FASTADAPT

FAST ADAPTation of stone fruit to pesticide reduction with digital phenotyping

ABSTRACT

Adapting crops to low-input management for a more healthy and sustainable production is a global challenge in agriculture. In stone fruit (Prunus genus), this is a hot topic since lowering the pesticide cover will affect orchards durably given that trees are planted for up to ten years. However little is known about how stone fruit can cope with a new environment where pesticides are withdrawn and where multiple and potentially new or re-emerging diseases (fungi, bacteria, virus) and pests (e.g.arthropods) attack the trees year after year. To observe the potential responses to this new environment, a more integrative phenotyping is needed, going beyond the typical approach of “one pathogen/pest at a time”. Researchers must rethink which traits must be measured and how to better describe tree health through time. Digital phenotyping (DP), relying on a diverse panel of sensors and acquisition devices, offers the opportunity to catch more information and at a faster pace than the human eye. However the application of imaging technologies is in its infancy in stone fruit.This project aims at producing a proof of concept for the use of DP to characterize the phenotypic response of peach (Prunus persica) under zero pesticide protection. It will rely on two orchards planted at two contrasted sites in South-East France and containing the same 220 genotypes. This population is a core-collection and as such,maximizes the representation of peach cultivated diversity. The goal is to identify useful traits measured via DP to describe plant health by testing two complementary approaches for imaging the orchards using RGB cameras mounted on UAVs (Unmanned Aerial Vehicle, here a drone) and a hand-held pole such as LITERAL. It will rely on a new collaboration between two Labex members, the Research Unit GAFL, specialized in stone fruit genetics and breeding and the mixed Research Unit CAPTE, specialized in the development of remote sensing tools to monitor annual plants. Through this project the Young Researcher will establish a durable collaboration to develop new phenotyping procedures, with the goal to use DP routinely for screening genetic diversity with the support of our partner AHM (Experimental Unit). Through this work, UMT CAPTE will have access to adequate experimental designs to develop methods for canopies with complex structures such as orchards.These methods will then be transferred to other perennial plant systems such as mixed crops in the future. By leveraging cutting-edge technologies for stone fruit phenotyping, significant gains in precision and time are expected, which combined with genomics-informed methods developped at GAFL, will contribute to a faster adaptation of stone fruit to low-input management.

Keywords : Pesticide reduction, Prunus, Optical sensors, Trait prediction, Artificial intelligence

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Flagship project : no

Project leader : Morgane Roth
Project leader's institution : INRAE
Project leader's RU : GAFL

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Total budget allocated (including co-financing) : 20000 €
Funding : Labex

GOAL

Because fighting for pesticide reduction allows addressing altogether sanitary demands and food security we propose here to focus on the adaptation of stone fruit to biotic pressures (diseases and pests).
The general objectives of this 18 months project are:
• To evaluate the potential of DP for peach health characterization in the orchards as a proof of concept
• To characterize plant health in peach genetic resources conducted under low input conditions
• To identify robust genotypes in peach genetic resources, i.e. individuals sustaining a healthy canopy in the absence of pesticides over one phenotyping season.
The long term goal is to accelerate resilience breeding in stone fruit,i.e. breeding varieties which can sustain their production in the presence of pests and pathogens over the years. The final ambition is to develop a disruptive approach combining DP with genomics-informed breeding to multiply time gains for breeders and hence total genetic gain.