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To cite this version:
Fares Belhassine, Benoit Pallas, Damien Fumey, Evelyne Costes. How to understand the alternate production in apple tree? A modeling approach of carbon and hormones fluxes. 1. International Symposium on Flowering, Fruit Set and Alternate Bearing, Jun 2018, Palerme, Italy. 2017. hal-02735538

HAL Id: hal-02735538
https://hal.inrae.fr/hal-02735538
Submitted on 2 Jun 2020

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How to understand the alternate production in apple tree?

A modeling approach of carbon and hormones fluxes

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Acknowledgements
The PhD scholarship of Fares Belhassine is funded by INRA, BAP department and ITK company.
We thank Sébastien Martinez, Sylvie Bluy-Pierru and other members of AFEF team for their contributions in field experiments and measurements.

References
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Context
The alternate bearing in apple trees consists in a high fruit production in ON years followed by a low production in OFF years (Fig. 1) and represents a major problem in fruit industry.

Main hypotheses
Floral induction (FI) variability between successive years is caused by:
- Competition for carbohydrates between fruits and vegetative organs (Monselise et Goldschmidt, 1982)
- Inhibition by gibberellins (GA) coming from the fruits seeds (Nielsen and Dennis, 2000)
- Tree architectural variability (Lespinasse et Delort, 1986)

Previous results
Analyzes of transcript differentially expressed in terminal buds of ‘ON’ and ‘OFF’ trees show starvation for carbon and stress hormonal metabolism in ‘ON’ trees (Guitton et al., 2016)

Objectives
- Understanding the physiological processes controlling FI in apple trees
- Modeling and simulating carbon and hormone fluxes within the trees and their consequences on FI
- Integrating genotypic variability in the modelling approach to account for the variability in bearing patterns

Experimental design
- First experiment (2015-2017): Leaf and fruit removal at different scales (shoot, branch and Y shape-trees; Fig. 2) to locally modify Carbon source/sink relations and GA content
- Second experiment (2017-2018): Characterizing the genotypic variability in production patterns and architecture on a subset of genotypes selected in an apple tree core collection(Fig. 3)

Measurements
- Digitizing trees to get 3D representations
- Flowering and fruit production and their within tree distributions
- Non structural carbohydrates and gibberellins concentration before bud break, at FI and fruit maturity
- Photosynthetic activity of leaves at the FI period

Analyses
- Quantifying the effect of distances on FI and calibration of the flux models
- Analyzing the relationships between architecture, functioning and flower induction on the subset of genotypes of the core collection

Expected output
Development of a decision support model to help breeders managing fruit thinning and crop load

Fig 1: Trees in ON (left) and OFF (right) years.

Fig 2: Experimental design for local leaf and fruit removal on 10 year-old ‘Golden’ trees

Fig 3: 3D representation of a subset of genotypes in the French apple core collection (planted in 2014)

Fig 4: Different architectures of trees simulated by MappleT model (Costes et al, 2008)