



Co-operative Research Programme:  
Sustainable Agricultural and Food Systems  
Theme I 'Managing Natural Capital'

**Fellowship Summary Report**

**Environmental monitoring using honey  
bee colonies and a novel sampling tool**

**M. Marta Guarna**

**Agriculture and Agri-Food Canada**

**Host Institution:** University of Almeria, Almeria, Spain

**Host collaborators:** Drs. Amadeo R. Fernandez-Alba &  
María Murcia-Morales

**Fellowship dates:** 27 March 2023 - 19 May 2023

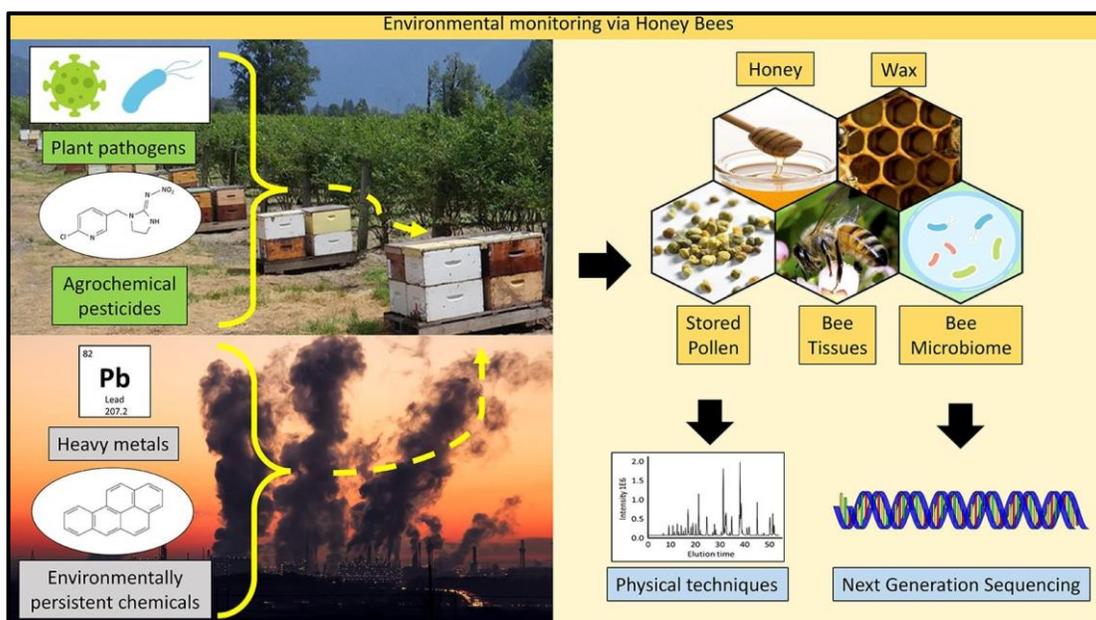
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## What were the objectives of the research project? Why is the research project important?

A challenge of current agriculture is to balance the use of agrochemicals for increased productivity with the need to protect pollinator and environmental health. Monitoring for environmental contamination is therefore crucial to guide stakeholders and inform policy decisions towards increasing food security and environmental sustainability. The European honey bee, *Apis mellifera*, has proven to be an effective bio-sampler of the environment as it brings pathogens and contaminants to the hive where they can be detected (Figure 1, Cunningham et al, 2022, Lee et al, 2023). The goal of the project was to develop an intercontinental collaboration for knowledge exchange and technology transfer on bee-mediated monitoring and to facilitate a comprehensive study of the environmental distribution of agrochemicals. This study leverages previous knowledge from the fellow and the host laboratory (Murcia-Morales et al, 2022), as well as data collected during this new collaboration.

**Figure 1.** Honey bee colonies contain tens of thousands of forager bees that can act as bio-samplers of the surrounding environment. Honey bees carry contaminants and pathogens to the hive and they can be detected by analyzing bees, pollen, honey, or beeswax. Graphical abstract from Cunningham et al, 2022, CC BY 4.0 published by Elsevier.



The fellowship supported a Canadian fellow hosted at the EU reference laboratory of Professor Fernández-Alba, University of Almería, Spain (Figure 2) to examine a new tool, the APIStrip, which allows for non-invasive sampling of beehives (Murcia-Morales et al, 2020). The APIStrip developed by the team in Almería, is a non-biological sampler consisting of a treated polystyrene strip that adsorbs agrochemical pesticides in its surface, which is covered in the sorbent Tenax®. It can be used as an effective, bee-proof, in-hive passive sampler of pesticides that are then analyzed by standardized methods. Reports of its use in Spain and Denmark are published (Murcia-Morales, 2020, 2021), and it is now being utilized in a large scale comprehensive pan-European environmental pollution monitoring study by the INSIGNIA- EU consortium, including all 27 European Union countries. This fellowship included training on how the tool is prepared and utilized, as well as planning its use in Canada. It also facilitated networking with researchers of other OECD member countries involved in bee-mediated monitoring of pesticides and other pollutants. By the end of the fellowship, a plan was established to send APIStrips to Canada for testing in Canadian honey bee colonies in the two important crops in

western Canada, blueberries in the Fraser Valley of British Columbia and canola in the Prairie region of Alberta. The resulting data will promote communication between stakeholder groups that need to balance the use of agrochemicals for crop protection and productivity with the promotion of pollinator health, in addition of following guidelines and regulations which vary between countries and regions. Monitoring exposure to agrochemicals is crucial as it may affect honey bee health, serve as an indicator of environmental contamination, and also affect trade possibilities for hive products.

## **1. Were the objectives of the fellowship achieved?**

Yes, the objectives were achieved. The fellow, M. Marta Guarna, was hosted by Dr. Amadeo R. Fernandez-Alba at the University of Almeria, Chemistry and Physics Department, Agrifood Campus of International Excellence, 04120, Almería, Spain (Figure 2). The fellow:

- I. participated in the preparation, processing, and analysis of APIStrips, working with post-doctoral researcher, Maria Murcia-Morales, the main investigator instrumental in the development of the APIStrips, as well as with other members of the laboratory.
- II. met with a collaborator of the host laboratory, Alice Pinto, at the Instituto Politécnico de Bragança, Bragança, Portugal, and visited an apiary where the APIStrips were used to discuss practical technical details including their insertion in colonies, inertness of the material, and bees acceptance (Figure 3).
- III. initiated a collaboration with the host laboratory and planned the utilization of the APIStrips in Canada, initially in sites of western Canada in the provinces of British Columbia and Alberta during the pollination period of two important crops, blueberries and canola. Laboratory analysis of agrochemical pesticides is planned at the University of Almeria for consistency with previous studies involving APIStrips.
- IV. initiated a comparative study on agrochemicals used and identified in Canada and the EU, which will be further informed by data from analysis of APIStrips obtained from this new Spain-Canada collaboration, as well from the EU Insignia project.

## **2. What were the major achievements of the fellowship? (up to three)**

The major achievements of the fellowship were:

- I. Initiated an intercontinental collaboration between Amadeo R. Fernandez-Alba and his team at the University of Almeria, Spain and the fellow from Agriculture and Agri-Food Canada, which also facilitated additional interactions, in particular with Dr. Alice Pinto, Instituto Politécnico de Bragança, Bragança, Portugal, and with Flemming Vejsnæs, Danish Beekeepers Association, Fulbyvej 15, DK-4180 Sorø, Denmark. These were consolidated by meetings of the fellow with them during a later Congress, the 48th Apimondia Congress in Santiago, Chile.
- II. Transfer of knowledge and expertise between the host laboratory and the fellow on the preparation and use of APIStrips. This knowledge facilitated planning its utilization in Canada.
- III. Initiated a comparative study on agrochemicals used in different regions to inform stakeholders, and policy makers.

Figure 2. Fellow Marta Guarna with hosts Dr. Amadeo R. Fernandez-Alba, post-doctoral researchers Dr. Maria Murcia-Morales, and members of the host laboratory at the University of Almeria, Chemistry and Physics Department, Agrifood Campus of International Excellence, 04120, Almería, Spain where the new tool for non-invasive, passive sampling of pesticides, the APIStrip, was developed.



Figure 3. Fellow Marta Guarna visiting the apiary of host's collaborator Dr. Alice Pinto, Instituto Politécnico de Bragança, Bragança, Portugal. The fellow discussed practical details regarding the use of the APIStrips including their insertion in colonies, inertness of the material, and bees acceptance. A photo of the fellow with Dr. Pinto and a member of the laboratory, Andreia Quaresma, is shown as well as photo of the an APIStrip being pulled out of a colony.



**3. Will there be any follow-up work?**

Yes, follow up collaborative work to utilize the APISrips in Canada is planned.

○ **Is a publication envisaged? Will this be in a journal or a publication? When will it appear?**

Yes, we have already introduced the project at a world congress, the 48th Apimondia Congress in Santiago, Chile in September 2023 in an oral presentation entitled: *Bee-mediated monitoring of pesticides, pathogens, and emerging threats*. Our joint results from utilizing the APISrips will be submitted to scientific and stakeholder publications, with a plan to submit in Q1 of 2024.

○ **Is your fellowship likely to be the start of collaboration between your home institution and your host?**

Yes, a collaboration is already planned as defined above.

○ **Is your research likely to result in protected intellectual property, novel products or processes?**

This is not envisioned at this time.

**4. How might the results of your research project be important for helping develop regional, national or international agro-food, fisheries or forestry policies and, or practices, or be beneficial for society? Please express this in terms of environmental/food security/food safety/economic/health (human and livestock and plant) benefits, etc.**

The project contributes to the acquisition of science-based evidence to guide conversations and policies on pesticide used in Canada, in European countries, and in other OECD members. It will also inform the development of integrated pest management strategies to promote pollinator and environmental health while supporting crop protection and productivity. As a member of several organizations and as Chair of the Research Committee of the Canadian Association for Provincial Apiculturists, the fellow is sharing experiences related to this fellowship with other scientists and stakeholders to encourage future collaborative efforts towards standardized environmental monitoring of agrochemicals, and continued intercontinental conversations. Improving and standardizing monitoring for the acquisition of consistent data will have positive consequences beyond the groups involved. The data will inform stakeholders and policy makers towards evidence-base regulations regarding the use of agrochemicals to increase pollinator and ecosystem health, the sustainability of agricultural system and increased food security.

**5. How was this research relevant to:**

○ **The objectives of the CRP?**

The project increased international and intercontinental communication, technology transfer and knowledge exchange between Canada and Spain, two OECD Member Countries. It is also encouraging networking with other members, including European countries where the APISrip tool is already being used such as Denmark and Portugal. Networking with other members will follow, particularly with those where issues of pesticide use and environmental contamination are of increasing concern. This project has provided the foundation for standardized acquisition of new scientific data on the prevalence of environmental agrochemicals in different regions. This standardized bee-mediated monitoring data will inform stakeholders and provide data-driven evidence to guide agricultural policy decisions. It will also inform the debate on the current agro-

environmental matter of agrochemical use, its environmental persistence and the effect on pollinator and environmental health. These factors directly affect the sustainability of agri-food production systems and food security.

- **The CRP research theme?** Theme I. Managing Natural Capital. Topic: Integrated Agricultural Production Systems

The use of agrochemicals to increase crop productivity carries an environmental risk and undesired effects on human, pollinator, and overall ecosystem health. To inform efforts towards the protection of the natural ecosystem, this collaborative project with researchers from two member countries, Spain and Canada, aimed to establish a collaboration to expand the acquisition of bee-mediated environmental monitoring data. This project included the planning and implementation of the expanded use of a new tool for honey bee-mediated environmental monitoring of pesticides, the APIStrip. This tool is non-invasive and allows for standardized sampling and testing methodology where the timing of exposure is defined. It was developed by the laboratory of Professor Fernández-Alba, University of Almería, Spain, the host of this fellowship. During the project, a compilation and review of data currently available in Canada and Europe was initiated aimed to provide evidence on environmental presence of agrochemicals. The data acquired with the APIStrips after the fellowship will further inform this study. The results will guide the development of integrated pest management strategy to promote pollinator and environmental health while supporting crop protection and productivity. This project has, and will continue to contribute towards sustainable food production systems, food security and environmental sustainability.

## 6. Satisfaction

- **Did your fellowship conform to your expectations?**
  - Yes, the host laboratory exceeded my expectation in terms of personnel, expertise and laboratory equipment as well as their great disposition to share access to their laboratories, their time, and their expertise.
- **Will the OECD Co-operative Research Programme fellowship increase directly or indirectly your career opportunities? Please specify.**
  - Yes, the OECD Co-operative Research Programme fellowship has expanded my opportunities for collaborations, contributions, and impact. The fellowship resulted in a new intercontinental collaboration with the Spanish laboratory. It has also facilitated interactions with other scientists and stakeholders, as well as increased my interest and knowledge on policy issues which may open future opportunities in this area.
- **Did you encounter any practical problems?**
  - Prior to the fellowship, there were some challenges with the coordination of paperwork and payments between AAFC and OECD-ORP but all was resolved.
- **Please suggest any improvements in the Fellowship Programme.**
  - Suggest OECD-CRP organizes an open e-meeting once a year to address questions from potential applicants. Previous fellows may share their experience and OECD-CRP may answer practical questions about the application process and fellowship implementation.

## 7. Advertising the Co-operative Research Programme

- **How did you learn about the Co-operative Research Programme?**
  - I learned about the programme from AAFC's International office via my regional director, and from your website.
- **What would you suggest to make it more “visible”?**
  - This very helpful program could be promoted in scientific conferences.
  - Another suggestion would be to coordinate a session to explain the program and address questions (a couple of months before applications are due). Previous fellows could be asked to share their experience.
- **Are there any issues you would like to record?**
  - None. The experience exceeded my expectations. My especial thanks to OECD-CRP, AAFC, my host and members of his laboratory, for making possible the start of an intercontinental collaboration. I would also like to express my appreciation to Nathalie Elisseou Légise for her responsiveness to my many inquires. Thank you.

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