



Highlights of 2019

SLU Centre for Biological Control, CBC

A popular science report on activities during 2019

CONTENTS

Words from the director	3
About CBC	3
Research from CBC	4
Upcoming projects	6
Collaboration and outreach activities	7
Our communication channels	8
CBC in the media	8
Our seminar series	9
Conferences and meetings	10
Scientific advice	11
Visiting scientists, students and new coworkers	12
Happenings at CBC	13
Writeshop and team meeting	14
CBC financed projects and teaching	15

Cover photo: An experiment outside Uppsala where the abundance of natural enemies in barley fields were investigated. Photo by Cajsa Lithell.

Layout: Cajsa Lithell

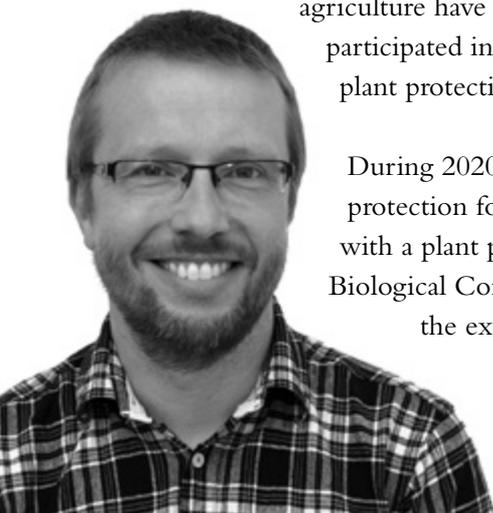
WORDS FROM THE DIRECTOR

Another exciting year with SLU Centre for Biological Control has passed and a new equally exciting one has just begun. In times when the chemical pesticide toolbox in crop protection is shrinking and the sustainability of our current agricultural production is being questioned the role of biological control is bound to increase. Within SLU Centre for Biological Control we are well placed to have a key role in this transition, since our research aims to both understand when, where and how we can best support natural enemies and antagonists of pests, and when, where and how further biological control agents can be applied in a safe and effective way. You are welcome to read more about some of the achievements and activities of the centre during 2019 in this report.

During the past year our research has for example contributed to show that a high diversity of natural enemies is critical for effective biological control across agroecosystems globally, that the fungus *Clonostachys rosea* can be used to control plant-parasitic nematodes and how EU-regulations can be modified to encourage the use of microorganisms in biological control. A manifestation of the excellent research conducted at the centre is that Paul Becher and colleagues received the IG Nobel prize for their finding that we can sense the smell if one banana fly has been in a glass of wine. A key role for the centre is to support biological control related activities at SLU. During the year we have therefore granted funding to four pilot projects and have organized a workshop for SLU researchers to update the definition of biological control. SLU Centre for Biological Control has also engaged with stakeholders in many different ways during 2019. For example the spread of the invasive pest *Drosophila suzukii* has been monitored with help of hobby growers, representatives from the Swedish board of agriculture have been taught how to identify nematodes and researchers from the centre have participated in several focus groups with stakeholders to discuss burning topics within the area of plant protection.

During 2020 it is the International Year of Plant Health. The aim is to raise awareness about plant protection for sustainable development and SLU will organize and participate in many activities with a plant protection focus during the year. Please keep an extra eye out for SLU Centre for Biological Control and come and have a chat with us. We look forward to meet you and talk about the exciting world of Biological Control!

Mattias Jonsson
Director of SLU Centre for Biological Control

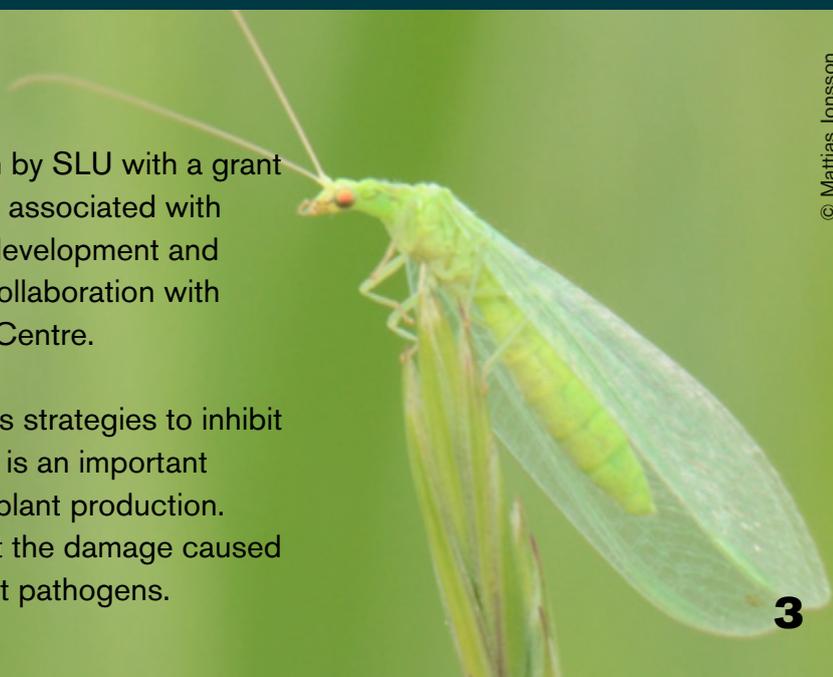


www.slu.se/cbc

ABOUT CBC

The Centre for Biological Control (CBC) is run by SLU with a grant from the Swedish government. Six 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.

Biological control is a collective term for various strategies to inhibit pests and diseases using 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.



RESEARCH FROM CBC

A few examples of research that CBC produced during 2019.



Biodiversity provides higher crop yields

A high diversity of different natural enemies and pollinators in an agricultural landscape leads to a greater harvest. This is shown in an extensive international study where researchers from SLU participated. “Our study shows that biodiversity is essential to ensure the provision of ecosystem services and to maintain a high and stable agricultural production”, says Mattias Jonsson.

[Read more here.](#)



Assessments of potential toxin production of biological control agents are unnecessary harsh in the EU

The introduction of microbial control agents onto the European market for practical use in pest and disease control is a very slow and costly process. This is partly due to unnecessarily strict regulations since metabolites from microorganisms have been assessed in the same way as metabolites from synthetic sources. In a new article, Ingvar Sundh and colleagues give recommendations for new risk assessments in the EU that will benefit all stakeholders. [Read more here.](#)



Growing strawberries with environmentally sustainable strategies

Strawberry growers rely heavily on pesticides. Without pesticides, the flowers are damaged by insects, and yields are reduced. In her doctoral thesis, Johan Stenberg’s student Daniela Weber investigated alternative, environmentally sustainable strategies for strawberry cultivation. “We need a very good understanding of the interactions between crop plants, pests, and mutualists such as pollinators and natural enemies in order to design optimal IPM strategies”, says Daniela. [Read more here.](#)

MORE RESEARCH



Bark beetles that threatens Norway spruce may be defeated with natural enemies

The bark beetle, *Ips typographus*, is a severe insect pest on Norway spruce that reduces timber quality. Harvesting infected timber is a method that is used to get rid of the pest, but this method has problems as the bark beetles may already have moved on to new trees or to soil where most of the bark beetle adults overwinter. Therefore, Maria Sousa together with Göran Birgersson, Kristina Karlsson Green and Paul Becher are investigating if natural enemies can be used as biological control agents against the bark beetle.

[Read more here.](#)



DNA-methods reveal the web of life

Modern DNA-based methods provide entirely new insight into the interactions among different species in nature. Researchers can finally reveal the details of who is eating whom, who pollinates what flower and who lives on whose skin or feathers. A special issue of the scientific top journal *Molecular Ecology* now provides an overview of the state of the art in this field. “For those of us who deal with insect pests on crops, DNA methods are among the best thing that ever happened. The methods help us identify which predators keep insect pests in check.”, says Mattias Jonsson. [Read more here.](#)



Biological control of nematodes with the fungus *Clonostachys rosea*

Plant diseases caused by plant-parasitic nematodes are serious constraints to sustainable crop production due to high yield losses, the persistent nature of these nematodes and a lack of efficient control methods. Biological control is a promising approach to reduce plant diseases caused by nematodes. In his doctoral thesis, Mudassir Iqbal investigated the effect of the fungus *Clonostachys rosea* on nematode populations in nematode-infested soil planted with wheat. The study demonstrates that *Clonostachys rosea* can control plant-parasitic nematodes and improve the growth of plants at the same time. [Read the thesis here.](#)

[See more of CBC's research during 2019 here.](#)

UPCOMING PROJECTS

During 2019, CBC has acquired quite a few research grants. Read about our upcoming research projects here.

How worried should we be for the insects?

The number of insects has decreased in a worrying way in several parts of the world. In the media it has been called an “Ecological Armageddon”. But how serious is it really? Unfortunately, due to lack of data this cannot be answered. But in a new project, Mattias Jonsson and other researchers at SLU will analyze data from a 30-year collection of monitoring samples. The aim is to demonstrate any trends in insect populations in recent decades. One key question of relevance for biological control is whether predatory insects have declined more than herbivores. [Read more here \(in Swedish\)](#).



How do flower strips support ecosystem services above and below ground?

Growing flowers to support beneficial insects that consume pests is a sustainable way of utilizing natural processes in agriculture. So far, the adoption of this method has been limited, but Maria Viketoft with colleagues hope to change that. Maria has received close to three million SEK from Formas to investigate how different species of flowering plants affect beneficial and pestiferous organisms above and below ground and how they should be combined to maximize ecological and economic benefits. [Read more here](#).

What is the significance of climate and biodiversity for Kenyan harvests?

In East Africa, maize is the staple food number one, but the harvests are often poor due to major problems with pests, pathogens, weeds and poor soil fertility. However, there are good opportunities to increase returns. In a new project led by Mattias Jonsson, researchers in Sweden, Kenya and USA will study the importance of climate and biodiversity for today's and future pest control and harvests. The measures are based on the push-pull method that is already used today and which in some cases can more than double the yield of the maize. [Read more here](#).

Biological control in strawberry using a combination of insect and fungal agents

Heritable strawberry traits affect the performance and biocontrol potential of insect parasitoids. During spring 2020 Johan Stenberg will recruit a new postdoctoral researcher who will investigate if the same or different plant traits affect the establishment, growth and biocontrol potential of fungal biocontrol agents, incl. *Aureobasidium pullulans*. The project is funded by Formas and has implications for combinatory biological control within programs for integrated pest management.

COLLABORATION AND OUTREACH ACTIVITIES



2020 – The International Year of Plant Health

In December, the United Nations International Year of Plant Health 2020 (IYPH 2020) were kicked-off at SLU. This was the first event of many to come in order to raise global awareness on how protecting plant health can help end hunger, reduce poverty, protect the environment, and boost economic development. CBC is looking forward to using this platform during 2020 to communicate the importance of biological control. [Read more about the kick-off here.](#)

Spread of the invasive pest *Drosophila suzukii* is monitored with help of hobby growers

The fruit fly *Drosophila suzukii* that is a major pest on soft summer fruits such as blueberries and raspberries is spreading in Sweden. But how far has it spread? In a citizen science project, Paul Becher together with Isabella Kleman have investigated this question. In 2018, traps were distributed to hobby growers and the fly was found as far up as Stockholm. In 2019, a new project started to see if *Drosophila suzukii* has spread even further north. [Read more here.](#)



The Swedish Board of Agriculture learned about nematodes at SLU

At the end of April, Maria Viketoft held a training course on nematodes for four participants from the Swedish Board of Agriculture's Plant Protection Centers. "An excellent education that suited us perfectly!" says Lina Norrlund from the Advisory Unit North. [Read more here.](#)



SLU Centre for Chemical Pesticides (CKB) learned about biological pest control

In order to raise the awareness level about biological control at SLU's Centre for Chemical Pesticides (CKB) and its reference group, CKB invited Ingvar Sundh to their reference group meeting in April 2020. The title of Ingvar's talk was 'How do biological control contribute to a sustainable plant protection?'

CBC IN THE MEDIA



The law of the jungle prevails in the field

The interactions between different soil animals are complex. By reducing tilling and instead use direct seeding, soil communities may be less disrupted.

This is shown in a sampling of a long-term tillage trial on Ultuna's clay soils. Maria

Viketoft was interviewed about this trial in the trade journal *Lantmannen*. Preliminary results show that it is mainly large species, such as earthworms, that make vertical walkways up to the surface that are severely affected by tillage. [Read more here \(in Swedish\)](#).

How serious is the situation for our insects?

Mattias Jonsson was interviewed in the Swedish radio program *Vetenskapsradion*, about the newly financed project where data will be analyzed from 30 years of monitoring samples. "We hope to begin by answering if there have been any changes in the biomass of insects in Sweden. And then if there are some groups of insects that have changed more than others.", says Mattias. [Listen to the program \(in Swedish\) here](#).

IgNobel Prize winners gave lectures in Stockholm

The SLU professor Peter Witzgall has, together with CBC researcher Paul Becher and other colleagues, shown that we can sense the smell if one banana fly has been in a glass of wine and was therefore one of the winners of 2018 year's IgNobel Prize. In April 2019, Peter and Paul gave lectures at Karolinska Institutet and Stockholm University, respectively about their findings. The IgNobel Prize awards scientific research that "first make people laugh, and then make them think". [Read more about the lecture here](#).

OUR COMMUNICATION CHANNELS



www.slu.se/cbc



facebook.com/centreforbiologicalcontrol



twitter.com/CBC_SLU

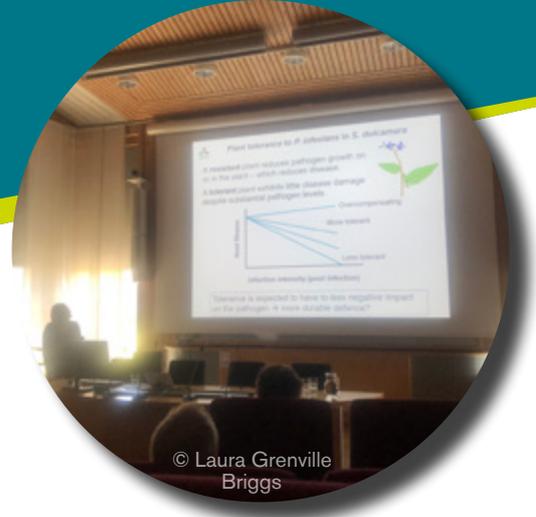


CBC - Kompetenscentrum för biologisk bekämpning



Our web page is our main communication channel, but we also use Facebook and Twitter to communicate with the public, stakeholders and other researchers. Our tweets have in some cases reached an audience of more than 5100 people. The most successful Facebook post reached 2100 people in 2019. In addition, we have a YouTube channel where we publish short movies on our activities.

OUR SEMINAR SERIES



CBC arranges a seminar series on biological control at SLU with invited speakers. These were our seminars during 2019.

Fighting biotic stresses with biological control in Sub-Saharan Africa

Georg Goergen from IITA in Benin gave an overview of past, present, and future activities of IITA. IITA is an award-winning, research-for-development (R4D) organization, providing solutions to hunger, poverty, and the degradation of natural resources in Africa. The main focus of the talk was the development and deployment of biological control and biopesticide solutions to fight biotic stresses to agriculture in Sub-Saharan Africa.

CBC Symposium on Plant Resistance Ecology

CBC arranged a half-day symposium in Alnarp that also could be followed on video-link. The symposium was divided into three sessions and keynote speakers were Paul Ode from Colorado State University in USA, Betty Benrey from the The University of Neuchâtel in Switzerland and Anke Steppuhn from the Free University of Berlin in Germany. [Read more about the symposium here.](#)

The use of drones in pest control

Annie Enkegaard from Aarhus University in Denmark talked about how drones can be used in biological pest control. Annie's work focus on biological and integrated control of arthropod pests in greenhouses and outdoor crops. Drones provide an interesting addition to controlling pests on outdoor crops.

Compounds from bacteria can be used to control plant diseases

Professor Monica Höfte from Ghent University in Belgium gave a talk on cyclic lipopeptides produced by different species of *Pseudomonas* bacteria. Cyclic lipopeptides are an untapped reservoir for compounds that may be used to control plant diseases by direct antagonism and induced resistance.



CONFERENCES AND MEETINGS



Modelling natural pest control – the subject of a half-day seminar in Lund

Mattias Jonsson was one of the speakers at the seminar and talked about redundancy and climate resilience of aphid biological control in Swedish barley crops. The seminar was arranged within the network BECC, Biodiversity and Ecosystem services in a Changing Climate. [Read more about the seminar here.](#)

Insects, Plants and the smell of Microbes

Paul Becher was invited to give the keynote lecture on plant–insect interactions at the Entomology Congress (German Society for General and Applied Entomology, DGaE) in Halle, Germany. Paul talked about microbial volatiles and their effects on insects and plants.

Meeting in Portugal on using ecosystem services to optimize crop protection and production

The EU project EcoStack had its first annual meeting in October at the University of Coimbra in Portugal. EcoStack ([read more about EcoStack here](#)) is an EU-project with a budget of 10 million Euros that will span five years. The project started at the end of 2018 and SLU is one of 24 partners. Ingvar Sundh from CBC participated. “During the meeting we had a consultation meeting with stakeholders that provided very good input”, says Ingvar Sundh. [Read ore about the meeting here.](#)

The participants in EcoStack’s first annual meeting in Portugal.



Photo frp, @EcoStackH2020 on Twitter

SCIENTIFIC ADVICE

CBC regularly communicates on scientific issues and queries with Swedish and international authorities, industry and organisations.

Fact checking publications from the Swedish Board of Agriculture

During 2019 Maria Viketoft has fact-reviewed two publications from the Swedish Board of Agriculture. The first is about the great importance of earthworms for soil structure and for nutrient cycling. [Read more here \(in Swedish\)](#). The second publication is about biodiversity in the soil and about measures to preserve and strengthen biological life belowground. [Read more here \(in Swedish\)](#).

Focus groups at SLU

The Platform Plant Protection at SLU had five focus groups with the aim of improving collaboration between researchers and stakeholders between the years 2017 and 2019. The focus groups included farmers, foresters and other practitioners, advisers, representatives from businesses, governmental and non-governmental organisations, and researchers from different areas and faculties of SLU. CBC researchers have participated in all five focus groups Plant protection in (potato and other) root and tuber crops ([read a report on this subject in Swedish here](#)), Oilseed rape and other break crops as a strategic focus ([read a report in Swedish here](#)), Plant protection in cereal crops, Integrated use of low risk compounds in plant protection and Diagnosis, monitoring and risk management.

EFSA's QPS list of comparatively safe microorganisms

As member of EFSA's (European Food Safety Authority) work group for QPS (Qualified Presumption of Safety) of microorganisms, CBC researcher Ingvar Sundh contributed to the 2017-2019 update of the QPS-list. The list includes microbial species which are considered comparatively safe for use in the food and feed chain including crop protection and the update will be published in early 2020.

Supporting the EU Commission

Ingvar Sundh of CBC participates in the Commission's expert group for 'Biopesticides', contributing to new guidelines for low-risk microbial plant protection agents. Another important ongoing task of the expert group is the drafting of new data requirements for microorganisms, which will replace the current 20 years old and outdated requirements.

VISITING SCIENTISTS, STUDENTS AND NEW COWORKERS



© Cajsa Lithell

Using a traditional medicinal fungus for biocontrol of tomato diseases

Muhammad Asif visited CBC during six months in 2019. In order to reduce the use of chemical pesticides in perishable crops such as tomatoes, he aims to utilize proteins from the fungus *Ganoderma lucidum*. “I am hoping to reduce the use of chemical pesticides and to replace chemical fungicides with biopesticides. Antifungal proteins may help to lessen chemical pollution. An additional advantage is that this will reduce the hazardous effect of chemicals on human health as proteins are eco-friendly and easily degradable”, says Asif.

[Read more here.](#)



© Cajsa Lithell

Biological control of tomato pests in Benin and Tanzania

Growing tomatoes is not easy, there are many pests that may attack the plants, including various moth species. One example is the tomato leafminer, *Tuta absoluta*, which is an invasive pest in many countries in Africa. In a new project, the researcher Miriam Karlsson will investigate which natural enemies these moths have. The aim is to fight the leafminer using natural enemies.

[Read more here.](#)



© Cajsa Lithell

Winter survival of predatory mites that are used against pests is examined

In greenhouses and in open-air crops, predatory mites are often used against thrips, dark-winged fungus gnats, and mites that damage the crops. But what happens if predatory mites, who are not native to Sweden, succeed in establishing themselves here? Agronomy student Clara Kjellström investigated whether imported predators can survive the Swedish winter. This was a bachelor thesis in collaboration with the Swedish Environmental Protection Agency.

[Read an interview with Clara here.](#) [Clara's finished thesis can be read here.](#)



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Cultivar mixing for improved biocontrol of aphids

Nimra Musaqaf from the University of Copenhagen stayed at SLU during 2019 to carry out a field experiment with Johan Stenberg concerning effects of cultivar mixing of strawberries on biocontrol of aphids. 60 strawberry plantations with different degrees of cultivar mixing were monitored throughout the field season. The work will produce general knowledge about effects of botanical diversity for aphids and their parasitoids and will underpin recommendations to strawberry growers.

Endophytic insect pathogens

Rasmus Emil Jensen from the Danish Aarhus University was spending four months in 2019 at SLU Alnarp to work together with Paul Becher on multi-trophic interactions between endophytic insect pathogenic fungi, plant hosts, herbivorous pests and natural enemies. A main goal of the project is to evaluate the impact of endophytic *Beauveria* on volatile production by Faba beans, with potential consequences for the aphid *Aphis fabae* and their natural enemy *Aphidius colemani*.



© Rasmus Emil Jensen

HAPPENINGS AT CBC



CBC's new Director

Mattias Jonsson is the new Director of CBC since the beginning of 2019. He took over after Ingvar Sundh. Mattias has been part of CBC since its foundation in 2011. His main research area is biodiversity and conservation biological control with insects and arachnids. [Read more here.](#)

Professor inauguration lecture and interviews

In November 2018, Johan Stenberg became a Professor in integrated plant protection. On the 10th of May 2019 Johan gave his inauguration lecture with the title: "A bouquet of wild plant protection measures for future growers". [Read more about the inauguration lecture and see a film with Johan Stenberg here.](#) Johan was interviewed in SLU's staff magazine Resurs about strawberries. [Read the interview \(In Swedish\) here.](#)

The people at CBC



Mattias Jonsson (Director) – specialised in insects and arachnids for biocontrol. Mainly focused on conservation biological control of invertebrate pests in agroecosystems.

Johan Stenberg (Deputy director) – works with integrated plant protection for strawberry, and other horticultural crops. One important part is to optimize the biological control of harmful pests without weakening the crop's intrinsic resistance.

Ingvar Sundh – works with issues related to safety and regulatory measures. Focuses on strategies to determine that a biocontrol agent has no unacceptable adverse effects in humans or non-target organisms in the environment.

Paul Becher – interested in chemically mediated interactions between organisms like host finding and sexual communication. Aims to understand the importance of microbial signals on plant-insect interactions.

Magnus Karlsson – interested in microorganisms and their interactions with other microbes, with plants and with the environment. Investigates fungal interactions in relation to plant pathology and biological disease control.

Maria Viketoft – works with nematode ecology, in particular how these worms interact with plants (both crops and wild plant species) and other soil organisms.

Cajsa Lithell – Communicator responsible for CBC:s web, social media and printing material.

WRITESHOP AND TEAM MEETING



Writeshop: “When is it biological control?”

CBC arranged a writeshop in November on the subject “When is it biological control?” at Sunnersta Herrgård. Biological control is the use of living organisms to control pests and pathogens. However, because new biological, or semi-biological, control approaches are emerging at a fast pace, there is a need to clarify the terminology that surrounds the concept. SLU researchers within the area participated in this writeshop and now a publication is prepared as a result. [Read more about our writeshop here.](#)



CBC’s annual team meeting

In February 2019, a team meeting was held with CBC researchers as well as associated researchers at Sunnersta Herrgård outside Uppsala. “It was really good to get to know everyone a bit better. As a researcher in Uppsala it was really useful for me to be able to discuss with researchers from Alnarp. I think we will continue on with some of the research ideas we came up with during the meeting”, says Magnus Karlsson.

CBC FINANCED PROJECTS AND TEACHING



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CBC financed projects

During 2019 CBC supported pilot projects and literature studies at SLU on biological control. The supported projects are led by Mukesh Dubey, Sara Emery, Teun Dekker and Ramesh Vetukuri. During the autumn 2020 CBC will report the outcomes of these projects.



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Teaching

CBC give lectures on biological control, IPM and plant protection at different basic and advanced courses at SLU. In addition, we supervise candidate and master thesis work.

This year, Paul Becher was lecturing at the post-graduate course in Insect Chemical Ecology at ICIPE Nairobi, in Kenya and Mattias Jonsson was involved in a teacher student exchange in Embu, Kenya.