-protection-in-east-africa/. [or here http://vimeo.com/89908231]

The response to the workshop in Nairobi was positive and the participants recommended that it should be used as a model for similar workshops in other regions. Subsequently, representatives of agricultural institutions from Ghana, Malawi, Sierra Leone and Zambia gathered from 29 July to 1 August in Accra for a second joint workshop of CABI's Plantwise programme, the Secretariat of the International Plant Protection Convention (IPPC) and the FAO's Pesticide Management Group. The delegations for each country included representatives from the NPPOs, the national regulatory authorities for pesticides, agricultural extension, research and universities as well as members of the teams implementing Plantwise at a national level. Other resource persons represented the African Regional Office of the FAO, the Bureau of the Commission on Phytosanitary Measures (CPM), the Inter-African Phytosanitary Council (IAPSC) and the Southern African Development Community (SADC). The programme was similar to that of the workshop in Nairobi with the addition of a component on pesticide risk reduction. The FAO gave an overview of its work related to pesticides and introduced some guidelines and tools to support pesticide management. Representatives of each country presented on topics such as Plantwise in their countries, their NPPO, pest risk analysis and pesticide management. The country teams planned together how to respond to pest management issues such as the introduction of a new pest or problems with pesticides. The teams concluded by developing action plans to address some of the issues discussed in the workshop. Participants were enthusiastic about the workshop and recommended that Plantwise/CABI, the IPPC and the FAO explore other means of working together. Suggestions included sharing important or urgent information via an email listserver, joint portal, websites such as the knowledge bank, joint circulars, etc. Other ideas included further joint meetings and training activities.

Group work during the workshop in Accra (photo: J. Dennis)

Group photo for the joint workshop in Nairobi (photo: J. Dennis)

Group photo from the workshop in Accra (photo: J. Dennis)

Plantwise progress and renewed support at Donor Forum 2014

The Plantwise Donor Forum held its third annual meeting at CABI in Delémont to share the headline achievements, challenges and opportunities for the global food security programme in its efforts to reduce crop losses and improve rural livelihoods worldwide. All key donors were invited to attend, and those participating included the Swiss Development and Cooperation Agency (SDC), the European Commission (DEVCO EuropeAid), Irish Aid, the International Fund for Agricultural Development (IFAD) and the UK Department for International Development (DfID). The meeting participants also included external evaluators and, for the first time, two Plantwise National Coordinators (from Rwanda and Malawi) to provide first-hand accounts of their experience embedding Plantwise within national frameworks.

National data validation, which allows countries to ensure quality diagnosis and advice given at plant clinics, can also provide unique insights into the differing needs of men and women farmers. “This very useful,” commented Mrs Danila Chiaro of the EC. “It’s the kind of success we don’t often see in projects, working specifically on the role of gender.”

Plantwise National Coordinator with the Ministry of Agriculture in Malawi, Mrs Clodina Chowa, pointed out that Plantwise data is already supporting the government’s strategic interventions to reduce plant health problems. “The data has been used to improve knowledge of top crops and pests in Malawi, concentrating the power of limited resources and funding.”

“This is what is very unique to Plantwise- the focus on institutional strengthening,” says Dr Carmen Thönnissen of SDC. Supporting growth of skills and technology that will empower countries to sustain activities now becomes increasingly critical as more partners prepare to take over.

Among the programme highlights from the 33 countries, there were over 120 training workshops for 1700 national plant health specialists, including new plant doctors, data managers and national trainers ready to bring Plantwise to future generations. The launch of the Plantwise Online Management System (POMS) has given both CABI and its partners an additional tool for monitoring programme operation and analysing plant clinic data. As a result of concepts and activities developed through the Plantwise knowledge bank, Plantwise was the winner of the Open Data Award for Social Impact in 2014 for ‘innovation in targeting data usage towards a substantial societal issue’.

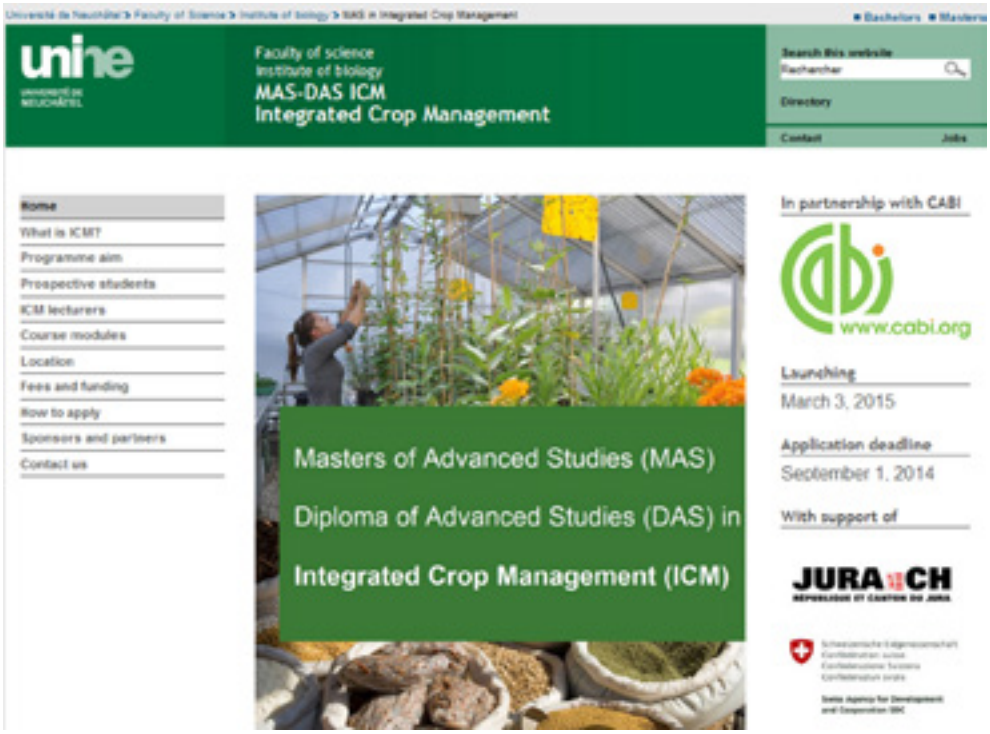
“Congratulations on what you have achieved and what has been done so far,” encouraged the Head of SDC’s Global Food Security Programme Dr Peter Bieler. “Go on and continue this fascinating work, adapting Plantwise as needed on the way.”

Key Plantwise stakeholders come together at CABI’s Switzerland centre for the Donor Forum meeting (photo: J. Dennis)

groundwork laid for the first inaugural class of the Masters of Advanced Studies for Integrated Crop Management

Drawing on its years of experience in the area of integrated crop management, CABI's Swiss centre, in partnership with the University of Neuchâtel and supported by the SDC, the Canton of Jura and Plantwise, will roll out the Canton's first post-secondary education programme. The Master of Advanced Studies course in Integrated Crop Management (MAS ICM), which begins in March of 2015, will provide advanced teaching in the field of sustainable agriculture and promote the adoption of sound crop management principles. Through pursuing the MAS in ICM, the ability of students to address global challenges such as food security, resource management and environmental change will be enhanced. The students will learn to explore solutions that can be incorporated into practice and policy back home. Modules will include lectures, research demonstrations, field visits, and study tours to partner organisations. The programme will be led by ICM experts from CABI and the University of Neuchâtel, and it will feature interdisciplinary guest lecturers from around the world. The MAS itself will take place at the CABI centre in Delémont and will require students to obtain a minimum of 60 credit points according to the European Credit Transfer and Accumulation System (ECTS).

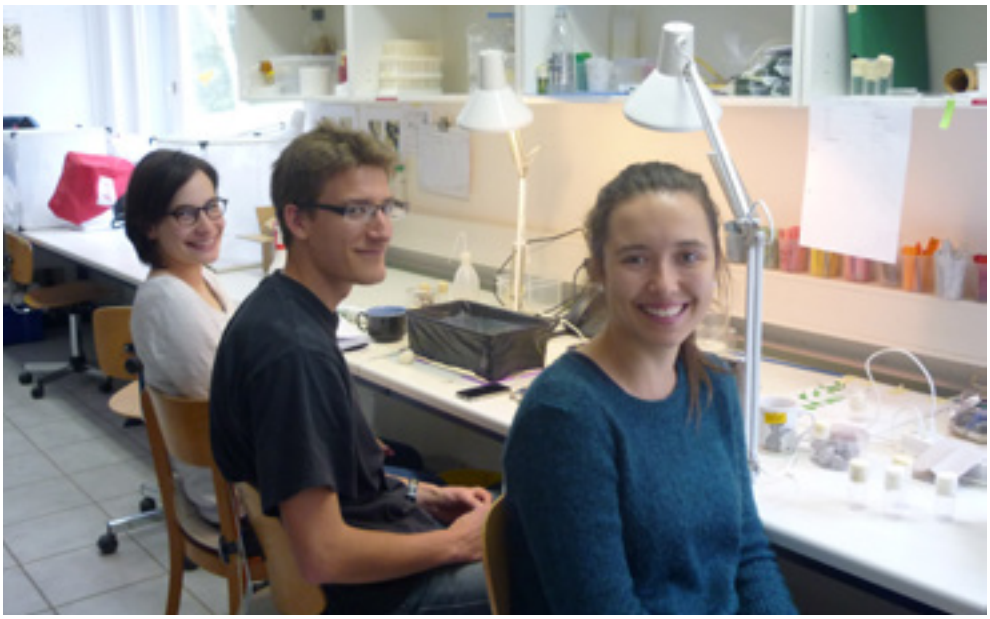
In the summer of 2014 a webpage for the MAS ICM was launched on the website of the University of Neuchâtel (http://www2.unine.ch/mas-icm/) and students were invited to apply to the programme. This announcement was met with a lot of interest and excitement. More than 100 applications were received by the September deadline. The twelve students accepted to the programme will bring a diverse range of experiences and backgrounds to the course. The participants will include university lecturers, researchers from agricultural institutes, policy-makers and extension officers. Eleven countries will be represented: Costa Rica, Ethiopia, Ghana, Kenya, Nepal, Pakistan, Rwanda, Sierra Leone, Sri Lanka, Tanzania and Zambia. Each of the students will receive a full scholarship.



Screenshot of the webpage for the MAS ICM (http://www2.unine.ch/mas-icm/)

collaboration with the University of Neuchâtel

In 2014 CABI was, for the third time, a host institute for Bachelor's students taking a problem-based learning (PBL) course at the University of Neuchâtel. During March and April, three students spent about three weeks at CABI working on "Risk assessment of weed biological control agents" using *Ceutorhynchus cardariae*, a gall-forming weevil on whitetop, *Lepidium draba*, as a model system.



Anaïs Cattin, Frédéric Sandoz and Estelle Bruni, PBL students from the University of Neuchâtel at CABI (photo: H.L. Hinz)

monitoring and evaluation training for ICM team in Delémont

In September, the ICM team took part in an intensive three-day training on Monitoring and Evaluation (M&E) with INTRAC (International NGO Training and Research Centre). The objectives of the training were to understand the purposes of M&E for ICM projects; to develop an understanding of effective M&E processes; to learn how to develop good objectives, define indicators and monitor performance against indicators; to be able to select and use a range of M&E methods effectively, particularly for collecting outcome and impact data; and to consider the ICM team's role in bringing about improved M&E within our programmes. Training topics included: how to design, plan, and implement M&E; outcome mapping; and an introduction to theory of change. The training proved to be beneficial not only for learning new methods of M&E, but also for assessing and improving the methods that are already in use by the ICM team.

ICM team members at the M&E training (photo: M. Grossrieder)

training course on experimental design and statistics

As an important capacity building activity for the MoA-CABI Joint Laboratory for Biosafety, Dirk Babendreier, based at CABI in Switzerland, conducted a training course on experimental design and statistical data analysis in October 2014 at the Institute of Plant Protection (IPP) of the Chinese Academy of Agricultural Sciences (CAAS). The course was opened by Julien Chen, Director of International Cooperation and Graduate Students, and was attended by some 25 junior scientists and postgraduate students from the Joint Laboratory and IPP-CAAS. The training was characterized by lectures and extensive group work to enlarge the knowledge of participants on crucial points of designing experiments in the field of agriculture and conducting sound analysis of data obtained. This was followed by one-to-one discussions with selected staff to make progress on individual research topics.

The training course was highly appreciated by CABI China and IPP-CAAS as a way to help increase the competence and capacity of younger researchers at an early stage of their research career. The participants were all pleased with the training content, particularly the participatory group work approach. Considerable new knowledge was gathered by participants in a short period of time and will be practiced and integrated with their own work to improve the quality of research at the MoA-CABI Joint Laboratory and IPP-CAAS.

Participants proudly presenting their certificates of successful course completion (photo: MoA-CABI Joint Laboratory)

Luca Heeb (photo: E. Gerber)

Julien Grunder (photo: E. Gerber)

the ICM team expands

The ICM team grew in 2014, with two new members coming on board to help implement the increasing number of projects being managed by the group: Luca Heeb and Julien Grunder (both from Switzerland). Luca has an academic background in tropical agriculture with a major in sustainable production systems and a minor in natural resource management. Through his previous work with different Swiss development NGOs he has experience in working on agricultural development projects in Asia (Bangladesh), Africa (Ghana), and the Caucasus (Azerbaijan) as well as on agricultural research projects in Switzerland. Julien has a MSc in agricultural sciences with a major in agricultural economics and a minor in plant protection, and he is also trained as farmer. Through previous work with the Swiss Agency for Development and Cooperation (SDC) and the Permanent Mission of Switzerland to the FAO, International Fund for Agricultural Development (IFAD) and World Food Programme (WFP), he also has experience working in both the bilateral and multilateral context of international cooperation.

As ICM advisors, the new team members work directly with farmers, extension workers, researchers, government representatives and other plant protection stakeholders to develop and implement sustainable solutions to agricultural problems. This involves developing frameworks for the implementation of ICM, production guidelines, curricula for farmer training programmes using participatory approaches, locally adapted strategies for capacity building and technology/knowledge transfer and soil management practices.

Stefan Toepfer seconded from CABI in Switzerland to MoA-CABI Joint Laboratory in Beijing

Swiss-based plant protection scientist Stefan Toepfer was seconded with his family to the Joint Laboratory for Biosafety of the Ministry of Agriculture and CABI in Beijing, China, from August 2014 onwards. Stefan joined the research team of the Joint Laboratory, which is based at the Institute of Plant Protection of the Chinese Academy of Agricultural Sciences (IPP-CAAS), and which is one of CABI's major collaborators as well as being a key player in agricultural research in China. Stefan's main task is to help strengthen the research capacity and national/international reputation of the Joint Laboratory through supporting junior researchers in planning and conducting their research in the field of invasive species management, in reporting to donors, and in publishing their findings in peer reviewed scientific journals. This is being carried out in close collaboration with Prof. Qiu Dewen, Deputy Director of IPP-CAAS and Prof. Wang Zhenying, head of the maize insect pest research group, as well as a number of scientists of other relevant research groups of IPP-CAAS. Stefan is also providing strong support to CABI staff in East Asia for the implementation of international development projects in the region, such as Plantwise in China or food security projects in DPR Korea.

Stefan Toepfer from CABI discussing a newly-emerging maize pest, the double dotted leaf beetle, Monolepta hieroglyphica, with county plant protection experts near Hohhot, Inner Mongolia (photo: Zhenying W., IPP-CAAS)

The Institute of Plant Protection of the Chinese Academy of Agricultural Sciences in Beijing, China, where the MoA-CABI Joint Laboratory for Biosafety is based (photo: Wan H.)

Stefan Toepfer from CABI in Switzerland seconded to the Joint Laboratory for Biosafety of the Ministry of Agriculture of China and CABI in Beijng (photo: I. Toepfer)

new steering committee members of the MoA-CABI Joint Laboratory

The new Steering Committee was voted-in during its 6th annual meeting held in Dehong Prefecture of Yunnan Province, China on 13–14 March 2014. Acting as the governing body of the MoA-CABI Joint Laboratory, the Steering Committee comprises eight senior representatives from the Chinese Ministry of Agriculture, CABI, the Chinese Academy of Agricultural Sciences (CAAS), and the Institute of Plant Protection (IPP) of CAAS. Mr Ian Barry, CABI's Chief Financial Officer, was elected as the 2014 Chair of the Steering Committee. Dr Ulrich Kuhlmann, CABI's Regional Director, Europe & the Americas, and Prof Zhou Xueping, Director General of IPP-CAAS were chosen as Co-Directors.

The MoA-CABI Joint Laboratory, located in IPP-CAAS, Beijing, is an initiative between the Chinese Ministry of Agriculture and CABI. It functions as a platform for research collaboration and technology transfer and as a centre of excellence for training and scientific exchanges. "We are very pleased that the Joint Laboratory has been developed into an open platform for co-operation among China, CABI and CABI's member countries. Through the platform, different cultures and working styles come together and are internationalized, and individuals' careers developed." said Dr Tang Shengyao, the 2013 Chair of Steering Committee and Deputy Director General of International Co-operations, Chinese Ministry of Agriculture.

Joint Laboratory Co-Directors Ulrich Kuhlmann and Zhou Xueping (right) together with Prof Wu Kongming, CAAS Vice President and Steering Committee member (photo: Zhang F.)

Media preparation and harvesting room, nematode production facility, Unjon County, North Pyongan (photo: K. Holmes)

17 entomopathogenic nematode mass production facilities established in DPR Korea

During a Directorate-General for Development and Cooperation – EuropeAid (DG EuropeAid) funded project (see Integrated Crop Management p. 73), 17 facilities were established to mass-produce beneficial nematodes that target soil insect pests. An experimental facility was installed in 2012 at the Plant Protection Institute, Academy of Agricultural Science, (AAS-PPI) Pyongyang, DPR Korea, to aid in the development of *in-vitro* and *in-vivo* mass production methods suitable for DPR Korea. A prototype facility was established at the Central Plant Protection Station, Department of Plant Protection, Ministry of Agriculture (MoA-CPPS), Pyongyang, in 2013. This facility supports both mass production methods, and served as the base for dissemination to the provincial and county level.

Between 2013 and 2014, three in-vitro facilities were established at the higher administrative provincial level, at the provincial plant protection stations in Sariwon City, North Hwanghae, Haeju City, South Hwanghae and at Sinuiju City, North Pyongan.

Similarly from 2012 to 2014, nine *in-vitro* facilities were established at the county level plant protection stations at Anak County, Sinwon County and Ongjin County, all in South Hwanghae, Yontan County, North Hwanghae, Kosan County, Kangwon, Sukchon County, South Pyongan, Unjon County and Dongrim County, North Pyongan and at Sinchon County, South Hwanghae. Three pilot facilities at cooperative farms were also established (Ryongsan, Anak County, Woldang, Sinwon County and Up, Ongjin County, South Hwanghae) utilizing the *in-vivo* method.

In 2014, the first year of production, the facilities mass-produced and supplied a total of 70 farms with beneficial nematodes. Application was focussed on maize seedbeds, prior to transplanting to the field, with over 500 ha of seedbeds treated. There are already indications of a positive effect on maize yield. It is expected that in the future with more proficient mass production, and increased distribution to farms, that the impact on yield will be increasingly significant.

Successful establishment was achieved through numerous consultancy visits by CABI staff based in Switzerland and China, supported by Chinese and Swiss nematode mass production specialists from Lvbenyuan Biotechnology Co. Ltd., Guangzhou, China, and Andermatt Biocontrol AG, Grossdietwil, Switzerland and a strong network of partners in DPR Korea.

Nematode mass production flasks, nematode production facility, Kosan County, Kangwon (photo: Ri H.C., CABI-KECCA Liaison Officer)

Malaysia and Vietnam National Plant Protection Organisations exchange knowledge and experiences with Ministry of Agriculture Department of Plant Protection, DPR Korea

As part of a DG DEVCO EuropeAid funded Partnership Project (see p. 72) an Institutional Exchange study tour took place between 7 and 19 April 2014. A delegation comprising five representatives from the Department of Plant Protection, Ministry of Agriculture (MoA-DoPP), DPR Korea, travelled to Malaysia and Vietnam to build upon previous knowledge gained from the Awareness Raising Study Tour in 2013 (see Highlights p.11, Annual Report 2013) on the roles and responsibilities of the National Plant Protection Organisations (NPPO) and national best practices. In Malaysia (8 to 12 April 2014) the delegation initially visited Sugai Burong to review the rice production and IPM programme in Malaysia. The delegation then travelled to the Cameron Highlands and visited a number of commercial vegetable producers and looked at production methods, GAP, and biocontrol use. Within Malaysia the delegation was accompanied by representatives from the Plant Biosecurity Division, Department of Agriculture, Malaysia (PBSD). On the final day of the visit a workshop was held at the PBSD headquarters in the Cameron Highlands where the Director General, Mr Yusuf Othman, presented information on the institutional organisation of the PBSD, key responsibilities and implementation of key plant protection activities, both nationally and internationally.

The delegation subsequently travelled to Vietnam to meet with representatives of the Plant Protection Department of the Ministry of Agriculture and Rural Development, Vietnam (PPD) (13 to 15 April 2014). The delegation travelled to Hai Phong City, Quangh Ninh Province, on 13 April 2014 and met with the Plant Protection Sub-Department to discuss roles and responsibilities, pesticide management, pest management and internal quarantine. This was followed by a meeting with the PPD Region 1 sub-Department for Plant Quarantine who discussed their role in the organisation of internal and external quarantine and sanitary phytosanitary issues for export and import. Later, in Hung Yen Province at the Northern Regional Centre for Plant Protection, the PPD pest monitoring and forecasting system was discussed. A final meeting was held at the PPD in Hanoi, on 15 April 2014 where the Deputy Director General Mr Ngo Tien Dung outlined the organisation of the PPD, key responsibilities and implementation of key plant protection activities nationally and internationally. The study tour in Vietnam ended with a visit to a vegetable farm in Gia Lam District, Hanoi.

The experience and knowledge gained from this study tour will be used to further adapt the institutional organisation and key roles and responsibilities of the MoA-DoPP to enhance its ability to perform its role as the NPPO for DPR Korea.

Representatives of PBSD, Malaysia and MoA-DoPP during a meeting in the Cameron Highlands, Malaysia (photo: K. Holmes)

Representatives of PPD, Vietnam and MoA-DoPP, DPR Korea during a meeting in Hanoi, Vietnam (photo: K. Holmes)

Adult of *Rhinusa pilosa* (photo: I. Toševski)

two new weed biocontrol agents released in Canada

Mainly based on work conducted by our colleague Ivo Toševski in Serbia, supported by a consortium of Canadian and US entities, a petition for field release for the stem-gall forming weevil *Rhinusa pilosa* against *Linaria vulgaris* in Canada and the USA was jointly submitted in March 2012 by Rosemarie De Clerck-Floate, and Sharlene Sing from the US Forest Service (USFS), Rocky Mountain Research Station, Bozeman, Montana. In September 2013 the USDA-APHIS (US Department of Agriculture – Animal and Plant Health Inspection Service) Technical Advisory Group for the Biological Control of Weeds and the Canadian Biological Control Review Committee recommended its release, and in April 2014, the Canadian Food Inspection Agency gave the go-ahead for field releases in Canada. The first release of R. pilosa took place in southeastern British Columbia (BC) on 8 May, followed by five further releases in northern BC and Alberta over the next few weeks. In August, gall development was confirmed at all eight release sites.

The second agent, the leaf-feeding noctuid moth, *Hypena opulenta*, has been screened mostly by Aaron Weed in the quarantine facility of the University of Rhode Island, USA, with insects sourced from Ukraine via CABI in Switzerland. Host-specificity tests conducted with more than 80 test plant species showed that *H. opulenta* is very host specific with successful larval development restricted to *Vincetoxicum* spp. In 2013, Canada approved release of the moth and first field releases were made by Rob Bourchier (Agriculture and Agri-Food Canada) and Naomi Cappuccino (Carleton University). In 2014, additional releases of almost 10,000 larvae and 500 pupae where conducted between the end of June and early-August in the Ottawa area and in Simcoe County. A second generation of *Hypena* larvae was confirmed from the Ottawa releases in late August and larvae had spread from the initial release site approximately 50 metres away.

For both agents, we are hoping that release in the USA will follow in 2015.

Larva of *Hypena opulenta* defoliating *Vincetoxicum* after release in Canada (photo: R. Bourchier, AAFC, Lethbridge)

the XIV International Symposium on Biological Control of Weeds

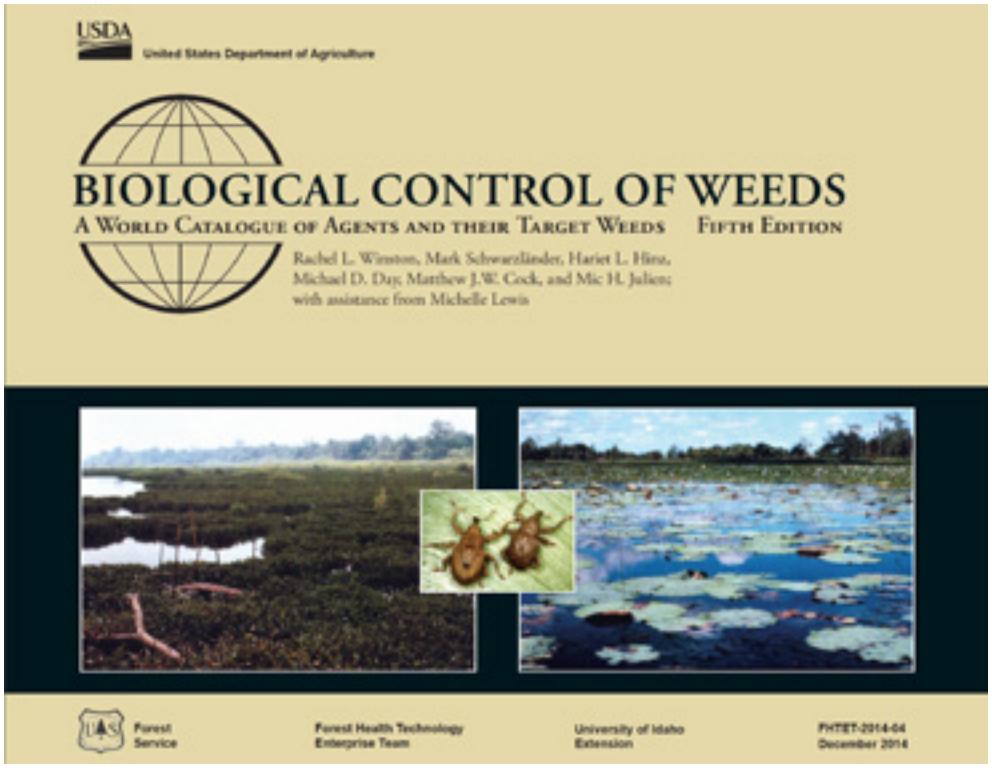
The International Symposium on Biological Control of Weeds (ISBCW) is the most important conference in the field of biological weed control. Not surprisingly, CABI was therefore well represented in Krüger National Park, South Africa, 3–6 March 2014 for the XIVth edition of this meeting. Between our Swiss, UK, China and Africa centres, a total of 14 CABI staff members participated, giving 12 oral presentations, seven short oral poster presentations, chairing three sessions and organizing one workshop. As usual, many formal and informal meetings were held between and after sessions with the many collaborators present. Of course we also benefited from the game tours organized almost each day before or after sessions. Unfortunately, possibly due to increasing funding constraints and travel restrictions, the Symposium was only attended by 156 delegates from 24 countries. We hope to bring the numbers up again for the next meeting, which will be held in Switzerland in September 2018, and which will be organized by the CABI Swiss and UK weeds groups. It is worth noting that the very first ISBCW meeting took place in Delémont, Switzerland, in 1969.

Current and former CABI staff participating in the XIV International Symposium of Biological Control of Weeds in March 2014 in South Africa (photo: A. J. McConnachie, Agricultural Research Council, South Africa)

the “Bible” of weed biocontrol revised

The *‘Biological Control of Weeds: a World Catalogue of Agents and Their Target Weeds’* lists all intentional and accidental weed biological control introductions worldwide, and also those organisms utilized for weed biocontrol in their native ranges. In addition, the catalogue provides data on the establishment and degree of control and information on factors that may limit biocontrol agents. It is, therefore, the most important resource on the status of weed biocontrol agents worldwide. However, the quality of the data in the catalogue relies on regular updating. In this respect, the fourth edition of the catalogue, published in 1998, was in dire need of a revision. After various discussions, Mark Schwarzländer (University of Idaho, USA), was able in 2009 to secure funding from the US Forest Service (Carol Randall and Richard Reardon) and engaged Rachel Winston and Michelle Lewis, two consultants with MIA Consulting based in Shelley, Idaho. Rachel and Michelle took on the colossal task of first entering all hardcopy data from the fourth edition, getting hold of any and all references and scanning them for relevant content, and finally contacting weed biocontrol scientists and practitioners around the world for help with the update of information for specific weeds. Rachel and Michelle were assisted by Mic Julien, Mark Schwarzländer, Hariet Hinz (Head of the Weed Biocontrol Section at CABI in Switzerland), Matthew Cock (Chief Scientist at CABI) and Michael Day (Queensland Department of Agriculture, Fisheries and Forestry, Australia). The new catalogue includes 224 target weed species, 551 biocontrol agent species and more than 2800 references on nearly 1000 pages. In addition, it was decided to make the catalogue available online (http://www.ibiocontrol.org/catalog/). The latter has been facilitated by Chuck Bargeron at the Center for Invasive Species and Ecosystem Health, University of Georgia, USA.

The hardcopy version of this monumental task has been printed free of charge (!) by the US Forest Service and will be available at the beginning of 2015. Provided additional funding can be secured, the plan is to update the catalogue continuously and not to wait for another 16 years!



Cover of the hardcopy of the 5th edition of the “World catalogue of agents and their target weeds”

successful IWGO conference in Chicago

Following long standing tradition, 104 scientists from 15 countries met in Chicago, USA to attend the 25th Conference of the International Working Group of Ostrinia and other maize pests (IWGO) from 13–17 April 2014. IWGO is a global working group of the International Organisation of Biological Control (IOBC Global). Participants came from North America, Europe, Asia, South America and Africa. For the first time, Dr Ulrich Kuhlmann, Convenor of IWGO, was able to welcome participants from Argentina, Brazil, South Africa, South Korea and Lao PDR, clearly demonstrating the high and growing global interest in this IWGO Conference and its scientific programme.

The 25th IWGO Conference was linked again with the 4th International Conference on Diabrotica Genetics, and was notably unique in being jointly held for the first time together with the North Central Corn Entomologist Technical Committees (NCCC46 and NC205). An impressive number of 60 professional oral presentations were given during the 12 scientific sessions and 21 posters presented, resulting in a packed but exciting programme. The ICM team based at CABI in Switzerland contributed to the conference considerably, in particular through a session on 'Science-based knowledge transfer to improve maize production and enhance food security in developing countries'. The well-organized conference was clearly successful in exchanging the newest information on innovative management of maize pests, both above and below ground, and facilitated opportunities to foster new collaborative projects between scientists who use a variety of different approaches to tackle similar problems.

Participants listening to one of the many interesting talks of the IWGO conference (photo: T. Sappington, USDA)

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 twice per year on a face-to-face basis and twice per year via video- or teleconference to oversee and advise on CABI's programmes and general operations. The Board itself is independent, comprised of eight external, international experts, with Mr John Ripley, former Unilever Head of Corporate Development, acting as Chair since August 2010. CABI's CEO, Trevor Nicholls, and Chief Financial Officer, Ian Barry, also sit on the Board. On 1 and 2 July 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. A reception was organised on one of the evenings to provide the Board members with an opportunity to meet the centre's PhD, MSc and summer students.

CABI Board members in action (photo: J. Dennis)

Speeches being given during the reception event (photo: T. Haye)

CABI hosts the Swiss Expert Committee for Biosafety

On 11 April, CABI welcomed members of the Swiss Expert Committee for Biosafety (SECB) to inform them about CABI's work on invasive species in Switzerland and quarantine practices at the Swiss centre. From 2015 onwards, Tim Haye will join the committee as an expert on invasive arthropods and exotic biological control agents.

Urs Schaffner introduces CABI to the Swiss Expert Committee for Biosafety (photo: T. Haye).

renovation of the facades

As in previous years, 2014 saw a major improvement of our 49 year-old building with the isolation and renovation of the facades. This included the building of a 20cm thick heat insulation layer, the renovation of the entrance door, fresh painting of the exterior walls and doors as well as new window blinds. It is expected that this will result in a 10-15% saving in oil consumption.

West side of the CABI building, 12 September 2014 (photo: A. Gassmann)

student highlights

Alicia Leroux defends her Master's thesis at the University of Manitoba

Alicia Leroux successfully defended her Master's thesis entitled 'Biological studies of a European fruit fly, *Euphranta connexa* (Diptera: Tephritidae), a candidate biological control agent for invasive swallow-worts, *Vincetoxicum rossicum* (Kleopow) Barbar and *V. nigrum* (L.) (Apocynaceae)' on 27 January 2014. This study was supervised by Prof. Neil J. Holliday (University of Manitoba) and Drs André Gassmann and Hariet L. Hinz (CABI).

Alicia Leroux (photo: A. Gassmann)

CABI summer student wins ESC award

The Entomological Society of Canada (ESC) awarded the 2014 President's Prize for Pest Management to Tina Dancau (Simon Fraser University) for her presentation on "Mortality factors affecting the diamondback moth (*Plutella xylostella*) in continental Europe: a preliminary life table analysis". At the Joint Annual Meeting of the Entomological Societies of Canada and Saskatchewan at Saskatoon (28 September to 1 October 2014) Tina presented research that she had conducted at the Swiss CABI centre under the supervision of Dr Tim Haye, Dr Peter Mason and Dr Dave Gillespie. Tina is one of the first undergraduate students to win this prestigious award.

Tina Dancau, winner of the 2014 President's Prize for Pest Management (photo: T. Haye)

Pierre Girod, new PhD student working on *Drosophila suzukii*

Pierre Girod has begun work towards a PhD within the framework of the DROPSA project on the ecology and biological control of the spotted-wing drosophila, *Drosophila suzukii*. The thesis is funded by the University of Neuchâtel and CABI. Pierre has already completed his MSc on *D. suzukii* in France. For his PhD thesis, he will be co-supervised by Dr Tim Haye and Dr Marc Kenis at CABI and Prof. Ted Turlings and Dr Alex Aebi at Neuchâtel. He will also work in close collaboration with Agroscope Changins in Switzerland and the DROPSA partners in China and France. The main objectives of his thesis will be to study mortality factors and natural enemies of *D. suzukii* in Europe and Asia, and to develop biological control strategies.

Pierre Girod (photo: S. Stutz)

Gabriela Maciel Vergara obtained her MSc for her work in Ghana

Gabriela Maciel Vergara carried out an MSc thesis in Ghana within the framework of the EU-funded Project PROteINSECT and under the field supervision of Dr Marc Kenis. Gabriela was registered in a joint programme between the University of Copenhagen (Denmark) and the University of Catania (Italy). In her thesis, she developed methods to improve the production system of house fly larvae, *Musca domestica*, at Fish for Africa, partner of PROteINSECT in Ghana. She successfully defended her thesis at the University of Copenhagen in October 2014.

Gabriela Maciel in the house fly rearing facilities in Ghana (photo: M. Kenis)

introduction

This year, the Arthropod Biological Control section at our Swiss centre was joined by four students from Canada (Dennis Quach, Tina Dancau, Chris Hughes, and Alysha Martins) primarily working on our joint projects with Agriculture and Agri-Food Canada (AAFC). In the autumn our team was joined by Laura Castellani from Switzerland to work on control options for the spotted wing *Drosophila*, *Drosophila suzukii*, our joint project with the "Risk analysis & invasion ecology" section at our Swiss centre and the MoA-CABI Joint Laboratory in Beijing. Our team in China was further involved in investigating biological control options for plant bugs and brown marmorated stink bugs, *Halyomorpha halys*. Stefan Toepfer and his team at the MoA-CABI Joint Laboratory of CABI and the Plant Protection Directorate at Hodmezovasarhely in southern Hungary continued their research on the invasive western corn rootworm, *Diabrotica virgifera virgifera*.

This tremendous amount of work resulted in ten research manuscripts in peer-reviewed international journals, including the *Journal of Pest Science*, *Journal of Applied Entomology, Journal of Integrated Pest Management, Biocontrol Science and Technology, Biological Control, Bulletin of Entomological Research, Agricultural Systems, Entomologia,* and *Molecular Ecology*. Our research was presented at national and international meetings including the Joint Meeting of the Entomological Society of Canada and the Entomological Society of Saskatchewan in Saskatoon, Canada, the Annual Meeting of the Entomological Society of America in Portland, USA, the 8th International Conference on Urban Pests in Zurich, Switzerland, the 59th German Plant Protection Conference in Freiburg, Germany, the Swiss Hymenoptera Conference in Bern, Switzerland, and the Brown Marmorated Stink Bug Working Group meeting in Georgetown, Delaware, USA. For the first time, two of our summer students, Tina Dancau and Dennis Quach, presented their summer projects at the Annual Meeting of the Entomological Society of Canada. Tina was one of the first undergraduate students to win the President's Prize for Pest Management. Furthermore, I would like to congratulate our long-term collaborator Dave Gillespie who was awarded with the gold medal of the Entomological Society of Canada this year.

I am delighted to announce that in September 2014, funding for the Marie Skłodowska-Curie Innovative Training Network BINGO (Breeding Invertebrates for Next Generation BioControl) was granted by the EU. As part of this network, starting in 2015, we will cooperate with 11 new partners from academia, non-profit organizations and industry located in the Netherlands, Germany, France, Spain, Czech Republic, Austria, Greece and Portugal. The aim of the project is to improve the production and performance of natural enemies in biological control by the use of genetic variation for rearing, monitoring and performance. Our group will engage a new graduate student who will investigate the benefits and risks of using native parasitoids for augmentative biological control of *Halyomorpha halys* in Europe.

At this point I would like to thank Stefan and his team in Hungary, our team from the MoA-CABI Joint Laboratory in Beijing and my colleagues Marc and René for their cooperation and support in 2014. I am grateful to our Canadian partners for supporting our work and I am looking forward to working with you in 2015.

Dr Tim Haye
Head of Arthropod Biological Control

Dr Tim Haye
Head of Arthropod Biological Control

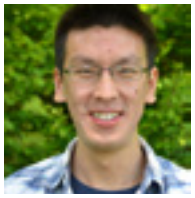
Dr Stefan Toepfer
Research Scientist Integrated Crop Management Advisor

Laura Castellani
Summer Student

Tina Dancan
Summer Student

Chris Hughes
Summer Student

Alysha Martins
Summer Student



Dennis Quach
Summer Student

Nora Levay
PhD Student based in Hungary

Andor Kiss
MSc Student based in Hungary

Ferenc Koncz
Summer Student based in Hungary

Rajmond Stuber
Summer Student based in Hungary

Cabbage seedpod weevil (photo: T. Haye)

Mesopolobus morys parasitizing larvae of the cabbage seedpod weevil (photo: T. Haye)

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

The cabbage seedpod weevil, *Ceutorhynchus obstrictus*, is a widely distributed pest of cruciferous crops in Europe and North America. Accidentally introduced from Europe, the weevil was first discovered in the Canadian province of British Columbia about 80 years ago, and has since spread to other parts of western and eastern North America. Since its arrival in North America, the weevil has become a problem, particularly in the Canadian Prairie Provinces of Saskatchewan and southern Alberta, where it causes substantial economic losses in canola crops. In eastern Canada, the occurrence of *C. obstrictus* is regarded as a threat to canola seed production. Yield losses result from adults feeding on flower buds and larvae feeding within seedpods. Currently, control measures for the cabbage seedpod weevil continue to rely on the application of broad-spectrum insecticides. In Europe, weevil larvae are heavily attacked by the parasitic wasps *Mesopolobus morys* and *Trichomalus perfectus*. Although never intentionally released in eastern Canada, the latter species was first recorded from Ontario and Québec in 2009. To date it remains unclear whether the parasitoid has the potential to spread and establish throughout the canola growing area of Canada.

Bioclimatic simulation models have been applied successfully to predict the distribution and extent of invasive insect pest establishment in new environments. To a much lesser extent, bioclimatic models have been developed to predict the potential areas where insect natural enemies being considered for classical biological control programmes may be successful against invasive pests. The objectives of our study are to investigate the temperature requirements of *T. perfectus* and *M. morys* and their distribution in Europe in order to develop bioclimatic models predicting the potential distribution and abundance of the parasitoids in North America.

In 2014, we studied the development of *M. morys* and *T. perfectus* at high temperatures to define their upper developmental thresholds, and the heat tolerance of newly emerged adults in order to develop degree-day models for both species. Additional surveys for cabbage seedpod weevil parasitoids were conducted in central France, Germany, southern Sweden and Denmark to determine the distribution and abundance of *T. perfectus* and *M. morys* in Europe. In total, nearly 12,000 weevil larvae were collected, from which more than 5600 parasitoids emerged. In all areas surveyed in 2014, *T. perfectus* was the most common species. In 2015, bioclimatic models for both species will be finalized.

T. Haye (t.haye@cabi.org), **A. Martins**, **T. Dancau**, **C. Hughes** and **D. Quach**, in collaboration with **A. Übelhardt** (Courroux) from Switzerland, and **P.G. Mason**, **G.A.P. Gibson** (both AAFC, Ottawa), **D. Gillespie** (AAFC, Agassiz), and **O. Olfert**, **R. Weiss** (both AAFC, Saskatoon), **T. Gariepy** (AAFC, London) from Canada. Funded by: AAFC, Canada.

Alysha Martins setting up cabbage seedpod weevil rearing bags in a canola field at Courroux, Switzerland (photo: T. Haye)

biological control of diamondback moth, *Plutella xylostella*

Diamondback moth, *Plutella xylostella* (photo: T. Haye)

The diamondback moth, *Plutella xylostella* (Lepidoptera: Plutellidae), is a globally distributed pest of a wide variety of Brassica crops. It was likely to have been introduced to North America from Europe about 150 years ago and now occurs throughout the continent, wherever its host plants are grown. In western Canada (Manitoba, Saskatchewan, Alberta and British Columbia) the moth mainly attacks canola and mustard crops, whereas in eastern Canada (Ontario, Québec and all Maritime Provinces) it can be a pest of Brassicaceae vegetable crops. Populations of the diamondback moth routinely infest canola in the Canadian Prairies, where in most years it causes minor economic damage, but in some years populations reach outbreak densities. For example, in 1995 more than 1.25 million ha were sprayed with insecticide to control diamondback moth populations at an estimated cost to producers of CND 45 to 52 million. An outbreak on an even greater geographic scale occurred in 2001, with approximately 1.8 million ha treated with insecticide in western Canada.

In Europe, Asia and Africa, *Diadromus collaris* is a major parasitoid of diamondback moth pupae. It has been successfully introduced to, and established in, several countries or regions for enhancing biological control of *P. xylostella,* including Australia, Barbados, Cook Islands, Malaysia and New Zealand. Because the diamondback moth has rapidly evolved resistance to chemical insecticides, grower options for control have been limited, leading to increasing crop losses and production costs. As a result, additional sustainable control options are needed.

Diadromus collaris, a pupal parasitoid of the diamondback moth (photo: T. Haye)

Since *Diadromus collaris* is currently not part of the existing parasitoid complex of the diamondback moth in Canada, life table studies were started in 2014 to determine if the introduction of *D. collaris* from Europe is a viable strategy for classical biological control of the diamondback moth in Canada. Parasitism of pupae by *Diadromus collaris* was highly variable among experimental field sites, ranging from 13 to 33%. Life table studies will be continued in 2015.

T. Haye (t.haye@cabi.org), **T. Dancau**, **C. Hughes** and **D. Quach**, in collaboration with **D. Gillespie** (AAFC, Agassiz) and **P. Mason** (AAFC, Ottawa) from Canada. Funded by: AAFC, Canada.

Chris Hughes, Tina Dancau and Dennis Quach infesting cabbage plants with diamondback moth larvae (photo: T. Haye)

Trissolcus plautiae emerging from a *Plautia fimbriata* egg (photo: T. Haye)

Brown marmorated stink bug, *Halyomorpha halys*, feeding on beans (photo: T. Haye)

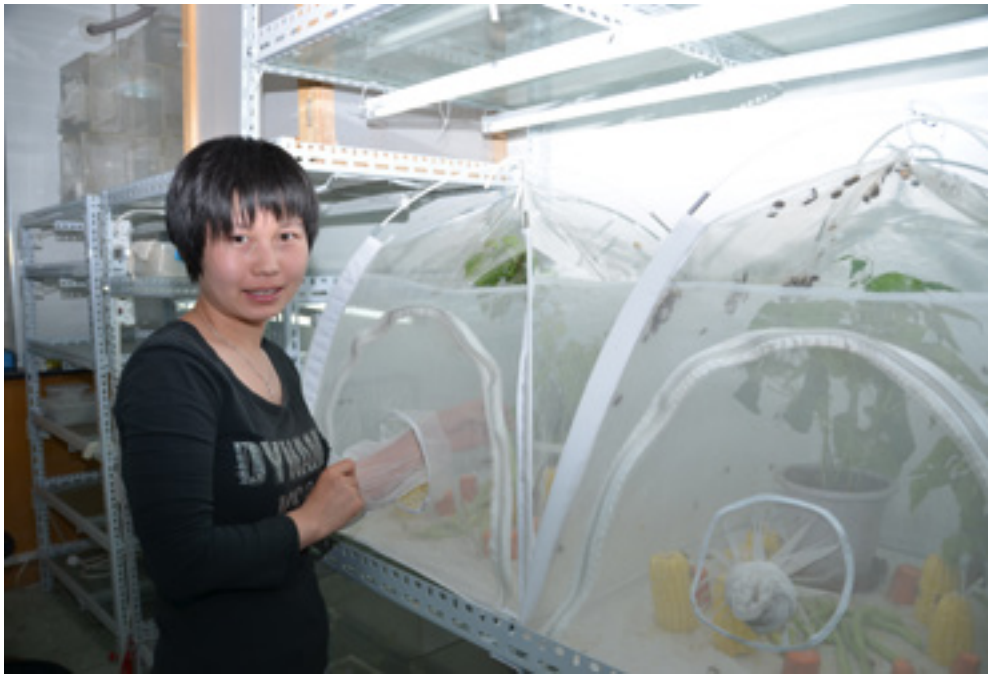
biological control of the brown marmorated stinkbug, *Halyomorpha halys*

The brown marmorated stink bug, *Halyomorpha halys*, is native to East Asia and invasive in the USA, Canada, Italy, France, Hungary, Greece, and Switzerland. Owing to its extremely wide host range it is a serious pest of many fruit trees, ornamental and other shrubs, and fruit and vegetable crops. In addition, its habit of entering structures to overwinter makes it a major nuisance pest in cities.

In North America the pest was first detected in 1996 in the US state of Pennsylvania, and is now present in 40 states in the USA. The discovery in 2012 that it was established in the Canadian province of Ontario immediately raised concern among Canadian fruit growers because major outbreaks of *H. halys* in 2010 had caused severe losses in fruit production in the mid-Atlantic states of the USA. It can be anticipated that in the coming years *H. halys* will continue to spread throughout Canada and become a serious threat to Canadian fruit production, with potential economic impact on other crops including maize and soybean. Control of *H. halys* is currently confined to broad-spectrum chemical insecticides, but research is being conducted on the use of natural enemies from Asia, which are thought to be an important mortality factor there. In China, parasitoid wasps in the genera *Trissolcus* and *Anastatus* cause high levels of egg parasitism. Of these, *Trissolcus japonicus* is the most promising candidate for biological control of brown marmorated stink bug in North America.

Field surveys to assess the natural enemy assemblage of *H. halys* and non-target stink bugs in China, which began in 2012, were continued in 2014. The main objective of our study is to investigate the ecological host range of *T. japonicus*. In 2014, hundreds of laboratory reared egg masses of *H. halys,* and the non-target species *Arma chinensis*, *Menida violacea*, *Plautia fimbriata* and *Dolycoris baccarum*, were exposed throughout the season to attract egg parasitoids at six sites outside Beijing. Our current knowledge of the ecology of *T. japonicus* suggests that it has a fairly broad host range and is able to develop on a wide variety of hosts. Investigations on the ecological host range of *T. japonicus* will be continued in 2015.

T. Haye (t.haye@cabi.org), **Zhang J.**, **Li H.M.**, **Zhang F.**, **T. Dancau**, **C. Hughes**, **L. Castellani** and **D. Quach** in collaboration with **K. Hoelmer** (USDA, Newark), **M. Buffington** and **E. Talamas** (both USDA, Washington DC) from the USA, **M.C. Bon** (EBCL, Montpellier) from France and **D. Gillespie** (AAFC, Agassiz), **T. Gariepy** (AAFC, London) and **P. Mason** (AAFC, Ottawa) from Canada. Funded by: AAFC, Canada.



Zhang Jinping rearing *Halyomorpha halys* at the MoA-CABI Joint Laboratory at Beijing, China (photo: T. Haye)

impact of climate on *Lygus* parasitoids

Lygus plant bugs are highly polyphagous pests of field and greenhouse crops throughout North America, including vegetable and fruit crops, alfalfa and canola. Overall parasitism by native parasitoids is insufficient to significantly suppress pest *Lygus* populations in North America, but parasitism of *Lygus* species in Europe was found to be much higher. Consequently, the European *Peristenus relictus* was released in large numbers in New Jersey and California for neoclassical biological control. It failed to establish in New Jersey from releases made between 2001 and 2012, but recently became established in California. Attempts were also made to introduce *P. relictus* into western Canada, but several smaller releases between 1978 and 1981 failed to result in establishment. Reasons for *Peristenus relictus*' failure to establish in New Jersey and western Canada are largely unknown but could be related to local climates.

The objective of our current study is to develop a bioclimatic model to predict potential range and relative abundance of *P. relictus* in North America and to investigate whether established populations in California could expand their distribution northwards into Canada.

In 2014, we investigate the upper developmental threshold and the impact of heat stress on the performance of *P. relictus*. In addition we collected distribution data from Europe, which will help to define its climate requirements and to develop a degree-day model for the parasitoid.

T. Haye (t.haye@cabi.org) and **T. Dancau**, **C. Hughes** and **D. Quach**, in collaboration with **O. Olfert**, **R. Weiss** (both AAFC, Saskatoon), **T. Gariepy**, **A.B. Broadbent** (both AAFC, London), **D. Gillespie** (AAFC, Agassiz) and **P.G. Mason** (AAFC, Ottawa) from Canada. Funded by: AAFC, Canada.

Lygus plant bug nymph (photo: T. Haye)

Peristenus relictus, a parasitoid of *Lygus* nymphs (photo: T. Haye)

Lygus mass collection site in the southern Rhine valley (photo: T. Haye)

biological control of red clover casebearer

Red clover casebearer moth (photo: T. Haye)

Red clover casebearer larva (photo: T. Haye)

The red clover casebearer, *Coleophora deauratella*, is a widely distributed pest of clover grown for seed in south-eastern and western Canada and in north-eastern USA. It is native to Europe, eastern Siberia and the Middle East and was accidentally introduced into North America as early as 1962, but the first economic damage to clover seeds, in the Canadian province of Ontario, was not reported until 1989. First records from western Canada date back to 2001, but since 2006 it has become a significant pest in the Peace River region of Alberta, causing up to 99.5% seed loss in second-year stands. Damage is caused by the larvae, which are present in fields from bud to harvest, feeding on florets and developing seeds from mid-June until late September.

In Europe, *Coleophora* species are controlled by a complex of at least 17 parasitoids. Thousands of parasitoids belonging to several species were imported from Europe into New Zealand between 1952 and 1969, resulting in the establishment of two species, *Bracon variegator* and *Neochrysocharis formosa*, which subsequently contributed to a considerable reduction in *Coleophora* populations there. The latter species was then imported from New Zealand into Canada, where it was released in Ontario between 1993 and 1995.

Remarkably, the parasitoids that contributed to the biological control of the moth in New Zealand were not those that had been predicted to be most likely to succeed. Studies in Europe had shown that two other parasitoids, *Agathis rufipalpis* and *Chelonus contractus*, were causing far higher parasitism and were more closely synchronized with the host than *B. variegator* and *N. formosa*.

The success of European parasitoids in New Zealand and the importance for seed and honey production of protecting pollinator species increased interest in biological control from clover seed producers in Alberta. Since the impact of parasitoids, particularly *A. rufipalpis* and *C. contractus*, on *Coleophora* populations is still not understood, life table studies in Europe may help to identify the most susceptible life cycle stage of the moth and the most promising candidates for biological control in Canada.

In 2014, moth populations were monitored in Switzerland and surveys for parasitoids were extended to southern Sweden. Mass collection in Skåne resulted in nearly 900 larvae. Nearly 400 larvae were taken into overwintering and will be incubated in spring 2015 to allow parasitoids to emerge. In 2015 we are planning to continue surveys in other parts of Europe.

T. Haye (t.haye@cabi.org), **T. Dancau**, **C. Hughes** and **D. Quach**, in collaboration with **J. Otani** (AAFC, Beaverlodge), **P.G. Mason** (AAFC, Ottawa), **D. Gillespie** (AAFC, Agassiz) and **T. Gariepy** (AAFC, London) from Canada. Funded by: AAFC, Canada.

Chris Hughes inspecting a pheromone trap for the red clover casebearer (photo: T. Haye)

biological control of plant bugs in Chinese cotton

Apolygus lucorum is a widely distributed species throughout Eurasia. In China, *A. lucorum* is one of the most important pests of cotton. It feeds on the terminal meristems, bolls and various other tissues of the plant, often leading to bushy plants and boll abscission. At high population density it can cause considerable yield loss. Historically, the cotton bollworm, *Helicoverpa armigera*, has been the most important pest of cotton in China. *Apolygus lucorum* was often treated as a secondary pest and usually controlled by insecticide sprays targeting the cotton bollworm. Since 1997, however, Chinese farmers have been increasingly adopting *Bt* cotton to combat the cotton bollworm and as a consequence the amount of insecticides applied in cotton production has fallen. This reduction in pesticide use has meant that in recent years mirids such as *A. lucorum* have become key insect pests of *Bt* cotton, particularly in the cotton growing regions of the Yellow River (Hebei, Henan and Shandong provinces) and Changjiang River (Anhui and Jiangsu provinces). In the last ten years, outbreaks in these regions have caused 15–50% yield losses in cotton. Currently, insecticide use is the sole pest management option available for most Chinese cotton farmers. As irrational pesticide use may have a number of undesirable effects, environmentally sound and sustainable management alternatives are urgently needed.

During surveys for parasitoids native to China in 2009, two native nymphal parasitoids, *Peristenus relictus* and *P. spretus*, were identified as potential biological control agents. A mass-rearing system was successfully developed for *P. spretus* at the MoA-CABI Joint Laboratory. This allowed us to conduct a study on the functional response of *P. spretus* to its host, *A. lucorum*, which was published in 2014. The ability to mass produce the parasitoid also means that for the first time we can test the efficacy of *P. spretus* in field cages, which have been set up in Hebei, Henan and Shandong provinces.

In 2014, we tested an IPM approach to control *Apolygus* in a 13,400 m2 jujube orchard located in the Shandong province, combining parasitoid releases, the use of sex pheromones, and cultural control methods. Small scale experiments testing the efficacy of parasitoid releases in cotton fields were continued in the Hebei and Henan provinces. For a second time since 2012, the exotic biological control agent *Peristenus digoneutis* was imported from Europe, and preliminary host range assessments were conducted for both the native and exotic parasitoids. In 2015, investigations on the host range and interspecific competition of both species will be continued.

Luo S.P., **Li H.M.**, **T. Haye** (t.haye@cabi.org), **Zhang F.**, **Wei N.**, **Chen Y.L.**, **Liu S.**, **Song G. H.** and **U. Kuhlmann**, in collaboration with **Prof. Wu K.M.** and **Lu Y.H.** (IPP-CAAS, Beijing) and **Men X.Y.** (Shandong Academy of Agricultural Sciences), China). Funded by: MoA, China

Peristenus spretus searching for hosts in a Chinese date tree infested with *Apolygus lucorum* (photo: Luo S.)

Grapes damaged by *Apolygus lucorum* (photo: Luo S.)

Luo Shuping demonstrating biological control of *Lygus* in a jujube orchard, Shandong Province, by releasing *Peristenus spretus* (photo: Luo S.)

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

A *Diabrotica virgifera virgifera* beetle, which originates from North America and has invaded Europe (photo: S. Toepfer)

finding the optimal dose for beneficial nematodes to control *Diabrotica* soil pests in European maize production

The western corn rootworm, *Diabrotica virgifera virgifera*, is one of the most destructive pests of maize in North America. The rootworm is a leaf beetle with eggs that overwinter in the soil. After the maize has germinated, the eggs hatch and its three larval instars feed on maize roots, often causing plant lodging and yield losses. Adults can also reduce yields through intensive silk feeding, which interferes with maize pollination. Over the last 30 years, the western corn rootworm has moved into Europe causing problems in maize there as well.

Ten years of joint efforts in research and development have led to a nematode-based biological control solution for this destructive maize pest. During this period CABI has collaborated with partners in different countries including universities (the University of Neuchâtel; the University of Kiel), research institutes (the Cereal Research Station, Szeged; Agroscope Reckenholz-Tänikon, Zurich; Landwirtschaftliches Technologiezentrum, Stuttgart), government institutions (the Plant Protection Directorate, Hodmezovasarhely; the Austrian Agency for Health and Food Safety – AGES, Vienna), farmer associations (fenaco – UFA-Samen Beneficials, Aesch), nematode producers (e-nema, Schwentinenthal; Andermatt Biocontrol AG, Grossdietswil), nematode application manufacturer (Cult-tec Ltd, Freiburg) and many others. As a result, mass-produced beneficial *Heterorhabditis bacteriophora* have been available as a commercial product since 2012. They are currently on the market in Germany, Italy, France and Austria, and registration is ongoing for the Czech Republic and Hungary.

Because of the potential for the use of this product in Bavaria in southern Germany, and in the light of a EU-wide ban on neonicotinoid seed coatings owing to bee toxicity, the Bavarian State Research Centre for Agriculture in Freising requested a three year study to further clarify the extent to which the nematode product can reduce *Diabrotica* populations below threshold levels.

Results from 2013 and 2014 revealed that control efficacies of both nematodes and pesticides have some variability, but the nematodes can usually achieve sufficient reductions in pest level to prevent severe root damage.

S. Toepfer (s.toepfer@cabi.org), **T. Haye** (t.haye@cabi.org) and **U. Kuhlmann** (u.kuhlmann@cabi.org), in collaboration with **M. Zellner** (Bavarian State Research Centre for Agriculture, Freising, Germany), and the Plant Protection Directorate, Hodmezovasarhely, Hungary. Funded by: the Bavarian State Ministry of Food, Agriculture and Forestry through LfL Germany. (2013-2015).

CABI`s Stefan Toepfer, summer students, and staff of the Cereal Research Station in Szeged apply entomopathogenic beneficial nematodes against the soil insect pest *Diabrotica virgifera virgifera* in southern Hungary (photo: A. Kiss, University of Gödöllő)

improving data quality of *Diabrotica* trials for early stage product testing

The maize pest, *Diabrotica virgifera virgifera*, also called the western corn rootworm, is among the pests against which most insecticides are applied annually in North America, and to a considerable extent also in Europe. Plant protection companies are searching for less toxic active ingredients, or for application methods that allow a reduction in the dosages applied. Research trials with this insect are challenging due to clustered pest distributions, so it was thought that working with artificial pest infestations might be more appropriate for early stage product testing and basic research questions than the use of natural populations.

With this in mind Syngenta Crop Protection AG, Basel, funded CABI to conduct field studies with artificial pest infestation in southern Hungary in order to assess the variability of the effects of insecticides on pest larvae, and consequently on root damage and yield.

The data quality obtained appeared to be high, as evidenced by distinct differences between infested and un-infested control plots, in low data variability, and in the fact that product effects on yield were detected, the latter being rarely the case in open-field efficacy trials. Assuming that further experiments would also show that trials based on artificial infestations lead to less variable data than trials based on natural populations, then early stage testing could become more reliable and could save companies' resources.

S. Toepfer (s.toepfer@cabi.org) and **T. Haye** (t.haye@cabi.org). Funded by: Syngenta Crop Protection AG Switzerland (2012 – 2013).

Diabrotica virgifera virgifera larvae feeding on and destroying maize roots (photo: A. Varga, Plant Protection Directorate, Csongrad County, Hungary)

Diabrotica virgifera virgifera larvae feeding on the maize roots in southern Hungary causes the maize plants to become lodged and un-harvestable (photo: S. Toepfer)

Artificial infestation of maize plants with *Diabrotica virgifera virgifera* eggs for early stage testing of potential plant protection products (photo: S. Toepfer)

risk analysis & invasion ecology

introduction

This section now clearly consists of two very distinct fields of research. The first pillar still involves projects on risk analyses and insect invasions. The largest project in this topic is the EU Seventh Framework Programme (FP7) project, DROPSA, which started in January 2014. This project focuses on an invasive fruit pest of Asian origin, the fruit fly, *Drosphila suzukii*, and three invasive fruit pathogens. We are investigating various aspects of the invasion ecology of *D. suzukii* and developing biological and integrated control methods, activities that also involve the CABI-MoA Joint Laboratory in China. To help us achieve our goals in this project we have hired a new PhD student, Pierre Girod, with funding from the University of Neuchâtel and co-supervised by Prof. Ted Turlings and Dr Alex Aebi. Another FP7 project, ISEFOR, together with the COST Action PERMIT, both dealing with the introduction of alien forest pests into Europe and the trade of live plants, finished in 2014 having produced excellent results and many scientific publications. They also gave rise to the development of a new COST Action, coordinated by René Eschen, Global Warning; a global network of nurseries acting as an early warning system against alien tree pests that will start in early 2015. This action involves more than 30 countries and aims at establishing a global network of scientists and regulators to facilitate the establishment of sentinel plantation systems and botanical gardens networks for the early detection of potential alien tree pests. COST Actions are an important part of the programme since we are involved in another Action, ALIEN CHALLENGE, in which I am coordinating a Working Group aiming to review the impact of invasive species in Europe and improving impact assessment methods. Finally, despite its international dimension, the invasive insects programme also focuses on projects at a local scale with the monitoring of the impact of the harlequin ladybird and the box tree moth in the Swiss Jura.

The second pillar of the section deals with the use of insects as a source of protein for animal feed and human food. It started in 2013 with the EU FP7 project PROteINSECT, which is progressing remarkably well, with efficient fly larvae production systems being developed in China, Africa and UK, and a CDF-funded seed project on insects as feed in West Africa. This later enabled us to develop a successful proposal to the Swiss Programme for Research on Global Issues for Development (R4D), a joint programme between the Swiss Agency for Development and Cooperation (SDC) and the Swiss National Science Foundation (SNSF). The proposal was accepted and the project officially starts in January 2015. The project is entitled IFWA - Insects as Feed in West Africa" (full title: "Sustainable use of insects to improve livestock production and food security in smallholder farms in West Africa"). The project is coordinated by CABI's Swiss centre and involves seven partners from Benin, Burkina Faso and Ghana, including the newly established CABI West Africa centre in Accra. In addition, CABI has decided to contribute to IFWA with CDF-funding to ensure the success of the project, which also indicates the growing interest of our organisation in the use of insects both as feed and food.

Dr Marc Kenis
Head of Risk Analysis & Invasion Ecology

Dr Marc Kenis
Head of Risk Analysis & Invasion Ecology

Dr René Eschen
Pierre Giroud
Research Scientist
PhD Student

Dr Saidou Nacambo
Research Scientist

Pierre Giroud
PhD Student

Laura Castellani
Summer Student

Félicien Corbat
Summer Student

Gabriela Maciel Vergara
MSc student
(in Ghana)

increasing sustainability of European forests: ISEFOR

The international trade in live plants is recognized as a key pathway for the spread of invasive forest pests and diseases. Despite precautionary regulations and phytosanitary border inspections, the number of exotic forest pests and diseases in Europe continues to rise. Factors affecting the risk of new and hitherto unknown pests– and diseases becoming established in Europe's forests include a large increase in trade volume over the past 15 years and changes in the identity and origin of the traded plants. In addition, climate change may be affecting the susceptibility of trees to pests and diseases. An analysis of the trade in live plants and quarantine inspection procedures in Europe and elsewhere will assist quarantine authorities in tackling the risks associated with alien pests and pathogens.

The ISEFOR project (Increasing sustainability of European forests: modelling for security against invasive pests and pathogens under climate change) addresses the threat to European forests from the combined forces of climate change and large increases in the numbers of invasive alien pests and pathogens. The ISEFOR consortium comprised 17 partners from the EU and China and the project was funded under the EU's FP7. CABI's input focused on defining threats to European forests from invasive species, drawing on current knowledge of pests and their host plants and through a critical assessment of issues related to the nursery trade and phytosanitary inspection procedures, mainly in Europe and China.

This project ended in 2014. During the course of the project, we investigated various aspects of the live plant trade together with teams from various European countries. For example, the inspection procedures for imports into the EU were assessed through a questionnaire survey. The results revealed large differences in the sampling of individual shipments of plants: the sampling in only a few of the countries that responded provided a high level of confidence that the infestation level was low. This is problematic as most imported plants do not arrive in the country of destination directly, but through another EU country. Monitoring results from the project's two test nurseries set up in China – one of which is close to Beijing and managed by CABI's China office – have revealed the value of inspecting commonly imported plants in their region of origin for identifying pests and pathogens that may be potentially harmful should they be imported into Europe.

M. Kenis (m.kenis@cabi.org), **R. Eschen** and **Li H.M.**, in collaboration with partners in the ISEFOR project. Funded by: EU RTD (Research, Technological development and Demonstration) FP7 (www.isefor.com/).

Leaf wilt on a *Fraxinus* tree in the sentinel nursery near Beijing (photo: R. Eschen)

Wild *Buxus sempervirens* in Turkey killed by box blight, a pathogen that arrived from East Asia with the live plant trade (photo: M. Kenis)

Sentinel nursery in China (photo: Li H.M.)

Inspectors sampling soil during a phytosanitary inspection of imported trees (photo: R. Eschen)

Beetles of the genus *Anoplophora* are of serious plant health concern (photo: R. Eschen)

pathway evaluation and pest risk management in transport: PERMIT

The number of invasive alien organisms in European forests is steadily increasing. Identification of pathways for the international transfer of pests, including species identity, known hosts, origins and trade patterns, may enable 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 that could also mitigate the threat of new, hitherto unknown pests.

The COST action PERMIT (Pathway evaluation and pest risk management in transport) focused on reducing threats from exotic pests by promoting enhanced pathway management. Thirty-two countries are participating in the Action. One of the working groups, co-chaired by Marc Kenis, was concerned with identifying pathways for the movement of forest pests and diseases, finding evidence of pests moving along these pathways, and analyzing international trade patterns in relation to the movement of pests and diseases along them. We discovered that most forest pests and pathogens arrive in Europe through the trade in plants for planting, with billions of live plants being imported into Europe every year. Therefore, most of our research in this project focused on that particular pathway. Other working groups developed mitigation measures to reduce the movement of pests along pathways and investigated the level of education and awareness of risks associated with different pathways.

In 2014, the last year of the Action, we completed a comparison of plant health legislation in countries around the world, with the aim of identifying measures that are effective in combating the introduction of new pests and diseases. In collaboration with colleagues from eight countries, we also carried out a questionnaire survey of stakeholders' awareness of tree pests, as well as their knowledge of the likely pathways of introduction and mitigation measures for selected pests. The results of the project will be useful for developing 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: the Swiss State Secretariat for Education, Research and Innovation (SERI) and the EU.

Bonsais, a pathway of introduction for forest pests (photo: M. Kenis)

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

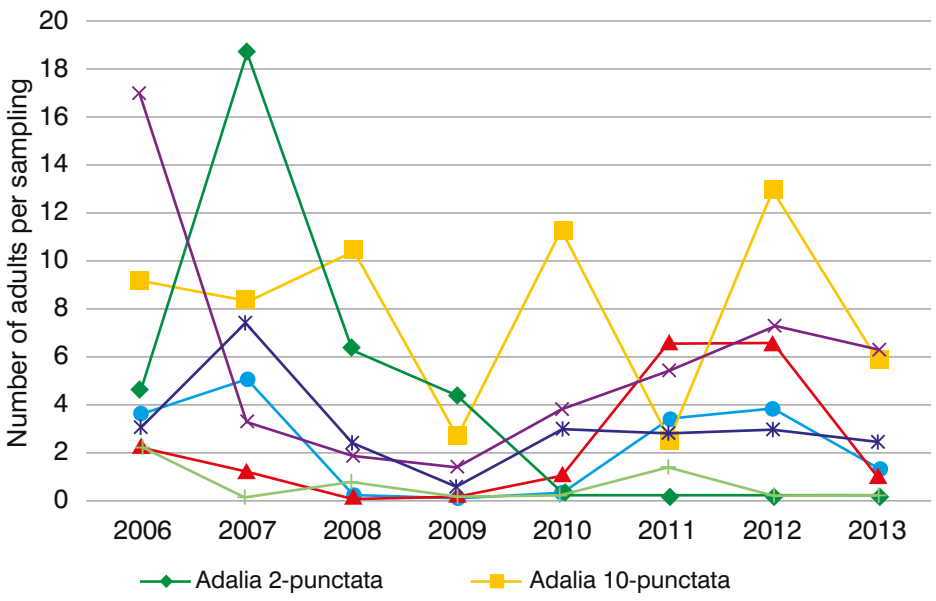
Harmonia axyridis, the harlequin ladybird, is a polyphagous predatory coccinellid beetle, native to Asia. It has been widely released as a biological control agent of aphids in the field and in greenhouses in both North America and Europe. Since its accidental establishment in North America in the 1980s 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. *Harmonia axyridis* can have strong negative effects on biodiversity owing to its predatory and competitive abilities, impacting on many native species, including aphids and other ladybirds and aphidophagous insects, as well as other kinds of herbivorous insect. It may have a direct effect on humans 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 captured and crushed during grape harvesting and processing.

The main objective of our research programme on *H. axyridis*, which started in 2005, is to assess the impact of the invasive ladybird on native ladybirds in Switzerland. A report was written for the Swiss Federal Office for the Environment that represents the results of eight years (2006–2013) of monitoring of ladybird populations in North-western Switzerland, following the arrival of *H. axyridis*. Ladybird populations were monitored using standardised sampling methods at 45 sites: 15 broadleaved hedgerows, 15 meadows and 15 conifer sites. *Harmonia axyridis* first appeared in the region in 2006 and since 2008 it has become the most abundant ladybird on broadleaves, accounting for 60 to 80% of all ladybirds collected throughout the year. In contrast, in meadows and on conifers *H. axiridis* is still rather uncommon. Only one species, *Adalia bipunctata*, has declined dramatically. While it was a dominant species on broadleaves before the arrival of *H. axyridis*, it has now become much rarer, except on some broadleaved trees in urban habitats. Other ladybirds sharing the same ecological niches with *H. axiridis* and *A. bipunctata* have not yet declined significantly. The monitoring programme was interrupted in 2014 but will be continued in 2015 until 2017 to confirm the long term decline of *A. bipunctata* and verify that other ladybirds do not decline at a slower rate.

M. Kenis (m.kenis@cabi.org) and **R. Eschen**. Funded by: the Swiss Federal Office for the Environment (FOEN).

Adalia bipunctata has become very rare following the establishment of *Harmonia axyridis* (photo: R. Eschen)

The two colour forms of *Harmonia axyridis* (photo: M. Kenis)



Number of adult ladybirds collected on broadleaves per day of sampling for seven of the most common indigenous ladybirds, from 2006 to 2013, showing the decline of *A. bipunctata*. *Harmonia axyridis* was too numerous and is not shown on the graph.

Elderberry, a favourite fruit for *D. suzukii* (photo: M. Kenis)

Chen Xiao, student from the Yunnan Agricultural University (YAU), inspecting a trap in China (photo: YAU)

investigating the invasion and management of *Drosophila suzukii*: DROPSA

The spotted-wing drosophila, *Drosophila suzukii*, is a vinegar fly originating from East Asia and which has invaded most continents in the last 8 years. It was found for the first time in Europe in 2008 and in Switzerland in 2011. In contrast to other vinegar flies (*Drosophila* spp.), it is able to lay eggs in ripe fruits. In invaded regions it has quickly become a serious pest of various soft fruits, in particular berries such as blackberries, blueberries, strawberries, raspberries, cherries and, more recently, grapes. It is also easily transported unintentionally in fruits and goes through many generations per year. Consequently, it has invaded most of Europe in just a few years.

In January 2014, we started a new EU FP7 project, DROPSA (Strategies to develop effective, innovative and practical approaches to protect major European fruit crops from invasive pests and pathogens). This project focused on *D. suzukii* but also on three invasive fruit pathogens, *Pseudomonas syringae* pv *actinidiae*, *Xanthomonas arboricola* pv. *pruni* and *Xanthomonas fragariae*. The biology and ecology of these newly invasive species are being assessed in order to develop new, sustainable control methods, which will be then combined to develop integrated management methods. More generally, the project will also gather data on the pathways of introduction of fruit pests and pathogens in Europe and elsewhere, and will produce recommendations for the development of preventative strategies against the introduction of other dangerous fruit pests and pathogens into Europe.

Both CABI Switzerland and the CABI-MoA Joint Laboratory in China are involved. The main roles of the CABI teams are to study various aspects of the ecology and biology of *D. suzukii*, with particular emphasis on natural enemies and biological control, climatic modelling and host range studies. In 2014, the first surveys for natural enemies were made in Europe and Asia and several parasitoids were found in China. A large study on the natural host range in Switzerland was completed, and more than 40 wild hosts were found.

M. Kenis (m.kenis@cabi.org), **T. Haye**, **P. Girod, R. Eschen**, **L. Castellani**, **Zhang J.**, **Liao R.** and **Zhang F.**, in collaboration with partners in the DROPSA project. Funded by: EU RTD FP7.

Drosophila suzukii female laying eggs in a fruit (photo: T. Haye)

the box tree moth, *Cydalima perspectalis*, in natural stands in the Swiss Jura

The box tree moth, *Cydalima perspectalis*, an invasive alien species of Asian origin, was first reported in Europe in south-western Germany in 2006. It quickly spread into Switzerland and many other European countries. Larvae feed on leaves, shoots and bark of box trees (*Buxus* spp.) and severe infestations can lead to the death 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* into Europe represents a severe threat to nurseries, parks and gardens, and natural *Buxus* stands.

In late 2013, we started a new project focusing on damage to wild box from the box tree moth in the Swiss Jura. In this project, we mapped natural box tree stands in the Jura and monitored damage by the box tree moth in the most important stands. We also studied the population dynamics of the box tree moth using pheromone traps and built a decision-aid document for the control of the box tree moth in wild box stands. Finally, we initiated an assessment of the actual and potential ecological impact of the moth on natural box stands in north-western Switzerland through direct monitoring and assessment of the ecological value of the box tree stands. The level of damage by the moth varies with locations. Around Basel, damage levels are high and some box stands have died. In contrast, in the Jura Canton, populations are much lower, probably because in these stands the moth is not able to complete two full generations per year. Surprisingly, in this region we observed that some stands were severely damaged by another invader from Asia, the box blight, *Cylindrocladium buxicola*. This fungal pathogen is also known to cause severe damage to natural box stands in Turkey and Georgia and to planted box hedges in western Europe and North America. The two pests are still spreading in Europe and are likely to cause severe damage to unique forest ecosystems in western and southern Europe as well as in the Caucasus. Observations in the Jura, Turkey and the Caucasus already showed that natural box tree stands quickly die from severe defoliation by the moth and/or the pathogen. Unfortunately, there are few control methods available to control the pest and the pathogen in forest ecosystems. Classical biological control through the introduction of parasitoids from the region of origin may provide a solution for the moth and, potentially, for the fungus. Our preliminary studies on the ecological value of box stands in Switzerland did not reveal a specific insect fauna, but the fungal community showed significant differences with neighbouring sites without box. The box tree moth and the box blight will be further monitored in the Swiss Jura in 2015.

M. Kenis (m.kenis@cabi.org), **F. Corbat**, **S. Nacambo** and **T. Haye**. Funded by: the Office of the Environment of the Jura Canton, Switzerland.

Wild box tree defoliated by the box tree moth in Switzerland (photo: G. Vétek, Corvinus University of Budapest)

Adult *Cydalima perspectalis* (photo: T. Haye)

Typical box tree stand in the Swiss Jura (photo: M. Kenis)

Partners of the COST Action Alien Challenge at a meeting in Cyprus (photo: M. Kenis)

Helen Roy, CEH, coordinator of the Alien Challenge Action and the project on IAS of EU concern (photo: M. Kenis)

assessing the risk and impact of invasive alien species for Europe

The European Union and European countries are currently developing national and international strategies to assess the full scope of the danger presented by invasive non-indigenous species, and to take the necessary measures to prevent and manage the threat effectively. Assessments can be made through full risk assessment for pests that have not yet, or have just entered into a continent or a country, or through impact assessments for species that are well established in the assessed area. Such assessments and the resulting lists of invasive species of concern can be used for various purposes; for example, to prioritize actions to prevent the entry or mitigate the spread of invasive species, or to improve the legislative framework at local, national or regional level. Therefore, it is important that the selection of species to be placed on these lists is made using standard, objective and transparent methods, such as scientifically based risk or impact assessment procedures.

In 2014, CABI Switzerland was involved in various international collaborative projects relating to the evaluation or development of risk/impact assessment tools. Firstly, we participated in a project: Invasive alien species – framework for the identification of invasive alien species of EU concern, led by the Centre for Ecology and Hydrology (CEH), UK, and funded by the EU Directorate-General for the Environment (DG Environment). The aim of this project was to provide a review of available invasive alien species (IAS) risk analysis protocols and use this, coupled with expert opinion, to inform the development of minimum standards necessary to ensure effective risk assessment methods for the EU. Additionally we considered gaps in knowledge and scope of existing risk analysis methods. Thus, we provided recommendations for developing existing risk analysis methods within a framework of minimum standards. Methods compliant with the minimum standards will be of value for supporting the development of a draft list of invasive alien species of EU concern. A publication was produced at the end of 2014 and is publicly available (Roy et al., 2014, in the publication list). In 2015, a similar project on prioritizing prevention efforts against invasive alien species through horizon scanning will be carried out.

Secondly, we are also involved in the COST Action Alien Challenge (European Information System for Alien Species), also coordinated by CEH. In this Action we are coordinating Working Group 3 on trends and analyses of the impact of priority invasive alien species in Europe. This project will last from 2013 to 2017 and in 2014 we mainly developed a pan-European testing exercise for impact assessment methods available in Europe. The results of this large scale study will be available in 2015.

M. Kenis (m.kenis@cabi.org). Funded by: The European Union, DG Environment , and the COST Office through the Alien Challenge Action (http://www.brc.ac.uk/alien-challenge/home).

Leptoglossus occidentalis, invasive conifer seed bug in Europe (photo: T. Haye)

insects as a source of protein: PROteINSECT

Global demand for animal-sourced foods is accelerating rapidly owing to population growth and economic development. Fishmeal and crops such as soya are key ingredients in animal feeds but their use for this purpose is not ecologically and economically sustainable. Insect protein presents a viable alternative, relieving pressure on fisheries and freeing up significant quantities of food crops for human consumption. Maggots, the larvae of various fly species, are particularly promising as animal feed because of their nutritional properties and because they can be mass produced easily on a wide range of waste substrates, offering potential for low economic and environmental costs. Working in collaboration with partners, the PROteINSECT project (Enabling the exploitation of insects as a sustainable source of protein for animal feed and human nutrition) is exploring insects as an alternative source of protein for animal nutrition in Europe, China and West Africa.

The three-year project, which started in February 2013, involves scientists from 12 institutions in Europe, China, Mali and Ghana who are working towards a number of goals that need to be achieved if the potential of insects in animal feed production is to be realized in these regions. The goals include solving the technical challenges associated with developing and optimizing existing and novel maggot production systems together with processing methods for animal feed. Other activities are aimed at determining associated safety and quality criteria, and evaluating the performance of protein extracts through fish, poultry and pig feeding trials. Comprehensive insect life cycle assessments, taking environmental and socio-economic considerations into account, should lead to technical and policy recommendations by the end of the project. A complementary goal for PROteINSECT is to support a pro-insect platform in Europe, to encourage adoption of insect protein as a long-term, sustainable source of animal feed and reduce the reliance on ecologically costly fish and plant sources – ultimately paving the way for insects to become a direct component of human food security.

Scientists from CABI's centres in Switzerland and China are leading the research aimed at optimizing existing production systems, and at developing new and economically viable fly breeding methods. We are particularly involved in Mali and Ghana, where we help developing and analyzing new fly production methods. We created a database of information on fly rearing and production methods. CABI is also collaborating on the environmental and socio-economic life cycle analysis that will be the basis of technical and policy recommendations.

M. Kenis (m.kenis@cabi.org), **S. Nacambo**, **G. Maciel Vergara**, **Tang R.** and **Zhang F.**,
in collaboration with partners in the PROteINSECT project. Funded by: EU RTD FP7 (www.proteinsect.eu/).

Poultry feeding trials in Mali (photo: M. Kenis)

Saidou Nacambo and Gabriela Maciel in the fly rearing facilities in Ghana (photo: M. Kenis)

Saidou Nacambo preparing food for fly rearing in Mali (photo: S. Nacambo)

Black soldier fly rearing at Fish for Africa in Ghana (photo: S. Nacambo)

Guinea fowl rearing facilities at the Animal Research Institute, Ghana (photo: M. Kenis)

Insects as Feed in West Africa: IFWA

In West Africa, smallholder poultry and fish farmers suffer from the increasing cost of feed. Many of them do not have access to protein feed sources, resulting in quantitative and qualitative feed shortages affecting the production of meat, eggs and fish, and reducing family income. One solution for developing sustainable household poultry farming and aquaculture systems is the use of untapped local, easily available and cheap protein sources. Insects, which are a natural food source of poultry and fish, are one such source. Insects are rich in protein as well as other valuable nutrients, and can be mass produced locally and on-farm. Fly larvae have the advantage over many other insects of feeding on organic waste material. The most promising and commonly used species for feed are the house fly, *Musca domestica*, and the black soldier fly, *Hermetia illucens*. Termites are another type of insect that can be used for animal feed.

Although the use of fly larvae and termites for poultry and fish nutrition is promising, several issues have to be addressed before the methods become widely adopted by smallholder farmers. In particular: on-farm fly larvae production and termite collection systems need to be optimized; the nutritional suitability of the insects for poultry and fish needs to be further assessed; the safety of insect rearing systems and insect-based feed needs to be evaluated for animal and human health; the capacity of fly larvae to recycle waste in smallholder farms and the value of residues from on-farm rearing systems need to be considered; the impacts on household nutrition, income and livelihoods needs to be assessed; the acceptability of eating animals fed with insects may have to be improved; the use of insects as animal feed needs to be promoted within the context of national policies.

These issues are all tackled in a new project, IFWA (Sustainable use of insects to improve livestock production and food security in smallholder farms in West Africa - Insects as feed in West Africa), which officially started in January 2015 and will last for six years. The project is coordinated by CABI Switzerland and involves seven other partners from Ghana, Benin, Burkina Faso and Switzerland. The objectives of the project will be to develop appropriate methods for fly larvae and termite production and utilization in smallholder farming systems in Benin, Ghana and Burkina Faso, based on waste material; to understand and ensure the social, economic and environmental sustainability of the proposed innovations; to validate and implement the innovations with the beneficiaries, and disseminate the project's findings to the stakeholders, general public, scientific community and policy makers.

M. Kenis (m.kenis@cabi.org), **V. Clottey**, **S. Nacambo**, **J. Grunder** and **J. Dennis** in collaboration with the partners of the IFWA project. Funded by: Swiss Programme for Research on Global Issues for Development (R4D), joint programme from the Swiss Agency for Development and Cooperation (SDC) and the Swiss National Science Foundation (SNSF).

Participants at the IFWA kick-off meeting (photo: A. Aebi, University of Neuchâtel)

ecosystems management

introduction

The year 2014 marked the beginning of a new era in the ecosystems management section. To date, work in this section has almost exclusively focused on ecosystems in temperate climatic zones. In 2014, we secured funding for a 6-year project on 'Woody invasive alien species in East Africa: assessing and mitigating their negative impacts on ecosystem services and rural livelihood'. This project, which is funded by the Swiss National Science Foundation (SNSF) and the Swiss Agency for Development and Cooperation (SDC), brings together scientists from Ethiopia, Kenya, Tanzania, South Africa and Switzerland, and aims to quantify the effects of invasive woody weeds on biodiversity, ecosystem services and human well-being in case study areas in East Africa. It also aims to develop and document Sustainable Land Management strategies that will help to mitigate the negative effects of woody weeds. The project will also strengthen the collaboration between the ecosystems management section and CABI Africa.

In addition, we managed to secure funding for a PhD position in the COST Action 'Sustainable Management of *Ambrosia artemisiifolia* in Europe' (SMARTER). One of the main goals of this PhD thesis will be to better understand the climate-dependent population growth rate of *Ophraella communa*, a North American beetle that was recently detected in southern Europe and which is successfully used as a biological control agent of ragweed in China.

In 2014 we continued with a project to improve the restoration of biodiversity in ecological compensation areas in the Swiss Jura mountains. This project is conducted in close collaboration with regional stakeholders (extension services, farmers etc.) and will strengthen CABI Switzerland's links with authorities at the cantonal and national level.

We also continued working on a long-term experiment to assess the impact of the native European clearwing moth, *Pyropteron chrysidiforme,* on established *Rumex* plants under a variety of environmental conditions. If this insect proves to have a sufficiently high impact on *Rumex*, it might become the first commercially available weed biological control agent in Switzerland.

Dr Urs Schaffner
Head of Ecosystems Management

Dr Urs Schaffner
Head of Ecosystems Management

Dr René Eschen
Research Scientist

Dr Patrick Häfliger
Research Scientist

Célien Montavon
MSc Student

Stefanie von Bergen
MSc Student based at the University Fribourg

Candice Baan
Summer Student

Rosalie Leiner
Summer Student

Alysha Martins
Summer Student

Shiwa Soukou
Summer Student

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

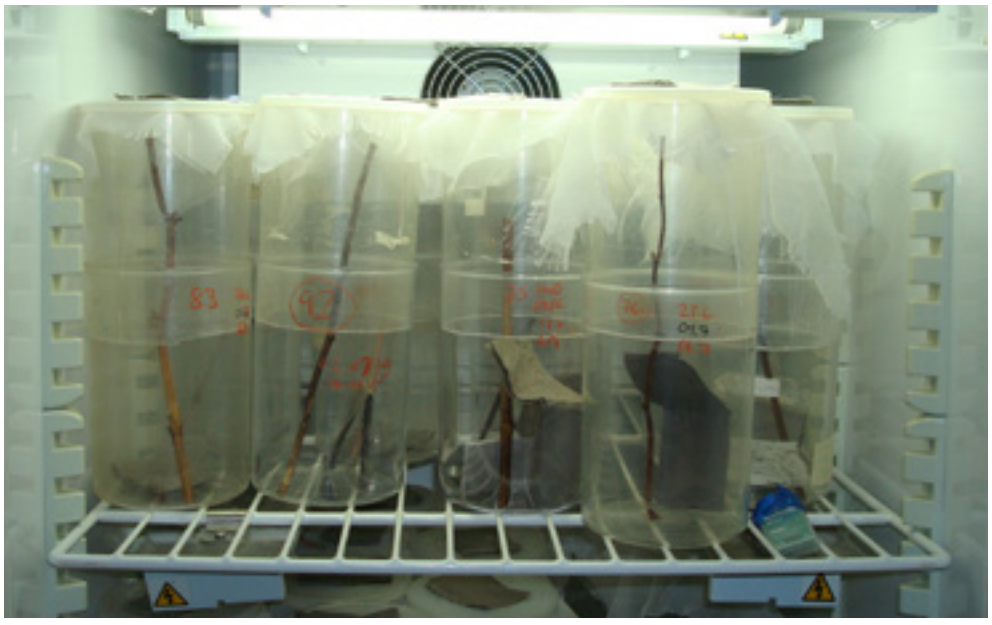
Broad-leaved dock, *Rumex obtusifolius*, is considered a weed of permanent pastures, meadows and arable crops throughout its native range in Europe. In Switzerland, it causes particular problems in organic and integrated farming systems. The only feasible control measure currently available for organic 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 the Swiss Commission for Technology and Innovation (CTI) to develop a biological control product for dock using the native clearwing moth *Pyropteron chrysidiforme*. This project was conducted in collaboration with Agroscope Reckenholz-Tänikon, Andermatt Biocontrol AG and the University of Fribourg in Switzerland.

The basic idea was to release eggs of the clearwing moth on *Rumex* plants, so the hatching larvae would attack the roots and weaken or even kill the plant. So far the main issue has been obtaining high enough attack rates. In field tests set up in 2012, we obtained larval establishment rates for the clearwing moth of over 50% for the first time. In the final year of the CTI project, we decided to establish a long-term field experiment which will run for four years and aims to test whether and to what extent the impact of *P. chrysidiforme* on *R. obtusifolius* builds up over time. We established six sites in Switzerland (three sites near Zurich and three in western Switzerland), marked 275 plants at each site using GPS and assigned them to different treatments (one, two and three years of egg applications and controls). Plant survival and vigour are recorded once a year and a small subset of plants are dissected in order to assess larval attack rates. The results after two years are not yet conclusive. In 2013, we obtained the highest attack rates ever observed during our study, with up to 80% of plants being attacked. Conversely, in 2014 there was nearly no attack of *Rumex* plants. We assume this is due to the relatively cold and wet weather conditions of this summer and are therefore planning to repeat the treatment in 2015.

U. Schaffner (u.schaffner@cabi.org), **C. Baan**, **A. Martins**, **R. Leiner**, **S. Soukou** and **P. Häfliger**.
Funded by: CTI, Federal Department of Economic Affairs, Education and Research, Switzerland.

Pyropteron chrysidiforme female (photo: T. Haye)

Toothpicks set up for release of clearwing moth eggs (photo: U. Schaffner)



Egg production of *Pyropteron chrysidiforme* at CABI (photo: P. Häfliger)

Adult ragweed leaf beetle, *Ophraella communa* (photo: P. Tóth, Slovak Agricultural University, Nitra)

Common ragweed in southern Switzerland completely defoliated by *Ophraella communa* (photo: P. Tóth, Slovak Agricultural University, Nitra)

working towards sustainable management of *Ambrosia artemisiifolia* in Europe

Common ragweed, *Ambrosia artemisiifolia*, has uniquely raised the awareness of invasive alien species in Europe. A major problem with this plant is its particularly large production of highly allergenic pollen, which generates huge medical costs and leads to reduced quality of life among the allergic population. Ragweed has also increasingly become a major weed in European agriculture, especially in spring-sown crops such as sunflower, maize, sugarbeet and soybean. Furthermore, the majority of infested land in Europe is non-crop land, and both the spread and impact of *A. artemisiifolia* are likely to increase with changing climate, posing a significant risk to society even in countries presently not yet affected. In January 2013, the COST Action FA 2013 on 'Sustainable Management of *Ambrosia artemisiifolia* in Europe' (SMARTER) was launched. The proposal was developed largely by Prof Heinz Müller-Schärer (University of Fribourg, Switzerland) and CABI in Switzerland. The goal of this Action is to develop habitat-specific and region-specific recommendations for the integrated management of ragweed across Europe. CABI has the lead in Working Group 1, which is focusing on developing biological control methods.

In 2013, the North American ragweed leaf beetle *Ophraella communa* was detected for the first time in Europe. This beetle is a most successful biological control agent against common ragweed in China, where it kills ragweed plants over large areas before seed set. In 2013 *O. communa* reached high enough densities in northern Italy and southern Switzerland to completely defoliate and prevent flowering and seed set of most ragweed plants. In contrast, *O. communa* densities in 2014 remained relatively low, probably due to the cold and rainy summer weather. In late 2014, we managed to secure funding for a PhD thesis which will specifically assess the climate-dependent population growth rate of *Ophraella communa* to help predict in which parts of Europe this beetle will be able to permanently establish and in which parts it will be able to build up high enough densities to cause significant impact on ragweed pollen and seed production.

In collaboration with CABI in China and the Institute of Plant Protection of the Chinese Academy of Agricultural Sciences, we also conducted an open-field host-specificity study in China to assess the non-target risks of *Ophraella communa* and *Epiblema strenuana* on various European sunflower varieties. Stephanie von Bergen, an MSc student at the University of Fribourg, monitored attack of sunflower under various experimental conditions and found low attack by *O. communa* (almost exclusively by adults) and no attack by *E. strenuana*.

U. Schaffner (u.schaffner@cabi.org), in collaboration with **H. Müller-Schärer**, **S. Lommen** and **S. von Bergen** (University of Fribourg). Funded by: EU COST programme and the Federal Office for the Environment (FOEN).

Setting up of a field experiment in China to assess the risks of non-target effects of *Ophraella communa* and *Epiblema strenuana* on European sunflower varieties (photo: U. Schaffner)

improving the establishment of ecological compensation areas in the Swiss Jura mountains

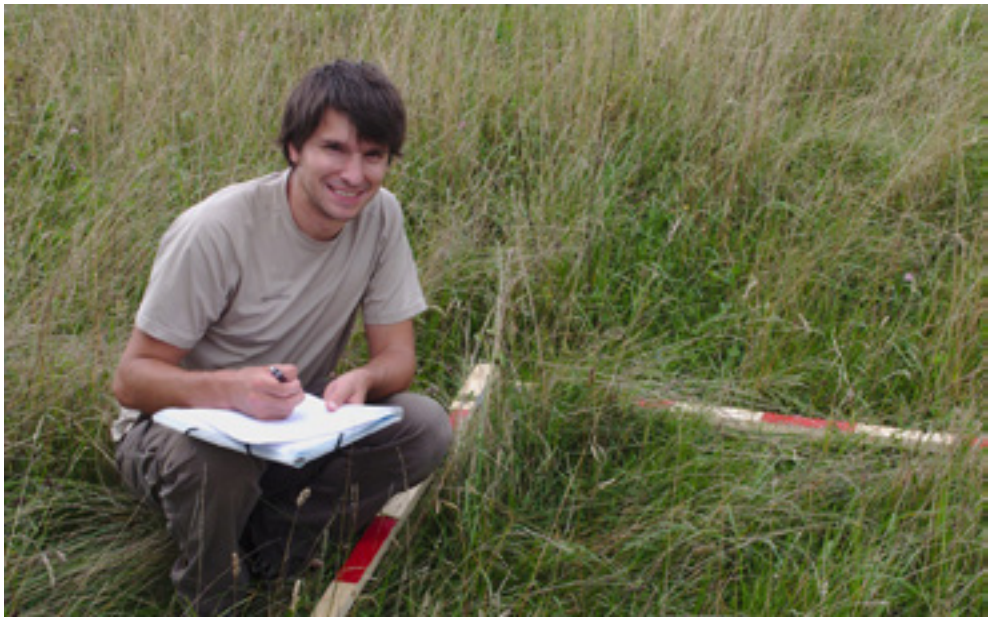
The intensification of agricultural practices and the widespread use of chemical fertilizers and pesticides in the 20th century have led to a strong decline in the biodiversity of European landscapes. The Swiss government now requires that farmers manage at least 7% of their land in ways that aim to halt the decline in biodiversity, for example through set-aside of arable fields, and compensates the farmers financially for these efforts. However, the success of ecological compensation measures is often disappointing and the policy may not achieve its goal of halting or reversing the decline in biodiversity. In particular, measures to promote the re-establishment of species-rich grassland on arable land rarely result in the development of grassland communities that resemble typical species-rich grasslands of calcareous soils. Moreover, little is known about the colonization of the newly established vegetation by invertebrates from existing grasslands nearby.

This project (Pour un meilleur établissement de surfaces de compensation écologique dans l'Arc jurassien), which started in 2013, aims to review the measures to promote the success of ecological compensation areas, and to compare successful and unsuccessful ecological compensation areas, in particular the vegetation, soil and invertebrate communities. In 2014, Célien Montavon, an MSc student from the University of Neuchâtel, carried out a correlative study of sixty fields in three regions of the Canton Jura to describe differences in the vegetation, invertebrate community and soil conditions between ex-arable fields that either have or have not achieved the desired ecological status. A literature study was started in order to collate knowledge about the effectiveness of compensation measures for the success of ecological compensation areas. The analyses of the data collected in these studies will be finished in 2015.

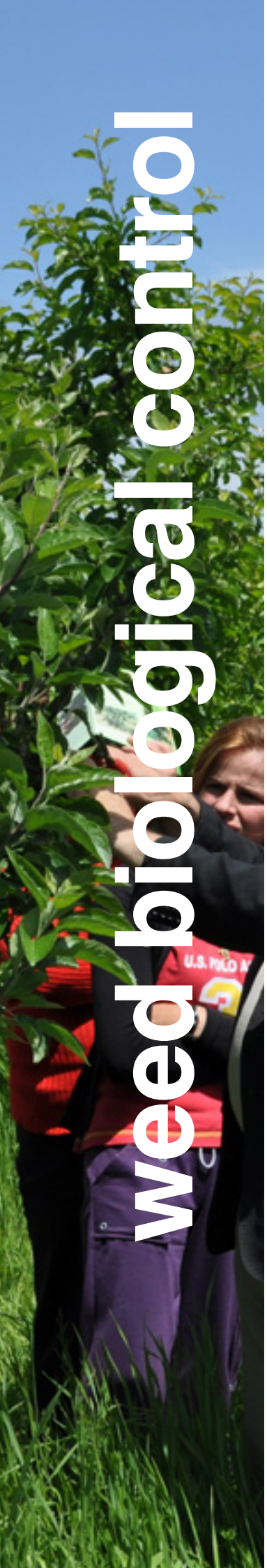
U. Schaffner (u.schaffner@cabi.org), **C. Montavon** and **R. Eschen**, in collaboration with **L. Scherrer** of FRI and the Service de l'économie rurale of the Canton Jura and the University of Neuchâtel. Funded by: Loterie Romande, the Federal Office for Agriculture (FOAG) and the Fondation sur la Croix, Switzerland.

Most plant species establishing on ex-arable land are of low conservation value (photo: R. Eschen)

Orobanche species are characteristic plants of species-rich grasslands in the Jura mountains (photo: R. Eschen)



Célien Montavon carrying out a vegetation survey on a field in the valley of Delémont (photo: R. Eschen)



weed biological control

introduction

The beginning of the year was dominated by two important conferences: the 3rd Northern Rockies Invasive Plant Council (NRIPC) Conference from 10–13 February in Spokane, WA, USA and the XIV International Symposium on Biological Control of Weeds (ISBCW) from 3–6 March in the Krüger National Park in South Africa.

Urs Schaffner and I went to the meeting in Spokane. We benefited from the presence of many of our donors and collaborators and eight consortia meetings were scheduled during lunch breaks and in the evenings. This made for a tight schedule, but created great opportunities to discuss some of the projects in more detail with interested participants. In addition, two symposia took place. Kevin Delaney and Sharlene Sing (USFS Rocky Mountain Research Station, MT, USA) organized a Russian Olive Symposium with the aim of identifying and addressing potential conflicts of interest for the biological control of Russian Olive. The event attracted a range of different stakeholders and researchers; a major output was the formation of a Russian Olive Task Force. Tim Miller (Washington State University) and others organized a Flowering Rush Symposium to exchange information on the status, impact, distribution, ecology and management of this relatively new exotic invader (for a project update see page 65). Finally, the opportunity was taken to acknowledge the lifelong contribution to biological control of Lars Baker, Weed Supervisor of Fremont County for 38 years, who retired at the beginning of 2014. Lars was instrumental in initiating the first biocontrol projects in Wyoming. The Wyoming Biological Control Steering Committee is now one of our largest donors.

Between our Swiss, UK, China and Africa centres, a total of 14 CABI staff members participated at the ISBCW meeting (for details see highlights section, page 16). The next meeting will be held in Switzerland, in September 2018, and will be organized by the CABI Swiss and UK weeds groups. It is worth noting that the very first ISBCW meeting took place in Delémont, Switzerland, in 1969.

On the agent front we have finally seen movement, with two agents, the stem-galling weevil *Rhinusa pilosa* for the control of yellow toadflax (*Linaria vulgaris*) and the leaf-feeding noctuid moth *Hypena opulenta* for the control of swallow-worts (*Vincetoxicum* spp.) being released in Canada during 2014. We are hoping that the USA will follow in 2015 (for details see highlights section, page 16).

As usual we were able to recruit a highly motivated group of ten summer students from five countries as well as Cornelia Cloşca, our only permanent technical assistant at the moment. Unfortunately, due to serious health issues, our garden helper Christian Lechenne, who has been working at the centre for 25 years, is no longer able to work full time. We have therefore employed a young local gardener, Lise Berberat, who fits very well into our team, and will hopefully stay as long as Christian! Finally, some more staff changes will be coming up in 2015. Esther Gerber, who has been with us for 17 years, will sadly be leaving to pursue a new direction in her life. Ghislaine Cortat will take over the garlic mustard project and Sonja Stutz the perennial pepperweed. We wish Esther all the best in her new endeavours.

Dr Hariet L. Hinz
Head of Weed Biological Control

From left to right: Mark Schwarzländer, Hariet Hinz, Lars Baker, Nancy Peiropan and Urs Schaffner during the NRIPC meeting in Spokane after handing over some gifts to Lars for his lifetime contribution to biological control (photo: I. Park, University of Idaho)

Dr Hariet Hinz
Head of Weed Biological Control

Ghislaine Cortat
Research Scientist

Dr André Gassmann
Research Scientist

Dr Esther Gerber
Research Scientist

Dr Patrick Häfliger
Research Scientist

Dr Urs Schaffner
Research Scientist

Dr Ivo Toševski
Research Scientist

Cornelia Cloşca
Research Assistant

Elena Olsen
MSc Student

Veronica Marcari
PhD Student

Sonja Stutz
PhD Student

Christian Leschenne
Assistant Garden Technician

Lise Berberat
Diploma Gardener

Olivier Rais
Assistant Garden Technician

Jeanne Steullet
Assistant Garden Technician

Florence Willemin
Diploma Gardener

Candice Baan
Summer Student

Miranda Elsby
Summer Student

Ana Falthauser
Summer Student

Rosalie Leiner
Summer Student

Alysha Martins
Summer Student

Dylan Sjolie
Summer Student

Shiwa Soukou
Summer Student

Jordan Squire
Summer Student

Daniel Slodowicz
Summer Student

Sophie Stattegger
Summer Student

Ludovic Winkler
Summer Student

Rhinusa pilosa
(photo: I. Toševski)

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: yellow toadflax (*Linaria vulgaris*), Dalmatian toadflax (*Linaria dalmatica*), and a type that appears to be morphologically intermediate. Of the five insect agents tested and released against toadflaxes since 1963, only the shoot-boring weevil *Mecinus janthiniformis* has been reported to have a significant impact on *L. dalmatica*. In contrast, the reported efficacy of the majority of these agents on *L. vulgaris* has been minimal, with only *Mecinus janthinus* recently showing some promise following its first release in the 1990s in both the USA and Canada. Since 2000, several other European insects have been investigated for their potential use against *L. vulgaris*. The first of these, the shoot-galling weevil *Rhinusa pilosa,* was released in Canada in May 2014. First observations indicate that the weevils are able to live, disperse and produce galls for several weeks after release.

Between 2006 and 2014, 87 plant species or populations were included in gall induction tests with *R. rara* ex. *Linaria genistifolia* (formerly named *R. brondelii*) of which 48 were native North American (NA) species in 37 genera. Results suggest that *R. rara* is even more specific than *R. pilosa;* no larval development was recorded on any native plant species.

Oviposition and larval development tests with *Mecinus heydenii* ex *L. vulgaris* and *M. laeviceps* ex *L. genistifolia* under no-choice conditions are almost complete. For *M. heydeni*, 593 females were tested in 2268 replicates on 86 plant species and populations in 46 genera, of which 51 were native NA species. Development to the adult stage occurred on the native NA *Epixiphium wislizenii*, *Maurandella antirrhiniflora*, *Nuttallanthus canadensis* and *Sairocarpus virga.* For *M. laeviceps*, 702 females were tested in 2322 replicates on 88 plant species and populations in 47 genera, of which 53 were native to NA. Larval development to the adult stage was limited to *N. canadensis* and *S. virga*. Repeated multiple-choice field cage tests with *M. heydeni* showed that *N. canadensis* is susceptible to attack when a high number of shoots are available compared with the target plant, *L. vulgaris*. Six multiple-choice field cage tests carried out from 2012–2014 with *M. laeviceps* found some attack on *N. canadensis* but none on *S. virga*.

Galls induced by *Rhinusa rara* on *Linaria dalmatica* in May 2014 (photo: I. Toševski)

In 2015, we will prepare and submit a petition for field release of *R. rara* in Canada and the USA in collaboration with our North American partners. In addition, work will focus on *Mecinus peterharrisi*, a species reared from *L. dalmatica* ssp. *macedonica* in southern Macedonia and northern Greece that should be more tolerant to low temperatures than *M. janthiniformis*. Work on *M. heydeni* and *M. laeviceps* will be completed.

I. Toševski, **A. Gassmann** (a.gassmann@cabi.org), **O. Krstić** and **J. Jović**. Funded by: Wyoming Biological Control Steering Committee, USDA-APHIS-CPHST (Animal and Plant Health Inspection Service – Centre for Plant Health Science and Technology), Montana Noxious Weed Trust Fund through Montana State University, South Dakota Department of Agriculture, USA; British Columbia Ministry of Forests, Lands and Natural Resource Operations, Canada.

Rosemarie DeClerck-Floate carrying out the first release of *Rhinusa pilosa* in Canada, 8 May 2014 (photo: AAFC)

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

Mogulones borraginis (photo: I. Park, University of Idaho)

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 adjacent states of the 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 are capable of attacking several indigenous North American species and they are no longer being considered as potential agents.

The only agent left with potential for release in North America is the seed-feeding weevil *Mogulones borraginis*. It is by far the most specific agent on houndstongue, with larval development restricted to the genus *Cynoglossum*. A petition for field release is in preparation.

In 2014, we were able to rear about 4700 larvae of *M. borraginis*. Resulting adults were used for shipments to the USA (see below), and will be used to continue our rearing at CABI in 2015.

During 2014, over 1000 *M. borraginis* adults were hand-carried by Prof. Mark Schwarzländer (University of Idaho, USA) to the quarantine facility in Pullman, Washington, for investigations on the host-choice behaviour of the weevil, conducted by PhD student Ikju Park. Some fantastic data have been collected by Ikju using dual-choice bioassays investigating olfactory and/or visual cues of *M. borraginis*. Ikju tested four North American threatened and endangered (T&E) species and the two houndstongue congeners *Cynoglossum grande* and *C. occidentale.* Twenty females each were given the choice between one of the test species and houndstongue. In only three cases out of the 20, one female each chose one of the test species. This overwhelming preference for houndstongue confirms previous single-choice test data in which no eggs were laid on any of the T&E species, as far as they could be tested, while only a few eggs were laid on *C. grande* and the plant was not attacked at all under more natural conditions exposed in a field cage. Thus we anticipate that a knowledge of the cues employed by biological control agents during host selection could confirm and improve the accuracy of host-specificity testing, especially direct non-target impacts.

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

Ikju Park (right) and B. Pakish (left), collecting volatiles of the native North American *Cynoglossum grande* in White Salmon, WA (photo: I. Park, University of Idaho)

Female *Aulacidea pilosellae* on *Pilosella officinarum* (photo: T. Haye)

Aulacidea pilosellae galls on *Pilosella glomerata* in the Czech Republic (photo: G. Cortat)

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

Eurasian hawkweeds have been introduced into North America where several species have become troublesome weeds, particularly in north-western USA and in the Canadian province of British Columbia. They invade roadsides, pastures, clear-cut areas and nature reserves. CABI has been investigating potential biological control agents of European origin for use in North America since 2000. To date testing has been discontinued for four of seven insect species, because they either lack specificity or show a preference for non-target *Pilosella* species, or because of difficulties in obtaining conclusive results. A petition for the field release of the root-feeding hoverfly *Cheilosia urbana* was submitted to USA and Canadian regulatory authorities for review in late 2014.

The gall wasp *Aulacidea subterminalis* attacks stolons of *Pilosella officinarum* (mouse-ear hawkweed), *P. flagellaris* (whiplash hawkweed) and *P. aurantiaca* (orange hawkweed). Since 2011, several field releases have taken place in the USA and Canada. So far, establishment has been recorded on *P. aurantiaca* and *P. flagellaris* in British Columbia and monitoring is ongoing at all release sites.

Two biotypes of a second gall wasp, *Aulacidea pilosellae,* which attacks the midrib of leaves, stolons and flower stalks of *Pilosella* spp., have been studied at CABI since 2003. Wasps associated with *P. officinarum* (*A. pilosellae* ex *P. officinarum*) occur in the southern (Switzerland and southern Germany) and northern range (Czech Republic, eastern Germany and Poland), and wasps associated with *P. caespitosa* (meadow hawkweed) and *P. glomerata* (yellowdevil hawkweed), (*A. pilosellae* ex *Pilosella* spp.) were collected from the northern range only. Host-range tests with *A. pilosellae* ex *P. officinarum* and *A. pilosellae* ex *Pilosella* spp. are continuing. Studies on host preference among separately collected field populations were conducted in 2013–14. Results were similar to the host-range tests conducted with mixed populations. *A. pilosellae* ex *P. officinarum* prefers *P. officinarum. A. pilosellae* ex *Pilosella* spp. prefers *P. caespitosa*, but also performs well on *P. flagellaris* and *P. glomerata.*

The rust *Puccinia hieracii* var. *piloselloidarum*, first evaluated for controlling *Pilosella officinarum* in New Zealand, was recorded from several *Pilosella* spp. in Europe. In 2014, we collected infected leaf samples from six *Pilosella* species in eastern Germany, the Czech Republic and Poland. Samples were sent to Drs DeClerck-Floate and Syama Chatterton (AAFC, Lethbridge) for studies in quarantine. We were unfortunately not able to find the rust on *P. caespitosa* and inoculations on this species were not successful.

G. Cortat (g.cortat@cabi.org), **H.L. Hinz**, **J. Squire**, and **S. Soukou**. 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.

Jordan Squire preparing herbarium samples in Poland (photo: G. Cortat)

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

Russian knapweed, *Rhaponticum repens* (synonym *Acroptilon repens*), a perennial forb that is native to Asia, 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. In the 1970s, first efforts to control Russian knapweed in the USA by biological means led to the release of a nematode species. However, this agent did not prove to be effective. Investigations into the biological control of Russian knapweed were therefore resumed in 1997.

In March, a shipment of approximately 500 galls of the gall wasp *Aulacidea acroptilonica* was made to the quarantine facility of AAFC at Lethbridge, Alberta, to continue rearing this biological control agent. The gall wasp, as well as the gall midge *Jaapiella ivannikovi,* have become established in the USA and in Canada.

In collaboration with Drs Ghorbani and Asadi, Mashhad University, Iran, we continued with the open-field host-range test with the mite *Aceria acroptiloni*. The test design was identical to the tests set up in 2013, but an additional ten test plant species were added to the field plot. In August, all above-ground plant parts were harvested and hand-carried to Drs Radmila Petanovic and Biljana Vidović, University of Belgrade, Serbia, for mite extraction and identification. The results of this test will become available in spring 2015. Mite-infested plants were also hand-carried to the quarantine facility at CABI in Delémont to continue with the no-choice host-range testing under quarantine conditions. Except for one mite found on *Centaurea rothrockii*, no mites survived more than one week on any of the 16 test plant species inoculated in 2014.

In late April/early May 2014, a field experiment was set up by Dr Toshpulat Rajabov, University of Samarkant, Uzbekistan, to test the host-specificity of *Galeruca* sp., a leaf beetle which was first found in 2008. Plants of the native North American test species *Centaurea rothrockii* and *Saussurea discolor* were transplanted to the edge of an artichoke field (*Cynara scolymus*), inoculated with larvae of *Galeruca* sp. and regularly inspected for feeding damage. While artichoke and *C. rothrockii* did not show any signs of feeding by *Galeruca* sp., all eight *S. discolor* plants revealed feeding damage which was likely to have been caused by the *Galeruca* sp. larvae. These findings suggest that larvae of *Galeruca* sp. accept members of the genus *Saussurea* under field conditions as well as under quarantine conditions.

Work in 2015 will focus on shipping field-collected galls of the gall wasp *Aulacidea acroptilonica* to Canada and on continuing host-range testing with the mite *Aceria acroptiloni*. It is planned to write a petition for field release of *A. acroptiloni* in late 2016.

U. Schaffner (u.schaffner@cabi.org) and **A. Martins**, 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-CPHST, and Montana Weed Trust Fund through Montana State University, USA.

Collection of mite-infested Russian knapweed plants for transplanting into the open-field host-range test with *Aceria acroptiloni* at the experimental farm of Mashhad University, Iran (photo: U. Schaffner)

Test plants for the open-field host rage test with the mite *Aceria acroptiloni* are reared for several weeks in the greenhouse before being transplanted into the field (photo: U. Schaffner)

Massimo Cristofaro taking pictures of Russian knapweed shoots infested by *Aceria acroptiloni* (photo: U. Schaffner)

Ana Falthauser collecting *Ceutorhynchus alliariae* (photo: E. Gerber)

Feeding marks by *Ceutorhynchus scrobicollis* on garlic mustard exposed in the open-field test (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 and is considered to be one of the most serious invaders in 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 at Cornell University in the USA. At present, we are concentrating on four weevil species: *Ceutorhynchus alliariae, C. constrictus, C. roberti* and *C. scrobicollis*.

A petition for field release of the root-mining weevil *C. scrobicollis* had been submitted to the USDA-APHIS Technical Advisory Group (TAG) in 2008. Additional information required by TAG was submitted at the beginning of September 2011. In May 2013, TAG reviewers raised additional concerns, whereupon a list of additional species to be tested was submitted for review in October 2013. In a reply received in November 2014, additional concerns were expressed by two reviewers. In collaboration with partners in North America we are currently trying to find a way forward to complete host-specificity testing with *C. scrobicollis*.

So far, none of the additional no-choice oviposition and development tests conducted with *C. scrobicollis* revealed any additional plant species that could support development to adult. An open-field test with *Thlaspi arvense*, a European species currently investigated as a cover, companion and oil crop in the US, was initiated in autumn 2014 but proved difficult because seedlings were heavily attacked by herbivores in the field. The few surviving *T. arvense* will be regularly monitored throughout winter and spring 2015 and ultimately dissected to examine them for attack by *C. scrobicollis*.

No-choice tests conducted in 2014 revealed no additional plant species that could support development to adult by the shoot miner *C. alliariae*. Emergence from *A. petiolata* plants established as control was however low and tests with two species accepted for oviposition need to be repeated in 2015. In single-choice tests with two species, *Thysanocarpus curvipes* and *Nasturtium gambelii*, the latter was also accepted by *C. alliariae* in the presence of the main host, *A. petiolata*. We plan to conduct an open-field test in 2015 to further investigate if *N. gambelii* is also attacked under natural conditions.

None of the test species exposed to the seed-feeding *C. constrictus* in no-choice oviposition and development tests in 2014 supported development to adult. An open-field test revealed no attack on *Brassica juncea* (brown, or Indian mustard), a species from which complete adult development has been recorded for *C. constrictus* during no-choice tests. Overall, our data indicate that the risk of *B. juncea* being attacked by *C. constrictus* under natural condition is very low to negligible.

Work in 2015 will concentrate on tests with *C. constrictus, C. alliariae* and *C. scrobicollis*. In addition, a shipment of *C. constrictus* to the quarantine facility at the University of Minnesota is scheduled for spring 2015, where additional tests with North American species will be conducted.

E. Gerber, **H.L. Hinz** (h.hinz@cabi.org), **C. Cloşca** and **A. Falthauser**. Funded by: USDA Forest Service through the University of Minnesota, Minnesota Department of Natural Resources and USDA-APHIS-CPHST, USA.

Plant arrangement in a single-choice test with *Ceutorhynchus alliariae* (right: *Alliaria petiolata*; left: *Nasturtium gambelii*). White dots on *A. petiolata* are feeding marks by *C. alliariae* (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 2014, we concentrated our work on four potential biological control agents.

In 2014, we continued conducting additional tests with the gall-forming weevil *Ceutorhynchus cardariae,* as requested by TAG. We conducted additional no-choice tests with 12 new species of test plants, all native to North America (NA), three of which supported development to a certain degree. In contrast to previous tests, three of the four species exposed in a multiple-choice cage test supported development. We are therefore planning to set up an open-field test with these species in 2015. In addition, we started collaborating with the University of Neuchâtel to investigate the underlying effect of the chemical composition of plants on their suitability of *C. cardariae* development. We are hoping to complete all additional tests in 2015 and submit the additional data to TAG by early 2016.

The seed-feeding weevil *Ceutorhynchus turbatus* is the most specific agent we are currently working with. Tests in 2014 advanced well, despite the fact that *L. draba* control plants only produced a few viable seeds. Of 18 exposed test species under no-choice conditions, none was accepted for oviposition. Unfortunately, no development tests could be set up due to a lack of *L. draba* plants with well-developed seeds.

We repeated an open-field test with the stem-mining weevil *Ceutorhynchus merkli* in southern Russia in 2014. Nearly all (85%) valid replicates of *L. draba* were attacked by *C. merkli,* but attack levels remained low. Mines and larvae were also found in the European *Nasturtium officinale*. None of the native NA species exposed were attacked. Despite these positive results, we will postpone further work with *C. merkli* for the time being due to reduced levels of funding.

We continued our investigations of the phenology, temperature thresholds and cold hardiness of the specialist strain of the root-galling weevil *Ceutorhynchus assimilis*. MSc student Adrien von Virag is currently writing up his thesis and results for publication. Overall, we believe that the specialist strain of *C. assimilis* has some potential to adapt to continental climates. Host-specificity tests advanced well. Under no-choice conditions, ten of 34 exposed test species supported development. In a subsequent multiple-choice cage test only three of the ten species were attacked and to a much lower degree than *L. draba*.

Field trips to Georgia and Armenia unfortunately did not reveal any new potential agents for *L. draba*.

H.L. Hinz (h.hinz@cabi.org), **C. Cloşca**, **S. Stattegger**, and **L. Winkler**, in collaboration with **A. Diaconu** (Institute of Biological Research, Iaşi, Romania) and **M. Dolgovskaya** (Russian Academy of Sciences, Zoological Institute, St Petersburg). Funded by: Wyoming Biological Control Steering Committee, Montana Weed Trust Fund through Montana State University, South Dakota Department of Agriculture, USDA-APHIS-CPHST, and USDI BLM, Oregon, through the Hoary Cress Consortium administered by the Panhandle Lakes RC&D, Idaho, USA; British Columbia Ministry of Forests, Lands and Natural Resource Operations, Canada.

Sophie Stattegger measuring *L. draba* control plants for a non-target impact experiment (photo: H.L. Hinz)

Adult of *Ceutorhynchus assimilis* (photo: T. Haye)

Ludovic Winkler setting up the multiple-choice cage test with *Ceutorhynchus cardariae* (photo: C. Cloşca)

PPW potentially attacked by *Metaculus lepidifolii* in Armenia (photo: M. Cristofaro, BBCA)

Ceutorhynchus marginellus (photo: L. Parson)

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 the Biotechnology and Biological Control Agency (BBCA) in Italy.

At present we are concentrating on three potential biological control organisms: the gall-forming weevil *Ceutorhynchus marginellus*, the root-mining weevil *Melanobaris* sp. near *semistriata* and the gall-forming eriophyid mite *Metaculus lepidifolii*.

No-choice oviposition and development tests conducted with *C. marginellus* in quarantine at CABI have so far revealed that 33 other species support adult development. Several of these have already been tested in multiple-choice cage tests in southern Russia, and results in 2014 showed that the native North American *Cardamine breweri* was attacked. In simultaneously established open-field tests, galls were recorded on *C. brewerii*, but no larvae were found. Open-field tests further revealed a single dead larva in *Lepidium crenatum* and living *C. marginellus* larvae in *L. huberi* and *L. virginicum*. Since these results are of concern, and levels of funding will be reduced in 2015, we decided instead to concentrate our efforts on the mite *M. lepidifolii*. We will however continue population viability tests with *L. eastwoodiae* and *L. virginicum* and rearing of *C. marginellus* in 2015.

Due to problems in obtaining a legal framework to work in Turkey, all tests scheduled for 2014 were suspended. Field surveys were carried out in two neighbouring countries, Georgia and Armenia, not yet covered in surveys in previous years. These surveys focused mainly on *M.* sp. n. pr. *semistriata* and *M. lepidifolii*, the two potential agents we previously worked with in Turkey.

The presence of *M. lepidifolii* was confirmed at a site in Georgia. Plant parts with galls similar to the ones caused by *M. lepidifolii* were also collected from several sites in Armenia, but no mites could be extracted from this material. Root-mining weevil larvae were found in Armenia, but molecular analyses revealed that they belong to other species than *M.* sp. n. pr. *semistriata*.

In December 2014, a co-operative agreement was signed with Erciyes University in Kayseri, Turkey, and preparations for an open-field test with *M. lepidifolii* were initiated. In parallel, a field trip is planned to collect mite infested material in Georgia in spring 2015, import it into the quarantine facility at CABI and try out methods for host-specificity tests developed by BBCA.

E. Gerber (e.gerber@cabi.org), **H.L. Hinz**, **C. Cloşca** and **A. Falthauser**. Joint project with **M. Cristofaro** (BBCA); in collaboration with **M. Dolgovskaya** (Russian Academy of Sciences, Zoological Institute, St Petersburg) and **C. Zieglmaier** and **S. Yüksel** (Ortahisar, Turkey). CABI funded by: Wyoming Biological Control Steering Committee, USDA-APHIS-CPHST and USDI BLM, USA. BBCA funded by: California Department of Food and Agriculture and USDA-ARS Western Region Research Center, Nevada, USA.

Francesca Di Cristina and Esther Gerber dissecting roots of PPW in Armenia (photo: M. Cristofaro, BBCA)

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 two biological control candidates; the seed-feeding weevil, *Ceutorhynchus peyerimhoffi,* and the root crown-mining weevil, *C. rusticus*.

Rearing of *C. peyerimhoffi* was very successful in 2014 and we currently have about 5700 larvae overwintering ready for adult emergence in 2015. Host-specificity tests also advanced well. Of 36 test plant species exposed, seven were accepted for oviposition. In subsequent no-choice development tests with six test species we found, for the first time, development to mature larvae in two test species, the native North American (NA) *Boechera hoffmannii* and *Streptanthus heterophyllus*. Both species will be exposed under multiple-choice conditions, i.e. in the presence of dyer's woad in 2015. Results of a multiple-choice cage test established in 2014 clearly showed that the two native NA species, *Lepidium nitidum* and *L. virginicum,* were not attacked in the presence of dyer's woad. Depending on the results of host-specificity tests in 2015, in particular with *B. hoffmannii,* we will decide whether to prepare and submit a petition for field release in winter 2015/16.

The open-field test established with *C. rusticus* in autumn 2013 worked very well in that adults emerged from nearly all exposed dyer's woad plants in 2014 in a relatively high number, rendering the results very robust. Unfortunately, for the first time, one test plant species, the native NA *Thelypodium sagittatum,* also supported development of one *C. rusticus* adult and typical mines were found in one plant of *Stanleya viridiflora*. From the closely related *Isatis glauca,* only one adult emerged, indicating that even this closely related plant is only a very suboptimal host of *C. rusticus*.

The open-field test in 2014 using two different distances, 0.5 and 2m from a central release point, clearly confirmed the preference of *C. rusticus* for dyer's woad in that 99.4% of all eggs were laid onto dyer's woad, but did not completely support our hypothesis that only test plants in very close proximity to dyer's woad are attacked. Most probably, the distance of 2m was not large enough. In addition, we cannot discount the possibility that some of the attack on test plants was due to contamination by oligophagous weevils present in the area. Ideally the experiment should therefore be repeated.

Two weevil species were found on dyer's woad during a field trip to Georgia, the oligophagous *Aulacobaris janthina,* and *A. ?licens*. In preliminary host-specificity tests with *A. licens* from eastern Turkey in 2008, we found that it was not very specific under no-choice conditions. However, since the specimens from Georgia are morphologically slightly different, it might be worthwhile repeating some of the tests with *A. ?licens* from Georgia.

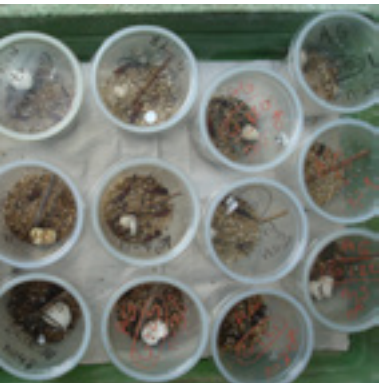
H.L. Hinz (h.hinz@cabi.org), **C. Cloşca**, **S. Stattegger** and **L. Winkler**. Funded by: USDI BLM, Idaho, Wyoming Biological Control Steering Committee, and USDA-APHIS-CPHST, USA.

Aulacobaris ?licens mining in root crown of *Isatis tinctoria* (photo: H.L. Hinz)

Multiple-choice cage test with *Ceutorhynchus peyerimhoffi* (photo: H.L. Hinz)

Cornelia Cloşca setting up an open-field test with *Ceutorhynchus rusticus* in autumn 2014 (photo: H.L. Hinz)

Manual larval transfer during rearing of *Archanara neurica* (photo: J. Freise)



Pupae of *Archanara geminipuncta* for adult emergence in plastic cups (photo: P. Häfliger)

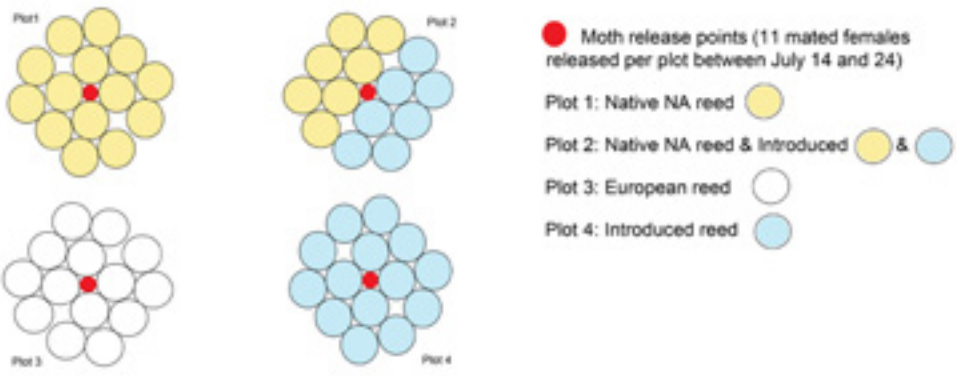
protecting the USA's wetland areas from common reed, *Phragmites australis*

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 North American populations of common reed were recently recognized as a distinct subspecies, *P. australis americanus*.

We are currently concentrating on two shoot-mining noctuid moths, *Archanara geminipuncta* and *A. neurica*. Although both species can develop on native North American reed under test conditions, we expect the native *Phragmites* to escape attack in the field, because their leaf sheaths are less suitable for oviposition and eggs suffer higher mortality during winter than on the invasive reed.

In 2014, we repeated an open-field test with *A. geminipuncta*, which had worked very well for *A. neurica* in 2013. In early July, four plots were set up: 1) seven pots of native and seven pots of introduced reed; 2) 14 pots of introduced reed; 3) 14 pots of native reed; and 4) 14 pots of European reed (see Figure below). Between three to eight different populations of reed per origin were randomly exposed. Each plot was placed in the corner of a 10x10m quadrate. Between 14 and 24 July 2014, 11 females of *A. geminipuncta* were released in the centre of each of the four plots, i.e. 44 females in total. Two weeks after the last release, all stems were harvested and checked for eggs. The test produced some very encouraging results. Of 326 *A. geminipuncta* eggs found, 312 (95.7%) were laid on European and invasive reed, and only one egg cluster with 14 eggs onto native reed. These results are very similar to those for *A. neurica* in 2013 and clearly confirm the strong oviposition preference of both moth species for invasive/European reed. Together with the higher overwintering mortality of eggs on native reed, we expect any impact of *A. neurica* and *A. geminpuncta* on native reed to be negligible, should the noctuids be released in North America. A petition for field release of both moth species is currently being prepared by our North American collaborators.

P. Häfliger (p.haefliger@cabi.org), **R. Leiner** and **S. Soukou**. Funded by: the Army Corporation of Engineers and US Fish and Wildlife Service through Cornell University, USA; British Columbia Ministry of Forests, Lands and Natural Resource Operations, Canada.



Set-up for open-field oviposition test with *Archanara geminipuncta* in 2014

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 it 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 biological control 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 this country, 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, they are leading this project in cooperation with staff at the MoA-CABI Joint Laboratory in Beijing.

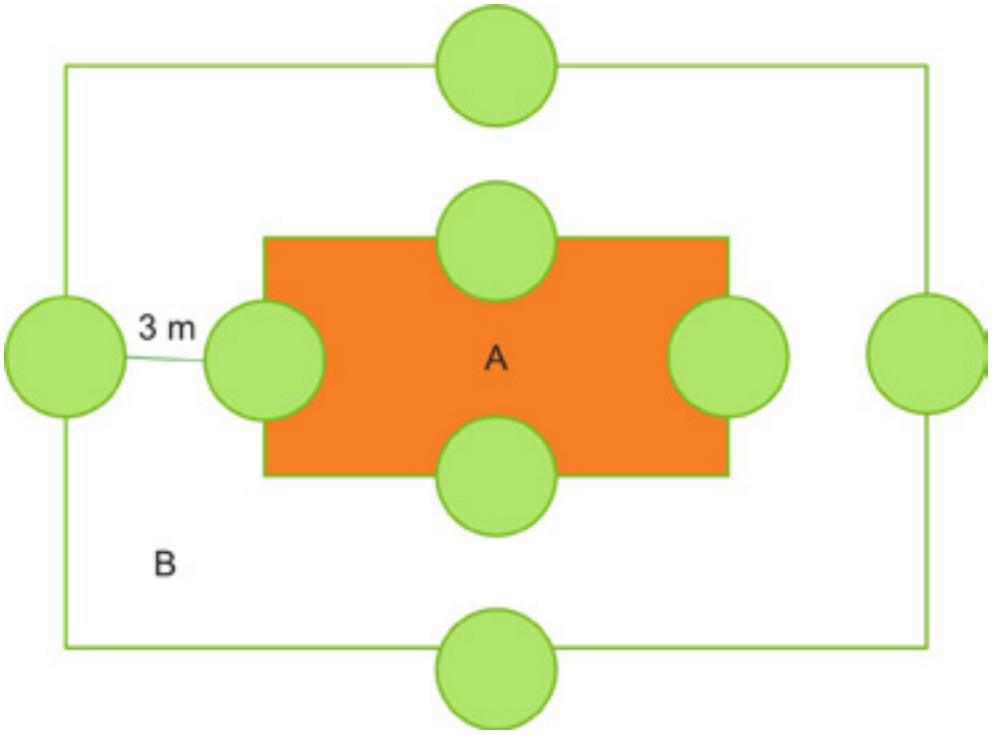
During surveys in 2010, different pathogens had been collected on *C. arvense*, and a white blister 'rust', *Pustula spinulosa*, was identified as the most promising agent. The blister 'rust' proved to be difficult to work with, but in 2013 fresh zoosporangia collected in Urumqi, Xinjiang Province, north-eastern China, were successfully used for simultaneous host specificity testing in China and the UK. Both tests showed that two of the four populations of *C. arvense* from North America tested were fully susceptible to the isolate, and that the three native North American *Cirsium* species/varieties tested (*C. undulatum, C. undulatum* var. *tracyi* and *C. ochrocentrum*) were only weakly susceptible.

In 2014 an open-field test was conducted in Urumqi, China, to test the specificity of *P. spinulosa* under natural conditions on the three native *Cirsium* species/varieties. Contrary to expectations, these species were shown to be more susceptible under field conditions, with larger pustules developing on the leaves than was observed in the glasshouse. Molecular analysis is currently being undertaken to confirm that the field infection on the North America natives is indeed *P. spinulosa* originating from *C. arvense*. Depending on results, we will decide whether it is worth continuing investigations on *P. spinulosa* or not.

C.A. Ellison (c.ellison@cabi.org), **Wan H.**, **K. Pollard**, **Li H.M.**, **Zhang F.** and **H.L. Hinz**. Joint project with the MoA-CABI Joint Laboratory for Bio-safety in Beijing. Funded by: USDA-APHIS-CPHST, USA, and the MoA-CABI Joint Laboratory, China.

Wan Huanhuan preparing plants for field trial at Xinjiang Agricultural University, Urumqi, China (photo: C. Ellison)

Cirsium undulatum, a native North America species infected with *Pustula spinulosa* in open field test, Urumqi, China (photo: Wan H.)



Design of field experiment: The patch of *Cirsium arvense* was approximately rectangular (B), with a focus of *Pustula spinulosa* infected plants in the centre (A). Eight replicated groups of the test plant species were placed at each position, denoted by a small circle. Plants were left in the field until full infection was observed on the plants, then infected leaves were picked and dried for molecular analysis.

F1 galls formed by *Rhopalomyia tanaceticola* at the base of rosette leaves of *Tanacetum huronense* from North America (photo: A. Gassmann)

Alecu Diaconu at the Biological Research Institute in Iaşi, Romania (photo: E. Pricop, Alexandru Ioan Cuza University, Iaşi)

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

Common tansy, *Tanacetum vulgare*, is a Eurasian perennial plant that 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 2014 focused on the stem-boring weevil *Microplontus millefolii*, the shoot-boring moth *Platyptilia ochrodactyla* and the shoot, leaf and flower gall midge *Rhopalomyia tanaceticola*.

Tests under no-choice conditions showed that, *T. camphoratum* and *T. huronense* from North America appear to be suitable host plants for oviposition and larval development of *M. millefolii*. Both species were also accepted in single-choice field cage tests but only very limited larval mining was recorded on these species in open-field tests carried out in Russia and the causal agent still needs to be confirmed. Results in Russia support the hypothesis that the field host range of *M. millefolii* is limited to *T. vulgare* since no other host plant is recorded in the native European range of the weevil.

The area around St Petersburg in Russia is the most promising in terms of the population density of *M. millefolii*. Because of the difficulty of working at CABI with weevils collected in this area, no-choice oviposition and larval development tests will be continued in Russia in 2015 in collaboration with the Zoological Institute in St Petersburg. These tests will be supplemented by additional field cage and open-field tests.

Work in 2014 confirmed the presence of *P. ochrodactyla* larvae in the flowerheads of *T. vulgare* up until late summer. Consequently populations can be completely exterminated if plants are mown during this period. Successful mating and oviposition have been achieved for the first time under laboratory conditions. Under no-choice conditions, some attack was observed on *T. huronense* from North America and *T. corymbosum*, however, the few early instar larvae found in *T. huronense* were all dead, indicating that this species is not a normal host plant of the moth. More replicates will be needed to test for complete larval development in *T. corymbosum*.

The gall midge *R. tanaceticola* has at least four generations per year in north-eastern Romania. Choice and no-choice tests indicate that native North American *Tanacetum* species are highly suitable for gall induction and larval development to the adult stage. Host suitability of one such native species, *T. parthenium,* in no-choice tests is reinforced by recent field records of the midge on this species in Georgia. Consequently, it has been decided to postpone any further work with *R. tanaceticola*.

In 2015, we will continue host-range testing with *M. millefolii* in Russia and investigations on the biology and host specificity with *P. ochrodactyla* at CABI.

A. Gassmann (a.gassmann@cabi.org), **M. Elsby**, **J. Jović** and **I. Toševski** in collaboration with **M. Dolgovskaya**, **M. Volkovitch** and **S. Reznik** (Russian Academy of Sciences, Zoological Institute, St Petersburg) and **A. Diaconu** (Biological Research Institute, Iaşi, Romania). Funded by Montana Noxious Weed Trust Fund through Montana State University, USA; BC Ministry of Forests, Lands and Natural Resource Operations, Saskatchewan Ministry of Agriculture, Canada-Saskatchewan Growing Forward 2 Bi-Lateral Agreement, Alberta Invasive Species Council, Canada.

André Gassmann collecting shoots of *Tanacetum vulgare* attacked by *Platyptilia ochrodactyla* larvae in western Germany (photo: A. Leroux)

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

Chrysochus asclepiadeus adults (photo: A. Gassmann)

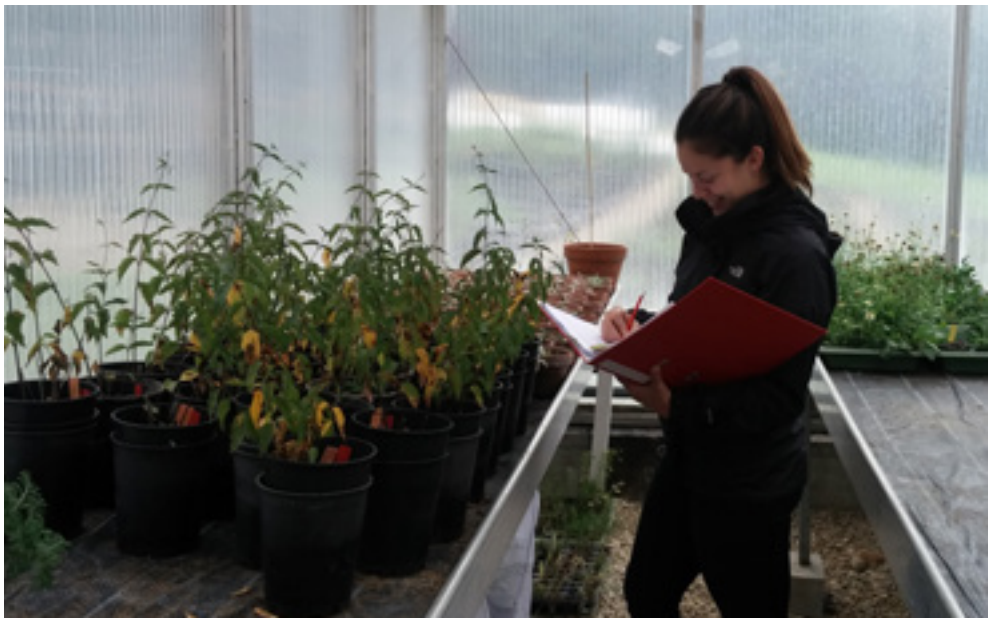
Two European species of swallow-worts, *Vincetoxicum nigrum* (black swallow-wort) and *V. rossicum* (pale swallow-wort) were introduced into eastern North America around 1850 as ornamental vines and have since become naturalized in north-eastern North America. Both species are considered invaders of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

Since 2006, several potential insect biological control agents have been investigated in collaboration with Prof. Richard Casagrande at the University of Rhode Island in the USA, and Dr Robert Bourchier at AAFC in Canada. The leaf-feeding chrysomelid beetle *Chrysolina aurichalcea asclepiadis* is polyphagous and unsuitable for biological control of *Vincetoxicum* spp. Work on the root-feeding chrysomelid *Chrysochus* (= *Eumolpus*) *asclepiadeus* has been suspended because test results showed that the larvae can develop on several native North American non-target plants mainly in the genus *Asclepias*. Also, female beetles 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*. A small rearing colony of *C. asclepiadeus* from Ukraine is maintained.

The leaf-feeding noctuid moth *Hypena opulenta* was approved for release in Canada and in autumn 2013 the first releases were carried out by Rob Bourchier (Agriculture and Agri-Food Canada) and Naomi Cappuccino (Carleton University). In 2014, additional releases of almost 10,000 larvae and 500 pupae were conducted between the end of June and early August in the Ottawa area and in Simcoe County. A second generation of *Hypena* larvae was confirmed from the Ottawa releases in late August and larvae had spread from the initial release site to a hedgerow approximately 50 metres away

Work in 2015 will focus on maintaining a small rearing colony of the chrysomelid *C. asclepiadeus* from Ukraine and to mass collect pupae of the fruit fly *Euphranta connexa* to re-start host-specificity tests in 2016, provided adequate funding is available.

A. Gassmann (a.gassmann@cabi.org) and **M. Elsby**. Funded by: AAFC, Canada.



Miranda Elsby, checking *Vincetoxicum nigrum* plants with transferred *C. asclepiadeus* larvae (photo: A. Gassmann)

Dr Asadi standing below the native *Ziziphus spina-christi*, a test plant species in the open-field host-range test with *Aceria angustifoliae* on Mashhad University's experimental farm in Iran (photo: U. Schaffner)

Russian olive shoot tip attacked by *Ananarsia eleagnella* (photo: U. Schaffner)

stemming the spread of Russian olive, *Elaeagnus angustifolia*

Russian olive, *Elaeagnus angustifolia,* a small tree native to Asia, has been widely planted in North America for erosion control, as a shade tree or as a nectar source for honey bees. To date, this tree has invaded semi-natural and natural habitats and has become the fifth most abundant tree along rivers in the western USA. In 2007, CABI started a biological control project against Russian olive, focusing on agents that attack the plant's reproductive parts or seedlings, so as to slow its spread without harming established trees. This work is being conducted in collaboration with BBCA, Prof. Ghorbani and Dr Asadi, University of Mashhad, Iran, Prof. Aloviddin Khamraev, Uzbek Academy of Sciences and Dr Toshpulat Rajabov, University of Samarkant, Uzbekistan.

In spring 2014, two additional North American (NA) test plants were shipped to Mashhad University, Iran, to complement the open-field host-specificity test with the mite *Aceria angustifoliae*. Mite-infested leaves were pinned to healthy leaves of the test and control species. Inspections of the plants during the growing season revealed that in the fourth year of this field experiment, as well as in previous years, only Russian olive trees were attacked by *A. angustifoliae*. In June, mite-infested branches were collected in Armenia and hand-carried to the quarantine facility of CABI in Switzerland. Infested leaves were pinned to leaves of ten test plant species, including representatives of three endemic NA genera of the family Rhamnaceae. As in previous years, no mites were found on any of the test plant species. Preliminary tests with the second mite found on Russian olive, *Aceria elaeagnicola*, suggest that it is also highly specific; none of the three test plant species of the family Elaeagnacae were attacked by this mite species.

As the larval host-range of the fruit-attacking moth *Ananarsia eleagnella* is not restricted to Russian olive, investigations focus on female oviposition behaviour. In July, infested Russian olive fruits were collected near Samarkant and emerging adults transferred into field cages with fruit-bearing Russian olive shoots. While several dozens of adults were released into the cages, no eggs were found. Further studies are needed to improve the experimental design for oviposition bioassays with *A. eleagnella*.

In February, a Russian olive symposium was held in Spokane, Washington (USA). We presented the biological control programme, emphasizing the focus on agents that reduce the seed output and hence the spread of this invader.

In 2015, we will continue exploring the host specificity and impact of the mite *Aceria angustifoliae* and the moth *Ananarsia eleagnella*. Depending on the availability of NA test plant species, it is envisaged that we will complete the host-range testing of *A. angustifoliae* in 2015 or 2016. We will also continue with surveys of the herbivore community associated with Russian olive close to the Uzbekistan/Tajikistan border.

U. Schaffner (u.schaffner@cabi.org) and **A. Martins**, in collaboration with **M. Cristofaro** (BBCA), **A. Khamraev** (Uzbek Academy of Sciences), **T. Rajabov** (University of Samarkant, Uzbekistan) and **R. Ghorbani** and **G. Asadi** (Mashhad University, Iran). Funded by: Wyoming Biological Control Steering Committee, Montana Noxious Weed Trust Fund through Montana State University, and USDI BLM Havre, Montana, USA.

Characteristic damage of *Aceria acroptiloni* on leaves and flowers of Russian olive shoot tips (photo: M. Cristofaro, BBCA).

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 has become a particularly aggressive invader in pastures and meadows. CABI started to explore the prospects for biological control of oxeye daisy in 2008.

In 2014, additional no-choice larval development tests were conducted with the root-mining tortricid moth *Dichrorampha aeratana* using 14 test plant species. A multiple-choice open field test was set up with five plant species that had been attacked in previous tests. All plants were dissected in autumn and no larvae were found on test plant species outside the genus *Leucanthemum* and only a few larvae on Shasta daisies.

To test whether Shasta daisy varieties vary in their susceptibility to *D. aeratana* we placed nine different Shasta daisy varieties in field cages and exposed them to females of *D. aeratana.* Adult emergence from these plants will be recorded in spring 2015.

An impact experiment set up in 2013 with *L. vulgare* and the Shasta daisy variety *L.* × *superbum* Amelia revealed that *D. aeratana* has a significant impact on the biomass and number of flowers of potted oxeye daisy plants but no impact on the Shasta daisies exposed.

In 2014, we began no-choice oviposition and development tests with the root-feeding weevil *Cyphocleonus trisulcatus* using 30 test plant species and varieties. Adults emerged from all tested Shasta daisy varieties as well as from *Glebionis coronaria*, *Matricaria chamomilla* and *M. occidentalis*. In a preliminary multiple-choice field cage test exposing oxeye daisies and Shasta daisies, fewer adults emerged from Shasta daisies compared to oxeye daisies. An impact experiment revealed that *C. trisulcatus* can have considerable impact on the growth of oxeye daisy.

In 2014 a few no-choice larval development tests with the root-mining weevil *Apion stolidum* were established using four test plant species in which larvae had been found in 2013. All emerged adults were identified as *A. stolidum* which confirms that this weevil has a rather broad physiological host range and that it is probably not a suitable biological control agent for oxeye daisy.

A few no-choice oviposition tests were also set up with the flower-head-mining fly *Tephritis neesii.* Only a few eggs were found on test plants but attack on control plants was also relatively low. The overwintering survival of adults collected in 2013 was higher when they were kept in a wooden shelter at ambient temperatures, or in an underground shelter, than when kept in an incubator set at 2°C.

In 2015, we will continue and possibly complete no-choice larval development tests with *D. aeratana*. In addition, we will continue with host-range tests and impact studies for *C. trisulcatus*.

S. Stutz, **M. Elsby**, **D. Sjolie**, **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, USA.

Adult *Cyphocleonus trisulcatus* (photo: T. Haye)

Adult *Tephritis neesii mating* on a flower head of oxeye daisy (photo: S. Stutz)

Dylan Sjolie arranging plants in the impact experiment with *Cyphocleonus trisulcatus* (photo: S. Stutz)

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

Melanagromyza albocilia pupa in a stem of *Calystegia macrostegia* (photo: G. Cortat)

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, the USDA initiated a programme for the biological control of this species. Two biological control agents were released, the gall mite, *Aceria malherbae,* and the bindweed moth, *Tyta luctuosa*. Establishment and impact of the two species did not prove satisfactory and the project was revived.

Investigations on three additional potential biological control agents began in 2009, i.e. the stem-mining agromyzid fly *Melanagromyza albocilia* and the root-mining flea beetles *Longitarsus pellucidus* and *L. rubiginosus*. *L. rubiginosus* did not prove specific enough to be further considered as a biological control agent in North America and results for *L. pellucidus* were inconclusive. Work with the two flea beetle species was therefore discontinued. In 2013, investigations on two further potential agents, the tortoise beetle *Hypocassida subferruginea* and the bindweed moth *Emmelia trabealis* were started.

Between mid-July and mid-September 2014, four mass collections were conducted for *M. albocilia* at seven sites in the Rhine Valley, southern Germany. About 2100 plants were dissected and from the 573 larvae and pupae extracted we obtained 266 live pupae. In order to obtain more *M. albocilia* available for host-specificity tests, we will try to find more sites with high attack rates to concentrate our collection efforts in 2015. However, such sites are not very common and the level of attack varies from year to year as well as within one season. We will therefore also try to establish a rearing colony at CABI. The first attempt at rearing in late summer 2014 failed, but we gained valuable insights into how to improve the method and we will continue our efforts in 2015.

In no-choice and choice tests exposing cut plant parts, the agromyzid fly *M. albocilia* accepted six of 11 test plant species for oviposition. In subsequent development tests with five test species, the fly was able to complete development on the two native North American (NA) plant species *Cal. macrostegia* and *Cal. purpurata.* We are planning to conduct multiple-choice cage and/or open-field tests with these two plant species in 2015. In addition, we will continue with no-choice oviposition tests using cut plant shoots. Any species accepted for egg laying will be exposed in no-choice development tests.

After encouraging preliminary results of the open-field test conducted by Dr Peter Tóth (Slovak Agricultural University, Nitra) in Slovakia in 2013 with the two new potential biological control agents, *H. subferruginea* and *E. trabealis*, we decided to repeat the test with additional plant species in 2014. Plants of *Convolvulus arvensis* and four NA native species were exposed at the same site. Unfortunately, a herd of goats damaged the plants. No data could be recorded and the experiment had to be stopped. Due to reduced levels of funding in 2015, further investigations with these two species have been postponed.

G. Cortat (g.cortat@cabi.org), **J. Squire**, **D. Sjolie**, **M. Elsby** and **H. L. Hinz**, in collaboration with **P. Tóth** (Slovak Agricultural University, Nitra). Funded by: USDA-APHIS-CPHST, USA.

Jordan Squire collecting field bindweed infested by *Melanagromyza albocilia* in southern Germany (photo: G. Cortat)

what are the prospects for biological control of tutsan, *Hypericum androsaemum*, in New Zealand?

Tutsan, *Hypericum androsaemum*, is a semi-evergreen shrub of European origin that has become a common weed in higher rainfall areas in New Zealand (NZ). Tutsan is shade tolerant, unpalatable to livestock, and tends to infest areas where mechanical and/or chemical control options are impractical. A rust pathogen, *Melampsora hypericorum*, which successfully controlled tutsan in Australia, is present in NZ but does not appear to be sufficiently virulent. In 2011, CABI started conducting field surveys in the area of origin of tutsan to evaluate prospects for its biological control.

During 2013 and 2014, a total of 92 tutsan populations were sampled in Ireland, the UK, France, Spain and Georgia, and 117 herbivorous insect morpho-species were collected. Of those sent for identification, eight species are known to be oligophagous within the genus *Hypericum* and the remaining species are either polyphagous, prefer another host species, or have unknown host ranges. Two species collected in Georgia were prioritized as potential biological control agents, the leaf beetle *Chrysolina abchasica,* which is only known from the Caucasus region and has no recorded host species, and the tortricid moth *Lathronympha strigana,* which is widespread on *Hypericum* spp. throughout Europe, but might have a biotype specialized on tutsan. In addition, a strain of the rust *Melampsora hypericorum* unique to Georgia might have potential as a biocontrol organism.

Elena Olsen and our NZ collaborator Hugh Gourlay from Landcare Research went to Georgia between 23 and 27 June 2014, to collect all three potential agents. The trip was successful, although fewer rust-infected leaves than last year were found. About 130 larvae and 25 adults of *C. abchasica* and about 170 tutsan fruits infested with *L. strigana* larvae were collected. The trip was again facilitated by our local collaborator Dr Davit Kharazishvili from the Botanical Garden in Batumi. The rust-infected tutsan leaves were shipped to our UK centre for additional inoculations of the so far resistant tutsan type 1 of NZ's North Island. The *C. abchasica* and *L. strigana* larvae were reared to adulthood in our quarantine facility at CABI in Switzerland. A total of 20 females and males of *L. strigana* emerged, which were used to infest 11 tutsan plants. Eggs were laid on fruits, shoots and leaves. Resulting larvae appear to develop fastest in fruits of tutsan. Mining larvae killed shoot tips (see picture). On 9 September about 200 *L. strigana* larvae and pupae and 288 *C. abchasica* adults, larvae and pupae were sent to the quarantine facility at Landcare NZ for host-specificity tests.

In addition, material of *Hypericum hirsutum* and *H. perfoliatum* attacked by *L. strigana* was collected close to the CABI centre at the end of July and sent for molecular analysis together with *L. strigana* material collected in Spain and Georgia either in the fruits or shoot tips of tutsan. Results did not indicate any difference between specimens with respect to feeding niche, but there was a clear genetic separation at the subspecies level between specimens from Spain/Delémont and Georgia, independent of the host plant.

H.L. Hinz (h.hinz@cabi.org), **C. Cloşca** and **E. Olsen**. Funded by: Landcare Research New Zealand Ltd.

Lathronympha strigana mining in young tutsan shoot (note dead shoot tip) (photo: H.L. Hinz)

New Zealand tutsan infected with the rust *Melampsora hypericorum* (photo: E. Olsen)

Elena Olsen collecting *Chrysolina abchasica* in Georgia (photo: H. Gourlay, Landcare Research Ltd)

Adult *Aphalara itadori* (photo: R. Eschen)

evaluating the risk of biocontrol introductions for Japanese knotweed, *Fallopia japonica*, in Switzerland

In 2010, the psyllid *Aphalara itadori* was released in the UK against Japanese knotweed, *Fallopia japonica*, an exotic plant in the family Polygonaceae that is a particularly aggressive invader along watercourses. The UK government approved its field release based on the results of many years of pre-release studies conducted by CABI's centre in the UK. While these studies covered almost all close relatives of Japanese knotweed native to the UK, they did not include related plant species native to other parts of Europe.

In spring 2012, the Federal Office for the Environment (FOEN) approved a two-year project proposed by CABI's Swiss centre that aims to assess the risks of potential non-target attack by the psyllid if released in Switzerland. Host-specificity studies were conducted with species in the family Polygonaceae that are native to Switzerland, as well as with varieties of closely related cultivated species that are grown in Switzerland and neighbouring countries.

Between August 2012 and July 2014, no-choice oviposition and development tests were established with *Persicaria alpine, P. lapathifolia* subsp. *lapathifolia, P. mitis*, *Rumex alpestris*, *R. patientia*, *R. thyrsiflorus* and the closely related species *Fallopia convolvulus* and *F. dumetorum*, all native to Switzerland, as well as one variety of *Fagopyrum esculentum* (buckwheat) and one of *Rheum rhabarbarum* (rhubarb) sourced in Switzerland. Individually potted plants were each exposed to five pairs of psyllid adults for five days. Eggs were laid on all *Fallopia japonica* control plants and on most of the test plant species, but in much lower numbers than on *F. japonica* (mean number of eggs per plant: 360 on *F. japonica* vs $<$ 40 on test plant species). No development to adult occurred on test plants, while the survival rate to adult was about 40% on the *F. japonica* controls. On *F. convolvulus,* one nymph reached the fifth instar (representing only 0.6% of total eggs laid on this species). On the other test plant species, nymphs died before they reached the second instar.

Although no development occurred on the Swiss variety of *F. esculentum* (buckwheat), the psyllid was able to develop on one of the North American varieties tested in the UK. We therefore chose this species for a spill-over effect experiment. Sixteen buckwheat plants were placed individually into cages together with one Japanese knotweed plant. Half of the cages received 50 adult *A. itadori*. *Fagopyrum esculentum* plants were measured and psyllid numbers were recorded for every development stage once a week for six weeks. Plants were touching to allow free movement of nymphs between the two plants. Results did not show any impact of the psyllids on the growth of buckwheat.

We also studied variation in resistance of various genotypes of *Fallopia* × *bohemica* by assessing the growth rate and survival of the psyllid on replicated clones of five genotyped hybrids. There was no significant difference in the number of eggs or adults or in the survival to adult between the different genotypes of the hybrid compared to *F. japonica*

G. Cortat, **H.L. Hinz**, **E. Gerber C. Cloşca** and **U. Schaffner** (u.schaffner@cabi.org). Funded by: FOEN, Switzerland.

Ghislaine Cortat counting *Aphalara itadori* adults emerging from *Fallopia* × *bohemica* (photo: R. Eschen)

prospects for biological control of *Butomus umbellatus*

Flowering rush (*Butomus umbellatus*) is an aggressive invader of freshwater systems that is becoming an increasing problem in the mid-western and western states of the USA. Since no effective control methods are currently available, a biological control project was started in spring 2013 and CABI in Switzerland was subcontracted to conduct surveys on potential insect agents.

Based on the results of a literature search on phytophagous arthropods and fungal pathogens associated with flowering rush in Europe, we prioritized four insect species as potential biological control agents, since they are described as monophagous on flowering rush, and information currently available suggests they will damage the plant. These are two weevil species, *Bagous nodulosus* and *B. validus*, and two flies, *Phytoliriomyza ornata* and *Hydrellia concolor.* All are described as feeding in the leaves and stems of flowering rush.

Field trips were made in 2013 and 2014 to the Bremen and Kiel areas of northern Germany, to the Czech Republic, Slovakia, Poland and Hungary. We found at least twelve sites with *B. nodulosus* adults or larvae. We also found two reed beetles, larvae of two lepidopterans, and three fly species, including *P. ornata* and probably *Hydrellia concolor.*

In 2014, we continued our efforts to improve rearing success with *B. nodulosus*. However, we are still experiencing high larval mortality and only a few adults emerged from plants onto which larvae or ovipositing females had been transferred. Thanks to successful field collections we were nevertheless able to overwinter over 160 adults. In addition, we began setting up host-specificity tests under no-choice conditions with *B. nodulosus*. Of the ten test plant species offered, none was accepted for egg-laying by female weevils, confirming the narrow host range of *B. nodulosus*.

So far, we have searched without success for a second weevil, *Bagous validus*, in Hungary and the Slovak Republic. We found one female which might be *B. validus* in Serbia, but we will need to collect more (male) individuals in 2015 in order to confirm identification. We collected several pupae of the agromyzid fly, *Phytoliriomyza ornata*. Since only one fly emerged, we were not able to work with this species in 2014. We suspect that the species overwinters in the pupal stage.

We were able to grow ten test plant species in 2014. Seeds of 12 native North American species are currently being cold- and wet-stratified for germination in early 2015. We also hope to receive several US populations of flowering rush as rhizomes in early 2015.

For 2015, we are planning to continue field surveys for additional potential agents and to continue host-specificity tests with *Bagous nodulosus*. We will also continue searching for *B. validus* and trying to establish rearing of the fly *Phytoliriomyza ornate.*

P. Häfliger (p.haefliger@cabi.org), **R. Leiner**, **C. Baan**, **A. Martins**, **S. Soukou**, **D. Sjolie**, **I. Toševsk**i and **H.L. Hinz**. Funded by: U.S. Army Corps of Engineers, Montana Weed Trust Fund through the University of Montana, Washington State Department of Agriculture, USA; British Columbia Ministry of Forests, Lands and Natural Resource Operations, Canada.

Adult *Bagous nodulosus* (photo: I. Toševski)

Setup for no-choice oviposition test with *B. nodulosus* (photo: P. Häfliger)

Daniel Slodowics at a Slovak field site (photo: P. Häfliger)

integrated crop management

introduction

It was another good year for the ICM team, with ongoing projects being successfully implemented and a potentially significant project opportunity presenting itself towards the end of the year. This exciting new initiative will involve the strengthening of our collaboration with Philip Morris International (PMI), with whom we have been working since 2005 on various tobacco IPM projects. PMI informed us about the launch of a new internal global IPM programme and requested CABI's support in implementing it. It is anticipated that a programme framework will be developed by May 2015 after which implementation of activities will commence directly. This will strengthen our global private sector stakeholder network and will also bring further opportunities for the ICM team to collaborate with other CABI centres across the world.

It is always good to welcome new staff on board, and this year we had two new additions to the ICM team. Julien Grunder was hired following the departure of Frida Rodhe who, after two years of working with us, decided to return to her home country of Sweden for personal reasons. Julien started work on 1 October as an Integrated Crop Management Advisor and has already been instrumental in assisting with the implementation and coordination of our PMI project work. Luca Heeb was also hired in July this year as part of a junior professional officer training scheme organised by the Swiss Agency for Development and Cooperation (SDC). Although Luca will work on some ICM projects, he will mostly focus on Plantwise activities and has therefore been given the job title of Plantwise Assistant Programme Support Manager. Other staff movements in 2014 included Stefan Toepfer, who is normally based in Hungary, going on secondment to CABI in Beijing, China. Stefan will spend at least two years in Beijing, based at the MoA-CABI Joint Laboratory, and will focus on strengthening the quality and potential of its research programme.

A large portion of ICM staff time in 2014 was devoted to preparing for the new Masters of Advanced Studies in Integrated Crop Management (MAS ICM) programme, which is being developed as part of the collaboration between CABI, the University of Neuchâtel and the Canton Jura. Student applications were received towards the end of the year and twelve candidates were selected from ten countries: Kenya, Ethiopia, Sierra Leone, Tanzania, Zambia, Rwanda, Ghana, Pakistan, Sri Lanka and Costa Rica. The first MAS ICM programme, which will last for nine months, will welcome its students to Switzerland in March 2015 and will be hosted in Delémont. Lecturers will predominantly include members of the ICM team, but there will also be lecturers bringing in expertise from organisations such as the University of Neuchâtel, the School of Agricultural, Forest and Food Sciences (HAFL), the Fondation Rurale Interjurassienne (FRI) and the Research Institute of Organic Agriculture (FiBL), all in Switzerland.

Given the number and size of projects that the ICM team is currently managing and implementing, it is becoming increasingly important to ensure that effective monitoring and evaluation (M&E) procedures are in place to be able to measure progress, identify and respond to risks, and report back to donors to justify investment. For this reason, the ICM team took part in a 2-day M&E training event in Delémont, given by INTRAC, a UK-based training and research centre. This training was both useful and motivating, and a number of different aspects of the training have already been put into practice.

Related to this topic, Manfred Grossrieder and Dirk Babendreier, both worked in collaboration with CABI UK to develop impact studies for project work carried out in DPR Korea and Albania, respectively. These studies were developed following a specific request from the Department for International Development (DfID) and were included in a report consisting of other similar impact studies from CABI. Manfred will work on further developing the DPR Korea impact paper with the aim of publishing it in a peer-reviewed journal in 2015. Hopefully, this will be the first of many more such papers to come!

Dr Ulrich Kuhlmann
Head of Integrated Crop Management

Dr Ulrich Kuhlmann
Head of Integrated Crop Management

Dr Dirk Babendreier
Integrated Crop Management Advisor

Dr Melanie Bateman
Integrated Crop Management Advisor

Erica Chernoh
Integrated Crop Management Advisor

Manfred Grossrieder
Integrated Crop Management Advisor

Julien Grunder
Integrated Crop Management Advisor

Luca Heeb
Integrated Crop Management Advisor

Dr Keith Holmes
Integrated Crop Management Advisor

Dr Wade Jenner
Integrated Crop Management Advisor

Dr Emma Jenner
Integrated Crop Management Advisor

Frida Rodhe
Integrated Crop Management Advisor

Dr Stefan Toepfer
Integrated Crop Management Advisor

Julia Dennis
Plantwise Communications Manager

A farmer showing a problem with his tomato plant to a plant doctor in Tanzania (photo: S. Toepfer)

Plant clinic session in Beijing Province, China (photo: S. Toepfer)

steering CABI's flagship programme: Plantwise

Plantwise is a global programme, led by CABI, to increase food security and improve rural livelihoods by reducing crop losses. Working in close partnership with relevant parties, Plantwise strengthens national plant health systems from within, enabling countries to provide farmers with the knowledge they need to lose less and feed more. This is achieved by establishing sustainable networks of local plant clinics, run by trained plant doctors, where farmers can find practical plant health advice. Plant clinics are reinforced by the Plantwise knowledge bank, a gateway to online and offline actionable plant health information, including diagnostic resources, pest management advice and front-line pest data for effective global vigilance.

The Plantwise programme was implemented in over 30 countries across Africa, Asia, Latin America and the Caribbean in 2014. For each country, there is a dedicated CABI Country Coordinator who is responsible for the day-to-day management and implementation of the programme activities in the country. The CABI Country Coordinator is supported by additional CABI staff or associates in the region and/or one of the CABI centres in the UK or Switzerland.

Plantwise is coordinated globally by the Plantwise Programme Board (PWPB), the members of which are distributed across CABI's centres in Switzerland, the UK, Kenya, Pakistan and India. The Plantwise Programme Executive (Ulrich Kuhlmann) and Plantwise Programme Support Manager (Wade Jenner) are based in the Swiss centre. The PWPB meets quarterly for face-to-face discussions on programme progress (successes and challenges) and ways forward.

As part of steering the programme, PWPB members are engaged in a wide range of activities outside the quarterly meetings, such as developing programme policies, building high-level partnerships, capturing and sharing lessons learned within the programme, promoting Plantwise globally, and strengthening links with donors.

The Plantwise programme has continued to build on its collaboration with other international organizations. To identify opportunities for further expanding joint work, CABI presented on Plantwise and its policies to the FAO's Plant Production and Protection Division in January. Discussions with the Pesticides Management Group, the Rotterdam Convention Secretariat and the FAO Emergency Prevention System (EMPRES) were particularly fruitful, leading for example to the drafting of a partnership statement with the Rotterdam Secretariat and participation of the Plantwise programme in a workshop organized by EMPRES to develop an approach to address an emerging problem with *Fusarium* wilt on banana in Africa. The leader of the FAO Pesticides Management Group led the session on pesticide risk reduction at the workshop in Accra, and he presented on the FAO's work on pesticides management at the Plantwise implementation team meeting. Likewise, engagement with FAO regional and subregional offices was on the rise.

Implementation of the activities outlined in the work programme of the IPPC-CABI technical working group (TWG) yielded positive results. The joint workshops (described in the highlights section) are examples of achievements under this framework. Likewise, communication and awareness raising activities about national obligations under the International Plant Protection Convention (IPPC) were particularly strong, both internally within CABI and with the wider world. A representative of the IPPC Secretariat presented on the IPPC to CABI staff at CABI Africa and at the Plantwise implementation

The 33 countries, grouped by region, where Plantwise was operating in 2014

team meeting in Davos. Together, Plantwise and the IPPC Secretariat led a side event entitled "Plantwise and NPPOs: Building Linkages" at the ninth Session of the Commission on Phytosanitary Measures (CPM). An information sheet on the IPPC, the IPPC National Reporting Obligations and Plantwise was developed and distributed at the CPM side event and at the regional workshops. More than ten blogs and other news articles on a range of topics were published on the websites of the FAO, CABI and Plantwise as well as other news sites. Also under the TWG work programme, enhancements were enacted on the Plantwise knowledge bank on how information on emerging pest problems is shared with stakeholders, such as national contact points to the IPPC.

In 2014, the Plantwise Strategy was reviewed and revised by the PWPB, based on the lessons learned during the first three years of implementation. The Plantwise Strategy is a 'living document', guided by CABI governance bodies, donors and other experts, as well as the Plantwise policies. The new Plantwise Strategy includes a roadmap to sustainability consisting of five programme phases (assessment, pilot, consolidation, scaling-up and sustainability). The sustainability roadmap includes a scoring tool to evaluate the progress of countries through the implementation phases towards sustainability. This scoring tool supports key decision making, for instance related to the level of investment and the role of CABI vs partners. The tool also provides guidance on when to withdraw CABI support from countries.

In 2014, an external evaluation of Plantwise coordination and implementation was conducted, including visits to Kenya, Ghana, Zambia, Malawi, Rwanda and Uganda to talk to Plantwise partners and visit plant clinics. The overall conclusions from this evaluation state that Plantwise is a highly relevant and timely initiative. The approach (plant clinics, knowledge bank and strengthening plant health systems) is sound and only minor adaptations are needed to further increase outcomes and impact. In all countries visited, Plantwise has been integrated into the national plant health system, with a high degree of ownership by national stakeholders, which has led to stronger plant health systems. Importantly, feedback from farmers interviewed during field visits was positive, with farmers who had been visited in previous cropping cycles reporting that past recommendations had helped avoid major crop losses and even total crop failures. Some suggestions to further strengthen the programme were also reported. These were shared with all Plantwise staff at the year-end Plantwise implementation team meeting, held in Switzerland in November 2014. This six day workshop was attended by 65 CABI staff from around the world and was a unique opportunity to discuss lessons learned, identify weaknesses and find potential solutions for 2015 implementation plans.

Once each year, the major Plantwise donors convene with a group of PWPB members to assess programme progress and discuss priorities and emerging opportunities. The 2014 Donor Forum meeting was held from 1 to 2 October at the CABI centre in Switzerland and was attended by SDC, the International Fund for Agricultural Development (IFAD), EuropeAid, Irish Aid, and DfID. The feedback provided by the donors at the meeting was overall very positive. They were pleased with the results of the external evaluation presented by one of the two evaluators. One key action agreed upon was that before the scale-out of the Plantwise approach in too many new countries, the focus should be on consolidating activities in the existing Plantwise countries. This and other key actions and questions will become focal discussion points for the PWPB in 2015 and beyond as the programme continues to build partnerships and chart its course in diverse countries with equally diverse challenges and opportunities.

U. Kuhlmann (u.kuhlmann@cabi.org) and **W. Jenner** (w.jenner@cabi.org)

National representatives of Plantwise countries present at the CPM side event at FAO (photo: J. Dennis)

Participants at the year-end Plantwise implementation team meeting in Davos in Switzerland – a workshop attended by 65 CABI staff from around the world who are involved in implementing the programme (photo: J. Dennis)

'Insect zoo' activity as part of the ToT on IPM in Myanmar (photo: D. Babendreier)

A participant of the ToT on rice IPM in Lao PDR prepares a drawing of rice pests and natural enemies (photo: D. Babendreier)

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

Rice is a major staple food in the Greater Mekong Subregion (GMS) and increased productivity in rice is crucial for the GMS in terms of food security and economic development. The crop is attacked by a number of key pests, including stem-boring and leaf-folding pests such as stem borer or leaf rollers, often reducing yields by 20% or more. In addition, a key problem is the amount and type of pesticide being used in rice fields, often linked with a lack of knowledge about more sustainable practices within the framework of IPM. This project, which is being implemented in the south-western Chinese provinces of Yunnan and Guangxi, the Lao People's Democratic Republic (Lao PDR) and Myanmar, aims to increase rice production sustainably through multi-regional research, capacity building and the implementation of biologically-based pest management through local production and release of *Trichogramma* wasps.

In the fourth year of this five-year project, considerable progress has been achieved regarding the implementation of *Trichogramma* rearing facilities (TRFs).So far, one TRF has been established in each of the four target regions while all additional eight facilities are either in progress or at an advanced planning stage. A main activity planned for project year 4 was to train partners and TRF staff on rice moth and *Trichogramma* production within the context of IPM. However, it was only towards the end of the year that the TRFs established so far have managed to overcome numerous technical problems in rearing the host and the *Trichogramma*. Upscaling is in progress to produce a sufficient amount of the biocontrol agent product for distribution to farmers in the upcoming rice growing season.

In all four target regions the IPM strategy developed was implemented on 'IPM demonstration plots'. These IPM plots were implemented for the second year in Guangxi and Yunnan Province, South West China, where again positive results were obtained in terms of slightly higher yield, reduced pesticide use, more natural enemies and overall higher cost efficiency compared to common farmer's practice. Fewer clear differences were found in Lao PDR and particularly Myanmar where not many IPM measures could be successfully implemented.

In a joint effort based on an innovation systems method, a model concept was developed for the implementation of the *Trichogramma*-based IPM strategy, considering a village approach, since IPM strategies are likely to be successful and sustainable only on an area-wide scale. Important components of this document include the link between the training of farmers and the production and delivery of *Trichogramma* biological control agents as well as the involvement of local stakeholders.

A Training of Trainers (ToT) on IPM was implemented in Lao PDR and Myanmar involving relevant staff from the extension service and plant protection offices in the areas where the TRFs have been or will be established. The training focused specifically on rice IPM and the release of *Trichogramma* but also provided a lot of information on general important IPM aspects such as preventive measures or rational pesticide use. Based on the ToT's conducted in 2013 in China, and in line with the IPM implementation concept, more than 1200 farmers have been trained on IPM in both Yunnan and Guangxi Provinces in SW China. At the same time, as a result of the ToT, the first farmers have been trained on IPM in Myanmar and Lao PDR.

D. Babendreier (d.babendreier@cabi.org), **Zhang F.**, **Tang R.** and **U. Kuhlmann**, in collaboration with IPP-CAAS, Beijing, Xing'an Plant Protection Station, Guangxi Zhuang Autonomous Region, Dehong Plant Protection and Quarantine Station, Yunnan Province, China; the Plant Protection Centre, Department of Agriculture of the Ministry of Agriculture and Forestry, Lao PDR; Plant Protection Division, Department of Agriculture, Ministry of Agriculture and Irrigation, Myanmar; Tianyi Biocontrol Company Ltd (TBCC), Hengshui, China; and the International Rice Research Institute (IRRI). Funded by: the European Commission (EC) through DG DEVCO EuropeAid (DCI-FOOD/2010/230-238).

Project staff inspecting IPM demonstration plot in Guangxi Province, China (photo: D. Babendreier)

strengthening maize producing farming communities in the Greater Mekong Subregion

Maize plays a key role in rural livelihoods in the Greater Mekong Subregion. It is grown as a cash crop as well as for human consumption and animal feed. However, pest problems, unstable markets and a lack of investment contribute to overall low productivity and profitability. Funded by Directorate-General for Development and Cooperation (DG DEVCO) EuropeAid, collaborative action aims to improve agricultural productivity of smallholder farmers through the effective transfer of a validated and sustainable plant protection technology.

The project is based on the establishment of village-level production facilities for a *Trichogramma* egg parasitoid, which will be used to protect maize crops from the destructive Asian corn borer, *Ostrinia furnacalis* (ACB). These production facilities will make the control method affordable and available to smallholder farmers. Building on prospective improvements for farming communities, the project is further supporting these communities to improve market linkages in joint village-level interventions.

In 2014, *Trichogramma* production facilities were established in each of the countries the project is working in: Myanmar, Lao PDR and China (Yunnan Province). In order to improve ownership by, and involvement of community representatives, local implementation groups (LIGs) have been created by the communities for organizing facility establishment at a local level. Village-specific construction plans for the *Trichogramma* facilities have been developed first, defining contributions from the community and project, taking the available village resources and skills into account. Communities selected the personnel to be in charge of the different aspects of the production. Focus groups, composed of interested farmers, were composed to work together and sustainably organize *Trichogramma* production management, farmer's training and marketing of *Trichogramma* egg cards. One focus group was responsible for the planning of a village project to improve market linkages.

In Lao PDR, farmers have to temporarily store maize for about 2 to 3 months after the harvest and considerable losses are caused by the maize weevil, *Sitophilus zeamais* during this period. In order to avoid crop losses after harvest and to increase the livelihoods of smallholder farmers, the project supports the identification of the most appropriate grain management strategies and related integrated pest management options. Appropriate technologies will be jointly developed with the farmers' focus groups from the participating villages.

A strong capacity-building component will ensure that the technology transfer is successful. Concepts for knowledge transfer have been developed for the countries that summarize training activities, define training objectives, outline training curricula and define the didactic materials and information resources for the extensive training activities. On specifically established demonstration plots, extension officers as well as trainers selected by the communities have been taking part in Training of Trainers courses for the release of *Trichogramma* and other related ICM practices. With the training continuing at the farm level, the project will assure that the jointly developed pest management approach will now be applied and reach its full potential in the Greater Mekong Subregion.

M. Grossrieder (m.grossrieder@cabi.org), **U. Wittenwiler**, **F. Rodhe**, **Liu Z.**, **Wan M.** and **U. Kuhlmann**, in collaboration with **Bai S.** and **Wang Z.**, IPP-CAAS, and Dehong Plant Protection and Quarantine Station, Yunnan Province, China; the Plant Protection Centre, Department of Agriculture of the Ministry of Agriculture and Forestry, Lao PDR; Plant Protection Division, Myanmar Agriculture Service, Ministry of Agriculture and Irrigation, Myanmar; and TBCC, Hengshui, China.
Funded by: the EC through DG DEVCO EuropeAid (DCIFOOD/ 2010/230-238) with co-funding from IPP-CAAS and the MoA-CABI Joint Laboratory in China.

Preparation of maize for the rearing of host insects in Lao PDR (photo: U. Wittenwiler)

Farmers in Myanmar discuss and analyze their maize production system using visualized findings of a focus group discussion (photo: Nini Thain, Plant Protection Division, Ministry of Agriculture and Irrigation, Myanmar)

Trichogramma production group (from Phinphit village, Myanmar) during a practical training session in their newly established production facility (photo: Yee Yee Myint, Plant Protection Division, Ministry of Agriculture and Irrigation, Myanmar)

Keith Holmes and Ri Hak Chol conduct a stakeholder interview in Chongryongri Cofarm, Kaechon City, South Pyongan (photo: K. Holmes)

Workshop participants carry out group work to review the Pesticide Spray Operators Manual, Pyongyang (photo: K. Holmes)

MoA-DoPP delegates study tigerfly, a biocontrol agent in an organic farm in the Cameron Highlands, Malaysia (photo: K. Holmes)

enhancing capacity for crop protection through partnership with MoA DPR Korea

This three year DG DEVCO EuropeAid funded project aims to support the efforts of the recently established Department of Plant Protection, Ministry of Agriculture in DPR Korea (MoA-DoPP) to address food security challenges by enhancing its institutional and technical capacity, as well as its ability to collaborate on a national and international level.

To promote exchange and collaboration on an international level, members of MoA-DoPP participated in a study tour to Malaysia and Vietnam (see Highlights p. 15). Here they met with the Plant Biosecurity Division, Department of Agriculture, Malaysia and the Plant Protection Department of the Ministry of Agriculture and Rural Development, Vietnam. This provided an opportunity for the MoA-DoPP to exchange information on the management and organisational structures, terms of reference and objectives of the NPPOs. It also facilitated discussion on national and international pesticide legislation, policies for pest management and best agricultural practices.

To facilitate a review of the institutional set-up within MoA-DoPP a series of stakeholder interviews were carried out with representatives of provincial agricultural management boards, county farm management boards and cooperative farms to review current needs and expectations as regards plant protection. In addition, a SWOT analysis was jointly developed for MoA-DoPP. This information, as well as that gathered during the study tour on international counterparts institutional set-up, was used to review and provide the basis for updating the current mandate, objectives and terms of reference of MoA-DoPP.

To enhance MoA-DoPP`s ability to provide support and solutions to pest related problems information materials were provided in both electronic and hard copy, including the Crop Protection Compendia. Access to international information databases, such as CAB Direct, was ensured through the link to the Academy of Agricultural Sciences' (AAS) international internet connection previously established by CABI. A workshop was also held where a concept for a national pesticide training and certification scheme was developed and in support of this proposed scheme a Pesticide Spray Operators Manual (previously developed with SDC funding) was reviewed and updated, before printing 3000 copies to be distributed to cooperative farms.

Improvements to the operational capacity and internal communication between MoA-DoPP and other departments within MoA was enabled through provision of equipment and materials to establish an effective intranet within MoA and a more productive working environment within MoA-DoPP. This newly installed infrastructure will also enhance their capacity to network on a national basis, enabling MoA-DoPP to direct and channel its support to target groups, i.e. local authorities, extension personnel and cooperative farms. This in turn will enable the nation's 3000 cooperative farms to improve agricultural production, in terms of yield and quality, for the ultimate benefit of the farmers, farming communities and other consumers across DPR Korea.

K. Holmes (k.holmes@cabi.org), **M. Bateman**, **Zhang F.**, **Tang, R.** and **U. Kuhlmann**, in collaboration with the MoA, DPR Korea. Funded by: the EC through DG DEVCO EuropeAid (DCI-FOOD/2012/309-173). Co-funding from CABI Development Fund.

MoA-DoPP delegates discuss hydroponic vegetable production, Cameron Highlands, Malaysia (photo: K. Holmes)

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

Soil insect pests are an ongoing threat to agricultural production in DPR Korea. Therefore the DG DEVCO EuropeAid funds CABI to implement locally sustainable pest control tools with local partners, based on mass production and application of beneficial entomopathogenic nematodes.

By the beginning of the 4th project year, 2014, there were 17 nematode mass production facilities established in DPR Korea. These included the experimental nematode production facility at the Plant Protection Institute of the Academy of Agricultural Sciences (AAS-PPI), the Korean prototype national production facility at the Central Plant Protection station (CPPS), both in Pyongyang, and nine county and three provincial nematode production facilities all capable of employing both *in-vivo* and *in-vitro* nematode mass production methods. There were also three cooperative farm facilities utilizing the *in-vivo* method (see Project Highlights p. 14).

In early 2014 all nematode production facilities started to produce nematodes, including two indigenous and one Chinese isolate and their associated bacteria. Nematodes were then distributed to cooperative farms, who applied the nematodes to maize seedbeds, prior to field transplanting.

In-facility training and support was provided to all the mass production facilities at county and provincial level by both AAS-PPI and CPPS in early 2014, to ensure all facilities were able to mass produce the nematodes. In addition, in September 2014 a workshop was held, attended by production personnel from all nematode production facilities to review and discuss problems observed during this first attempt at nematode mass production. This was led by AAS-PPI and focussed on key issues updated in the national technical guideline, stock maintenance and production cycle management.

In addition, research field trials were carried out by AAS-PPI at three cooperative farms to assess the efficacy of nematodes against wireworms, cutworms and grubs. Initial results indicated that the use of the nematodes was leading to increased yield.

At the end of 2014 a number of workshops were held where all stakeholders were involved in reviewing the facility establishment process and using this knowledge as support information to develop a national dissemination strategy for scale-up of the nematode mass production technology across the country. It is envisaged that the beneficial nematodes produced and applied through this project will contribute to a reduction in the volatility in the nation's food production.

K. Holmes (k.holmes@cabi.org), **S. Toepfer**, **Li H.M., M. Grossrieder** and **U. Kuhlmann**, in collaboration with the Academy of Agricultural Sciences of DPR Korea and the Ministry of Agriculture of DPR Korea, and supported by the associates, Lvbenyuan Biotechnology Co. Ltd. of the Guangdong Entomological Institute, Guangzhou, China, and Andermatt Biocontrol AG, Grossdietwil, Switzerland.

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Training in nematode application for cooperative farm chief engineers, Unjon County, North Pyongan Province (photo: Son K.M., MoA-CPPS)

Ms Ryang, a biological control specialist of AAS-PPI, presents updates for the technical guideline for nematode production, during the workshop for production facility personnel, Pyongyang September 2014 (photo: K. Holmes)

DPR Korean nematode production specialists, trained in this project, review the establishment of the nematode production facilities, Pyongyang, September 2014 (photo: S. Toepfer)

Farmer training in the use and application of nematodes, Sinwon County, South Hwanghae Province, May 2014 (photo: Son K.M., MoA-CPPS)

Stefan Toepfer (CABI) and Li Kebin (Institute of Plant Protection of the Chinese Academy of Agricultural Sciences) train experts from the Rwanda Agricultural Board in survey methods of soil pests (photo: J. Rischbieth)

Xuehong Qiu (Guangdong Entomological Institute, China) and experts from the Rwanda Agricultural Board and the University of Rwanda check soil samples for dead insect larvae infected by beneficial nematodes (photo: S. Toepfer)

transfer of beneficial nematode technology for biological control of soil pests from China to Rwanda

Farmers in Rwanda have limited options available to manage soil insect pests. Controlling soil insects is also challenging due to their concealment below ground, making their detection and appropriate and timely control difficult. Poor yields result in demand exceeding supply, which can lead to higher food prices. Harvested root crops damaged by soil pests mean a poor shelf life because of secondary infections.

A team from CABI China, Africa, the UK and Switzerland is working with the Rwanda Agricultural Board (RAB) and Chinese technical partners to provide smallholder farmers access to an environmentally-friendly, biologically-based option to control soil-borne pests in vegetables such as beans, cassava, Irish potato or cabbage. This technology is in the form of naturally occurring tiny parasitic worms called entomopathogenic, or simply beneficial nematodes which kill soil dwelling insects such as grubs, cutworms and bean flies.

The international team together with RAB and local stakeholders: (i) surveys current soil pest communities in northern, eastern and southern Rwanda; (ii) conducts household and market surveys on the impact of soil pests; (iii) searches for local isolates of beneficial nematodes adapted to the Rwandan environment; (iv) develops a low-input pilot nematode mass production factory using locally adapted technology originating from China; and (v) builds capacity of local researchers and technical staff to develop and implement the technology.

In 2014, a systematic household and market survey was conducted in the Bugesera, Musanze and Nyamagabe districts of Rwanda, including 110 households, 19 traders, 15 consumers, 20 agro-dealers and 18 additional key informants. A building for the biocontrol agent production factory was renovated at Rubona Station of RAB and is ready for the installation of equipment. In 2015 we will focus on capacity building for the mass production and use of the local species/strains of nematodes found in 2014.

The pilot nematode mass production factory will serve as an example for establishing biocontrol agent factories across the country. Ultimately farmers of Rwanda will obtain an alternative, practical, effective and safe tool to combat a number of soil pests, a method that is largely unique in the region of eastern and central Africa.

Li H.M. (h.li@cabi.org), **S. Toepfer**, **C. Agwanda**, **R. Musebe**, **D. Karanja** and **J. Rischbieth** in collaboration with Guangdong Entomological Institute in Guangzhou and the Institute of Plant Protection of the Chinese Academy of Agricultural Sciences in Beijing, China, and Rwanda Agricultural Board. Funded by: Department for International Development (DFID) – AgriTT Research Challenge Funds, UK (AgriTT-RCF-1335) (2014-2015). see http://www.cabi.org/projects/project/32743 or http://www.ippcaas.cn/sites/IPP/List_2585_47965.html

Team for field survey of indigenous beneficial nematodes in natural habitats in Rwanda; Prime, Athanase, Christine (all RAB), Stefan Toepfer (CABI), Xuehong Qiu (Guangdong Entomological Institute) (photo: Driver, RAB)

implementing a global tobacco IPM programme

Towards the end of 2014, Philip Morris International (PMI) announced the start of a global IPM programme, named 'IPM@PMI', and requested CABI's support in rolling it out across all of its tobacco growing regions. The major objectives of the programme are to: (i) promote a more judicious use of Crop Protection Agents (CPAs) so as to reduce risks to the health and safety of farmers and farm workers and minimise the impact of chemical products on the environment and; (ii) promote tobacco as the crop of choice for farmers through an increase in income resulting from optimum crop quality and yield.

In October, Ulrich Kuhlmann and Julien Grunder presented CABI's proposed support to the IPM@PMI programme during a PMI Agronomy Programmes meeting in Guadalajara, Mexico. It was agreed by the PMI Regional Agronomy Managers that as a first step, CABI should work closely together with PMI Affiliates and/or leaf suppliers in ten countries to conduct a baseline study aimed at defining current perceptions and practices related to the use of crop protection agents (CPAs) and the implementation of IPM. The countries selected for the study were Argentina, Brazil, Greece, Indonesia, Italy, Malawi, Pakistan, Tanzania, Turkey and the USA. It was decided that Mozambique and the Philippines would also be targeted, but only in 2015.

A workshop was then held in Delémont later in October involving the CABI staff who would conduct the baseline studies, as well as two CABI monitoring and evaluation specialists, in order to develop the methodology and tools to be used for gathering information for the study. Each of the tools was targeted at specific stakeholders, for example: (i) questionnaires for the PMI operations centre, PMI regional teams, leaf supplier agronomy team/management, farmers and field technicians; (ii) focus group discussions for farmers, field technicians, leaf suppliers and; (iii) key informant interviews for other relevant stakeholders, including ministries, research institutions/universities, agro-input suppliers, agro-input retailers, etc.

The baseline studies were conducted in all of the ten countries during the last week of November and throughout December by teams comprised of two CABI staff members, who were selected from our CABI operations in Switzerland, Brazil, Kenya, Malaysia or Pakistan depending on the location of the study. External support for translation was also sought where necessary. CABI staff collaborated very closely with in-country PMI affiliates and leaf suppliers during the lead up to, and throughout the country visits in order to establish an agenda, make the necessary logistical preparations and carry out the studies. Data was gathered over a period of five days using the tools developed during the workshop and then entered into spreadsheets for later analysis.

An analysis of the baseline study results will be made early in 2015 to identify the strengths and challenges in each country, and to recommend areas of intervention. Together with PMI and the leaf suppliers, CABI will support the prioritization of these interventions, as well as the development of global and country-specific IPM road maps for 2015–2017.

E. Jenner (e.jenner@cabi.org), **J. Grunder** (j.grunder@cabi.org) and **U. Kuhlmann** (u.kuhlmann@cabi.org), in collaboration with PMI and local partners in the ten countries.

A tobacco farmer shows his CPA storage facility at his farm in the region of Santa Cruz do Sul, Rio Grande do Sul, Brazil (photo: K. Holmes)

An interview with an agro-retailer in Blora, Indonesia (photo: L.Y. Chiang)

Farm workers transplanting tobacco seedlings in Urambo District, Tanzania (photo: R. Musebe)

CABI team interviewing model farmers in Mugla, Turkey (photo: E. Chernoh)

An IPM instructor trains farmers on best management practices for the seedbed stage during the initial phase of the project (photo: E. Jenner)

Oriental tobacco seedlings (photo: E. Chernoh)

official close of the IPM programme in oriental tobacco in Turkey

In September 2009, CABI began working with the leaf suppliers of Oriental tobacco in Turkey and the Philip Morris International (PMI) Regional Office in Izmir, Turkey, on a programme focused on integrated pest management (IPM). The overall objective of the programme was to reduce the inappropriate use of crop protection agents (CPAs) in order to minimise CPA residues on harvested tobacco leaves. The programme was unique in that it united the leaf supplier companies to work together to provide an industry approach to implementing IPM. In early 2014, the programme officially drew to a close with CABI presenting a final report to the programme's Steering Committee.

Through this partnership, CABI supported the sustainable improvement of Oriental tobacco production through the implementation of IPM as a component of the PMI Good Agricultural Practice (GAP) standards. Notable achievements from the IPM programme include: the development of IPM Technical Guidelines for Oriental Tobacco Production (including a CPA list, Green & Yellow lists for key pests, and record sheets to support farmers with the implementation of the IPM requirements); 45 'IPM instructors' (from each leaf supply company) trained in IPM and participatory training methods; and over 8,500 farmers trained in IPM in 2010 and 2011.

In 2011, the programme shifted the focus to agronomic practices to increase the market competitiveness of the industry by sustainably increasing the yield of Oriental tobacco through the implementation of best agricultural practices, while preserving the existing quality and reducing production costs. During this phase, Agronomy Technical Guidelines were developed based on PMI's GAP standards with the aim to support farmers with implementation of PMI's agronomy requirements; an inspection protocol was designed and implemented to assess impact of farmer training; model farms were established to demonstrate to farmers selected best agronomic practices and their effect on yield, quality and labour; and several large and small-scale research trials were implemented to test new varieties, agronomic practices and methodologies.

As a final output of the programme, a video was produced about the use of model farms for demonstrating best agricultural practices to farmers. Farmers who participated in the project were interviewed to obtain qualitative data and farmer perspectives on the impact of model farms on the adoption of the new practices and technologies and reduction of CPA use.

E. Chernoh (e.chernoh@cabi.org), **D. Babendreier** (d.babendreier@cabi.org), **E. Jenner** (e.jenner@cabi.org) and **U. Kuhlmann** (u.kuhlmann@cabi.org), in collaboration with partners at Alliance One Tütün A.Ş., Socotab Yaprak Tütün Sanayi ve Ticare A.Ş., Türkiye Tütünleri A.Ş., & T.T.L., Öz-Ege Tütün Sanayi ve Ticaret A.Ş. Funded by the four partner Oriental tobacco leaf supplier companies above (funding during the first years was also provided by PMI Regional Office, Izmir, and two additional leaf suppliers: Prestij Tütün Sanayi ve Ticaret A.Ş., and Sunel Ticaret Türk A.Ş.).

Tobacco farmer being interviewed in Kirkağaç, Turkey to determine the impact of the model farm project (photo: E. Chernoh)

sustainable forest management for fuelwood production in Brazil

Tobacco is the major income source for many farmers in southern Brazil. The tobacco leaves are cured before they are marketed, and this process requires fuelwood. Currently, mainly exotic tree species, such as Eucalyptus are used for curing. These are either produced directly at the farm, or purchased from other sources in the area. In order to improve the sustainability and especially the level of self-sufficiency of fuelwood production, Philip Morris International (PMI) started a major initiative to address these problems in the context of a global programme to reduce carbon emissions. Through awareness creation, training and capacity building, tobacco producers are encouraged to improve fuelwood management practices. They are made familiar with sustainable reforestation approaches including the use of native and exotic tree species, and they are provided with ideas about agroforestry techniques and management. This will enhance the environmental sustainability of the farm production system, but will also have an effect in restoring degraded areas on the farm, and at the same time reducing pressure on the natural forest habitats.

For the development of the training component, CABI staff based in Switzerland and Brazil have been working in close collaboration with PMI (headquarters, PM Latin America and PM Brazil), the International Union for Conservation of Nature (IUCN) as well as with local specialists in forestry, including the local tobacco growers association (Associação dos Fumicultores do Brasil, Afubra). A training curriculum had been developed and validated in 2013, addressing theoretical and practical aspects of sustainable fuelwood production and forest management through presentations, exercises, semi-structured discussions and other didactic materials including video productions.

In 2014, activities focused on the training of tobacco field technicians, which support the tobacco farmers in the three main tobacco producing states; Santa Catarina, Paranà and Rio Grande do Sul. The training course covered a broad range of activities and topics, including technical issues such as good management practices for different commonly grown tree species (e.g. soil preparation, planting, pruning, nutrient and pest management), reforestation of degraded areas, agroforestry, the use of native tree species and the protection of ecologically sensitive areas. Besides the technical issues, the complex Brazilian forest law and the legal requirements regarding planting, cutting and integrating trees (especially native species) on property has been of high importance, since the farmers' uncertainty about the national and state law had been identified as a major reason for using exotic fuelwood tree species. In order to improve the effect of training activities through the field technicians, it was important to provide them with participatory tools and methods for knowledge and skills transfer to the tobacco producers.

During two-day Training of Trainers workshops within the scope of the project, 75 field technicians have been trained for further transferring knowledge and skills about sustainable fuelwood management to the farmers. This represents more than half of all technicians in the three Brazilian states in the project area. A full training package including power-point presentations, videos (produced by IUCN), leaflets on legal aspects and native species, a booklet on good Eucalyptus management practices and a booklet on native tree species were made available in English and Portuguese for further training of all field technicians later in the year. Thus it could be assured that tobacco farmers will profit from a high quality, practical and motivating knowledge transfer towards further improving the sustainability of fuelwood production at the farm level.

M. Grossrieder (m.grossrieder@cabi.org), **F. Rodhe**, **Y. Colmenarez** and **A. Santana**, in collaboration with **L. Ruffieux** (PMI) in Switzerland; **E. Mulle**, **R. Boettcher** (PM Latin America), **A. Biesdorf** and **H. Kothe** (PM Brazil); **P. Buffle** (IUCN) in Switzerland and **F. Machado** (IUCN) in Brazil. Funded by: PMI, Switzerland.

Demonstrating how to prune young Eucalyptus trees (photo: F. Rodhe)

Information about the correct handling of Eucalyptus seedlings at Afubra (photo: F. Rodhe)

Trainers' group exercise to introducing sustainable fuelwood production systems at the farm level (photo: F. Rodhe)

Visiting a local producer using Eucalyptus for fuelwood production (photo: F. Rodhe)

Field technicians conducting a calibration exercise (photo: E. Chernoh)

Training of Trainers: preparing practical exercises for farmers (photo: Y. Colmenarez)

Training farmers about safe storage of pesticides in the Santander department of Colombia (photo: Y. Colmenarez)

rational pesticide use training in Colombia

In 2014, CABI staff based at the centres in Switzerland and worked with Coltabaco, Colombia's biggest tobacco company, to train field technicians and farmers in Rational Pesticide Use (RPU). The main objectives of the activities were to reduce farmers' health risks and to lower Crop Protection Agent (CPA) residues on the harvested leaves. Experiences from other countries show that improving farmers' knowledge and skills for applying CPAs lead to a reduction of the inappropriate use of the CPAs and the associated negative effects such as the reduced efficacy of products, increased risk of residues, and human health and environmental problems.

Participatory training methods were used for both the field technician and farmer training. The training curriculum covered a broad range of topics including theoretical and practical field based exercises. Technical issues like the safe application of CPAs using personal protection equipment, the correct mixing of products, sprayer nozzles and pressure applied, the correct calibration of spraying equipment as well as safe storage of products and correct disposal of empty containers have been the focus of the training.

CABI began by training field technicians in tobacco RPU enabling them to create awareness about the risks and dangers of inappropriate CPA use, and to provide technical assistance to farmers as part of their routine visits. Following the field technician training, a group of field technicians was trained as 'master trainers' and the training materials and information were jointly adapted to be more suitable for farmers. Practical tools and methods were developed for these future trainers to transfer the knowledge to tobacco producers. A pilot implementation of the training was carried out for randomly selected farmers in order to evaluate and further adapt the training materials for wide-scale rollout.

With the validated training curriculum and didactic materials for farmer training, CABI provided support for further Training of Trainers (ToT) to assure that 'master trainers' could consolidate their newly acquired knowledge and skills concerning the proposed participatory training methodology and materials. Further rollout of the farmer training programme has been planned with the participants, and final adaptations to the curriculum were made assuring suitability for the local context of the different tobacco growing areas. Finally, CABI monitored and evaluated the performance of the 'master trainers' during the training of tobacco producers in various locations of Colombia.

During the entire ToT process, the field technicians were highly motivated and showed keen interest, not only in technical issues but they also stressed the fact that their new skills and experiences concerning training methodology have been very useful. Last but not least, the feedback from the tobacco producers was very positive about the new knowledge and the way in which knowledge and skills were transferred to them. Overall, this will lead to the anticipated safer use of CPAs with the benefits of better health conditions of producers as well as a more efficient and therefore more economic and judicious use of the chemical products at the farm level.

M. Grossrieder (m.grossrieder@cabi.org), **E. Chernoh**, **Y. Colmenarez** and **J. Garcia**, in collaboration with **L. Moreno**, Coltabaco. Funded by: Compania Colombiana de Tabaco (COLTABACO S.A.).

Field technicians learning how to properly monitor a field and measure pest thresholds (photo: E. Chernoh)

publications

Asadi, G., Ghorbani, R., Cristofaro, M., Chetverikov, P., Petanović, R., Vidović, B. and **Schaffner, U.** (2014) The impact of the flower mite *Aceria acroptiloni* on the invasive plant Russian knapweed, *Rhaponticum repens*, in its native range. *BioControl* 59, 367–375.

Buckingham, D.L., Brook, A.J., **Eschen, R.**, Maczey, N., Wheeler, K. and Peach, W.J. (2014) Integrating biodiversity conservation with grassland farming: extensive cattle grazing and farmland birds. In: *Grassland Science in Europe, Vol. 19. Proceedings of the 25th European Grassland Federation on "EGF at 50: The Future of European Grasslands"*, Glasgow UK. pp. 236–238.

Eschen, R., Holmes, T., Smith, D., Roques, A., Santini, A. and **Kenis, M.** (2014) Likelihood of establishment of tree pests and diseases based on their worldwide occurrence as determined by hierarchical cluster analysis. *Forest Ecology and Management* 315, 103–111.

Gariepy, T.D., **Haye, T.,** Fraser, H. and **Zhang, J.** (2014) Occurrence, genetic diversity, and potential pathways of entry of *Halyomorpha halys* in newly invaded areas of Canada and Switzerland. *Journal of Pest Science* 87, 1, 17–28.

Gassmann, A. and **Toševski, I.** (2014) Biological control of *Rhamnus cathartica*: is it feasible? A review of work done in 2002–2012. *Journal of Applied Entomology* 138, 1–13.

Gassmann, A., De Clerck-Floate, R., Sing, S., **Toševski, I.**, Mitrović, M. and Krstić, O. (2014) Biology and host specificity of *Rhinusa pilosa*, a recommended biological control agent of *Linaria vulgaris*. *BioControl* 59, 459–485.

Gerber, E. and **Schaffner, U.** (2014) Gebietsfremde Staudenknöteriche im Schweizer Wald – Auswirkungen und Massnahmen (Exotic knotweeds on Swiss forest sites: consequences and measures to take). *Schweizerische Zeitschrift für Forstwesen* 165, 150–157.

Haye T., Abdallah, S., Gariepy, T. and Wyniger, D. (2014) Phenology, life table analysis, and temperature requirements of the invasive brown marmorated stink bug, *Halyomorpha halys*, in Europe. *Journal of Pest Science* 87, 407–418.

Haye, T., Wyniger, D. and Gariepy, T. (2014) Recent range expansion of brown marmorated stink bug in Europe. In: Müller, G, Pospischil, R., Robinson, W.H. (eds.): *Proceedings of the Eighth International Conference on Urban Pests*, 20–23 July, Zurich, Switzerland, 309–314.

Hinz, H.L., **Gassmann, A.**, Schwarzländer, M. and Bourchier, R.S. (2014) Successes we may not have had: a retrospective analysis of selected weed biological control agents in the United States. *Invasive Plant Science and Management* 7, 565–579.

Hulme, P.E., Pyšek, P., Pergl, J., **Schaffner, U.** and Vilà, M. (2014) Pragmatism required to assess impacts of invasive plants. *Frontiers in Ecology and the Environment* 28, 212–218.

Jenner, W.H., **Kuhlmann, U.**, Miall, J.H., Cappuccino, N. and Mason, P.G. (2014) Does parasitoid state affect host range expression? *Biological Control* 78, 15–22.

Kang, S.I., Ryang, Y.S., Pak, I.C., Kang, C.H., Min, S.K., **Holmes, K.**, **Toepfer, S.**, Bollhalder, F., Chen, J. and **Li. H.** (2014) *Entomopathogenic Nematode Production Manual*. Foreign Language Publishing House, Pyongyang, DPR Korea, 82 pages. [In Korean]

Kenis, M., Koné, N., Chrysostome, C.A.A.M., Devic, E., Koko, G.K.D., **Clottey, V.A.**, **Nacambo, S.** and Mensah, G.A. (2014) Insects used for animal feed in West Africa. *Entomologia* 2(2), 107–114. doi: 10.4081/entomologia.2014.218.

Kim, M.K., Choe, K., Kim, R.J., Han, W.S., Ri, J.K., Kang, S.I., **Holmes, K.**, Ri, J.O., Ri, K.N, **Hunt, E.**, **Kuhlmann, U.** and **Grossrieder, M.** (2014) *Pesticide Spray Operators Manual*. [Revised and Reissued]. Foreign Language Publishing House, Pyongyang, DPR Korea, 44 pp. [In Korean]

Ko, K., Liu, Y., Hou, M., **Babendreier, D.**, **Zhang, F.** and Song, K. (2014) Evaluation for potential *Trichogramma* (Hymenoptera:Trichogrammatidae) strains for control of the stripped stem borer (Lepidoptera: Crambidae) in the Greater Mekong Subregion. *Journal of Economic Entomology* 107(3), 955–963.

Levay, N., Terpo, I., Kiss, J. and **Toepfer, S.** (2014) Quantifying inter-field movements of the western corn rootworm (*Diabrotica virgifera virgifera* LeConte) — A Central European field study. *Cereal Research Communications*, 1–11.

Li, H., Guillemaud, T., French, B.W., **Kuhlmann, U.** and **Toepfer, S.** (2014) Phenotypic trait changes in laboratory – reared colonies of the maize herbivore, *Diabrotica virgifera virgifera. Bulletin of Entomological Research* 104, 97–115.

Luo, S., **Li, H.**, Lu, Y., **Zhang, F.**, **Haye, T.**, **Kuhlmann, U.** and Wu, K. (2014) Functional response and mutual interference of *Peristenus spretus* (Hymenoptera: Braconidae), a parasitoid of *Apolygus lucorum* (Heteroptera: Miridae). *Biocontrol Science and Technology* 24, 247–256, doi: 10.1080/09583157.2013.855703.

Maxwell, A., Vettraino, A.M., **Eschen, R.** and Andjic, V. (2014) International Plant Trade and Biosecurity. In: Dixon, G. and Aldous, D. (eds.) *Plants for People and Places*. Springer, Berlin. pp. 1171–1195.

Müller-Schärer H., Lommen S.T.E., Rossinelli M., Bonini M., Boriani M., Bosio G. and **Schaffner U.** (2014) *Ophraella communa*, the ragweed leaf beetle, has successfully landed in Europe: fortunate coincidence or threat? *Weed Research* 54, 109–119.

Musebe, R., Massawe, A., Mansuet, T., **Kimani, M.**, **Kuhlmann, U.** and **Toepfer, S.** (2014) Achieving rational pesticide use in outdoor tomato production through farmer training and implementation of a technical guideline. *Journal of Agricultural Extension and Rural Development* 6(12), 367–381.

Muys , B., Norgrove, L., Alamirew, T., Birech, R., Chirinian, E., Delelegn, Y., Ehrensperger, A., **Ellison, C. A.**, Feto, A., Freyer, B., Gevaert, J., Gmünder, S., Jongschaap, R. E. E., Kaufmann, M., Keane, J., **Kenis, M.**, Kiteme, B., Langat, J., Lyimo, R., Moraa, V., Muchugu, J., Negussie, A., Ouko, C., Rouamba, M. W., Soto, I., Wörgetter, M., Zah, R. and Zetina, R. (2014) Integrating mitigation and adaptation into development: the case of *Jatropha curcas* in sub-Saharan Africa. *GCB Bioenergy* 6, 169–171.

Nacambo, S., Leuthardt F.L.G., **Wan, H., Li, H., Haye, T.**, Baur, B., Weiss, R.M. and **Kenis, M.** (2014) Development characteristics of the box-tree moth *Cydalima perspectalis* and its potential distribution in Europe. *Journal of Applied Entomology* 138, 14–26.

Pilz, C., **Toepfer, S.**, Knuth, P., Strimitzer, T., Heimbach, U. and Grabenweger, G. (2014) Persistence of the entomoparasitic nematode *Heterorhabditis bacteriophora* in maize fields. *Journal of Applied Entomology* 138(3), 202–212.

Rahioui, I., Eyraud, V., Karaki,L., Sasse, F., Carre-Pierrat, M. , An, Q., Zheng, M.H., **Toepfer, S.**, Sivignon, Ch., Royer, C., Da Silva, P. and Gressent, F. (2014) Host range of the potential biopesticide Pea Albumin 1b (PA1b) is limited to insects. *Toxicon* 89, 67–76.

Rice, K., Bergh, C.J., Bergmann, E.J., Biddinger, D.J., Dieckhoff, C., Dively, G., Fraser, H., Gariepy, T., Hamilton, G., **Haye, T.**, Herbert, A., Hoelmer, K., Hooks, C.R., Jones, A., Krawczyk, G., Kuhar, T., Martinson, H., Mitchell, W., Nielsen, A.L., Pfeiffer, D.G., Raupp, M.J., Rodriguez-Saona, C., Shearer, P., Shrewsbury, P., Venugopal, P.D., Whalen, J., Wiman, N.G., Leskey, T.C. and Tooker, J.F. (2014) Biology, ecology, and management of brown marmorated stink bug (Hemiptera: Pentatomidae). *Journal of Integrated Pest Management* 5(3), 13pp. doi:10.1603/ipm14002.

Roy, H., Schonrogge, K., Dean, H., Peyton, J., Branquart, E., Vanderhoeven, S., Copp, G., Stebbing, P., **Kenis, M.**, Rabitsch, W., Essl, F., Schindler, S., Brunel, S., Kettunen, M., Mazza, L., Nieto, A., Kemp, J., Genovesi, P., Scalera, R. and Stewart, A. (2014) Invasive alien species – framework for the identification of invasive alien species of EU concern. Brussels, European Commission, 298pp. (ENV.B.2/ETU/2013/0026). http://ec.europa.eu/environment/nature/invasivealien/docs/Final%20report_12092014.pdf

Schumann, M., **Toepfer, S.**, Vemmer, M., Patel, A., **Kuhlmann, U.** and Vidal, S. (2014) Field evaluation of an attract and kill strategy against western corn rootworm larvae. *Journal of Pest Science* 87(2) 259–271. doi: 10.1007/s10340-013-0551-5.

Streito, J.-C., Rossi, J.-P., **Haye, T.**, Hoelmer, K. and Tassus, X. (2014) La punaise diabolique (*Halyomorpha halys*): nouveau ravageur à la conquête de la France. *Phytoma* 677, 26–29.

Sun, Y., Müller-Schärer, H. and **Schaffner, U.** (2014) Plant neighbours rather than soil biota determine impact of an alien plant invader. *Functional Ecology* 28, 1545–1555.

Szalai, M., Kiss, J., Kövér, S. and **Toepfer, S.** (2014) Simulating crop rotation strategies with a spatiotemporal lattice model to improve legislation for the management of the maize pest *Diabrotica virgifera virgifera. Agricultural Systems* 124, 39–50.

Toepfer, S., Knuth, P., Glas, M. and **Kuhlmann, U.** (2014) Successful application of entomopathogenic nematodes for the biological control of western corn rootworm larvae in Europe – a mini review. *Proceedings International Conference on the German Diabrotica Research Program*, November 14-16, 2012, Berlin, Germany, Julius-Kuhn-Archives 444, 59–66. doi 10.5073/jka.2014.444.019.

Toepfer, S., **Li, H.**, Pak, S.G., Son, K.M., Ryang, Y.S., Kang, S.Il., Han, R. and **Holmes, K.** (2014) Soil insect pests of cold temperature zones of East Asia, including DPR Korea: a review. *Journal of Pest Science* 87, 567–595.

Toševski, I., Caldara, R., Jović, J., Baviera, C., Hernandez-Vera, G., **Gassmann, A.** and Emerson, B.C. (2014) Revision of *Mecinus heydenii* species complex (Curculionidae): integrative taxonomy reveals multiple species exhibiting host specialization. *Zoologica Scripta* 43, 34–51.

Vilà, M., Rohr, R.P., Espinar, J.L., Hulme, P.E., Pergl, J., Le Roux, J.J., **Schaffner, U.** and Pyšek, P. (2014) Explaining the variation in impacts of non-native plants on local-scale species richness: the role of phylogenetic relatedness. *Global Ecology and Biogeography* 24, 139–146.

Volkovitsh, M.G., Dolgovskaya, M. Yu., Korotyaev, B.A., Reznik, S. Ya. and **Gassmann, A.** (2014) Factors influencing the population density of the weevil *Microplontus millefolii* Schze. (Coleoptera, Curculionidae: Ceutorhynchinae) in the environs of St. Petersburg. *Entomological Review* 94, 1218–1228 (published in Entomologicheskoe Obozrenie (2014) 93, 539–554).

Wan, H., Haye, T., Kenis, M., **Nacambo, S.**, Xu, H., **Zhang, F.** and **Li, H.** (2014) Biology and natural enemies of *Cydalima perspectalis* in Asia: Is there biological control potential in Europe? *Journal of Applied Entomology* 10, 715–722.

Wang, Z.-Y., He, K.L., **Zhang, F.**, Lu, X. and **Babendreier, D.** (2014) Mass rearing and release of *Trichogramma* for biological control of insect pests of corn in China. *Biological Control* 68, 136–144.

Winston, R.L., Schwarzländer, M., **Hinz, H.L.**,Day, M.D., **Cock, M.J.W.**, and Julien, M.H. (eds.) (2014) Biological Control of Weeds: A World Catalogue of Agents and their Target Weeds. 5th edition. USDA Forest Service, Forest Health Technology Enterprise Team, Morgantown, West Virginia. FHTET-2014—04. 838 pp.

theses:

Leroux, A.M. (2014) Biological studies of a European fruit fly, *Euphranta connexa* (Diptera: Tephritidae), a candidate biological control agent for invasive swallow-worts, *Vincetoxicum rossicum* (Kleopow) Barbar and *V. nigrum* (L.) (Apocynaceae). MSc thesis, University of Manitoba, Winnipeg, Canada. Supervised at CABI by A. Gassmann and H.L. Hinz.

Levay, N. (2005-2014) Modelling dispersal behaviour and population dynamics of western corn rootworm (*Diabrotica v. virgifera*), PhD thesis, Institute of Plant Protection, Szent Istvan University of Godollo, Hungary, Finalised 15 December 2014, Examiner: Helyes Lajos, Supervised by J. Kiss and S. Toepfer 126 pp. [In Hungarian]

Sun, Y. (2014) Assessing ecosystem impact of and recovery from invasive plants. PhD thesis, University of Fribourg, Switzerland. Supervised at CABI by U. Schaffner.

Vergara, G.M. (2014) Improvement of a house fly maggot production system for animal feed in Ghana. MSc thesis, University of Catania, Italy, and University of Copenhagen, Denmark. Supervised in Ghana by M. Kenis in the framework of PROTEINSECT.

reports:

CABI, AGES, e-nema (2014) Biological control of *Diabrotica* larvae in the soil of maize fields: A trial summary. Dossier funded by e-nema Ltd. pp.43.

Cortat, G., Tóth, P., **Chabaane, Y.**, **Higashi, C.**, **Medeiros de Souza, N.**, **Oliveira, E.** and **Sauvain, L.** (2014) Biological control of field bindweed, *Convolvulus arvensis*. Project report 2012–2013. 23 pp.

Cortat, G., **Chabaane**, **Oliveira, E.** and **Sauvain, L.** (2014) Biological control of hawkweeds, *Pilosella* spp. Annual report 2013. 20 pp.

Eschen, R., **Kenis, M.** and Aubry, R. (2014) Suivi de l'impact de la coccinelle asiatique *Harmonia axyridis* sur les coccinelles indigènes. Rapport final, mai 2011–avril 2014. 14 pp.

Gassmann, A., **Palmer, E.** and **Leroux, A.** (2014) Biological control of swallow-worts *Vincetoxicum rossicum* and *V. nigrum*. Annual report 2013. 9 pp.

Gassmann, A., **Leroux, A.**, **Palmer, E.**, Dolgovskaya, M. Yu., Volkovitch, M., Reznik, S., Diaconu, A., Jović, J. and **Toševski, I.** (2014) Biological control of common tansy *Tanacetum vulgare*. Annual report 2013. 29 pp.

Gerber, E., **Inskeep, J.**, **Cloşca, C.** and **Hinz H.L.** (2014) Biological control of garlic mustard, *Alliaria petiolata.* Annual report 2013. 20 pp.

Gerber, E., **Hinz H.L.**, **Inskeep, J.**, **Cloşca, C.**, Cristofaro, M., Di Cristina, F., Paolini, A. and Dolgovskaya, M. (2014) Biological control of perennial pepperweed, *Lepidium latifolium.* Annual report 2013. 40 pp.

Häfliger, P., **Medeiros de Souza, N.**, **Freise, J.** and **Hinz, H.L.** (2014) Biological control of flowering rush, *Butomus umbellatus*. Annual report 2013. 25 pp.

Hinz, H.L., **Cloşca, C.** and **Pardo, P.** (2014) Biological control of dyer's woad, *Isatis tinctoria.* Annual report 2013. 20 pp.

Hinz, H.L., **Cloşca, C.**, Diaconu, A., Dolgovskaya, M. and **Pardo, P.** (2014) Biological control of whitetops, *Lepidium draba, L. chalepense* and *L. appelianum*. Annual report 2013. 27 pp.

Schaffner, U., Asadi, G., Chetverikov, P., Ghorbani, R., Khamraev, A., Petanović, R., Rajabov, T., **Scott, T.**, Vidović, B. and Cristofaro, M. (2014) Biological control of Russian knapweed, *Rhaponticum repens.* Annual report 2013. 16 pp.

Schaffner, U., Asadi, G., Chetverikov, P., Ghorbani, R., Khamraev, A., Petanović, R., Rajabov, T., **Scott, T.**, Vidović, B. and Cristofaro, M. (2014) Biological control of Russian olive, *Elaeagnus angustifolia.* Annual report 2013. 17 pp.

Stutz, S., Sauvain, L., Inskeep, J., Oliveira, E., Palmer, E., Hinz, H.L. and **Schaffner, U.** (2014) Prospects for the biological control of oxeye daisy, *Leucanthemum vulgare*. Annual Report 2013. 23 pp.

Toševski, I., Krstić, O., Jović, J. and **Gassmann, A.** (2014) Biological control of Dalmatian and yellow toadflaxes, *Linaria dalmatica* and *L. vulgaris*. Annual report 2013. 44 pp.

Toepfer, S. and **Haye, T.** (2014) Suppressing established *Diabrotica* populations below thresholds using environmentally friendly control options based on entomopathogenic nematodes. Intermediate Project Report 2014. CABI, Delemont, Switzerland, for Bayerische Landesanstalt für Landwirtschaft LfL, Freising, Germany, 33 pp. [in German and English].

Toepfer, S. and **Kuhlmann, U.** (2014) Improving success rate and data quality of *Diabrotica v. virgifera* trials for early stage product testing. CABI, Delemont, Switzerland and Hodmezovasarhely, Hungary, for Syngenta Crop Protection AG, Basel, Switzerland, 25 pp.

talks:

Dancau, T., **Haye, T.**, Mason, P. and Gillespie, D. (2014) Mortality factors affecting the diamondback moth (*Plutella xylostella*) in continental Europe: a preliminary life table analysis. Joint Annual Meeting of the Entomological Society of Canada and the Entomological Society of Saskatchewan, 28 September–1 October 2014, Saskatoon, Saskatchewan, Canada.

Haye, T., Gariepy T., Gillespie D., Mason, P. and **Zhang, J.** (2014) Seasonal Field Parasitism of *Halyomorpha halys* and Co-occurring Non-target Species in China. Annual Meeting of the Entomological Society of America, 15–19 November 2014, Portland, USA.

Haye, T. (2014) Classical Biological Control in a changing world. Symposium: Biological Control in a Changing World. Joint Annual Meeting of the Entomological Society of Canada and the Entomological Society of Saskatchewan, 28 September–1 October 2014, Saskatoon, Saskatchewan, Canada.

Haye, T. (2014) The brown marmorated stink bug (*Halyomorpha halys*) in Europe – current situation and background. 59th German Plant Protection Conference, 23–26 September 2014, Freiburg, Germany.

Haye, T., Wyniger, D. and Gariepy, T. (2014) Recent Range Expansion of Brown Marmorated Stink Bug in Europe. 8th International Conference on Urban Pests, 20–23 July 2014, Zurich, Switzerland.

Haye, T. (2014) Seasonal field parasitism of *Halyomorpha hal*ys and co-occurring non-target species in China. Brown Marmorated Stink Bug Working Group Meeting, 16 June 2014, Carvel Research & Education Center Georgetown, DE, USA.

Haye, T. (2014) The use of parasitic Hymneoptera for biological control – insides from current research. Swiss Hymenoptera Meeting, 25 January 2014, Bern, Switzerland.

Hinz, H.L. (2014) Foreign exploration for weed biocontrol agents. 3rd Northern Rockies Invasive Plant Council Meeting, Spokane, Washington, 10–13 February 2014.

Hinz, H.L. (2014) Update on the biological control project for mustard weeds. 3rd Northern Rockies Invasive Plant Council Conference, Spokane, Washington, 10–13 February 2014.

Hinz, H.L. and **Häfliger, P.** (2014) Update on the biological control project for flowering rush. Flowering Rush Symposium; 3rd Northern Rockies Invasive Plant Council Conference, Spokane, Washington, 10–13 February 2014.

Hinz, H.L., **Toševski, I.** and **Gassmann, A.** (2014) Update on the biological control project for toadflaxes. 3rd Northern Rockies Invasive Plant Council Conference, Spokane, Washington, 10–13 February 2014.

Hinz, H.L., Gassmann, A. and **Toševski, I.** (2014) Update on the biological control project for common tansy. 3rd Northern Rockies Invasive Plant Council Conference, Spokane, Washington, 10–13 February 2014.

Hinz, H.L. and **Cortat, G.** (2014) Update on the biological control project for hawkweeds. 3rd Northern Rockies Invasive Plant Council Conference, Spokane, Washington, 10–13 February 2014.

Hinz, H.L., Schwarzländer, M. and Winston, R. (2014) How safe are weed biological control agents? A worldwide review of non-target attack. XIV International Symposium on the Biological Control of Weeds. Krüger National Park, South Africa, 2–6 March 2014.

Hinz, H.L., Schwarzländer, M. and Winston, R. (2014) How safe are weed biological control agents? A worldwide review of non-target attack. XIV International Symposium on the Biological Control of Weeds. Krüger National Park, South Africa, 2–6 March 2014.

Hinz, H.L., Gerber, E., Katovich, J. and Becker, R. (2014) Will any of the potential biological control agents for garlic mustard ever get a green card? Terrestrial Invasive Plant Species II Conference 2014. 6–8 August 2014, Toronto, Canada.

Hinz, H.L. (2014) Update on CABI's activities in Switzerland. W3185 meeting, Kauai Island, Hawaii, 27–29 October 2014.

Hinz, H.L. (2014) Update on CABI's weed biocontrol projects with relevance for Wyoming. 70th Wyoming Weed & Pest Conference, Rock Springs, Wyoming, USA, 3–7 November 2014.

Hinz, H.L., Gerber, E., Katovich, J. and Becker, R. (2014) Will any of the potential biological control agents for garlic mustard ever get a green card? W3185 meeting, Kauai Island, Hawaii, 27–29 October 2014.

Kenis, M. (2014) Nouvelles invasions d'insectes en Suisse et en Europe: Modes d'introduction et impacts. Invited presentation at the « Cercle des Sciences naturelles de Nyon-La Côte », 13 February 2014.

Kenis, M. and Hien, K. (2014) Prospects and constraints for the use of insects as human food and animal feed in West Africa. Conference: Insects to Feed the World, Wageningen, Netherlands, 14–17 May 2014.

Kenis, M. (2014) La pyrale du buis: simple ravageur des jardins ou désastre écologique ? Annual Meeting of the « Groupe des Entomologistes Forestiers Francophones (GEFF) », Lucelle, France, 16–18 September 2014.

Kenis, M., Eschen, R., Grégoire, J.C., Potting, R., Rigaux, L., Roques, A., Santini, A., Sukovata, L. and Vettraino, A.M. (2014) Pathways of introduction of exotic woody plant pests: the leading role of the live plant trade. Final Conference of the COST Action PERMIT, Estoril, Portugal, 27–29 October 2014.

Kenis, M., Gonzales Moreno, P., Preda, C. and colleagues of Alien Challenge (2014) Pan-European evaluation of impact assessment protocols for invasive alien species. NEOBIOTA 2014. Antalya, Turkey, 3–8 November 2014.

Kenis, M. (2014) Assessing the ecological impact of invasive insects in natural and semi-natural ecosystems: a global review. Drivers, Mechanisms and Impacts of Insect Invasions. Centre of Excellence for Invasion Biology. Stellenbosch, 24–25 November 2014.

Kenis, M. (2014) Les insectes exotiques envahissants: pourquoi sommes-nous tous concernés? Keynote talk: Insect Invasions in a Changing World. Le Studium, Orléans, France, 17–19 December 2014.

Kiss, A., Kiss, J., Zellner, M. and **Toepfer, S.** (2014) Pushing *Diabrotica v. virgifera* populations below threshold through entomopathogenic nematodes. Hungarian Plant Protection Science Days, 18–19 February 2014, Budapest, Hungary. [In Hungarian]

Koné, N., **Nacambo, S.** and **Kenis, M.** (2014) Evaluation and improvement of a house fly larvae production system in Mali. Conference: Insects to Feed the World, Wageningen, Netherlands, 14–17 May 2014.

Quach, D., **Haye, T.** and Fischer, S. (2014) The bionomics of *Anastatus bifasciatus* and its potential for the control of *Halyomorpha halys*: a case study from Europe. Joint Annual Meeting of the Entomological Society of Canada and the Entomological Society of Saskatchewan, 28 September–1 October 2014, Saskatoon, Saskatchewan, Canada.

Schaffner, U. (2014) Misconceptions about classical biological control of weeds. 3rd Northern Rockies Invasive Plant Council Conference, Spokane, Washington, 10–13 February 2014.

Schaffner, U. (2014) Assessing the prospects of classical biological control of Russian olive. 3rd Northern Rockies Invasive Plant Council Conference, Spokane, Washington, 10–13 February 2014.

Schaffner, U. and Cristofaro, M. (2014) 50 years of open-field host-range testing. XIV International Symposium on the Biological Control of Weeds. Krüger National Park, South Africa, 2–6 March 2014.

Schwarzländer, M., Winston, R., **Hinz, H.L.** and Bargeron C. (2014) The new version of „Biological Control of Weeds – A World Catalogue of Agents and Their Target Weeds." XIV International

Symposium on the Biological Control of Weeds. Krüger National Park, South Africa, 2–6 March 2014.

Stutz, S., Hinz, H.L., Schaffner, U. and Müller-Schärer, H. (2014) Comparison of ploidy levels and herbivore communities of oxeye daisy (*Leucanthemum vulgare* s.l.) in its native and introduced range. XIV International Symposium on the Biological Control of Weeds. Krüger National Park, South Africa, 2–6 March 2014.

Toepfer, S. (2014). Management of *Diabrotica* beetles. Tozou county plant protection station, Inner Mongolia. PR China, 25–26 September 2014 (invited speaker).

Toepfer, S. (2014). Biology and monitoring of *Diabrotica* beetles. Tozou county plant protection station, Inner Mongolia. PR China, 25–26 September 2014 (invited speaker).

Toepfer, S., Anguleova, K. and **Kuhlmann, U.** (2014) International collaborative research and plant health service developments for combatting invasive alien pest species and other plant health problems: the CABI approach. "Agriculture for Life, Life for Agriculture" International Conference, Bucharest, Romania, 5–7 June 2014 (invited key note speaker).

Toepfer, S., Glas, M., Knuth, P., Lichtenberg, M., Maier, J. and Müller-Sämann, K. (2014) New application techniques for beneficial nematodes to better control rootworm larvae. 25th IWGO conference of IOBC/WPRS and 4th International Conference on *Diabrotica* Genetics) and Open Meeting of NC205/NCCC46 Corn Insect Technical Committees. 14–17 April 2014, Chicago, USA.

Toepfer, S., Zellner, M. and **Kuhlmann, U.** (2014) Crop rotation remains the key to successful rootworm control in Europe. 25th IWGO conference of IOBC/WPRS and 4th International Conference on *Diabrotica* Genetics) and Open Meeting of NC205/NCCC46 Corn Insect Technical Committees. 14–17 April 2014, Chicago, USA.

posters:

Cortat, G., Hinz, H.L., Tóth, P. and Hansen, R. (2014) Field bindweed (*Convolvulus arvensis*): New solutions for an old problem – the search continues... XIV International Symposium on the Biological Control of Weeds. Krüger National Park, South Africa, 2–6 March 2014.

Gerber, E., Hinz, H.L., Cristofaro, M., Di Cristina, F. and Dolgovskaya, M. (2014) Host specificity of two potential agents for perennial pepperweed: comparing results from quarantine versus field tests. XIV International Symposium on the Biological Control of Weeds. Krüger National Park, South Africa, 2–6 March 2014.

Fife, D., **Haye, T.** and **Gerber, E.** (2014) Does parasitism reduce the efficacy of *Ceutorhynchus constrictus* (Coleoptera: Curculionidae), a potential biological control agent for garlic mustard? XIV International Symposium on the Biological Control of Weeds. Krüger National Park, South Africa, 2–6 March 2014.

Extension material:

Toepfer S., Mkondo F.C., Kitandu L., Mwangi J.J., Kimomwe K.H., Bakengi J.K., **Otieno W. and Kimani M.** (eds.) (2014) Pest management decision guides, factsheets, Diagnostic services. Plantwise. CABI, Nairobi, Kenya. 157 pp. www.plantwise.org

staff

centre management

Kuhlmann Ulrich, DnatSc, Regional Director, Europe – Switzerland, and Plantwise Programme Executive
Gassmann André, DnatSc, Assistant Director
Jenner Emma, PhD, Assistant Director
Gyseler Monique, Centre Administrator
Schaffter Catherine, Finance Officer (until July)
Pierre-Henri Scherer, Finance Officer (from June)
Baume Olivia, Finance Project Officer
Häfliger Patrick, DnatSc, IT
Grosskopf-Lachat Gitta, DnatSc, Personal Assistant to Regional Director


Ulrich Kuhlmann


André Gassmann


Emma Jenner


Monique Gyseler


Catherine Schaffter


Pierre-Henri Scherer


Olivia Baume


Patrick Häfliger


Gitta Grosskopf-Lachat

programme leaders

Haye Tim, DnatSc, Arthropod Biological Control
Hinz Hariet L., DnatSc, Weed Biological Control
Kenis Marc, PhD, Risk Analysis & Invasion Ecology
Kuhlmann Ulrich, DnatSc, Integrated Crop Management
Schaffner Urs, DnatSc, Ecosystems Management


Tim Haye


Hariet L Hinz


Marc Kenis


Ulrich Kuhlmann


Urs Schaffner

scientists & integrated crop management advisors

Babendreier Dirk, DnatSc, Integrated Crop Management
Bateman Melanie, PhD, Integrated Crop Management
Chernoh Erica, MSc, Integrated Crop Management
Cortat Ghislaine, MSc, Weed Biological Control
Eschen René, DnatSc, Ecosystems Management and Risk Analysis & Invasion Ecology
Gassmann André, DnatSc, Weed Biological Control
Gerber Esther, DnatSc, Weed Biological Control
Grossrieder Manfred, DiplBiol, Integrated Crop Management
Grunder Julien, MSc, Integrated Crop Management (from October)
Häfliger Patrick, DnatSc, Weed Biological Control and Ecosystems Management
Heeb Luca, MSc, Integrated Crop Management (from August)
Holmes Keith, PhD, Integrated Crop Management
Jenner Wade, PhD, Integrated Crop Management
Nacambo Saidou, MSc, Risk Analysis & Invasion Ecology
Rodhe Frida, MSc, Integrated Crop Management (until June)
Schaffner Urs, DnatSc, Weed Biological Control

Toepfer Stefan, DnatSc, Arthropod Biological Control and Integrated Crop Management, based at the Plant Protection Directorate, Hodmezovasarhely, Hungary and seconded to the CABI-MoA Joint Laboratory, Beijing

Toševski Ivo, PhD, Weed Biological Control, based in Serbia


Dirk Babendreier


Melanie Bateman


Erica Chernoh


Ghislaine Cortat


René Eschen


André Gassmann


Esther Gerber


Manfred Grossrieder


Julien Grunder


Patrick Häfliger


Luca Heeb


Keith Holmes


Wade Jenner


Saidou Nacambo


Frida Rodhe


Urs Schaffner


Stefan Toepfer


Ivo Toševski

MSc and PhD students

Girod, Pierre, MSc, PhD student, Risk Analysis & Invasion Ecology in collaboration with the University of Neuchâtel, Switzerland

Kiss Andor, BSc, MSc student, Arthropod Biological Control in collaboration with the Szent Istvan University of Gödöllő, Hungary

Levay, Nora, MSc, PhD student, Arthropod Biological Control in collaboration with the Szent Istvan University of Gödöllő, Hungary

Marcari Veronica, MSc, PhD student, Weed Biological Control in collaboration with the University of Neuchâtel, Switzerland

Marciel Vergara, Gabriela, BSc, MSc student, Risk Analysis & Invasion Ecology in collaboration with the University of Copenhagen, Denmark, and the University of Catania, Italy

Montavon, Célien, BSc, MSc student, Ecosystems Management in collaboration with the University of Neuchâtel, Switzerland

Olsen Elena, BSc, MSc student, Weed Biological Control in collaboration with the University of Fribourg, Switzerland

Stutz Sonja, MSc, PhD student, Weed Biological Control in collaboration with the University of Fribourg, Switzerland

von Bergen, Stefanie, BSc, MSc student, Ecosystems Management in collaboration with the University of Fribourg, Switzerland

research assistants

Cloşca Cornelia, MSc, Weed Biological Control

temporary research assistants

Baan Candice, MSc, University of Neuchâtel, Neuchâtel, Switzerland (May–July)

Castellani Laura, BSc, University of Fribourg, Fribourg, Switzerland (October)

Corbat, Félicien, BSc, University of Neuchâtel, Neuchâtel, Switzerland (September-December)

Dancau Tina, Simon Fraser University, Barnaby, Canada (May–August)

Elsby Miranda, Diploma in Horticulture, University of British Columbia, Vancouver, Canada (April–September)

Falthauser Ana, University of Buenos Aires, Buenos Aires, Argentina (March–July)

Hughes Chris, BA, Concordia University, Montreal, Canada (May–August)

Koncz Ferenc, College, Hodmezovasarhely, Hungary (May–August)

Leiner Rosalie, MSc, University of Hawaii, Honululu, USA (April–July)

Martins Alysha, BSc, Simon Fraser University, Barnaby, Canada (April–July)

Quach Dennis, Simon Fraser University, Barnaby, Canada (April–August)

Sjolie Dylan, BSc, University of Alberta, Edmonton, Canada (April–October)

Slodowicz Daniel, BSc, University of Fribourg, Fribourg, Switzerland (September)

Soukou Shiwa, BSc, Ruhr-Universität Bochum, Bochum, Germany (April–September)
Squire Jordan, BSc, Bishop's University, Sherbrocke, Canada (April–August)
Stattegger Sophie, MSc, Georg-August-Universität, Göttingen, Germany (June and October)
Stuber Rajmond, College, Hodmezovasarhely, Hungary (July)
Winkler Ludovic, MSc, University of Neuchâtel, Neuchâtel, Switzerland (April–September)

support staff

Berberat Lise, DiplGard, Garden Technician (from March)
Leschenne Christian, Assistant Garden Technician
Rais Olivier, Assistant Garden Technician (until May)
Steullet Jeanne, Assistant Garden Technician
Willemin Florence, DiplGard, Garden Technician

about CABI

what does CABI do?

CAB International (CABI – www.cabi.org), originally established in 1910, is a not-for-profit science-based development organization. It operates under an international treaty agreement amongst its, currently 48, member countries, that is registered with the United Nations. It has a Headquarters Agreement with the Government of the UK and operates through a network of centres located around the world. CABI's mission is to improve people's lives worldwide by providing information and applying scientific expertise to solve problems in agriculture and the environment. CABI has over 400 staff operating from bases in 11 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 such as 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 which 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 ministries, scientific institutions, universities, development cooperation agencies, and the plant protection industry. 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 the 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, including insects, diseases and weeds. Many of the most damaging of these pests 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 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, 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 (Federal Office for Agriculture) and FOEN (Federal

Office for the Environment), to provide inputs to protocols and guidance documents required for regulation. We also carry out 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 developed 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 owing to their current or potential environmental impact. By doing this, the centre contributes to the development of regional and national strategies for the 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 also 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 its 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 for farmers around the world to adopt good agricultural practices (GAP) and elevate standards of food production because of market globalization and growing consumer concerns about food safety and environmental health. Our centre's ICM 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 IPM in order to reduce unnecessary use of pesticides.

CABI staff based in Switzerland annually offer international student placements through which 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)
AAS-PPI	Plant Protection Institute, AAS (DPR Korea)
ACB	Asian corn borer (*Ostrinia furnacalis*)
AGES	Austrian Agency for Health and Food Safety
ALIEN CHALLENGE	European information system for alien species (COST Action)
APHIS	USDA Animal and Plant Health Inspection Service
ARS	USDA Agricultural Research Service
BBCA	Biotechnology and Biological Control Agency, Rome (Italy)
BC	British Columbia
BINGO	Breeding Invertebrates for Next Generation BioControl
BLM	USDI Bureau of Land Management
Bt cotton	cotton genetically modified to contain *Bacillus thuringiensis* toxin(s)
MoA-CABI Joint Laboratory	Chinese Ministry of Agriculture – CABI Joint Laboratory of Biosafety, Beijing
CAAS	Chinese Academy of Agricultural Sciences (part of MoA)
CDF	CABI Development Fund
CEH	Centre for Ecology and Hydrology,UK
COST	European Cooperation in Science and Technology (EU)
CPA	crop protection agent
CPHST	USDA-APHIS Center for Plant Health Science and Technology
CPM	Commission on Phytosanitary Measures
CPPS	Central Plant Protection station, Korea
CSIRO	Commonwealth Scientific and Industrial Research Organisation (Australia)
CTI	Swiss Commission for Technology and Innovation
DfID	Department for International Development (UK)
DG DEVCO	Directorate-General for Development and Cooperation (EC)
DG Environment	EU Directorate-General for the Environment
DPR Korea	Democratic People's Republic of Korea
DR Congo	Democratic Republic of the Congo
DROPSA	Strategies to develop effective, innovative and practical approaches to protect major European fruit crops from pests and pathogens (FP7)
EBCL	USDA-ARS European Biological Control Laboratory
EC	European Commission
ECTS	European Credit Transfer and Accumulation System
EPPO	European and Mediterranean Plant Protection Organization
ESC	Entomological Society of Canada
EU	European Union
FAO	Food and Agriculture Organization of the United Nations
FiBL	Research Institute of Organic Agriculture (Switzerland)
FOAG	Federal Office for Agriculture (Switzerland)
FOEN	Federal Office for the Environment (Switzerland)
FP7	RTD Seventh Framework Programme (EU)
FRI	Fondation Rurale Interjurassienne (Switzerland)
GAP	Good Agricultural Practice
GMS	Greater Mekong Subregion
HAFL	School of Agricultural, Forest and Food Sciences (Switzerland)
IAPSC	Inter-African Phytosanitary Council
IAS	invasive alien species
ICM	integrated crop management
IFAD	International Fund for Agricultural Development
IFWA	Insects as Feed in West Africa
IOBC	International Organization for Biological Control

IPM	integrated pest management
IPP-CAAS	Institute of Plant Protection, CAAS (China)
IPPC	International Plant Protection Convention
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 (FP7)
IUCN	International Union for Conservation of Nature
IWGO	International Working Group of Ostrinia and other maize pests
KECCA	Korean–European Cooperation Coordination Agency
Lao PDR	Lao People's Democratic Republic
LfL	Bayerische Landesanstalt für Landwirtschaft (Germany)
MAS	Master of Advanced Studies
M&E	monitoring and evaluation
MoA	Ministry of Agriculture (China or DPR Korea depending on context)
MoA-CPPS	Central Plant Protection Station, MoA (DPR Korea)
MoA-DoPP	Department of Plant Protection, MoA (DPR Korea)
NA	North America/American
NGO	non-governmental organization
NPPO	national plant protection organization
NRIPC	Northern Rockies Invasive Plant Council
NROs	national reporting obligations
NZ	New Zealand
OECD	Organisation for Economic Co-operation and Development
PBL	problem-based learning
PBSD	Plant Biosecurity Division, Department of Agriculture, Malaysia
PERMIT	Pathway evaluation and pest risk management in transport (COST Action)
PMI	Philip Morris International
POMS	Plantwise Online Management System
PPD	Plant Protection Department of the Ministry of Agriculture and Rural Development, Vietnam
PPW	perennial pepperweed, *Lepidium latifolium*
PROteINSECT	Enabling the exploitation of insects as a sustainable source of protein for animal feed and human nutrition (FP7)
PWPB	Plantwise Programme Board
RAB	Rwanda Agricultural Board
R4D	research for development
RPU	Rational Pesticide Use
RTD	EU Research, Technological development and Demonstration (Framework Programmes)
SADC	Southern African Development Community
SDC	Swiss Agency for Development and Cooperation
SECB	Swiss Expert Committee for Biosafety
SMARTER	Sustainable management of *Ambrosia artemisiifolia* in Europe (COST Action)
SNSF	Swiss National Science Foundation
TAG	USDA-APHIS Technical Advisory Group
TBCC	Tianyi Biological Control Company Ltd (China)
T&E	threatened or endangered [species]
ToT	Training of Trainers
TRF	*Trichogramma* rearing facility
TWG	technical working group
USDA	US Department of Agriculture
USDI	US Department of the Interior
USFS	United States Forest Service
WFP	World Food Program
YAU	Yunnan Agricultural University

contact CABI

Africa

Kenya

CABI, CABI, Canary Bird
673 Limuru Road
Muthaiga
PO Box 633-00621
Nairobi, Kenya
T: +254 (0)20 2271000/ 20
E: africa@cabi.org

Ghana

CABI, CSIR Campus
No.6 Agostino Neto Road
Airport Residential Area
PO Box CT 8630
Cantonments
Accra, Ghana
T: +233 302 797 202
E: westafrica@cabi.org

Americas

Brazil

CABI, UNESP-Fazenda Experimental Lageado, FEPAF (Escritorio da CABI)
Rua Dr. Jose Barbosa de Barros
1780, Fazenda Experimental Lageado
CEP:18.610-307
Botucatu, San Paulo, Brazil
T: +5514-38826300
E: y.colmenarez@cabi.org

Trinidad & Tobago

CABI, Gordon Street, Curepe
Trinidad and Tobago
T: +1 868 6457628
E: caribbeanLA@cabi.org

USA

CABI, 745 Atlantic Avenue
8th Floor
Boston, MA 02111
USA
T: +1 617 6829015
E: cabi-nao@cabi.org

Asia

China

CABI, Beijing Representative Office
Internal Post Box 56
Chinese Academy of Agricultural Sciences
12 Zhongguancun Nandajie
Beijing 100081, China
T: +86 (0)10 82105692
E: china@cabi.org

India

CABI, 2nd Floor, CG Block,
NASC Complex, DP Shastri Marg
Opp. Todapur Village, PUSA
New Delhi – 110012, India
T: +91 (0)11 25841906
E: cabi-india@cabi.org

Malaysia

CABI, PO Box 210,
43400 UPM Serdang
Selangor, Malaysia
T: +60 (0)3 89432921
E: cabisea@cabi.org

Pakistan

CABI, Opposite 1-A,
Data Gunj Baksh Road
Satellite Town, PO Box 8
Rawalpindi-Pakistan
T: +92 (0)51 9290132
E: sasia@cabi.org

Europe

Switzerland

CABI, Rue des Grillons 1
CH-2800 Delémont
Switzerland
T: +41 (0)32 4214870
E: europe-CH@cabi.org

UK

CABI, Nosworthy Way
Wallingford, Oxfordshire
OX10 8DE, UK
T: +44 (0)1491 832111
E: corporate@cabi.org

CABI, Bakeham Lane
Egham, Surrey
TW20 9TY, UK
T: +44 (0)1491 829080
E: microbiologicalservices@cabi.org
E: cabieurope-uk@cabi.org

www.cabi.org

www.cabi.org

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