



Highlights of 2023

SLU Centre for Biological Control, CBC

A popular science report of CBC's activities



About the SLU Centre for Biological Control

The SLU Centre for Biological Control (CBC for short) is run by SLU with a grant from the Swedish government. Five researchers associated with the Centre engage in research, education, policy development, and communication to stimulate the development and implementation of biological control, working in close collaboration with several stakeholders. A specialist communicator is also linked to the Centre.

'Biological control' is a collective term for various strategies to limit pests and pathogens using living organisms; it is an important component of Integrated Pest Management in plant production. Biological control has great potential to restrict the damage caused by harmful organisms, including insect pests and plant pathogens.

Highlights of 2023 - SLU Centre for Biological Control

Year of publication: 2024, Uppsala

Publisher: SLU Centre for Biological Control

Layout: Cajsa Lithell

Illustrations: Fredrik Saarkoppel

Cover Photo: Pixabay

Where no photographer is indicated in the report, the photo is from Pixabay, [CCO](#)

Content

The raison d'être of biological control -----	5
Future biological control strategies -----	6
Interdisciplinary research for green transformation -----	11
Strawberry plants were collected from across Europe -----	12
Teaching -----	13
Bumblebees, yeasts and biofungicides: our agricultural heroes -----	15
The diversity of earthworms and bees surprised the kids at SciFest -----	17
The researchers at CBC -----	18
Challenges and possibilities in plant protection -----	19
New co-workers -----	21
Patents: Developing beneficial microbes to products -----	23
Scientific advice -----	25
Weed regulation and arbuscular mycorrhiza -----	26
Team and reference group meetings -----	27
In memory of Margareta Hökeberg -----	28





The *raison d'être* of biological control

This year (2023) has presented a rocky road for everyone following EU policy developments in the area of crop protection. After more than a year of tough negotiations, the suggested EU Regulation (SUR) aiming to reduce the use of chemical pesticides was finally rejected by the European Parliament. As there are currently no plans to proceed with re-negotiations, it seems that our policy makers are back to square one – thus, chemical pesticides will remain a legal option for the foreseeable future in Europe.

The decision not to phase out chemical pesticides may result in an identity crisis for biological control, because its *raison d'être* used to be to provide eco-friendly alternatives for future pesticide-free agriculture. But if pesticides remain, what then is the role of biological control?

The answer to the above question may, perhaps, be spotted in recent scientific output from CBC and other biocontrol institutions around the world. Year after year we see that biocontrol innovations provide better and better crop protection, in many cases matching or even surpassing chemical pesticides. Biological control is gradually being adopted by farmers due to its increasing efficacy. Although satisfactory and affordable biocontrol solutions have not yet been developed for all cropping systems – far from it – we are seeing amazing developments. Biological control is gradually growing into a new entity, existing in its own right and not just as a B-list substitute for prohibited pesticides.

This popular science report provides some highlights of the activities and results achieved during 2023 by the *SLU Centre for Biological Control*. We hope it will provide an idea about the

encouraging developments that SLU is leading in this area. With or without pesticides, biological control will be an important part of future crop protection in Sweden, Europe, and around the world.



Johan A. Stenberg, Director of the SLU Centre for Biological Control



Future biological control strategies

— Examples of research at CBC during 2023

Clover in oat fields supports pollinators and suppresses weeds

To produce food in a sustainable way, we must conserve biodiversity and facilitate ecosystem services in agriculture. Intercropping of cereals with legumes such as clovers holds great potential to create more biodiversity and increase ecosystem services in agricultural fields.

In a new study, undersowing oats with clover resulted in fewer weeds, more flowers and



Undersowing annual clovers suppresses weeds and supports pollinators. PHOTO: ANNETTE MEYER

therefore more pollinators. The undersown plant mixtures can be tailored to support more natural pest control, but even now, the benefits are striking without any disadvantages.

— This study demonstrates that undersowing annual clovers suppresses weeds and supports pollinators, without reducing crop yields or taking land out of arable production, says Maria Viketoft.

[Read more about this research here.](#)

Beneficial yeast can save strawberries from grey mould

Strawberry is the most economically important soft fruit crop in Sweden, but great losses are caused to strawberry farmers, retailers, and consumers each year by grey mould. Several different chemical fungicides are used against grey mould, but unfortunately the harmful pathogen causing the disease has developed resistance to almost all chemical pesticides.

Therefore, novel and reliable biocontrol agents are needed to replace the chemical fungicides. The beneficial fungus *Aureobasidium pullulans* is a promising biocontrol agent which can help to combat this plant disease.

CBC researchers have shown that this beneficial fungus reduces grey mould severity after harvest and increases the shelf life of the harvested strawberries during storage. The researchers have also investigated the mechanisms behind the biocontrol.

[Read more about this research here.](#)



PhD student Afrasa Mulatu by a coffee plant that has been treated with a formulation containing the beneficial fungus *Trichoderma*. PHOTO: RAMESH VETUKURI

Beneficial fungi can protect coffee plantations against serious plant disease

Coffee wilt disease is caused by the fungus *Fusarium xylarioides*, which leads to a 30–40% decline in coffee yield. The disease is a big challenge, not least for small-holder farmers, as coffee is their most important cash crop. Unfortunately, there are neither resistant coffee varieties nor effective chemical pesticides.

Now, researchers from SLU and Ethiopia have developed, formulated and evaluated a range of biofungicides that are effective against the disease in the lab, in greenhouses and in field conditions. The biofungicides are now recommended for the management of coffee wilt disease.

–To the best of our knowledge, this is the first report of a biological solution that can effectively manage coffee wilt disease that has been taken from the laboratory into the field. We hope that our formulations will soon be widely used to combat coffee wilt disease in Ethiopia, says Ramesh Vetukuri.

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

The invasive Spanish slug is attacked by parasitic worms

Slugs are important economic pests of several crops and are a serious threat to agricultural and horticultural production. Climate change, with milder winters and warmer and wetter growing seasons, will benefit slug populations. For the first time, a survey of slug-parasitic worms has been conducted in Sweden.

Parasitising worms could potentially reduce the size of slug populations, such as the Spanish slug, that cause yield losses in agriculture. In total, 268 terrestrial slugs were collected from 27 agricultural field edges in three seasons over 2020 and 2021.

–The two worm species that were dominant in the slugs have never been recorded in Sweden until now. They are not lethal to the slugs, but further studies on slug-parasitic worms in other types of habitats may reveal other worm species that are good candidates to be biological control agents to combat slugs, says Maria Viketoft.

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



The invasive Spanish slug has spread throughout Europe, becoming an established pest both in home gardens and agricultural crops. PHOTO: CASTEL IVANO, [CC BY-SA 4.0 DEED](#)



Integrated pest management needs better implementation to provide ecological results

Agricultural policies in the European Union promote both organic management and integrated pest management, or IPM, as environmentally friendly alternatives to conventional approaches. IPM is a decision support system for crop protection in integrated farming, where a key goal is to deliver biodiversity conservation and economic profitability through the balanced use of chemical, biological and cultural practices to manage pests. Organic management is largely beneficial for biodiversity, including the natural enemies of crop pests. IPM, however, has received much less scrutiny.

– Olive is an important cash crop in the EU. We conducted a meta-analysis based on 294 observations extracted from 18 studies to compare the effects of three different cultivation strategies on biocontrol potential and herbivore pressure, says Mattias Jonsson.

The results showed that, in its current form, IPM is not enhancing ecosystem services such as biocontrol potential or reducing disservices such as herbivore pressure when compared

with conventional crop management in olive cultivation. We need to shift to a more comprehensive implementation of IPM practices.

[Read the whole story here.](#)

***Aureobasidium* – an upcoming agricultural hero**

Aureobasidium spp. are black, yeast-like fungi. These microorganisms can provide eco-friendly and safe strategies that might be adopted in agricultural production systems and food processing. In a new review, our knowledge and knowledge gaps about the potential of these microorganism is summarised.

– We know that *Aureobasidium* species can produce a plethora of metabolites, many of which find applications in the agricultural sector to combat plant pathogens, says Johan Stenberg.

Although research is progressing in the right direction, many gaps remain in our knowledge of *Aureobasidium*. For example, many of the mechanisms underlying biocontrol and the promotion of plant growth are still unexplored.

– Increasing our knowledge of the variation and distribution of these microbial traits on a global scale would make it possible to target isolates and optimise crossbreeding to develop these microorganisms for use in agriculture and food processing, says Johan.

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

Bark beetles can't hide from their natural enemies

Long-legged flies of the genus *Medetera* are the most useful natural enemies of the spruce bark beetle *Ips typographus*, which causes enormous damage in European spruce forests. *Medetera* flies lay eggs on infested spruce trees, and when the larvae hatch, they move into the beetle galleries to prey on the developing beetles. To make better use of the flies in forest management, it is important to understand the ecological interactions between predator and prey. An important question in this context is how the flies find the beetles that develop under the bark.

Our studies shows that *Medetera* flies are able to sense specific odour compounds emitted by the beetles and the infested trees. That means that the flies are able to sense and find the beetles, even when they are hidden inside the tree. A synthetic blend of these compounds can be used to attract and to monitor the flies, says Paul Becher.

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

New research grant: A yeast that can cure and protect spruce seedlings from grey mould

Johan Stenberg will lead a new project that will investigate how a beneficial yeast can protect and



A sampled Medetera larva inside a glass vial. The larva was collected under the bark of a beetle-infested spruce tree. PHOTO: PAUL BECHER

save spruce seedlings that have been attacked by grey mould. The project has SEK 1.5 million of funding from the *Skogssällskapet* foundation.

– In the project, we will test how the beneficial yeast *Aureobasidium pullulans*, which is found naturally on spruce, can be used to protect spruce seedlings against attack. We are starting with what is found naturally in the forests, says Johan Stenberg.

More research from CBC can be viewed here: www.slu.se/cbc-publications



Interdisciplinary research for green transformation

The Interdisciplinary Academy is a programme at SLU aimed at promoting and exploring cross-disciplinary research within the institution. SLU's researchers are offered the opportunity to collaborate across disciplinary boundaries on complex issues in the broad field of green transformation. Paul Becher participates in the programme Food production and food security through agritecture: Interdisciplinary group on rooftop greenhouse (RTG) technology.

Climate change, combined with global population growth, is challenging our food systems and we need to find more creative solutions to produce food in the future. A promising solution that, in addition to producing food locally, also provides several other advantages is greenhouses on roofs.

The advantages are many; optimised land use, high yields, water and energy efficiency are just a few examples. In the programme, the researchers are investigating this exciting solution.

–To strengthen knowledge about RTGs, a number of researchers from different subject areas within SLU are now collaborating says Paul Becher. Biological pest control is of key importance for greenhouse production in urban environments. Ventilation systems are important for efficient energy use but challenge crop production through pests and pathogens coming in, or pollinators and biocontrol organisms getting out.

[Read more about rooftop greenhouses here \(in Swedish\).](#)



Paul Becher. PHOTO: CAJSA LITHELL

These are the researchers in the Interdisciplinary group on rooftop greenhouse technology:

- Paul B Becher, Department of Plant Protection Biology
- Marie-Claude Dubois, Department of Biosystems and Technology
- Karl-Johan Bergstrand, Department of Biosystems and Technology
- Sara Spendrup, Department of People and Society
- Tobias Emilsson, Department of Landscape Architecture, Planning and Management
- Anders Larsolle, Department of Energy and Technology

Strawberry plants were collected from across Europe

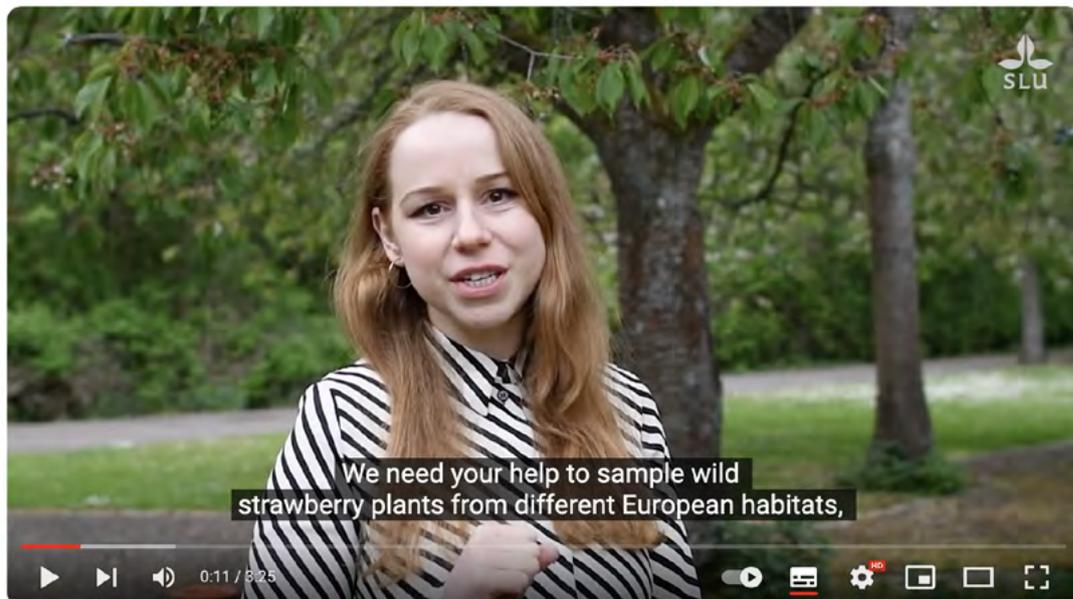
Strawberries, like many plants, are threatened by plant diseases. Examples are grey mould, common leaf spot disease, anthracnose disease and leaf scorch. Fortunately, certain wild microbes are beneficial and may function as plant bodyguards against these diseases. The black yeast *Aureobasidium pullulans*, is one of wild strawberries' most important microbial bodyguards. It is present in almost all strawberry populations across the European continent.

In a new project, Johan Stenberg and his postdoctoral researcher Nataliia Khomutovska wanted to investigate how plant resistance and yeast traits vary – and perhaps co-vary – across

Europe and across different environments. To do this, they asked for help from people affiliated with universities or research institutes to collect wild strawberry plants from their country and send them the samples. In total, 248 samples were collected, around 60 of which were received from the collaborators. The plan now is to analyse them for *Aureobasidium pullulans* and investigate how plant–microbe associations evolve at the continental scale.

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

[See a film in which Nataliia asks for help with strawberry plant collection.](#)



Help us sample wild strawberries!



CBC - Centrum fö...
55 prenumeranter

Teaching

CBC researchers are involved in teaching on many courses at undergraduate, graduate, and postgraduate level. To mention some examples, undergraduate level biological control was taught as part of courses in ecology, plant production and plant protection.

At graduate level, CBC was, for example, included in teaching about biodiversity and ecosystem services on the course “Horticultural systems and future challenges”. At postgraduate level, CBC was, for instance, included in teaching the course “Primary production of animal source food – systems perspective and assessment of environmental sustainability” and taught chemical interactions underlying biocontrol in the PhD course “Insect Chemical Ecology”.

Ramesh Vetukuri receives supervision excellency award

Ramesh Vetukuri received the Best Supervisor Award 2023 from the Faculty of Landscape Architecture, Horticulture and Crop Production Sciences. Ramesh received this award because



One example of postgraduate education that CBC was involved in was the course “Insect Chemical Ecology”. PHOTO: PAUL BECHER



In the citation it says that Ramesh is kind, understanding, helpful, encourages critical thinking and independent planning, allows room for errors and to grow from those mistakes. PHOTO: CAJSA LITHELL

of his supportive approach, his high level of responsibility and the very smooth supervisory relationship he has with his students, creating an excellent working environment for everyone.

The award was handed out by Mahboobeh Yazdani from the PhD student council and by the Dean of the faculty, Christina Lunner Kolstrup.

– I believe that good supervision is a two-way street, where both the supervisor and the student contribute equally to the process. My role is not just to guide but also to listen, learn, and evolve alongside my students, said Ramesh.

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



Bumblebees, yeasts and biofungicides: our agricultural heroes

— CBC in the media

Beneficial fungi can save your morning coffee

New biofungicides have been invented and are now recommended for the management of coffee wilt disease. Ramesh Vetukuri, who leads this research, was featured in over 50 different Swedish newspapers and on Swedish radio.

- [Listen to a radio program on SR \(in Swedish\).](#)
- [Read an article in SvD.](#)
- [Read an article in Aftonbladet.](#)

Protect your garden with animals, fungi and bacteria

How can you get rid of the pests that damage your strawberries? Johan Stenberg talked about how you can put an end to attacks by diseases that affect your plants with biological plant protection products in the podcast *Om vetenskap*, produced by the *Swedish Foundation for Strategic Research*.

[Listen to the podcast in Swedish.](#)

A yeast that can cure and protect spruce seedlings from grey mould

SLU actively develops environmentally friendly methods to protect plant production, including trees and forests. Here Johan Stenberg talks about his new project, explaining how a beneficial yeast

can protect and save spruce seedlings that have been attacked by grey mould.

[Listen to a radio program in Swedish from P4 Kristianstad.](#)

Fungal sprays and bumblebees can save strawberries from mould

By only spraying every other strawberry plant with a biocontrol fungus, SLU researchers are investigating whether the use of crop protection





products can be reduced. Bumblebees can also act as flying doctors in greenhouses by spreading the fungus in a targeted way. Watch Johan Stenberg and colleagues talk in Swedish about ongoing research at SVT Nyheter:

[Watch Johan Stenberg and colleagues talk about ongoing research at SVT Nyheter in Swedish.](#)

Pest control and source of beneficial enzymes

The black and yeast-like fungus *Aureobasidium* can be useful both in agriculture and the food industry. Johan Stenberg is interviewed in the trade journal *Jordbruksaktuellt* about the ongoing research on this fungus.

[Read the article in Swedish here.](#)

Hovering doctor – a new weapon in crop cultivation

Hoverflies are invisible pollinator heroes and masters of confusion! They can deliver both

biological control and pollination in crop cultivation. Paul Becher was interviewed about this by the trade journal *Lantmannen* (in Swedish):

[Read more about it here.](#)

It's important to protect biological diversity below-ground

What is the status of species diversity within the soil? It remains uncertain, says Maria Viketoft. The significance of preserving biodiversity, including that below-ground, is behind the EU's investment in soil health. But despite lofty ambitions, the work is slow. The initial proposition for legislation that focused on soil health, ultimately transformed into a monitoring law and lacks the indicators recommended by scientists.

[Read an interview with Maria in the trade journal *Extrakt* \(in Swedish\).](#)



The diversity of earthworms and bees surprised the kids at SciFest

At the science festival SciFest in Uppsala, people of all ages with a curious mindset had the opportunity to delve deeper into research and its practical applications. At one of SLU's booths, Maria Viketoft engaged with visitors, enlightening them about the intricacies involved in potato chip manufacturing.

– SciFest plays a vital role in revealing the complexities behind everyday items, prompting curiosity to explore further, says Maria.



This year, more than 6,000 people participated over the three days. On Thursday and Friday, the festival was open to schools and on Saturday, which accounted for just over half of the visitors, the festival was open to the public.

– It was fun to meet children and show them our fantastic animals and plants!

[Read more about SciFest \(in Swedish\) here.](#)



SLU and Uppsala University organise the science festival SciFest together.

The event spans three days, with the initial two days dedicated to school participation and Saturday open to all. The festival offers a diverse range of activities, providing captivating insights into the research endeavours of both universities. It serves as an opportunity for inquisitive minds of all ages to explore and experience research across various scientific disciplines. The primary aim is to encourage young people to ponder significant inquiries, engage in cutting-edge research, experiment, and recognise the excitement and significance of scientific exploration.



PHOTOS: IDA KOLLBERG AND MARIA VIKETOFT

The researchers at CBC

This is CBC's operational group that has been active during 2023. These researchers are team leaders and work with post docs, PhD students and Master's students. Ramesh Vetukuri is the newest addition to the team and started in 2023.

Johan Stenberg (Director) – (Director)
– Johan's work focuses on optimisation and evolution-proofing biocontrol within the framework of Integrated Pest Management, often involving wild genetic resources and studies of natural selection in agroecosystems.

Maria Viketoft (Deputy director) – works on nematode ecology, particularly these worms' interactions with plants (crops and wild species) and other soil organisms.

Paul Becher – studies chemically mediated interactions between organisms, including host-finding and sexual communication in insects. He is specifically interested in the function of semiochemicals in biological control.

Mattias Jonsson – specialises in insects and arachnids for biocontrol. He mainly focuses on natural and conservation biological control of invertebrate pests in agroecosystems.

Ramesh Vetukuri – Ramesh is interested in plant-microbe and microbiome interactions, focusing on developing new and sustainable ways to improve plant yield and control diseases. He focuses on microbes and their effectors, including small RNAs that modulate plant traits.

Cajsa Lithell – CBC's Communications Manager.



Challenges and possibilities in plant protection

— CBC's seminar series

An invasive avian vampire fly

CBC organises a seminar series each year. This year Professor George Heimpel from the Department of Entomology at the University of Minnesota, USA kicked things off in April with a seminar entitled “Risks and Benefits in Biological Control: Protecting Darwin’s finches from an invasive parasite in the Galapagos Islands”. The Avian Vampire Fly (*Philornis downsi*) is invasive in the Galapagos Islands, where it threatens Darwin’s Finches with extinction. Several potential control methods are being investigated, of which the most promising is the introduction of one or more specialised parasitoid species from the fly’s native range in South America.

Ecology og zombieflyies

Henrik Hjarvard de Fine Licht, Associate Professor from the Department of Plant and Environmental Sciences at Copenhagen University in Denmark gave a seminar on the evolutionary ecology of zombieflyies. Evolutionary ecology is a field within both ecology and evolution that examines how interactions between and within species evolve. Understanding the evolutionary effects of organism interactions is of fundamental significance in ecology, evolution, agriculture, and human health.

Push-pull cropping systems

Daniel Mutyambai from the International Centre of Insect Physiology and Ecology (ICIPE) and the Southeastern Kenya University gave a seminar entitled “More than Push and Pull: Plant-soil feedbacks in push-pull cropping systems”. Plants can alter nutritional availability, structure, and the chemistry of the soil they grow in. These soil

changes can positively or negatively influence the growth and metabolism of other plants that co-occur or grow later in the conditioned soil. Plant-soil feedbacks could affect community interactions and dynamics but also be applied in agroecosystems to promote sustainable plant growth and resistance to pests. Daniel talked about how aboveground interactions have been well studied in cropping systems over the last two decades, but the impact on the belowground biota is less known.

Effects of tillage on weed regulation

Eirini Lamprini Daouti from the Department of Crop Production Ecology at SLU talked about the effects of tillage on weed regulation by carabid beetles. This was a CBC financed project led by Ola Lundin. Read more about this project on page 27 in this report.



A carabid beetle. PHOTO: EIRINI LAMPRINI DAOUTI



Cassandra Vogel checks predation on seed cards. A field camera documents the process. PHOTO: CAJSA LITHELL

New co-workers

Using biocontrol for more resilient agricultural systems

Ramesh Vetukuri is the newest researcher at CBC. His specialty is novel and sustainable methodologies to enhance plant yield, while effectively managing disease outbreaks. In the long term, Ramesh wants to contribute to the development of sustainable and climate-resilient agriculture.

Ramesh is a dedicated molecular biologist with expertise in both fundamental and applied research, specifically focusing on advancing biocontrol strategies to optimise crop yield and bolster crop protection.

– My extensive experience encompasses a diverse array of pathogens and biocontrol agents, allowing me to contribute a multifaceted skill set to CBC. I also hope to contribute with my innovative approaches to sustainable agriculture and enhanced crop productivity, says Ramesh.

[Read more about Ramesh Vetukuri here.](#)



Ramesh Vetukuri demonstrates the Biotron at a networking meeting in Alnarp. PHOTO: CAJSA LITHELL



Cassandra Vogel by one of her field sites. PHOTO: CAJSA LITHELL

Climate change impacts on pest control services

Cassandra Vogel started her two-year post doc at SLU in May 2023 and is mentored by Mattias Jonsson. She will investigate how resilient natural enemies and their pest control services are to disturbances. The aim is to contribute to the knowledge necessary to design agricultural landscapes and management in such a way that conserves biodiversity and the services it provides to farmers.

– Our project aims to investigate how resilient natural enemies and their pest control services are to disturbances. We do this by identifying the climatic conditions under which various species of predators are active and measuring these, and by collecting data on predators' diets. We are also assessing the species richness and abundance of predators before and after management in twelve pairs of tilled and untilled wheat fields located in landscapes around Uppland, ranging from simple to complex habitats.

– By collaborating with teams in Italy, Austria, and Germany, we can repeat our measurements under various climatic conditions in Europe so that we get a better idea of potential climate change impacts on predators and pest control services.

[Read an interview with Cassandra Vogel.](#)

Exploring evolutionary patterns in the "Plant-pathogen-bodyguard" model

Nataliia Khomutovska is a postdoctoral researcher working with Johan Stenberg and Alessandra Di Francesco on the investigation of patterns in the evolution of woodland strawberry (*Fragaria vesca*), its bodyguard (*Aureobasidium pullulans*) and pathogens across the European continent.



Nataliia Khomutovska. PHOTO: CAJSA LITHELL

– The main goal of our project is to fill fundamental knowledge gaps regarding the factors shaping the distribution of plant (*Fragaria vesca*) resistance and the biocontrol potential of a beneficial fungus (*Aureobasidium pullulans*) on the European continent. We aim to apply evolutionary theory to create a method that accelerates the identification of wild resources. This optimisation focuses on enhancing both utilising plant resistance and employing biological control. Current methods in crop protection using these approaches are less effective than desired, but with improvement, they could match the efficiency of chemical fungicides in controlling plant pathogens.

Within the project, we collected 248 strawberry genotypes from late spring to autumn 2023 and obtained 200 strains of the fungus *Aureobasidium*, which are currently under investigation.

– Our project involves collaboration between SLU and the University of Udine in Italy. This collaboration facilitates the exchange of experience among the research teams and the replication of experiments in diverse laboratory

settings. We invited researchers from various European institutions to assist us in sampling strawberries and obtaining the most representative plants and strains from diverse European habitats.

[Read more about Nataliia's project here.](#)

Herd immunity to increase efficiency of microbial biological control

PhD student Esther Kuper joined Johan Stenberg's group in April 2023. In a 4-year project, she will explore the concept of herd immunity in relation to crop plants (strawberry, *Fragaria ananassa*). More specifically, she will investigate whether targeted application of the biological control fungus *Aureobasidium pullulans* on selected plants and mixed cultivation of different plant cultivars can reduce disease level not only in treated plants, but also in their untreated neighbours.

A herd immunity-like effect in crop plantations would allow for more precise application of biocontrol products – and perhaps chemical products – without compromising the crop protection at the field level. This would reduce the amount of products applied to the field, leading to both economic savings and reduced environmental risk.

The patchy use of biocontrol product and mixed growth of different strawberry cultivars could interrupt the evolutionary adaptation of the pathogen and delay the development of resistance. Field data and microbiological methods will be used to test this hypothesis.



Patents: Developing beneficial microbes to products

Ramesh Vetukuri was a panellist at the Skåne Innovation Day meeting that, this year, focused on investing in innovation.

During the day, researchers were able to gain a robust understanding of how to transition their research from a theoretical framework to practical application and product development.

Ramesh was a panellist on the topic "The Food Chain as a Development Arena for Sustainability and Competitiveness."

– Our discussion centred on collaboration between the industry, test bed facilities, and academia. We explored how startup companies utilise test bed facilities for product development and the impact of test bed environments on their business development, says Ramesh.

An eye opener for innovation opportunities

Beyond the panel, Ramesh had the opportunity to engage with diverse professionals, including

industry startups, representatives from various test bed facilities, and researchers from universities across southern Sweden.

– The meeting was very useful. I gained a robust understanding of how to transition my research on biocontrol and probiotics from a theoretical framework to practical application and product development, says Ramesh.

– I think this meeting served as an eye opener regarding the many opportunities that are available for researchers at SLU, especially for those looking to advance ideas like biocontrol or the use of beneficial microbes in product development.

[Read more about Skåne Innovation Day here.](#)



The panellists in the session "The Food Chain as a Development Arena for Sustainability and Competitiveness".

PHOTO: HENRIK HEDLUND



PHOTO: EIRINI LAMPRINI DAOUTI

Scientific advice

CBC continuously communicates with Swedish and international authorities, industry bodies, farmer organisations and individuals about biological control issues.

Commissioned by the Swedish Environmental Protection Agency (Naturvårdsverket), Paul Becher and Maria Sousa contribute to the risk assessment of lady beetles considered for biocontrol of scale insects and aphids and scale insects, and Eirini Daouti is involved in the risk assessment of parasitoid and predatory thrips. Mattias Jonsson, Sasha Vasconcelos, Miriam Karlsson, Mohammad Rezai and Samuel Musyoka have performed cold tolerance tests of predatory mites.

In September, Mattias Jonsson and Maria Viketoft participated in a webinar arranged by Lantbrukarnas riksförbund (LRF), the federation of Swedish farmers. Mattias talked about natural

enemies, climate change and extreme weather and Maria talked about her project on flower strips in strawberry cultivation. Maria also presented this project at a webinar arranged by the Swedish Board of Agriculture in October.

In December, Mattias Jonsson held a half day course on natural enemies at the Swedish Board of Agriculture. The target group was farm advisors.

– It was great to have time to discuss natural enemies in agriculture in detail with the participants. It was also nice to look at some insects under the stereomicroscopes together, says Mattias.



Weed regulation and arbuscular mycorrhiza

— CBC financed projects

How does tillage affect weed regulation by seed eaters?

Weeds cause major yield losses despite frequent use of herbicides. Carabid beetles are frequent consumers of weed seeds, thus potentially offering important biological control services, and regulating weed populations. Ola Lundin from the Department of Ecology was given a grant from SLU Centre for Biological Control in 2021 to investigate this. The abundance of carabid beetles has been shown to be correlated to weed seed regulation in directly seeded fields without tilling, indicating a role of carabids in regulating weed seeds in these fields.

[Read Ola's report here.](#)

Crop diversity to boost bottom-up pest control

Conventional agriculture often harms soils, leading to reliance on external inputs instead of natural soil interactions for crop growth. Soil microorganisms like arbuscular mycorrhizal fungi (AMF) help plants with nutrients and pest resistance, but their potential in reducing pest damage remains untapped due to complexities in agricultural fields.

Laura Riggi inoculated potato plants with aphids and with a commercial AMF inoculum to disentangle the soil effects (crop diversity) from the management effects (active AMF inoculation). Preliminary results suggest that, when there is aphid infestation, potatoes grown in intercropped soil have on average 10% more AMF root

colonisation than those grown in monocropped soil, except when commercial AMF is inoculated. Commercial AMF increases AMF root colonisation only in monocropped soils. Positive effects of intercropping soils on AMF root colonisation might be one reason for the observed lower aphid growth in potatoes grown in intercropped soil. Laura is now investigating how soil history (inter- and mono-cropped soils) and AMF root colonisation effect potato plants' defences against herbivores by looking at the potato leaf metabiome.



Team and reference group meetings

This year the reference group meeting and the CBC team meeting were held in Uppsala, 7–8 November.

Bridging academia and society

The tasks of the SLU Centre for Biological Control include dissemination of the University's collective knowledge for the benefit of society and the provision of a bridge between academia and various external actors, as well as between researchers. CBC's reference group provides one such bridge for interacting with other actors in society. The aim is to develop knowledge and understanding of biocontrol through collaboration between SLU and these actors. On 7 November, the annual meeting with the reference group was held at the Ultuna campus. At the meeting, representatives from the Swedish Board of Agriculture, the Swedish Environmental Protection Agency, the Swedish Chemicals Agency, the Swedish Federation of Rural Economy and Agricultural Societies and RISE (Research Institutes of Sweden) were present. The

CBC researchers and the reference group updated each other on ongoing research and what was happening in their organisations with implications for biological control practices.

– We ended the day with interesting discussions on new collaborative projects, says Johan Stenberg.

Team meeting in Uppsala

On 8 November, CBC held its annual team meeting, with researchers from the Ultuna and Alnarp campuses participating. During the day, the team members gave each other updates on ongoing research.

– A large part of the day was spent discussing a collaborative paper on biological control, says Mattias Jonsson.



Meeting with the reference group in November 2023. From the left: Mattias Jonsson, Johan Stenberg, Johanna Jansson (Swedish Board of Agriculture), Björn Ringselle (RISE), Petter Haldén (Swedish Board of Agriculture), Lisa Carlstrand (intern at the Swedish Board of Agriculture), Maria Viketoft, Mats Allmyr (Swedish Chemicals Agency), Peter Dalin (Swedish Board of Agriculture) Paul Becher, Zahra Omer (Swedish Rural Economy and Agricultural Societies) and Ramesh Vetukuri. PHOTO: CAJSA LITHELL

In memory of Margareta Hökeberg

Margareta Hökeberg has passed away aged 70, after a period of illness. Margareta had a long and successful career as an internationally recognised expert on the use of bacteria in biological control and was director of the SLU Centre for Biological Control, CBC, from its inception in 2011 until 2018 when she retired.

Margareta's work with bacteria-treated seeds to combat seed-borne diseases in cereal crops was groundbreaking. She was one of the researchers who, together with Lantmännen, discovered and then developed the bacterium *Pseudomonas chlororaphis* isolate MA 342 into a biological agent for seed treatment, with a focus on use in cereals, but also for use on vegetables.

feet firmly on the ground. She was a great source of inspiration for me, both for her qualities as a researcher and as a colleague and fellow human being, says Hanna Friberg from CBC's steering group.

[Read the article "Margareta Hökeberg, pioneering researcher in biological control, has passed away"](#)

– Margareta was an excellent example of a researcher who did not stay in the ivory tower of academia. She brought her discoveries to industry and succeeded in commercialising several products for biological plant protection. For me, Margareta was also a role model as a leader. Her inclusive, friendly, and motivating leadership style within CBC greatly contributed to a common identity so that everyone worked together towards the same goal, says CBC researcher Mattias Jonsson.

– When I think of Margareta, it is first and foremost the warmth she spread that I remember, but also her scientific sharpness – she had a unique combination of big visions and her

Margareta Hökeberg at the symposium "Biological control in crop protection: present challenges and future prospects" held in her honour at her retirement in May 2018.

PHOTO: CAJSA LITHELL





SCIENCE AND
EDUCATION **FOR**
SUSTAINABLE
LIFE