International Organization for Biological Control Nearctic Regional Section Organisation Internationale de Lutte Biologique Section de la Region Nearctique

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IOBC-NRS NEWSLETTER

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Towards ecologically-based slug management in no-till field crops

Slugs (mainly *Deroceras* spp.) are a formidable challenge for no-till farmers, and can even discourage some from adopting or continuing this form of conservation crop management. Over the past several years at Penn State University, we have been studying slug ecology with the aim of expanding the options available to growers. In particular, despite promising research in Europe, little work in North America has explored the potential for arthropod predators to contribute to slug suppression.

To start, we used tritrophic laboratory assays to identify potential slug predators. The most promising were two common ground beetle species (Carabidae: *Pterostichus melanarius* and *Chlaenius tricolor*) that consumed slugs and pro-Continued on page 3



Deroceras reticulatum is probably the most notorious pest slug around the world. It was introduced to North America from Europe in the 1800s.

Wildflowers, Pretty beneficial

Wildflower plantings composed of 15 native perennial flowering plants and three native grass species were established adjacent to crop fields and evaluated for their efficacy at enhancing beneficial insect populations and their delivery of ecosystem services to the cropping system (highbush blueberry).



An adult green lacewing feeding on boneset flowers.

Over a three year period after the wildflower establishment, I measured insect abundance in blueberry fields adjacent to wildflower plantings and in paired fields adjacent to mown grass field margins as a control. During the third year, the number of natural enemies collected in fields adjacent to the wildflower



Jon Lundgren a working group to expand

MESSAGE FROM THE PRESIDENT: Mobilizing Conservation Biological Control

We live in exciting times with many ongoing efforts to integrate species conservation and soil health into agroecosystems, and IOBC-NRS is joining the fray with a Conservation Biological Control Initiative. It seems that there is a recent shift or reprioritization in many biodiversity conservation groups, recognizing the predominance of agroecosystems as a habitat and that decisions made on farmland affect broad effects on conservation efforts in natural areas. The Nature Conservancy, National Wildlife Foundation, Environmental Defense Fund, the Buffett Foundation, the Noble Foundation, Xerces Society, and USDA-NRCS are all great examples of societies or agencies that are developing sustainable farming initiatives as an effort to conserve biodiversity and reduce harmful effects on the environment.

Earlier this year, IOBC-NRS formed a working group to promote and incentivize Conservation Biological Control (CBC) practices on farms (please contact me if you are interested in participating). We currently have researchers from 14 states involved in the project, as well as dozens of members from NGOs, NRCS, and farmers interested in practicing conservation biological control on their farms. The first step in this process is combing the literature for what we know and don't know regarding practical recommendations for CBC on farms. This effort will produce a white paper to develop outreach material for end-users as well as strategize research efforts to fill knowledge gaps.

One thing that we need from IOBC-NRS membership is information. Specifically, if you know of good case studies where farmers are implementing conservation biological control practices (e.g., insect conservation strips, cover crops for pest management, intercropping, etc.), the working group needs to hear about them so that we can highlight these examples as we move forward! Please drop me a line or an email.

> Jonathan Lundgren, President USDA-ARS, Brookings SD Jonathan.Lundgren@ars.usda.gov

Book of interest: Biological Control of Weeds

Excerpt from http://weedsnetwork.com/traction/permalink/publications2



Biological control of weeds has been practised for over 100 years and Australia has been a leader in this weed management technique. The classical example of control of prickly pears in Australia by the cactus moth *Cactoblastis cactorum*, which was imported from the Americas, helped to set the future for biocontrol of weeds in many countries. Since then there have been many projects using Classical Biological Control to manage numerous weed species, many of which have been successful. Importantly, there have been no serious negative non-target impacts – the technique, when practised as it is in Australia, is safe and environmentally friendly. Economic assessments have shown that biocontrol of weeds in Australia has provided exceedingly high benefit-to-cost ratios. This book reviews biological control of weeds in Australia to 2011,

RESEARCH BRIEFS

Continued from page 1 Slugs

tected seedlings from damage. We next explored the influence of cropping systems on slugs, insect pests, and their predators in a three-year field experiment with corn as a focal crop. We found that low-input cropping systems using cover crops and relying on IPM were competitive with systems that relied heavily on insecticides and transgenic traits for preemptive pest control. In the low-input systems we detected enhanced predation services on some sample dates. In a separate field experiment in a farmer's field, we found that intercropping corn with rye early in the season shifted slug feeding away from corn while boosting the abundance and diversity of ground-dwelling predators.

Most recently, we have been exploring the intersection of slugs, predators, and neonicotinoid seed treatments. In the laboratory, thiamethoxam was transferred from soybeans to *C. tricolor* via slugs, a phenomenon with potential importance not only for slug management but also for the broader environmental safety of these seed treatments. We are currently exploring whether this trophic transfer of insecticides has the potential to disrupt predation on slugs in the field.



Chlaenius tricolor is a North American native carabid that has shown promise for controlling slug populations. Photo credit: Ian Grettenberger.

Maggie Douglas & John Tooker Penn State University

Continued from page 1 Wildflowers

plantings was significantly greater compared to control fields, whereas insect herbivore densities were generally not enhanced by the provision of floral resources. Using sentinel pest eggs to investigate the efficacy of wildflower plantings as a method for conservation biological control, by the fourth year of establishment I measured significantly greater biological control of eggs along crop borders in blueberry fields adjacent to wildflower habitat. Similarly, wild bees and pollination parameters, including percent fruit set and berry weight, were significantly greater in fields adjacent to wildflower plantings three and four years after seeding, leading to higher crop yields with value exceeding the cost of establishing and maintaining the plantings.



Wildflower plantings next to a blueberry field.

Currently, to determine the movement patterns of beneficial and pest insects from wildflower plantings into crop fields I am working on a project using inexpensive immuno-marking methods to measure the distribution of insects in response to wildflower plantings. The general patterns observed from these projects will be used to help guide future efforts in the conservation and support of beneficial insects in the natural and agricultural landscapes.

TOYS OF THE TRADE

Characterizing trophic webs within agricultural fields is critical for developing management plans that promote biological control services. But documenting feeding events can be difficult, and so technologies that can identify trophic linkages to a focal prey species without disrupting normal behaviors of the players involved are necessary. Molecular technologies give researchers the ability to collect data on feeding events that would be inaccessible using other techniques, such as direct observation or gut dissection.¹

Two of the most commonly-used molecular techniques are enzyme-linked immuno-sorbent assay (ELISA) and polymerase chain reaction (PCR), which can be used to isolate and identify proteins or DNA (respectively) from recently ingested meals inside an animal's gut² or from specific labels used to experimentally mark proteins³. In particular, researchers can take advantage of publically-accessible DNA databases to acquire and develop molecular markers for PCR, making it a preferred technology for gut-content analysis.

Using these techniques, meals are often detectable for hours or even days after consumption, greatly enhancing our ability to collect data on feeding events. However, these assays require some specialized training and careful testing to be properly conducted and interpreted.

Molecular gut-content analysis can be a useful tool for evaluating the ecology of natural enemies, the structure of agroecosystem food webs, and the biological control services provided by natural enemies. For example, molecular tools are often used to test natural enemies for predation on crop pests, or to test for consumption of non-prey foods, such as pollen and nectar. This information can be used to determine which natural enemies are likely to be useful biological control agents, and to identify trophic resources that will help sustain natural enemy populations and fitness, in a way that other techniques simply cannot.

Sources:

- 1. Symondson, W.O.C. (2002). Molecular identification of prey inside predator diets. *Molecular Ecology* 11:627-641.
- 2. Sheppard, S.K. & Harwood J.D. (2005). Advances in molecular ecology: tracking trophic links through predator-prey food webs. *Functional Ecology* 19:751-762.
- 3. Hagler, J.R. (2011). An immunological approach to quantify consumption of protein-tagged *Lygus Hesperus* by the entire cotton predator assemblage. *Biological Control* 58:337-345.

Kelton Welch USDA-ARS, Brookings, SD



A beetle feeding, and its gut dissected afterward, ready for molecular analysis. Photo credit: Jon Lundgren.

Highlights

Agents on the prowl

Two biological control agents were approved for field release in March 2013.

Scymnus coniferarum for Hemlock Wooly Adelgid APHIS "is proposing to issue permits for the release of Scymnus coniferarum, a native predaceous beetle from the western United States, into the eastern United States for use as a biological control agent to reduce the severity of hemlock woolly adelgid (Adelges tsugae) infestations on hemlock."

http://www.gpo.gov/fdsys/pkg/FR-2013-03-06/html/2013-05141.htm

Aphelinus glycinis for Soybean Aphid

"...issue permits for the field release of the insect Aphelinus glycinis to reduce the severity of soybean damage from infestations of soybean aphid in the United States. Permitting the release of this parasite species is necessary to determine its impact on soybean aphid populations and its ability to survive in the target area."

http://www.gpo.gov/fdsys/pkg/FR-2013-03-06/html/2013-05140.htm

Public outreach about invasive pests

APHIS has a nice website showing the 8 main ways that invasives are spread: Passenger baggage, plants and plant parts, internet sales, firewood, outdoor gear, RVs, outdoor furniture, and agricultural materials. http://www.hungrypests.com/how-they-spread/

Continued from page 2 Book

covering over 90 weed species and a multitude of biological control agents and potential agents. Each chapter has been written by practising biological control of weeds researchers and provides details of the weed, the history of its biological control, exploration for agents, potential agents studied and agents released and the outcomes of those releases. Many weeds were successfully controlled, some were not, many projects are still underway, some have just begun, however all are reported in detail in this book. Biological Control of Weeds in Australia will provide invaluable information for biological control researchers in Australia and elsewhere. Agents used in Australia could be of immense value to other countries that suffer from the same weeds as Australia. The studies reported here provide direction to future research and provide examples and knowledge for researchers and students.

Authors: Mic Julien, Rachel McFadyen, Jim Cullen.



Musings — How to expand the benefits of biological control

We often tout the benefits of biological control and rightly so. We talk about (and sometimes quantify) reductions in pesticide use, economic benefits, and reduction in spread or effects of invasive species. To these we could an-

other: the incentivization of sustainable agricultural practices. Practices such as cover cropping provide a number of benefits – such as nitrogen capture and carbon sequestration - that accrue to society at large but not necessarily to the farmers that practice them. And while other effects such as reduced soil erosion may benefit farmers, this is over the

long run. Given the added expense and time taken to use cover crops or other sustainable farming practices, farmers may have little incentive to actually implement them. However, improved biological control of insect pests could provide the motivation that leads to adoption. Surveys have borne this out for cover crops – farmers are more willing to use cover crops if they are confident that they will help to alleviate pest problems. To the extent that improved biological control enables implementation of sustainable farming practices, it seems fair to claim the broader benefits of these practices as an indirect effect of biological control.

George Heimpel University of Minnesota

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The International Organization for Biological Control— Nearctic Regional Section Newsletter is published 3 times a year to provide information and to further communication among members of the Region (Bermuda, Canada, & the United States).

Upcoming Events

10-14 August. American Phytopathological Society Annual Meeting, Austin, Texas. Contact <u>BFord@scisoc.org</u> <u>http://www.apsnet.org</u>

9-13 September. 12th International Symposium "Ecology of Aphidophaga" Belgrade, Serbia. Info: <u>http://aphidophaga12.bio.bg.ac.rs/</u>

22-27 September. 16th European Carabidologist Meeting. Prague, Czech Republic. <u>http://europeancarabidology.eu</u>

18-24 October. 150th Entomological Society of Ontario Annual Meeting, jointly with the Entomological Society Of Canada, Guelph, Ontario Info: Nicole.McKenzie@hc-sc.ca http://www.entsocont.ca

10-13 November. The 61st Annual Meeting of the Entomological Society of America, Austin, Texas. Email <u>Meet@entsoc.org</u> <u>http://www.entsoc.org</u>

10-15 November. 36th National Congress of Biological Control, Oaxaca, Mexico. www.ciidiroaxaca.ipn.mx

25-27 February 2014. IOBC Working Group "**Pesticides and Beneficial Organisms**", Namur, Belgium. Email: <u>Labecotox@cra.wallonie.be</u>

21-23 May 2014. IOBC Working Group "Landscape Management for Functional Biodiversity", Poznan, Poland. Email: <u>A.Kwiatkowski@iorpib.poznan.pl</u> Send items for the IOBC-NRS Newsletter to:

Newsletter Editor, Jana Lee Horticultural Crops Research Unit USDA-ARS Corvallis, OR 97330 USA E-mail: janalee@hotmail.com

IOBC Working Group "Pesticides and Beneficial Organisms"



will be held in Namur, Belgium, from the 25th to the

27th of February 2014. Namur is the administrative capital of the Walloon area, located 50km south of Brussels and a nice and quiet place on the Meuse River.

New topics include:

- Effects of Plant Protection Products and alternative products (Induced resistance elicitors, plant decoctions and extracts, etc...) on beneficial and non-target organisms.
- Product substitution: How to replace non selective with more selective products for beneficials?
- Data extrapolation. Due to huge trends to standardization, the registration system in Europe and other areas has more high standard results but on a limited number of species and crop systems. How to deal with this for IPM ?

IOBC Working Group "Landscape Management for Functional Biodiver-

sity" The aims of the meeting are to bring together the latest advances in research and development on the landscape management for functional biodiversity, to provide the opportunity to exchange information and to coordinate common research and identify the main areas for future research.