Sveriges lantbruksuniversitet
Swedish University of Agricultural Sciences

**Centre for Biological Control (CBC)**

# HIGHLIGHTS OF 2017

# Contents



Cover: Mattias Jonsson guides students in a collaboration with a high school, where natural enemies in barley fields were investigated.


**Photos:** Cajsa Lithell, Ingvar Sundh, Mattias Jonsson and Jenny Svennås-Gillner
**Layout:** Cajsa Lithell

## The Centre for Biological Control

The Centre for Biological Control (CBC) contributes to a sustainable use of biological resources. Biological control is a collective term for various strategies to inhibit pests and diseases by the use of living organisms and is an important component of integrated pest management in plant production. Biological control has great potential to restrict the damage caused by harmful organisms such as insects and plant pathogens. CBC is run by SLU with a grant from the Swedish government. Five researchers associated with the centre conduct research to stimulate the development and implementation of biological control, in close collaboration with stakeholders. A communicator is linked to the centre.

# Words from the director

In this report we would like to highlight some of the activities from the SLU Centre for Biological Control during 2017. I hope you will enjoy the reading.

The research field of biological control continues to attract much attention, including both conservation and application biological control methods, directed towards both pests and plant diseases. An area that is receiving growing interest is how to combine different biological control methods with each other and with other plant protection measures, all within an integrated pest management framework. Also, more fundamental studies concerning the importance of the plant, soil and insect microbiomes will inevitably have a strong impact on the biological control area in the years to come.

During the year, some CBC research projects have been completed and new have started, and we have also engaged a number of new co-workers, all of which you can read about here. We also describe the four new pilot projects/literature studies that received grants from CBC, a successful collaboration with very engaged high school students at Katedralskolan in Uppsala, a CBC arranged session on biological control at a scientific symposium at Ultuna campus and a CBC debate article in a Swedish daily newspaper, among many other activities.

After six years with CBC I will now pass on to Ingvar Sundh as the new director of CBC and prepare for my retirement during the summer of 2018. It has been a privilege and a joy to contribute to the building up and establishment of CBC together with my fantastic CBC colleagues. The collaboration with other researchers and stakeholders with an interest in biological control has been a true inspiration. I am looking forward with great confidence to the future progress of biological control and to its increasing importance for a sustainable food production.

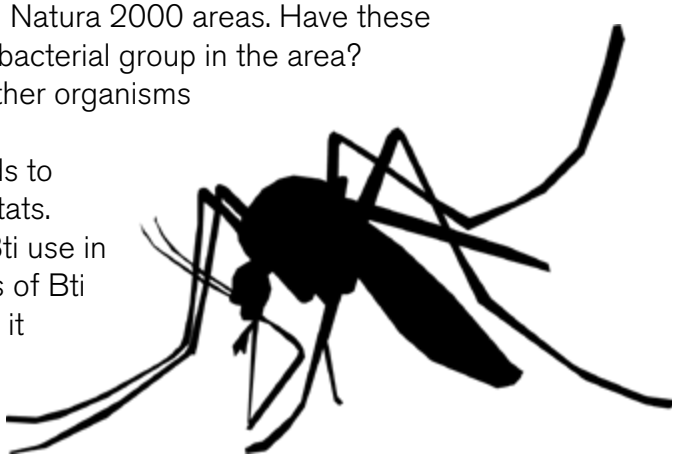
Margareta Hökeberg,
Director of CBC

# Research from CBC

## What effects do ten years of Bti-treatments in the floodplains of River Dalälven have on bacterial communities?

In Sweden, the larvicidal bacterium *Bacillus thuringiensis isarelensis* (Bti) has been applied on a large-scale for mosquito control in periodically flooded wet meadows and swamps of the River Dalälven floodplain since 2001. Several of the treated sites are situated in Natura 2000 areas. Have these applications of Bti led to changes in the populations of this bacterial group in the area? This is something that potentially could lead to effects on other organisms that were not the targets of these actions.

These questions were addressed using molecular methods to analyse samples from soil and sediment from different habitats. The data showed that it is highly unlikely that ten years of Bti use in the River Dalälven floodplains has changed the abundances of Bti and the *Bacillus cereus* group collectively, to an extent that it might have any longer-term effects on mosquito larvae or potentially on other, non-target organisms.
**Read more about the study here.**



## Foreign biological control agents do not reach Sweden

Researchers at CBC have evaluated four biological control agents based on microorganisms that are not available on the Swedish market today. Several of the products gave good effects in Swedish crops.

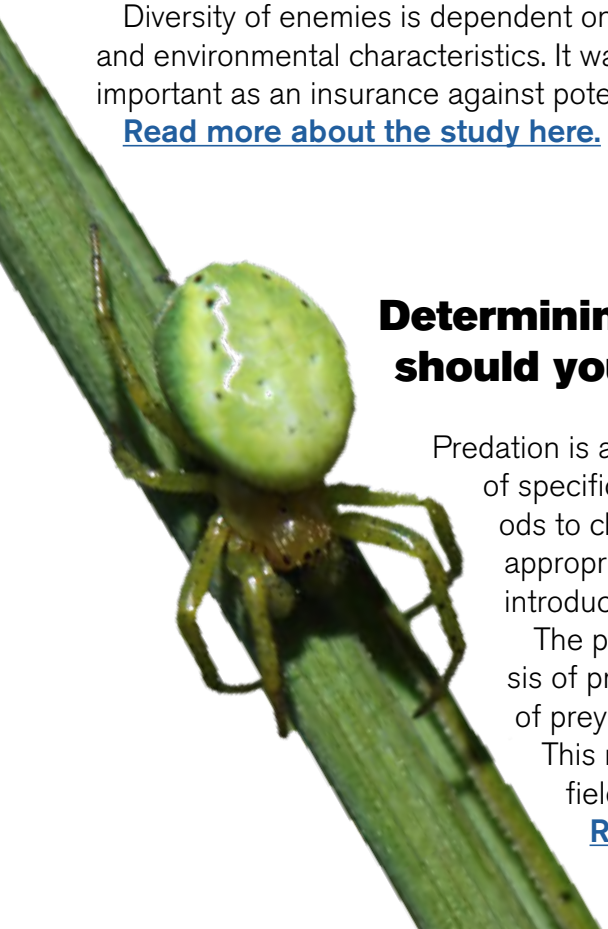
Unexpectedly, it proved difficult to obtain biological products to evaluate in the project. Several companies were reluctant to let the researchers test their products. They wanted to run their own tests in the countries they consider to be interesting markets. Sweden is a small market and the companies, that are often small, are probably deterred by the cost of trying to register their product for the Swedish market.
**Read more here (in Swedish).**

## Relationships between natural enemy diversity and biological control

In general, the more diverse communities of natural enemies are, the stronger the biological pest control is. However, individual studies have found everything from positive to negative effects. This review article critically investigates the factors responsible for the different outcomes and discusses recent progress at predicting the biological pest control effect.

Diversity of enemies is dependent on both ecological characteristics of the natural enemies and prey and environmental characteristics. It was concluded that maintaining a high diversity of enemies is important as an insurance against potential effects of climate change.

Read more about the study here.



## Determining the prey of predators – which method should you use?

Predation is among the most important biotic interactions. When identifying prey of specific predators in terrestrial systems, there are several different methods to choose from. In this article, a decision tool is provided to select the appropriate method for a specific study. Each method is presented with an introduction, examples for application and advantages and disadvantages.

The presented methods are, direct field observations of predation, analysis of prey remains, cage studies (enclosures and exclosures), deployment of prey baits, molecular analyses, stable isotopes, and fatty acid analyses. This review will be especially useful to researchers that are new to the field.

Read more here.

## Combating corky root rot in organic production

Soil-borne plant diseases are a major problem in organic tomato production, and are considered to be one of the main reasons that crops are often lower in organic production than in conventional. One of the most important diseases is corky root rot caused by the fungus *Pyrenochaeta lycopersici.* We collaborate with Swedish tomato growers to evaluate the possibilities of using different types of biological control against corky root rot on tomato.

Watch Hanna Friberg and Christoffer Berner talk about the project in a film.

## Plant protection in greenhouse systems

In a Bachelor thesis, Stina Moritz has compiled information on plant protection measures that limit the root diseases in tomatoes and how these measures work in an organic greenhouse farming system. Stina found that root diseases are best combated when several plant protection measures are combined.

Read more about the thesis here (in Swedish).

# Calls and Teaching

## CBC awards research grants for projects on biological control

CBC announced a call at SLU to apply for grant money for pilot projects or literature studies on biological control. The grants were given to projects led by Adriana Puentes, Åsa Lankinen and Dan Funck Jensen. Final reports are due in May, 2018.

Adriana and colleagues will do a literature study on plant-herbivore-enemy interactions. The goal is to identify key priorities for future research and how different applied research fields can take advantage of this knowledge and implement better and more sustainable practices.

Åsa and colleagues will do a pilot study on combinatory integrated pest management in Swedish potato production. The effect of biocontrol, in combination with other plant protection methods, will be investigated to help improving pest control in potato.

Dan and colleagues will investigate biological control of seed-borne diseases of rice and vegetables in Vietnam in a pilot study. The project aims to reduce pesticide use and form the basis for future research collaboration in this area.
Read more about the projects here.

## Teaching: "Biological control: Microbial interactions for improved plant health"

During spring 2017, SLU organised a course for PhD students within the Nordic-Baltic University network NOVA: "Biological Control: Microbial Interactions for Improved Plant Health". The course included definitions, terms, concepts and theories in biological control and had two main themes in biocontrol as the core of the course schedule: 1) augmentation biological control where biocontrol microbes (BCAs) are applied to the plant crop and 2) conservation biological control where indigenous microbial communities suppress plant diseases.

The organizing committee consisted of Dan Funck Jensen, Magnus Karlsson and Hanna Friberg. Several Nordic researchers gave lectures on various aspects of biological control. Among them were Margareta Hökeberg and Ingvar Sundh, presenting and discussing Commercialization and legislation of biocontrol agents and Hanna Friberg presenting the area of conservation biological control of soil-borne plant diseases. Two main teachers were invited: Professor Enrique Monte from the University of Salamanca in Spain and Alexandre Jousset, Assistant Professor at Utrecht University in The Netherlands.

The course was arranged as a series of literature studies, followed by an intense and stimulating course week at Älvkarleö Herrgård.

# Collaboration and outreach activities

## Ladybug games and secret boxes on SLU's 40th anniversary

SLU celebrated 40 years with an open campus at Ultuna in Uppsala. CBC informed visitors about biological control and presented different examples for illustration. Ground beetles that are important emenies to pests was on display as well as peas treated with antagonistic bacteria and many more examples of biological control. The brave visitors could put their hand into a secret box to catch a natural enemy.
Read more here (in Swedish).

## Old regulations slow down the development of new plant protection

There is a strong will from politicians, growers and consumers to invest in alternative plant protection measures for both environmental and health reasons. Nevertheless, the sales of chemical pesticides in recent years has remained at similar levels or even showed a slight increase. There is a big need for new rules and policies that stimulate, not hinder, development, wrote CBC in DN Debate.
Read the article in DN Debate here (in Swedish).

# Outreach - schools

## Aphids in barley fields were investigated together with students from Katedralskolan

Mattias Jonsson wanted to investigate if a higher diversity of natural enemies, like predatory beetles and spiders, could provide more stable biological control of aphids. In addition, he wanted to know if the effects would remain if the climate would change. Six students from the high school Katedralskolan in Uppsala helped him. Mattias reports that it was great fun to work with the students. He was impressed by how well they wrote their project plans before the start of the project. It was not difficult to find interested students, 29 reported interest! Mattias recommend more researchers to work with high school students. In addition to getting some help collecting data, it is also a good way to attract new students to SLU.

Read more about the project here (in Swedish) or watch a movie from the field work here.

## Social media

On the CBC YouTube channel, videos on research about biological control and happenings can be found.

On Facebook, CBC post regular updates on research results, meetings, photos from events and available job positions. Via this channel we communicate with both international researchers and stakeholders.

On the CBC Twitter account, we post photos, express opinions about biological control and link to current news.

A potato leafhopper.
Photo: gailhampshire, CC BY 2.0

# CBC's seminar series on biological control

**CBC arranges a seminar series on biological control with invited speakers.**

## The struggle against the potato leafhopper

Cory Straub from Ursinus College in USA held a seminar on non-target effects and the efficacy of host plant resistance against potato leafhopper. Stimulating host plant resistance, to insect pest damage, is an essential pest management strategy. However, host plant resistance can also impact the competitors and predators of the target pest, and these non-target effects can influence their efficacy. Cory talked about ongoing research where he and his colleagues examined these non-target effects in alfalfa, where the focal pest is the potato leafhopper.

## Towards more integrated disease control in potato

Potato is cultivated on less than 1% of the agricultural land, but accounts for approximately 30% of all agricultural fungicide usage in Sweden due to plant pathogens. There is an urgent need to develop more integrated disease control approaches. Laura Grenville-Briggs from the Department of Plant Protection Biology at SLU in Alnarp talked about ongoing research with mycoparasitism in the biocontrol agent *Pythium oligandrum.*

## Interactions between an invasive aphid in Chile and introduced parasitoides

Blas Lavandero from Instituto de Ciencias Biologicas, Universidad de Talca in Chile held a seminar on the English grain aphid that was introduced to Chile from Europe in the 1970s. During the late 70s, several aphid parasitoids were introduced to combat this new pest. However, the interactions of these different introduced species were never studied. Now, the population dynamics of the main aphid species and the endosymbionts and their parasitism levels were observed on cereal crops in different landscapes.

## "No country without maize"

John Larsen from the National Autonomous University of Mexico held a seminar arranged by CBC on plant biotic interactions in maize ecosystems. During the seminar, John presented three examples on biocontrol in maize, involving interactions among mycorrhizal fungi, pathogens such as white grub larvae and fall armyworm and natural enemies such as mycoparasitic Trichoderma fungi.

Read more about the seminar here.

View the seminar on Facebook live here.

# Conferences

## A biological control session at an Ecological networks and Molecular Analysis symposium

CBC arranged a session on biological control at the meeting “3rd Symposium on Ecological Networks and 3rd Symposium on Molecular Analysis of Trophic Interactions” that took place at Ultuna Campus in Uppsala 11-15 September.

At the conference, more than 170 researchers discussed how molecular methods can resolve how species interact with each other.

In the session on biological control, hosts and parasitoids in biological control program were discussed. There were also talks on tracking of invasive flies and changes in food webs after fertilization. In addition, biological control of aphids and how biological control is an important method in urban agriculture were discussed.

Read more about the session on biological control here.

Read more about the conference here.

*Tara Gariepy gave the keynote talk for the biological control session and discussed evaluations of biological control programs.*

## New research findings on harmful Fusarium fungi

Fungi within the genus Fusarium cause severe problems in cereal production worldwide, due to the diseases they are causing as well as mycotoxins they produce. On the 9-10 of March, researchers from Nordic and Baltic countries met in Riga to discuss the current situation, recent research findings and possible solutions to the problems. Hanna Friberg presented Ida Karlsson’s research within the field and an example where newly developed methods have been used to understand factors that limit the development of pathogenic or mycotoxigenic species.

Read more here.

## Plant protection products in organic crop production

Margareta Hökeberg and Ingvar Sundh from CBC were invited to the workshop “Växtskyddsmedel i ekologisk odling: användning, nytta och risker” (Plant protection products in organic crop production: utilisation, benefits and risks), arranged 27 April at LRF, Stockholm by EPOK, SLU. Margareta and Ingvar also provided detailed comments on manuscripts of two reviews on the topic by EPOK.

# New coworkers

## Johanna Nykyri

Johanna Nykyri started as a postdoc in June. She will develop a new method that could be useful in the study of potential microbial biocontrol agents, or in different kinds of formulation and stability studies to create new microbial products or enhance current ones. Johanna is also interested in stress related factors that could improve utilization of microbes in plant protection products.
Read more about Johanna here.

## Eirini Daouti

In a new project funded by C-IPM, five European countries will investigate the overlooked ecosystem service of weed seed predation for weed control in cereal fields. Eirini Daouti will assess the importance of weed seed predation for weed control in cereal fields and determine whether higher predator species richness can assure natural weed control. Based on the findings, landscape and in- field management options that will support weed seed predator biodiversity and mitigate the environmental impact of herbicides usage will be developed.
Read more about Eirini and her project here.

## Benjamin Feit

Benjamin Feit, most recently from the University of New South Wales in Australia, has started a postdoc to work with biological control of aphids by natural enemies. Benjamin will use aphids and their natural predators in barley fields as a model system to investigate if seemingly redundant natural enemy communities can provide stable biological control under climate change. He will also investigate if the stability will depend on agricultural intensification in the landscape.
Read more about Benjamin and his project here.

## Lina Sjöholm

Lina Sjöholm is doing a postdoc project where she investigates how disease control actions exert selection pressure on *Phytophthora infestans* (agent of potato late blight) and on other plant-associated microbial populations. Lina aims to increase our understanding of how disease control actions affect the pathogen and plant-associated microflora populations, and eventually the outcome of disease control.

# Visitors

## John Bosco Muhumuza

John Bosco Muhumuza from Makerere University and the Mbarara Zonal Agricultural Research & Development Institute in Uganda visited CBC in August-November. He is working with termites and the invasive fall armyworm in maize fields. John is working in an interdisciplinary research and training program, funded by Sida, on building capabilities to develop innovations for sustainable intensification of maize based cropping systems. The goal is to improve productivity, food security and resilience to climate change in Uganda.
Read more about John and his research here.

# Referrals and scientific advice

## New rules for nematodes, insects and spiders as biological control products

A new system for application and approval in Sweden of invertebrate animals to be used as biological control products will be introduced in 2018. In the new system, it is the species and not the product that will be evaluated. Once a species has been approved, it is possible for anyone who wishes to use the species as a biological control agent to do so.

## Potential risks with biological control

CBC personnel were invited to meetings to provide scientific advice on evaluation of potential risks of metabolites from microorganisms. Once to the Swedish Chemicals Agency and twice to the Biopesticides working group of the EU commission.

In addition, CBC was asked to provide advice on the draft for a guidance document of the EU Commission, for the biocontrol and biostimulants sector, regarding the implementation of the Nagoya protocol for access and benefit sharing of the UN CBD (Convention on Biological Diversity). The Nagoya protocol aims to establish a clear, legally-binding framework determining how researchers and companies can obtain access to the genetic resources of a country and to the traditional knowledge associated with these resources.

## EFSA

The engagement of CBC in EFSA´s work continues, and Ingvar Sundh´s mandate in the QPS working group (Qualified Presumtion of Safety for microorganisms) was extended with the period 2017-2019.

efsa
European Food Safety Authority

## Focus groups

CBC has participated in several focus groups of the Platform Plant Protection at SLU: 1.) Oilseed rape and other break crops as a strategic focus, 2.) Plant protection in cereal crops and 3.) Integrated use of low risk compounds in plant protection.