



Sveriges lantbruksuniversitet
Swedish University of Agricultural Sciences

Centre for Biological Control (CBC)



HIGHLIGHTS OF 2016

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Cover: A crab spider is waiting for a pollinator.

Photos: Cajsa Lithell, Mattias Jonsson, Hanna Friberg, Mårten Svensson, Jenny Svénnås Gillner and Lina Wu
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 with living organisms and is an important component of integrated pest management in plant production. Biological control has a great potential to restrict the damage caused by harmful organisms like insects, plant pathogens and other pests.

CBC is run by SLU with a grant from the Swedish government. Five researchers associated with the centre conduct research that aim 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

We hope you will enjoy this brief overview of our activities in 2016, the centre's fifth full year. It is a privilege to work as director of CBC, as integrated pest management gets increasingly important. It is vital to find and develop environmentally sound methods for pest control that are also reliable and manageable from a production point of view. In this context, the potential of biological control solutions have attracted a rapidly growing attention world wide. The researchers connected with CBC have an important mission to contribute to the understanding of how different biocontrol systems work and help to provide solutions for agriculture, forestry and horticulture.

This year several projects that CBC has been involved in have been concluded. Among them was the OSCAR project that aimed to improve conservation tillage systems, a case where biological control is a very useful method. In the BCA Consortia project, we looked at the possibilities to combine different biological control agents to get improved and broadened biological control effects of several plant diseases in field crops.

We also arranged, together with The Swedish Board of Agriculture and Partnership Alnarp, a well visited theme day outside Ängelholm in November. The theme was biological control and future food production. These theme days are an excellent way to open communication channels between growers, government agencies, companies, researchers and advisers.

I am very much looking forward to the coming year!

Margareta Hökeberg,
Director of CBC





To control disease in organic tomato production

Christoffer Berner started as a post doc with Hanna Friberg in the project “Disease control in organic tomato production – combined biological control with microorganisms and biofumigation” in August. He previously studied how climate change, specifically increasing water temperatures, affect growth and communities of cyanobacteria and heterotrophic bacteria in the Baltic Sea, at the Linnaeus University in Kalmar.

- With this new project, I want to understand how to use biofumigation and biological control organisms in a more effective way to combat corky root rot on tomato plants, says Christoffer.

He hopes that the results of the experiments can be used as the basis for new guidelines for growers. [Read an interview with Christoffer here](#) and [more about the project here](#).

Suppressing plant diseases with beneficial protozoans

Ida Karlsson recently finished her PhD on fungi (especially *Fusarium*) in different agricultural production systems. Now she has started working as a post doc studying soil protozoans and their importance in suppressiveness to plant diseases with Hanna Friberg. Plant roots are surrounded by beneficial microorganisms that can suppress plant diseases. Increasing this natural disease suppression in soil would be an environmentally friendly way to improve plant health.

- We hypothesize that predation pressure from protozoans can increase the disease suppressive capacity of the soil microbiota. In this project, we evaluate the potential of protozoans to be used in biocontrol of soil- and seed-borne diseases, says Ida. [Read more about Ida's research here](#).



The king of Sweden awarded scholarships from King Carl XVI Gustaf's 50-years fund for Science, Technology and Environment on the 31st of May. Ida Karlsson was one of the researchers that received funding. She will use them to do laboratory studies in Utrecht, The Netherlands. [More information here \(in Swedish\)](#).

Visiting scientists

An important part of CBC's work is to interact with researchers from other universities all over the world. Contacts in the research world often lead to collaborative research projects. Sometimes we are lucky enough to get visitors. Here, we present some of them.

Shem Kuyah works with meta-analysis of the effects of mixed cropping on pest control with CBC

Shem Kuyah is an ecophysiologist and a lecturer at the Department of Botany at Jomo Kenyatta University of Agriculture and Technology (JKUAT), and holds a PhD in plant science.

Charles Midega is an agroecologist and senior research scientist at the International centre of insect physiology and ecology (ICIPE), in Kenya. They both visited CBC with a grant from [AgriFoSe2030](#) in September 2016. Together they performed a meta-analysis on how mixed cropping, i.e. when growing more than one type of plant in the same field, helps controlling weeds, pests and diseases. [Read more about Shem and Charles.](#)

Maria Belousova is visiting SLU with an Erasmus Mundus stipendium from November 2016 to March 2017. Her work is to characterise new bacterial isolates of *Bacillus thuringiensis* that may have potential as new biological control agents. [Read an interview with Maria.](#)

Katja Poveda from Cornell University, USA visited CBC 6-9 September to discuss research collaborations. She also gave a seminar called "Natural habitats improve yields: how landscape complexity can increase yield through arthropod-mediated ecosystem services" as a part of CBC's seminar series.

Peris Nderitu from Embu University in Kenya visited CBC in April. She is a PhD-student co-supervised by CBC who is working with crop protection and specializes on the tomato leaf miner. [Read more about Peris' visit.](#)

An interview with Peris led to financing of her PhD project when a senior lecturer from Kenyatta University, Kenya, contacted her after having seen Peris' profile at the CBC web-site. Peris' project is now financed by Koppert Biological systems and ARF Netherlands. [Read more about it here.](#)

Peris Nderitu, PhD student at Embu University.





Grants and Calls 2016

Call for applications for research on biological control

In December CBC set aside in total **420 000 SEK** to support three to four research projects on biological control at SLU. The projects can either be scientific literature reviews or aim to test new ideas in a pilot project.

[Read more about the call here.](#)

Funding by CBC of pilot projects

CBC distributed research funding at the end of 2014 to three pilot projects at SLU. One of the funded projects was Christer Björkman's "How predation varies in time and space? Development of a general approach." In 2016, the project was finalised with a scientific review article and a field experiment with artificial larvae and pupae.

[Read more about the pilot project here.](#)

Received grants

Mattias Jonsson received nearly 3 million SEK from Formas for a project where he will investigate if predator communities can contribute to stable biological control in the future.

The New Steering Group

The CBC steering group are made up of experts who oversee CBC's activities to ensure that the mandate is followed and provide advice and troubleshoot where necessary. The steering group also influences strategic research decisions.

The Dean for the Faculty of Natural Resources and Agricultural Sciences has appointed a new steering group for CBC. Johan Meijer is the new Chair for the steering group and the other members are Johanna Boberg, Dan Funck Jensen, Erland Liljeroth and Tomas Roslin.

CBC in media



How to attract aphid predators to your garden

Mattias Jonsson was interviewed by the daily paper Västerbottens-Kuriren about biological control and how to take advantage of it in gardens. He talked about where to find beneficial insects and arachnids and how to attract them to your garden.

Listen to the program [Så får du lusedöarna till trädgården](#) – Mattias för Västerbottens-Kuriren (in Swedish).

Both pathogens and antagonists stimulated by reduced tillage

Hanna Friberg wrote a popular science article in the trade journal Arvensis that is published by the Rural Economy and Agricultural Societies (Hushållningssällskapen).

Hanna discussed how beneficial and pathogenic fungi are influenced by the cropping system.



On the [CBC YouTube channel](#), videos on research about biological control and happenings can be found.



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



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.



We have expanded the Swedish page about Biological control and related subjects on Wikipedia. [Check out the entry "Biologisk bekämpning"](#).

A seminar series about biological control

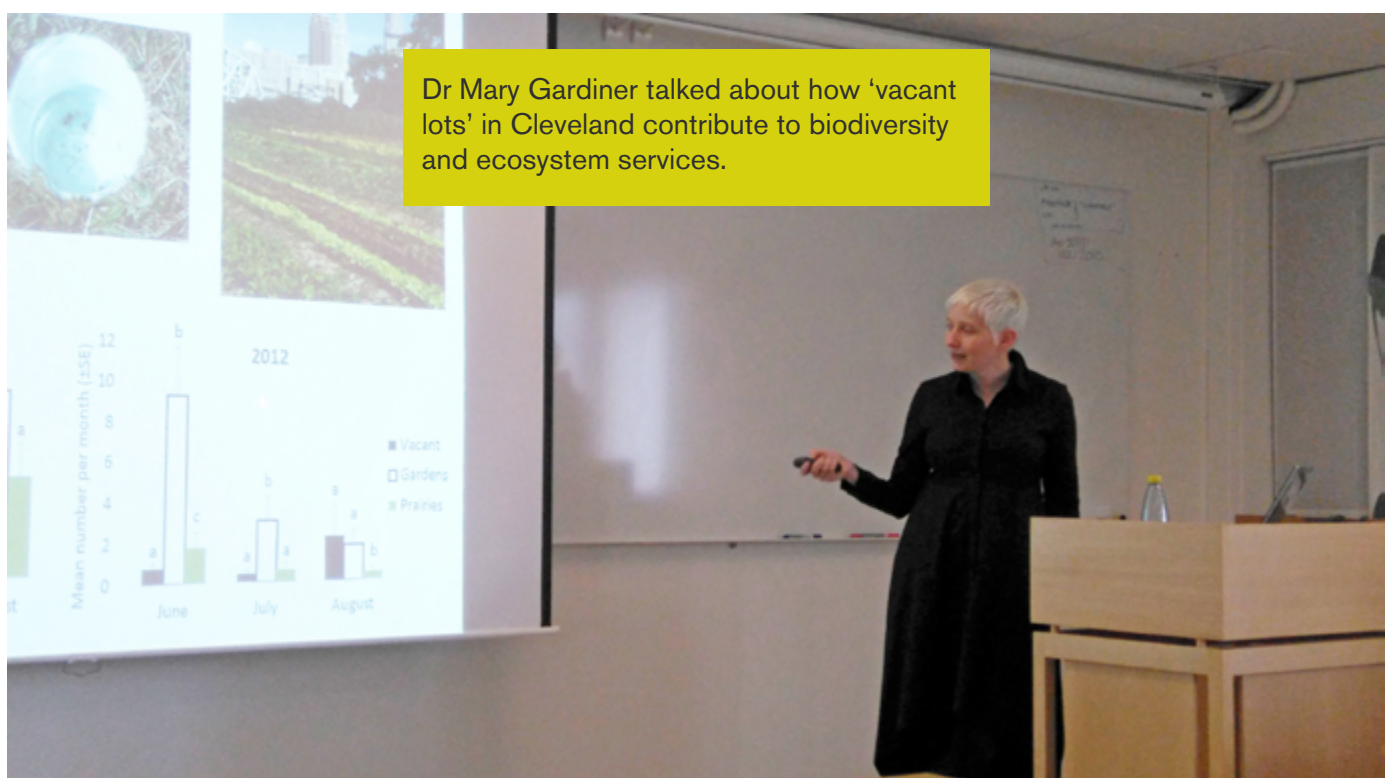
CBC arranges a seminar series on biological control with invited speakers.

The first seminar in 2016 was called ["Quantifying the Value of Urban Vacant Land for Conservation and Ecosystem Services"](#) and took place in April. The seminar was given by Dr. Mary Gardiner from Ohio State University, USA.

The second seminar, in June, was called ["Cirsium arvense - economic impact and potential biological control of a European plant in New Zealand"](#) and was held by Dr Graeme Bourdot from the research institute AgResearch in New Zealand. Dr. Bourdot talked about how naturally occurring plant pathogenic fungi and an exotic leaf-feeding

beetle can be used as biological control agents against the creeping thistle.

Dr Katja Poveda from Cornell University (USA) held the last seminar in September, ["Natural habitats improve yields: how landscape complexity can increase yield through arthropod-mediated ecosystem services"](#). Dr Poveda presented data on potato, strawberry and cabbage systems to find out if maintaining natural areas increases yield in cropping systems. In all cases, the landscape composition had an effect on arthropods that influenced crop yield.





Participation in advisory boards and expert groups

CBC participates in several expert panels. Below are two examples.

Prospective studies on future agriculture

Hanna Friberg was part of Future Agriculture working group at SLU that presented prospective studies for year 2030. [More information about SLU's prospective studies.](#)

New microorganisms recommended for the QPS list

Ingvar Sundh participated in the working group for updating the Qualified Presumption of Safety, QPS, list of comparably safe microorganisms in the food and feed chain. EFSA, the European food safety authority, is responsible for maintaining and updating the list.

Meetings and Conferences

CBC participates in meetings with the research world and the industry to maintain and establish new contacts and start collaborative projects. Here are some examples of the meetings attended this year.

A one-day meeting on mycotoxin problems in cereals was arranged by AgroVäst the 25 May in Vara, Sweden. The aim of the meeting was to discuss current problems in Swedish agriculture and present ongoing projects. Hanna Friberg presented information about the ecology of *Fusarium graminearum* (an important producer of the mycotoxin deoxynivalenol, DON) and how its ability to survive and spread is influenced by the cropping system and by organisms that are occurring naturally in soil or can be added to the system.



The XXV International Congress of Entomology was arranged 25-30 September in Orlando, Florida. Mattias Jonsson was invited to give the talk "Predicting biological control of cereal aphids across agricultural landscapes".

The 6th Congress on microbial diversity of the Amazon basin & 2nd meeting of biological collections of the Amazon took place in Brasil 22-25 November. Sebastian Håkansson gave the talk "Microbiota associated with *Anopheles darlingi* in the Amazon basin".

The 3rd Thünen Symposium on Soil Metagenomics - From gene predictions to systems ecology, was arranged in Braunschweig, Germany, 14-16 December. The aim of the conference was to discuss new developments in soil metagenomics, transcriptomics, proteomics and metabolomics, with a focus on integrative approaches and network analyses. Hanna Friberg presented a poster at the conference.

Student works on biological control



Christina Hultman and Julia Dahlqvist are investigating coffee plants for symptoms of attack by the coffee twig borer. The symptoms can be yellowing leaves or entry holes covered with whitish dust.

MFS students investigate a coffee pest in Uganda

Julia Dahlqvist, Christina Hultman and Lina Wu, all students at SLU, investigated an insect pest that heavily reduces coffee bean production. This pest is called the coffee black twig borer and bores through twigs and branches which then dry out. In addition, no coffee berries are produced. In severe cases, the entire tree can die.

– It seems that one of the best ways to prevent the spread of the coffee twig borer is to prune the infected branches and burn them to access the eggs and larvae that live there. Vi-agroforestry also promotes a more diverse coffee cultivation, namely a cultivation that would include several other trees and that may influence also the coffee twig borer, says Lina.

By growing agricultural crops with trees and shrubs, the crops are protected as they are shaded. In addition, the trees and shrubs provide soil nutrients and protect the crops from drying out and prevent erosion. Agroforestry often enhances biological control and reduces pests, but the effect is highly dependent on the type of pest. [Read more about their work here.](#)

[Lina Wu's master thesis can be downloaded here](#), [Julia Dahlqvist's here](#) and [Christina Hultman's here](#).

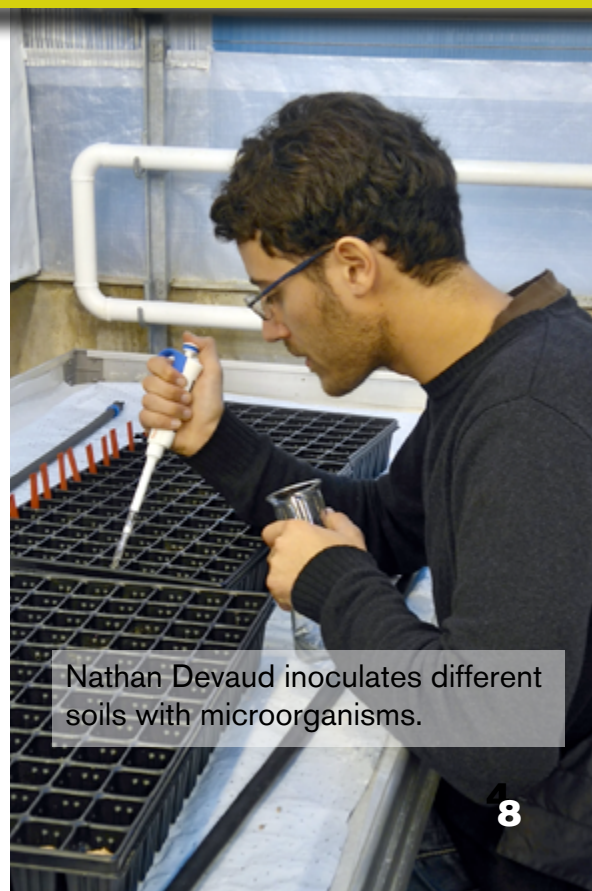
From participatory action research to freeze-drying and soil suppressiveness

Mira Rur finished her licentiate thesis called “Developing IPM tools for greenhouse cucumber production in Sweden – A participatory action research approach.” [Read the licentiate thesis here.](#)

Radoslaw Sawicki began his master thesis on impact of culture conditions on freeze-drying survival and storage stability of *Lactobacillus reuteri*. Radoslaw will present his thesis in 2017.

Nathan Devaud is from France and was doing an internship during 2016 which he started in 2015. Nathan worked with soil suppressiveness in cropping systems with intercropping within the OSCAR project ([see page 9](#)).

Eve Roubinet finished her PhD-thesis called “Food webs in agro-ecosystems Implications for biological control of insect pests”. [Read the thesis here](#) and a [popular summary in Växtskyddsnotiser here](#).



Nathan Devaud inoculates different soils with microorganisms.



The OSCAR project worked with improving conservation tillage systems. The photo is from the poster session at the final meeting.

Completed projects

Reducing the need for fertilisers and pesticides



The OSCAR project was a collaborative European research project supported by EU to develop

more sustainable systems of conservation agriculture and increase the diversity of cover crops and living mulches. OSCAR involved 20 partners from 9 European countries, Morocco, Brazil as well as the international research centre ICARDA. The projects worked with minimizing the need for soil tillage and reduce tillage intensity and the need for fertilisers, pesticides and herbicides.

[See Hanna Friberg talk about pests in agriculture - the pros and cons of with non-tilling systems](#) (in Swedish). [Read more on the OSCAR web page](#).



Plant health can be improved by combining different biological control agents.

Ecosystem services and biodiversity

The APPEAL project investigated the relationship between land use and biodiversity, the relationship between biodiversity and the ecosystem service of biological control and provided a framework for estimating the value of biological control in European agricultural landscapes. Mattias Jonsson from CBC was project coordinator. [Read more about the APPEAL project](#).



Combining biological control agents to get additive effects

The Project Consortia of biological control organisms formulated for improving plant health - a novel technology for sustainable crop, was completed. The possibilities to combine different biological control agents to increase and broaden the disease controlling effects was investigated in biocontrol of several diseases in a plant crop.

The project also put forward new ideas on how a consortia of biological control agents are compatible with existing technologies such as application with fungicides in full or reduced dosages. Margareta Hökeberg, Hanna Friberg, Sebastian Håkansson and Ingvar Sundh participated in the project.



Completed projects continued

Products which contain bacteria have been used for several years to control the flood water mosquito in periodically flooded wetlands along the river Dalälven.

Fighting mosquitoes with bacteria

The project “Studies on population ecology of the biological insecticide *Bacillus thuringiensis* subsp. *israelensis* in temporarily flooded wetlands” was led by Ingvar Sundh. Products which contain the bacterium *Bacillus thuringiensis* subsp. *israelensis* (Bti) are used all over the world to control mass occurrence of mosquito larvae. Bti has been used for a number of years to control floodwater mosquitoes in periodically flooded wetlands along the river Dalälven.

In the project, comparisons of published full genomes, including a Bti-strain contained in the product (VectoBac) that is used for mosquito larvae control, led to identification of useful regions for making new PCR-primers. The dynamics of the *Bacillus cereus* group populations in soil from both Bti treated and untreated sites were studied using the new PCR-primers.

This project is an important step towards providing new insights into the ecology of this extensively used bacterial insecticide and contributes to more effective and relevant safety assessment of microbial products. The Bti-research is now continued by Maria Belousova ([see page 3](#)).

How do diversity affect biological control?

“The importance of natural enemy diversity and food-web structure for biological control at organic and conventional farms” was a project that improved our understanding of how diversity affects biological control through a food-web approach.

Trophic interactions among multiple predators and prey were quantified under realistic conditions. Increased predator species richness was, on average, beneficial for biological control, but these effects were found to be context dependent.



Ground beetles such as *Harpalus rufipes* help to control aphids and other pests in agriculture.

Research results from CBC

CBC's research on biological control is done in collaboration with national and international universities and research institutes. Here are some examples from 2016.

Why do natural habitats sometimes fail to enhance biological pest control?

This is a question that Mattias Jonsson and colleagues wanted to answer in a new article. They put forward five different hypotheses on why natural habitats sometimes fail to enhance pest control. The conclusion was that the relative importance of natural habitat for biocontrol can vary dramatically depending on the type of crop, pest, predator, land management and landscape structure. [Read a popular science version of the article.](#)

New genus of bacteria that may be used to prevent malaria discovered

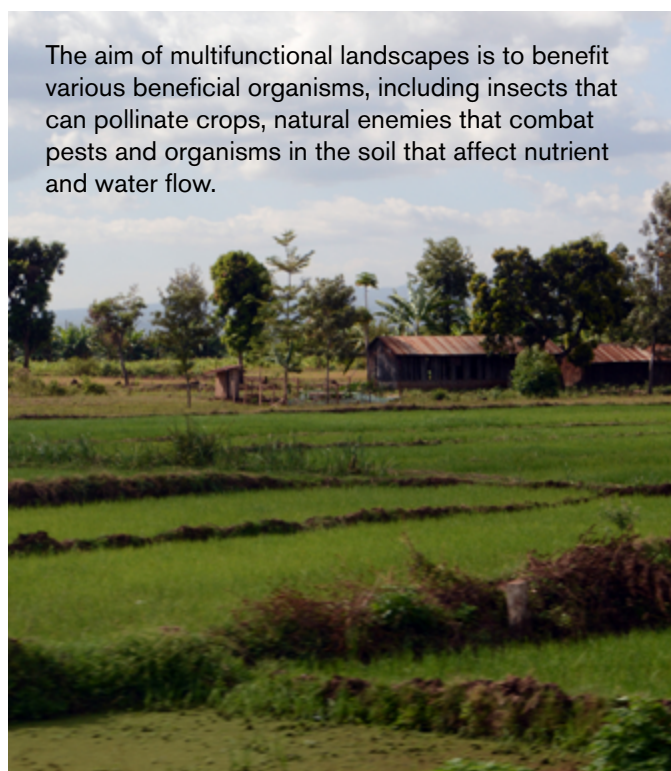
Sebastian Håkansson was one of the researchers that described a new genus of bacteria, Coetzee, from the malaria mosquito Anopheles. The new genus is related most closely to species of the genus Thorsellia, that may be used to prevent the transmission of malaria in the future.

Trees in agricultural landscapes provides valuable ecosystem services in Africa

When agriculture expands and is intensified it often results in a decline of biodiversity and ecosystem services. In order to restore important ecosystem services, multi-functional landscapes

can be used. In a new study, researchers from SLU (among them Mattias Jonsson) and Kenya has studied the role of trees in multi-functional landscapes of Africa. In general, trees in the agricultural landscape were positive, but in some cases a decline in production of particular crops was noted as a trade-off. [Read a popular science version of the article.](#)

The aim of multifunctional landscapes is to benefit various beneficial organisms, including insects that can pollinate crops, natural enemies that combat pests and organisms in the soil that affect nutrient and water flow.



Biological control and future food production

On the 16th of November, CBC, The Swedish Board of Agriculture and Partnership Alnarp arranged a theme day outside Ängelholm: "Biological control and future food production." The day was well attended with representatives from growers, various government agencies, companies, researchers and advisers.

Amanda Allvin from Skåne Food Innovation Network started the day with a talk about upcoming trends in food consumption and consumer confidence. During the day, many speakers from different companies, authorities and universities highlighted different aspects of biological control and future food production.

Mariann Wikström from Agro Plantarum talked about coming biological pesticides from the research projects BIOCOTES and MASE. Maria Björkman from the Swedish Environmental Protection Agency talked about the new Swedish system for approving nematodes, insects and arachnids as biological control agents in Sweden.

The audience was informed, by Peter Bergkvist from the Swedish Chemicals Agency, that certain substances and organisms used in crop protection can get a simplified authorization in the EU.

Researchers Peter Witzgall and Velemir Ninkovic, both from SLU, talked about their research on insect communication and why certain cultivar mixtures work better than others.

Per Wessman from Rise (previously SP), explained how formulation of a microorganism can be tricky, and how to get the microbial control agent to function when it is delivered to the intended location.

Margareta Hökeberg from CBC talked about the BCA consortia project with three years of field trials where they found that

spraying with a mixture of microbes gave better control effects than the microbes separately.

Towards the end of the day Katarina Holstmark and Johanna Jansson, both from the Swedish Board of Agriculture, talked of biological crop protection today and in the future. The theme day ended with a panel discussion, led by Anna Lehrman from SLU, with representatives from all invited groups.

[More information about the day can be found here \(in Swedish\).](#)

