

The Third International Congress of Biological Control (ICBC3), San José, Costa Rica

<https://www.iobc-icbc.com/>

Dates of travel: June 24 – 27 2024

Name of GCRI travel grant recipient: Dr Michelle Fountain



Highlights

- Meeting IOBC colleagues on the first day and reconnecting with previous collaborators
- Field visit to Nicoverde and Icafe businesses to learn more about coffee and pineapple production
- The diverse topic areas including familiar topics, e.g. Latest *Drosophila suzukii* (SWD) research, to controlling invasive weeds on the Pacific Islands
- Speaking to a new generation of PhD scientists from across the globe eager to talk about their research
- Bringing home lots of ideas for new research areas and improving what NIAB East Malling does

Background

The **Third International Congress of Biological Control (ICBC3)** in San José, Costa Rica was co-organized by the Inter-American Institute for Cooperation on Agriculture (IICA), the Ministry of Agriculture and Livestock of Costa Rica, CAB International (CABI), and the International Organization for Biological Control (IOBC).

There were 23 scientific session topics, 5 plenary keynote sessions/panels including the associated expert volunteers who were responsible for organizing these sessions and panels, and the congress was attended by over 250 biological control experts from around the world. The session subjects and panel discussion topics encompassed various cross-cutting issues: biocontrol safety, pre-release studies, post-release evaluation, socio-economic studies, the Nagoya Protocol and biological control, the role of molecular tools in biological control, community engagement prior to release, long-term impact / cost savings of biocontrol, regulatory issues hindering market accessibility, and uptake of biological control. As with most conferences with multiple parallel sessions it is sometimes difficult to choose sessions to attend when there are so many interesting topics. I decided to focus on topics relevant to the UK Horticultural industry or topics where I have a low understanding.

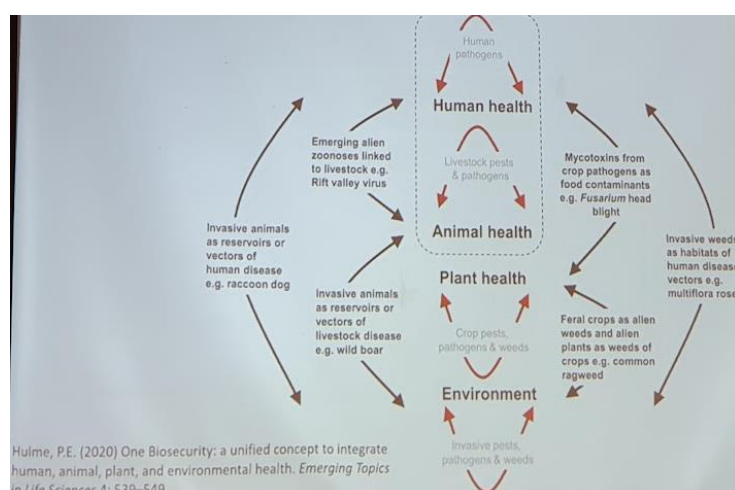
As convener of the Integrated Protection of Fruit Crops of the IOBC I also attended the General Assembly of the IOBC on Monday 24 June where the Executive Committee of the IOBC Global revealed plans for the organization for the next four years including newly elected members and to formalize the Statutes of the association International Organization for Biological Control (IOBC-Global) with seat in Zürich. IOBC also sponsored 5 early career researcher travel grants.

Alongside Liam Harvey from Biobest, I chaired the session, “Biocontrol in a changing world: Looking forward to how to develop and deploy Biocontrol faced with climate and biodiversity changes”.

The conference was an opportunity to gain up-to-date experience and information on Biological Control (BC) from other parts of the world, widen my views on the progress of BC strategies, and catch up with industry and research collaborators at the poster sessions, breaks and evening events. In addition, I reconnected with academic collaborators working in similar fields of research and exchanged ideas and formed new partnerships. This congress was particularly interesting to me because the UK is becoming increasingly reliant on biological controls and it stimulated many ideas where we might be able to help the UK industry in the future.

Travel findings

The Scientific Programme opened with plenary speakers (Nick Mills, Raghu Sathyamurthy) who focused on the ‘One Health’ hypothesis which considers the broader benefits of using Biological Control (BC). This theory originated in the 1090’s and incorporates benefits to Human, Plant, Environmental and Animal Health. Examples given ranged from unexplored bacteriophages in aquaculture, adjusting habitats slightly to be more biodiverse in favour of pest and disease control, to

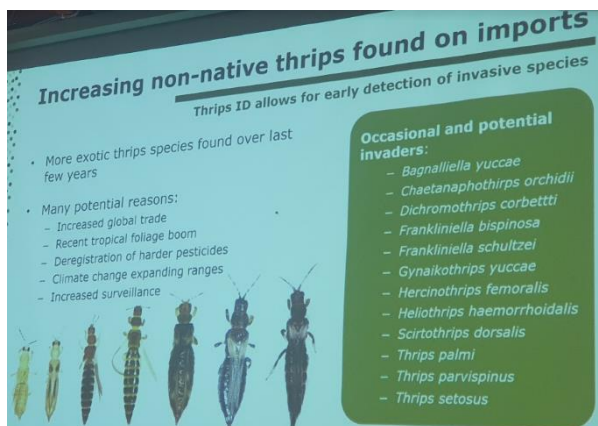


thinking of BC’s in terms of their modes of action. Speakers highlighted the need to incorporate analyses of wider social and economic benefits of BCs, diversify approvals so that BCs can be streamlined, promote multi-actor collaboration across stakeholders, using functional genomics to pre-select BCs before lab and field testing, and the need to plan for climate change.

Tara Garipey spoke about utilising museum insect specimens to investigate host-parasitoid interactions using non-destructive DNA extraction to exploit historic biocontrol options. Their team also used differed DNA fragments (different base pairs) to identify Figitidae species to track the adventive introduction of *Drosophila suzukii* (spotted wing drosophila, SWD) parasitoids across the USA. This is relevant to the work at NIAB East Malling where we are identifying parasitoids of SWD and aphids in the UK. Kent Daane gave a talk on the augmentation of *Pachycrepoideus vindemniae* for *Drosophila suzukii* control. This was particularly interesting for our team as we have a Growing Kent and Medway project aimed at controlling SWD in wild habitats with augmentation of parasitic wasps. Their sentinel *D. melanogaster* traps had 47% parasitism, but the parasitoid was not effective inside the crop and was more abundant in *D. melanogaster* baited traps in the margins of crops. Issues with insecticide sprays (10-15 in some crops in the USA) made parasitoid contributions unviable inside crops.

Ted Turling summarised many years of research on the volatile organic compounds (VOCs) of parasitoid-host interactions and the possibility of developing in-field GS-MS to alert growers where insect damage is happening in a crop for spot treatment. In the lab there is good separation of damaged and undamaged plants but there is still a way to go for field efficacy. His team are also developing gel beads for nematode release that are baited with caterpillar feeding attractant. The beads contain leaf extract and UV protectants. He showed a nice video of a caterpillar feeding on a gel sphere full of nematodes. Maria Zwysig looked at combining BCs for insect control using nematodes to increase susceptibility to *Pseudomonas*. The nematodes were found to increase the opportunistic pathogen infection in infected insects. Interestingly the toxins produced by both BCs is the same.

Hemp and Marijuana are a growing industry in many regions of the world for fibres and CDB, respectively. However, the crop protection strategies are lagging. Jorge Jaramillo-Gonzalez surveyed the main pests and natural enemies (NEs) of crops in Pennsylvania. Fibre crops have a shorter life cycle than the CBD varieties, leaving them less prone to issues. Common pest problems are aphids (*Phorodon* sp.) followed by 3 species of thrips (wester flower thrips, onion thrips and soybean thrips), flea beetles, and leafhoppers. Common NEs in the crops were ladybirds > spiders > anthocorids > earwigs, hoverflies and parasitic wasps. A new parasitic wasp, *Aphelinus maculatus*, is being further studied for aphid control in this crop. Thomas V. M. Groot alerted the industry to a new pest of peppers



- *Thrips parvispinus* in addition to *Scirtothrips dorsalis*. Angelos Mouratidis looked at improving *Orius* numbers in floriculture using chrysanthemums. *Echinothrips americanus* was difficult to control but *Orius majusculus* and *O. laevigatus* gave some efficacy. Rose Buitenhuis documented how in Canada ornamental and protected edibles surveys are done every 4 years to identify the dominant pests so that BC practices can be adjusted. Thrips species have changed over the years and predators have been screened in response.

Myself and Liam Harvey (Biobest) chaired the session, "Biocontrol in a changing world: Looking forward to how to develop and deploy Biocontrol faced with climate and biodiversity changes". Our first speaker Giselher Grabenweger from Agroscope spoke about the reaction of Switzerland plant health to the invasion of the Japanese beetle, *Popillia japonica*, which has now been in the USA for over 100 years. The initial widespread use of broad-spectrum insecticides was not appreciated by the wider community, but ongoing research is showing that *Metarhizium* baited attractants may have some promise in the field. Our second speaker, Chris McGrannachan, from Landcare Research in NZ discussed the ongoing community challenges associated with the mapping and removal of invasive weeds in the Pacific Islands. The emphasis of this talk was on the need to build relationships with

indigenous inhabitants and the time take for approvals, deployment and monitoring. Following this, Rebecca Boulton from Stirling University gave a high-level talk on the impact of sexual and asexual forms of parasitic wasps. Facultative sex came at a cost because these individuals were less successful at parasitism. Hence biocontrol companies need to consider what forms of parasitoids they are marketing for best efficacy. Our final speaker, Norbertas Noreika, from Estonia looked at pesticide-induced food and macronutrient limitation in beneficial carabid beetles in agroecosystems. Ground beetle communities in organic vs conventionally sprayed cereal fields were compared. Interestingly, the beetles from sprayed fields (up to 17 pesticides detected in the beetles) were larger than those from organic fields. The hypothesis proposed was that the high diversity of NE in organic fields led to higher competition for prey.

On day 3, there were 2 excellent keynote speakers, Tania Zaviezo, who gave a good overview of BC and where the gaps are in determining the mechanisms by which conservation biological control is effective. Gaps included the need to provide habitats for all life stages of BCs, landscape connectivity, and non-crop vegetation management, very relevant to the NIAB East Malling EU AgroBioconnect project which is attempting to address this gap in knowledge. The second speaker, Ralf-Udo Ehlers spoke on his many years' experience of nematodes production and use as BC agents, including phenotyping for virulent lines and their equivalent cost to pesticides (80 euro/ha for 1 billion nematodes/ha).

Relevant to the UK horticultural industry, Felix Wäckers informed the audience of an exciting new mite predator, *Pronematus ubiquitous* (Tydidae), for control of phytophagous mites and mildew. Studies have been done in strawberry, grapes, pepper and tomato. It is thought the ominous *P. ubiquitous* stimulates resistance mechanisms in the plants to protect against mildew. This species has not yet been identified in the UK, although it is likely a similar species, *Homeopronematus anconai*, could be used instead. I have put Felix Wäckers in touch with Belinda Kemp at NIAB East Malling to begin the search for this mite on UK vines.

Bruno Jaloux presented data on an elicitor based attract and reward strategy against rosy apple aphid, *Dysaphis plantaginea*, in apple orchards. Broad beans were used as companion plants as a source of extrafloral nectaries and acybezoar-S-methyl (Bion) as a plant stimulator which reduced aphid numbers in trees. The impacts were not overwhelming, but more work is needed to improve this system. David Haviland used insecticide and sugar treated hydrogel baits to reduce ants attending mealy bugs in Californian vineyards. Worker ants take the toxin back to the nest killing the queen and subsequently the whole nest. Although this may initially help in mealy bug reduction, I could not help but wonder what the consequences of completely removing this major ecological player would have on other ecosystems services. At NIAB East Malling in an IUK project we are looking at feeding ants on the ground at key points in the growing season to prevent attending rosy apple aphid, but to distract them away but without removing whole populations of ants. Similarly, a talk by Juan Antonio Sanchez demonstrated that although ants might initially be perceived as detrimental in some systems, further study shows that they can also have a predatory role in orchards as in his studies on natural enemies of control of Mediterranean pear psyllids.

It was good to learn more about more unfamiliar crops. Alessandra Marieli Vacari talked about the use of green lacewing species deployed at 1000 eggs per ha by drone (25-30 USD) per application in coffee crops Drone application of biologicals is an area that NIAB East Malling is keen to develop for a range of crops.

Manuel Zumbado spoke on a topic of particular interest to me but in a Costa Rican setting. They looked to enhance biodiversity in agriculture using improved field margins and a selection of plants that were not attractive to whitefly on melon. They also found these margins increased bee numbers and species (55 spp.) and produced more natural enemies than control sites, reducing whitefly in melon crops by 35%. Native flowers were investigated to promote *Mastrus ridens*, a parasitoid of codling moth, by Tania Zaviezo. It was likely that the parasitoid needs extrafloral nectaries and host feeding to meet its

nutritional requirements. Beans can at least partially fill this requirement and are also good soil improvers, fixing nitrogen. This highlights a gap in research for augmented BC strategies. Oliver Bach investigated the establishment of habitat islands for natural enemies in oil palm plantations in Malaysia. Plants needed to be shade tolerant and with the agreement of the farmers on the spatial arrangement to allow continuation of operations – often a barrier to establishing habitat within crops. Palm trees have a life cycle of around 25 years – similar to our tree fruits – offering opportunity for long term sustainable habitat management. In the USA Samantha Willden has been working with high tunnel veg and salad growers to identify ‘weed’ species that harbour NE but not pests, improving biological control and reducing costs associated with weed removal. Dandelion, white clover and hairy bittercress were good sources of spiders and aphid mummies. In this study *Chrysoperla* were added as an augmentative curative control for aphids and was economically viable even in winter months.



One of the most interesting and new topics for me was Milpa farming system used in central Mexico. This is a system of 3 sister plants; maize, squash and bean which over thousands of years have been grown together with low pest pressure and high complementarity. This system provides nitrogen to soil (bean), ground cover to suppress weeds (squash) and structure for beans to grow up (maize). Betty Benrey and her team attempted to grow

these crops at a similar planting density, but separately in rows. The yield did not match the high yields of the Milpa system. Chengyun Li also spoke on agrobiodiversity and indications that maize can intercept phytophthora in the roots, suggesting that pepper should be intercropped with maize. Maize was also found to induce resistance to pathogens in soybean, and incorporating the umbellifer, *Cnidium monnier*, which could host nearly 30 species of NE, meant control of aphid could be achieved. The conclusion was that our landscapes need to be more heterogeneous to interrupt pests and diseases and provide more diverse BC. This is the topic of a NIAB East Malling EU funded project AgroBioconnect where we are looking at the delivery of aphid parasitoids and pollinators to strawberry tunnels in different landscapes. Landscape composition and heterogeneity was also found to affect the abundance and diversity of coccinellids, and biological control in alfalfa fields by Audrey Grez in Central Chile.

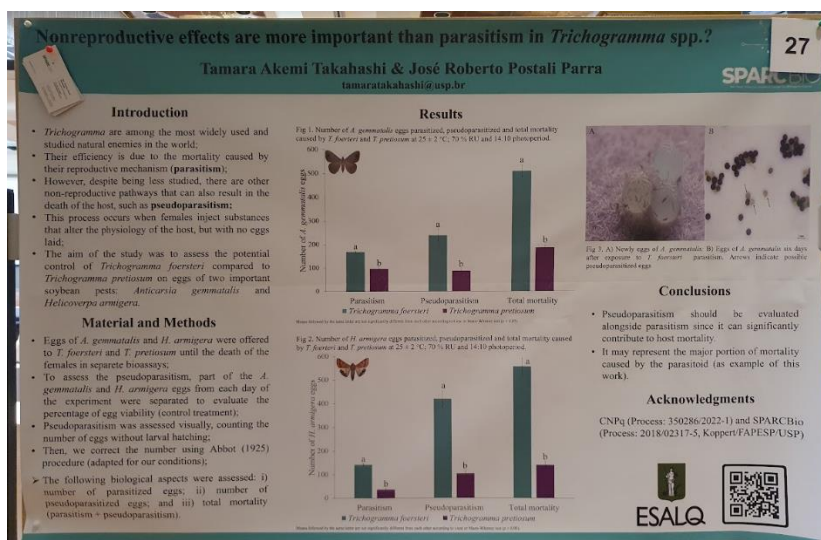
It was great to hear a talk on Collembola, the subject of my PhD, many... many, years ago. In this study Michael Rostás considered the role they play in foraging fungi, including beneficial *Trichoderma*. I have often wondered about the most common species I find in UK fruit crops, *Entomobrya multifaciata*, and its role in spreading beneficial or pathogenic fungi. Marc Bardin and team completed a review of 808 publications on microbial biocontrol agents against plant diseases. These generally composed of *Trichoderma* and *Bacillus*, mostly where strains were not recorded. They found many gaps in the literature including a lack of published negative results and a lack of experiments under commercial conditions. In addition, field studies by Pablo Garcia Palacios found arbuscular mycorrhizal fungi were negatively impacted by high fungicide use.

Andermatt Biotontrol (Marcel Tanner) are developing baculoviruses for lepidopteran pests which can be transmitted through direct, horizontal or vertical transmission. Their use is being proposed to ‘stress’ insect larvae making them more vulnerable to other deleterious effect, however this work needs more evidence to be convincing.

Poster Presentations

Some interesting and relevant posters were presented and related to ongoing research at NIAB East Malling. There was a poster discussing the under estimation of kill by parasitoids, e.g. not only direct parasitism by host injury during ovipositor probing and feeding. This is something we will consider in an IUK project that began this year on SWD parasitism. In another SWD study, grape varieties with a low pH were found to be a deterrent for egg laying (Dahise Brilinger). This is contrary to our studies on strawberry and raspberry in a Growing Kent and Medway funded project where sugar and colour seem to be the drivers of egg laying by SWD.

Another study looked at deploying stink bug eggs in the field to screen for native parasitoids (Joao Gabriel Cancellero). This would be useful for the UK to investigate native parasitoids of invasive Brown Marmorated Stink Bug and native Forest Bug – damaging to fruit and vegetable crops.



Angelos Mouratidis presented an informative poster on *Scirtothrips* which is a threat to the UK horticultural industry. The thrips, introduced from Asia to Europe, feed mostly on leaves severely stunting plant growth. *Amblyseius swirskii* and *A. limonicus* were effective predators of this pest thrips. However, *Neoseiulus cucumeris* could be added at 4 times the rate with equal efficacy but at the same cost.

A good contact, Kate Constantine at CABI, was made for future social science collaborations, an important factor when applying for funding recent years. They have studied the barrier to uptake by farmers of BCs.

It became clear through the conference that Conservation Biocontrol used in one region does not automatically apply in a different region; this was particularly evident in ant-aphid interactions in apple and pear orchards. Some ants were responsible for pear sucker control, and regular mowing could increase ant numbers in pear trees. Clearly, species, climate and local ecology all play an impact on BC functionality. It is therefore important that BCs are tested in regions independently. Equally, not all natural enemies are equal. A study by Audrey Grez looked at how habitat management of crops impacted ladybird species. Although habitat improvement around crop increased numbers of BC ladybirds it did not play a part in the conservation of native, more specialised species, indicating that there needs to be functional and conservation areas of habitat management.

Field Visit

On the last day of the congress, we visited coffee and pineapple businesses with credentials in BC and biodiversity. The coffee tour guide from Icafa talked about pest and disease issues and their use of regular applications of BC agents in pest and disease control. The pineapple production company, Nicoverde, tour guides explained the process of pineapple growing and how waste material and soil improvements are being made. Pineapple is one of the most polluting crops due to number of pesticides applied and soil erosion. This company has made great strides in organic and biodiversity accreditation. They produce all of their own inhouse microbial BC agents e.g. *Metarhizium*, and decomposition microbes e.g. *Lactobacillus*. They recycle waste as edible mushroom growing media, fibres for clothing or composting to return to the soil.

IICA INVITES YOU TO:

TOUR TO NICOVERDE & ICAFE

SUSTAINABILITY AND ECOFRIENDLY PRACTICES APPLIED TO PINEAPPLE AND COFFEE PRODUCTION

Time	Activity
6:30	• Departure to NICOVERDE, located in Pital / Alajuela
9:00	• Tour in NICOVERDE (Biological control, circular economy using pineapple byproducts for producing bioinputs and fiber extraction)
11:00	• Departure to the Coffee Institute headquarters (ICAFE)
13:00	• Lunch (in Barba / Heredia)
14:30	• Tour in ICAFE (Biological control, transformation of coffee pulp into briquettes for energy production for coffee drying, Coffee tour)
17:00	• Departure to the hotel
18:00	• Arrival at Barceló Hotel

TO PARTICIPATE REGISTER AT THE REGISTRATION POINT OF THE ICBC3



From top left clockwise; coffee plantations of different ages and incorporating semi-natural habitat, coffee grower speaking to congress delegates, coffee weevil which causes notching on leaves and a disease entry point.



Pineapples from the field being washed and an initial inspection for size and damage



Nicoverde in-house production of microbial biological controls for pest and disease management



Final products; pineapples (being supplied to Morrisons UK from 2025) and biological control products



Products from pineapple waste including fibres to make clothing and edible mushroom growing

Personal statement

As a UK-based fruit crop protection specialist, I was very pleased to have the opportunity to attend the ICBC congress to learn more about Biological Control at a key time when the UK industry is losing approval for many chemical products. The ability to properly network with scientists, plant protection specialists and the industry in person (not on a screen) enabled me to cement and reconnect with existing contacts and form new relationships which I hope will become valuable in the near future for funding opportunities including Innovate UK calls.

Clearly, control of pests and diseases with biological controls; augmentative, classical or conservation are a subject of global importance. The meeting demonstrated how the UK needs to embrace, test and improve biological control in its crops. It needs to lobby government for an easier, more straight forward, way of approving biological controls and for introducing non-native agents for controlling invasive species. The UK could take learnings from other global regions who are ahead in this aspect. It is startlingly clear that we cannot achieve pest and disease management on a huge industrial scale without consideration of our local habitats and landscape. The latter play an important role in a resilient system that will be less prone to climatic changes and invasive species. The UK should aim to restore biodiversity giving us the genetic pool to draw on when needed.

I have always been interested in natural history, so at the end of the congress I took a wildlife tour; some photographic examples are on the following page.

Contact details

Dr Michelle Fountain, Head of Pest and Pathogen Ecology, NIAB East Malling, New Road, East Malling, Kent ME19 6BJ

E-MAIL: michelle.fountain@niab.com

Acknowledgements

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Eyesh viper



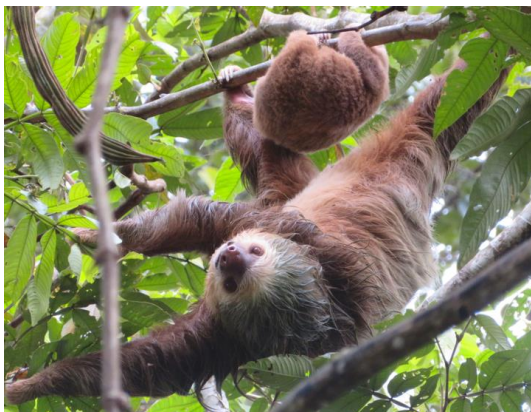
Owl moth



Resplendent quetzal



Toucan



Slouth with baby



Iguana