

Name: Maria José Aranzana Civit

The subject title: Understanding the mechanisms involved in epigenetic variability and inheritance in plant. Research Theme 3 (Transformational Technologies and Innovation)

Host institution: Whitehead Institute for Biomedical Research (Cambridge, MA, USA)

Host collaborator: Mary Gehring

The dates of the fellowship: 24th February 2020 to 25th August 2020

I give my consent to post this report on the Co-operative Research Programme's website.

1. What were the objectives of the research project? Why is the research project important?

The main goal of the project was to initiate a study on epigenetic variability and its inheritance in plants. This goal can be broken down into two sub-objectives:

- 1) Identification of mechanisms involved in the inheritance of epigenetic modifications across generations
- 2) Study of the implications of epigenetic variability in fruit tree response to biotic stress.

Epigenetic regulation plays a key role in plant response to the environment, in establishing reproductive barriers and gene inheritance. Therefore, the characterization of the epigenetic variation and its link with phenotypic variability in crops (in fruit trees in particular) can provide relevant scientific information on the contribution of epigenetic changes to adaptation and stability. Moreover, this knowledge will have important implications in advanced plant breeding.

2. Were the objectives of the fellowship achieved?

The objectives of the proposal couldn't be fully achieved due to the closure of the host institute three weeks after my arrival because of COVID19. However, thanks to the extension of the fellowship I was able to do some of the bench and plant work proposed in Task 1. The analysis of whole genome bisulfite-sequence (WGBS) data proposed in Task 2 could be done.

3. What were the major achievements of the fellowship? (up to three)

- We have identified differentially methylated regions in 3 apple genotypes grown in two agro-climatic regions.
- Advanced in the number of generations of Arabidopsis epigenetic mutants
- Determination of phenotypic variation in Arabidopsis epigenetic mutants

4. Will there be any follow-up work?

We expect that this fellowship will turn into a long-term collaboration between both institutions. We expect also a possible exchange of students and postdoctoral researches in the future.

5. 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?

Over decades agrobiodiversity of cultivated fruit tree species has been considerably reduced. Now a day, most cultivated varieties are highly susceptible to diseases and pests with limited ability to respond to challenging conditions.

The way plants respond to environmental changes and to stress varies among genotypes of the same species, denoting a natural genetic variability favoring adaptation (ability to respond positively to changes) and resilience (ability to recover after a stress). It has been demonstrated that epigenetic regulation plays a key role in many biological processes, including plant reproduction and plant response to the environment. Understanding and characterizing how epigenetic mechanisms participate in this processes in apple will have paramount implications in apple breeding and will help on the selection of natural resources to successfully address the new challenges in agriculture and food production, increasing resources use efficiency and lowering inputs.

Note that fruit tree species, and in particular apple, have important economic impact in OECD countries. In 2017, OECD countries dedicated more than 922 kha to cultivate apples, producing more than 22 Mt (FAOSTAT 2017). Apple cultivars are grown in commercial orchards for long periods (that could be decades), facing multiple stresses generated by biotic/abiotic conditions. Adverse conditions risk crop stability and, consequently, commercial value. For example, most of the apple quality traits revised in the guide of International Standards for Fruits and Vegetables published by the OECD are highly conditioned by the environment (OECD, 2011).

6. How was this research relevant to:

○ **The objectives of the CRP?**

The Co-operative Research Programme's main objective is to strengthen scientific knowledge and provide relevant scientific information and advice that will inform future policy decisions related to the sustainable use of natural resources, in the areas of food, agriculture, forests and fisheries. This project has provided cutting-edge scientific information with results transferable to applied science, particularly in the use of natural resources for breeding, with the consequent impact.

In addition, the aim of the CRP fellowship is to strengthen the international exchange of ideas and increase international mobility and co-operation among scientists working in these areas. The tasks of this project involved two species, the model plant *Arabidopsis thaliana* and a fruit tree (apple). This has favoured fruitful discussions and exchange of ideas that will end in future collaborations.

- **The CRP research theme?**

This project was directly relevant for the Theme III section “advanced breeding tools/Genetic and genomic technologies”. Understanding how epigenetic mechanisms participate in the control of some agronomic traits will be paramount in the development of new varieties in breeding programmes. Biotechnological tools, including genetic transformation and WGBS sequencing has been used here to understand molecular mechanisms enhance crop productivity and crop adaptation.

7. Satisfaction

Despite the adverse consequences of COVID19 pandemic in the development of the project, this fellowship has been very positive for my research. It has allowed me to increase my knowledge and understanding on epigenetic mechanisms in plants, as well has favoured the starting of new collaborations, that will increase my career opportunities.

The OECD has been of great help and support during my stay, characterized by the closure of the research centre and the uncertainty given the exceptional situation. The response from the OECD was always very supportive and I cannot be more grateful.

8. Advertising the Co-operative Research Programme

- How did you learn about the Co-operative Research Programme?
I learnt through other colleagues that were recipient of the fellowship in previous calls
- What would you suggest to make it more “visible”?
Recipient and host institutions could advertise it their social media.
- Are there any issues you would like to record?
No records, just to thank again the OECD all the support and the opportunity.