



Sveriges lantbruksuniversitet
Swedish University of Agricultural Sciences

Centre for Biological Control (CBC)

A close-up photograph of a field of wheat, showing several stalks with golden-brown heads and long, thin awns. The background is a soft-focus field of similar wheat, creating a sense of depth. The lighting is warm, suggesting late afternoon or early morning.

HIGHLIGHTS OF 2018

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Words from the director

This report presents some of the highlights of the activities at CBC, the SLU Centre for Biological Control, during 2018. I hope you enjoy reading it!

There is currently a big societal and public interest in new biological control approaches to combat pests and diseases. One driving factor is the implementation of IPM (Integrated Pest Management), where non-chemical control approaches and methods should take precedence, when available. I feel that CBC's output of strong science within new biological control organisms and methods not only helps to advance the research field, but also helps to fulfil societal goals related to the use of pesticides. Additionally, the many information and communication activities of CBC contribute to better public awareness in the area and to more informed, scientifically based, decisions of authorities.

On 1st of July, the researcher group of CBC was partly changed. Hanna Friberg, Sebastian Håkansson and Margareta Hökeberg left the centre. The new researcher group from July 2018 to June 2021 consists of Paul Becher, Mattias Jonsson, Magnus Karlsson, Johan Stenberg, Ingvar Sundh and Maria Viketoft.

Other important news is that from January 2019, Mattias Jonsson is the new director of CBC. This is therefore my first, but also last, "words from the director". Taking over as director from Margareta Hökeberg, who retired in 2018, during a period of transformation of CBC has for me been both inspiring and sometimes challenging. However, I very much look forward to contribute to the CBC mission of promoting biological control for another three years together with old and new colleagues in CBC's brilliant activity group. I consider it a true privilege.

Ingvar Sundh,
Director of CBC



www.slu.se/cbc

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 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. 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.

New knowledge on the mechanisms behind biological control with a mycoparasitic fungus

The fungus *Clonostachys rosea* has great potential as a biocontrol agent against several fungal diseases, especially in agricultural production systems. A new study from CBC researcher Magnus Karlsson and colleagues reveals new information on the mechanisms behind the biocontrol. Two previously unknown compounds involved in the control effect have been characterized. [Read more about the study here.](#)

More predators in food webs weakens predictive ability of single-trait models

Researchers from SLU have shown how an increasing number of predator species weakens the ability of a single-trait food web model to predict experimentally observed outcomes of trophic interactions. This new information will be important when developing food web models that can be used to predict the strength of biological control. “The findings in this study encourage the development of dynamical food web models explicitly including and exploring such indirect mechanisms, so that how the abundances of species in real ecosystems change over time can be better predicted” says Mattias Jonsson. [Read more here.](#)

Complex ecosystems provide better pest control with natural enemies

A more complex ecosystem is usually inhabited by a more diverse set of species. In a new study, it was found that complex ecosystems can induce rapid behavioural responses even before changes in diversity is evident. This can potentially promote the stability of ecosystem functions. “Our results have implications for agriculture, where increasing habitat heterogeneity could be used to make pest control more reliable by allowing a greater number of predator species to contribute to this service. Habitat heterogeneity induces rapid changes in the feeding behaviour of generalist arthropod predators”, says Mattias Jonsson. [Read more here.](#)



CBC funded pilot projects

CBC supported three research projects in biological control at SLU, either to test new ideas in a pilot project, or to finance a scientific literature review. The results of these projects have now been reported.

Combinatory IPM in Swedish potato production

Potato is a crop with many serious diseases, for example potato blight, that require extensive and repeated treatments with pesticides in Swedish potato production. To find alternative pest management regimes, Dr Åsa Lankinen has worked in a pilot project on potato with combinations of biological control agents and an inducing agent. A bacterial agent and an oomycete as well as an inducing agent called BABA was tested. A trend was that the combination of BABA and the bacterium had a reducing effect on development of potato blight, particularly evident for the number of sporangia in the lesion. [Read more here.](#)

Biological control of a seed-borne disease on red onion in Vietnam

Professor Dan Funck Jensen received a grant from CBC to lead a pilot project on biological control of seed-borne diseases in vegetables. The aim of the project was to establish a research collaboration between SLU and Can Tho University around biological control of seed-borne diseases in vegetables, especially in the Mekong delta. The project aimed to reduce pesticide use and form the basis for future research collaboration in the area. Significant biocontrol was demonstrated, in some cases the biological control was even better than the chemical control, but the results differed between the two experimental locations. [Read more here.](#)

Past, present and future on plant-herbivore-enemy interactions

The success and development of existing and novel biocontrol strategies is dependent on a detailed understanding of plant-herbivore-enemy interactions (tri-trophic interactions, TTIs). New technologies are increasingly improving our mechanistic and ecological understanding of TTIs, thus generating unprecedented opportunities for innovative pest management. Dr. Adriana Puentes wrote a synthesis along with 11 other world-leading researchers. Their review encompasses not only a historical overview, but also a unifying conceptual framework describing dynamics occurring below/aboveground, ranging from genes/individuals to a landscape/ecosystem scale. The authors propose a conceptual merger, where our knowledge on the mechanisms of focal species interactions is integrated to food web dynamics and ecosystem processes. Research on TTIs at multiple spatial scales will enable us to link multi-trophic interactions with broader-scale dynamics, which will be essential for developing effective biocontrol in changing landscapes.



New research funding



EcoStack – new EU project will combine ecosystem services for optimized crop production

EcoStack is a new EU-project with a budget of 10 million Euros that will span five years. The project started in September 2018 and SLU is one of 24 partners. The aim of the project is to use ecosystem services to optimize crop protection and production. CBC is represented in the project by Ingvar Sundh, Margareta Hökeberg and Hanna Friberg. [Read more here.](#)



Formas grant for research on resistant strawberry cultivation and biological control of plant diseases

Johan Stenberg received nearly three million SEK from FORMAS for a new research project dealing with effects of strawberry frost tolerance on biocontrol. Mukesh Dubey did also get a grant from FORMAS, nearly three million SEK for research on biological control of plant diseases together with Magnus Karlsson.



Fighting corky root rot in ecological tomatoes

Hanna Friberg received a scholarship from the foundation Flory Gates to fight corky root rot in ecological tomato cultivations. [Read more here \(in Swedish\).](#)



Climate resilience of push-pull management in maize and the tomato leaf miner

Mattias Jonsson received over five million SEK from the Swedish Research Council for a new research project that, among other things, investigates if natural enemies can contribute to climate resilient management of stemborer pests on Maize in East Africa.

Miriam Karlsson, a researcher that will work with Mattias Jonsson, also received over eight million SEK from Swedish Research Council and Formas to investigate if native natural enemies can be used to control the invasive tomato leaf miner in Africa.

Teaching

CBC has developed a half-day teaching module on biological control for basic level university courses. It includes introductory lectures and a group exercise with case studies representing augmentation, conservation and classical biological control. During 2018, the module was included in SLU courses in i) Crop Production and ii) Plant Pests in Agriculture. CBC also developed a brand-new plant protection block that included biocontrol and two SLU courses dealing with management of parks and uncultivated green areas. Moreover, CBC participated in developing the education in plant protection within the new MSc program in Horticultural Science at Alnarp. CBC also taught biological control at PhD courses, for example Plant protection biology in Alnarp and Future Plant Protection in Uppsala.



CBC at SciFest

SciFest is a science festival arranged by Uppsala University. Researchers, teachers and students from Uppsala University and SLU come together with exhibitors such as high schools and companies, to provide a three-day educational experience including interactive demonstrations, hands-on activities, scientific shows, and engaging scientific lectures. CBC was represented in SLU Future Food's stand and our theme was "villains and heroes in the fields". We demonstrated how crops can be protected from harmful organisms using live heroes (ladybugs) and villains (aphids) to interested school kids. Our very big natural enemy, Bob the Spider, scared many kids but as consolation they could bring a biological control mandala with them home for colouring. [Read more about SLU's participation at SciFest here.](#)



Ig Nobel prize for research on vinegar flies



Paul Becher and colleagues received the 2018 Ig Nobel prize in biology for their research on vinegar flies. The prize-winning research was a side study to a larger project that for the first time showed that female flies produce a species specific sexual pheromone that attracts flying flies at a distance. During this work, the researchers discovered that they themselves could distinguish between odours from males and female flies. A few nanograms of female pheromone was sufficient for a sensory panel to distinguish male and female flies, and a single female fly ending up in a glass of fine wine will ruin the taste. Only female flies carries this pheromone, not the males.

Since 1991, the Ig Nobel Prizes have been awarded to “honour achievements that first make people laugh, and then make them think.” In this respect the work provides a proof of principle for the existence of long-range active pheromones in *Drosophila* flies, which has potential for application in pest control. [Read more here.](#)

SLU and biological control from 2012 to 2018

CBC was started at SLU at the end of 2011. In 2018, CBC's operational group of researchers was partly changed and we took the opportunity to look back at what happened with biological control research at SLU and in Swedish society during that period. [Watch the movie here \(in Swedish\).](#)



CBC in the media

Assessing diversity on arable land

Four years ago, SLU presented a proposal for environmental monitoring of biodiversity in arable land on behalf of the Swedish Board of Agriculture. The method will be tested in a new pilot project at SLU. The journal "Miljötrender" wrote about when Maria Viketoft, Hanna Friberg and Mattias Jonsson taught three field assistants how to do an inventory of earthworms, nematodes, weeds, fungi and insects in arable fields. [Read more here \(in Swedish\)](#).

What is biological control?

Hanna Friberg explained in the journal "Allers Trädgård" how pathogens and weeds in gardens can be fought without toxic substances. "There are major advances in research and development of biological plant protection. Large manufacturers of chemical control agents now start switching to biological agents. Several companies have set aside one third of their development budgets for biological agents" says Hanna. [Read the article \(in Swedish\)](#).



Social media

CBC main social media channels have been Twitter and Facebook. Our tweets have in some cases reached an audience of more than 2500 people. The Facebook posts reached up to 350 followers.

[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.

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

CBC's seminar series on biological control



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



Investigating landscape configuration effects on natural enemies, pests, pollinators and their functions: pathways for ecosystem service prediction

This seminar was held by Dr. Emily Poppenborg Martin from University of Würzburg in Germany on the 2nd of February. Managing agricultural landscapes to improve ecosystem service provision to crops is a key feature of the ecological intensification of agriculture. Using a synthesis of data from 58 studies and 1960 sites across Europe, Emily examined the effect of changing landscape configuration on arthropod densities, pest control, pollination and yields. Fine-grained landscapes with high ecotone density impacted pollinators and enemies positively, pests negatively, and improved pest control and pollination.



Half-day seminar on biological control

CBC presented its new operations group this autumn, with a half-day seminar on biological control in Alnarp 4 October. CBC researchers presented their ongoing and future research. [Read more about the seminar here.](#)



Fungal interactions in the farming system can be utilized for healthier plants

Hanna Friberg held her docent lecture on the 7th of March. Her topic was how fungal interactions in arable fields can be used for healthier plants. She also presented her research on preceding crops and soil microflora. [Read more about the seminar here \(in Swedish\).](#)

Conferences and meetings

Biological control in crop protection: present challenges and future prospects

CBC arranged a half day symposium on the 23rd of May in honour of CBC's previous Director, Dr Margareta Hökeberg, who retired after a long and successful career as an internationally recognized expert in the use of bacteria in biological control. The invited speakers were international and represented both the academy and the corporate world. [Read more about the symposium and the talks here.](#)



Biological control at the National Plant Protection Conference

The National Plant Protection Conference was organized by SLU (with participation by CBC) and the Swedish Board of Agriculture and gathered researchers, organizations, authorities, companies and other stakeholders to exchange experiences, discuss current research and solutions for Swedish agriculture, forestry and horticulture. CBC organized a specific session on biological control. The speakers gave talks on biological control of nematodes and applying biological control agents to the correct plant parts. CBC researchers Hanna Friberg gave a talk on biological control of corky root disease in tomatoes and Paul Becher gave a talk on the invasive fruit fly *Drosophila suzukii* that harms fruit and berry cultivations in Sweden. Maria Viketoft gave a talk in a session on IPM in agriculture about how specific interactions between earthworms, mycorrhiza and nematodes can contribute to sustainable agriculture. [Read more here \(in Swedish\).](#)



Analysing genomes for efficient plant protection

Understanding the genetics of microorganisms, such as fungi, is important to gain a better understanding of the mechanisms that provide effective plant protection. Magnus Karlsson and a colleague arranged a session on this topic at the International mycological congress in Puerto Rico. [Read more here.](#)

Developments within safety assessment and regulatory policies

Regulatory developments can facilitate the implementation of biological control organisms and products in practice. Ingvar Sundh was invited speaker at "International Fresenius Biocontrol Conference: Biopesticides – Biofertilisers – Biostimulants" in Mainz, Germany. [Read more here.](#)

Scientific advice



Karolina Skog and Hanna Friberg at Nordic Gardens

Use of chemical plant protection products in home gardens?

The government will propose a ban on the private use of chemical plant protection products that will take effect in 2019. Therefore, Fritidsodlingens riksorganisation (The national organization of hobby farming) invited the Minister of Environment, Karolina Skog and CBC researcher Hanna Friberg to a hearing on March 22 at Nordic Gardens. Nordic Gardens is the leading garden show in Scandinavia with ca 50 000 visitors each year. Hanna Friberg talked about the need for more research and development on biological control and the the difference between hazardous products and low risk products such as rapeseed oil and soap. [Read more about the meeting here \(in Swedish\).](#)

Hurdles for implementation of biological control

CBC personnel (Margareta Hökeberg and Ingvar Sundh) met the secretariat group of National Board for Plant Protection (Växtskyddsrådet), and provided advice regarding the board's task to identify hurdles for implementation of alternative products and approaches for plant protection, including biological control. The report will be published during 2019.

Guidance regarding criteria for low risk products

The EU Commission is developing guidance for how to apply the criteria for classification of microbial control agents in the low risk product category. The criteria and guidance focus on presence of antibiotic resistance. Ingvar Sundh is invited as external expert in the "Biopesticides" work group of the commission, that develops the guidance text.

Supporting EFSA

CBC researcher Ingvar Sundh's mandate in the work group for QPS (Qualified Presumption of Safety for Microorganisms) continued during 2018. A paper presenting the QPS approach of EFSA was published in [FEMS Microbiology Letters](#).

Focus groups at SLU

SLU have funded five focus groups with the aim successful collaboration between researchers and stakeholders. The groups include farmers, foresters and other practitioners, advisers, representatives from businesses, governmental and non-governmental organisations, and researchers from different areas and faculties of SLU. During 2018, CBC researchers have participated in all the focus groups: *Plant protection in root and tuber crops, Oilseed rape and other break crops as a strategic focus, Plant protection in cereal crops, Integrated use of low risk compounds in plant protection and Diagnosis, monitoring and risk management.*

CBC's operational group

Since July 2018, CBC has partly changed its operational group. The previous Director of CBC, Margareta Hökeberg, retired and Ingvar Sundh was appointed new Director in the beginning of 2018 ([Read more about that here, in Swedish](#)). Below, we take the chance to introduce the team that will work at CBC for the coming three years. Do not hesitate to contact us if you have any questions!

Paul Becher is interested in interactions that are chemically communicated between organisms, for example to find a host or a partner. His special interest is to understand the importance of microbial signals between plants and insects.

– Manipulation of insects with pheromones and plant volatiles is an established and sustainable strategy for pest control. My view is that volatile substances from microbes complement the spectrum of semiochemicals that can be used for pest control, says Paul.

[Read more about Paul's research.](#)



Mattias Jonsson is a specialist in insects and arachnids in biological control. His research is primarily focused on conservation biological control of harmful insects in agricultural systems and the connection between biodiversity and biological control.

– A variety of natural enemies contribute to reduced pest problems in agriculture. In complex landscapes with a lot of non-crop habitat, they can reduce harvest losses due to bird cherry oat aphids by up to 70%. In ongoing research, we for example study whether a high diversity of natural enemies can contribute to stable biological control in the future, says Mattias.

[Read more about Mattias' research here.](#)



Magnus Karlsson is interested in microorganisms and their interactions with other microorganisms, plants and the surrounding environment. His research mainly focuses on fungal interactions that are important for the emergence of plant diseases and the biological control of these diseases.

– The search for effective alternatives to chemical pesticides in agriculture is of great importance to our future food supply. A new study shows that application of the fungus *Clonostachys rosea* in the soil results in a decrease in the number of plant-parasitic nematodes by between 40 and 73%. Both carrot and wheat also grew better in soil treated with this fungus, says Magnus.

[Read more about Magnus' research here.](#)





Johan Stenberg works with integrated plant protection for strawberry, and other horticultural crops. An important issue is to find new methods to benefit natural enemies with the help of plant traits and diversity.

– Plants have both resistance traits (such as chemical components) and rewarding traits (for example nectar) which, individually, can affect natural enemies. In addition, natural enemies are affected by botanical diversity (affected by e.g. intercropping and cultivar mixtures). Our research helps to understand how plant traits and botanical diversity can be optimized and combined to maximize the benefit of the natural enemies, says Johan. [Read more about Johan's research \(in Swedish\).](#)

Ingvar Sundh works with issues related to safety and regulations in biological control. He focuses on strategies to establish that a biological control agent has no unacceptable side effects in humans, on non-target organisms in agriculture and forestry or in the general environment.

– It is important that society's regulations and policies are well balanced and adapted to new achievements in research. Our research, as well as advice to the regulatory authorities, help ensure that new, safe products and methods can be put at the disposal of end users quickly and efficiently, says Ingvar.

[Read more about Ingvar's research here.](#)



Maria Viketoft is an expert in nematode ecology. She is especially interested in how these worms interact with plants (both cultivated crops and wild plants) and other organisms in the soil.

– In the soil there are a variety of animals that interact with each other in different ways. By studying how these soil animals are affected by measures such as ploughing or crop rotation, recommendations can be made to benefit the beneficial soil animals that can counteract, for example, plant parasitic nematodes, says Maria.

[Read more about Maria's research here.](#)



During 2018, **Hanna Friberg, Sebastian Håkansson** and **Margareta Hökeberg** left CBC.

- [Read about Hanna's ongoing research on fungi in biological control.](#)
- [Read about Sebastian's ongoing research on microbial formulation and stabilization.](#)
- Margareta Hökeberg has retired, but work part time in the [EcoStack project](#).

A communicator, Cajsa Lithell, is working with CBC.

CBC also has a **steering group** and a **reference group**. The steering group consists of five researchers from the NJ, S and LTV faculties at SLU and is chaired by Tomas Roslin from the Department of Ecology. CBC meets with the reference group at least once each year. The reference group consists of members from Swedish Board of Agriculture, Swedish Environmental Protection Agency, Swedish Chemicals Agency, Swedish Rural Economy and Agricultural Societies, LRF - The Federation of Swedish Farmers, RISE and the company Lantmännen BioAgri.