MAESTRO PG

Project title: Epigenetic priming of rootstocks and their effects on scion development in a stressful environment

Acronym: **MAESTRO PG**

Project duration: 24 months - Start date: 01/09/2020 End date: 31/08/2022

Key-words: Epigenetic, memory, rootstock-scion interaction, global warming, water availability

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Summary:

Plants are continuously exposed to environmental perturbations such as pests/pathogens infestation, extreme temperature, modification in light intensity, and variability in water supply. With the current climatic modifications observed due to global climate warming, our current agricultural model is faced with great challenges to maintain food production and quality. One of the challenges that growers are starting to face in some regions of the world is the decrease in water availability. Breeders and researchers are thus now faced with the need to provide varieties adapted to these new constrains.
Plants undergo many changes during stress exposure, and these adaptations are necessary for their survival. Besides the apparent morphological changes, researchers have also identified multiple modifications in gene transcription levels and pathways. In the last few years, studies have also revealed the importance of stress-induced chromatin changes, significant respond of non-coding RNAs, as well as modifications in DNA methylation levels. Some of these changes occurring during stress exposure, and known as epigenetic modifications, may revert to pre-stress state shortly thereafter. However, some may be retained by the plant, allowing a quicker and more adapted response when faced with a similar stress later on. Apples (Malus domestica) are perennial plants, and like many other plants, are reproduced clonally. Clonality in plants is widespread in nature, and includes species growing in heterogeneous environments. Yet, theory predicts that clonally reproduced plants may evolve at a slower rate than annual plants, which reproduction is principally based on sexual mating, thus benefiting from a greater genetic variation leading to evolutionary advancements. The success of clonality in dynamic environments indicates that clonally reproducing plants may have evolved mechanisms allowing plasticity and offering rapid responses not possible through genetic adaptation. Epigenetic-based plasticity could be a mechanism allowing clonal and perennial plant success. In this project, using apple as a clonally propagated and perennial model plant, we propose:
(i) to investigate the capacity of the plant to modify its morphological, transcriptomic and epigenomic response to hydric stress,
(ii) to investigate the memorization of the stress in the form of epigenomic modification,
(iii) to study the transmission of the acquired epigenomic modifications to a new plant via clonal reproduction (grafting),
(iv) to investigate the rootstock-scion interaction by evaluating the potential capacity of a hydric stress-primed rootstock to influence the development of the grafted scion when the whole plant is confronted to a hydric stress.
This project will allow us to better understand the plasticity of perennial plants via the process of epigenetic memory, and could potentially lead us to develop methods allowing the production of plants pre-adapted to their future environmental conditions in production.