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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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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 (Neilsen 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)
- Genetic variability in bearing behavior associated with a strong genetic determinism (Guitton et al., 2012)
- Genotypes can be classified for bearing behavior in three classes (irregular, biennial, regular) (Durand et al., 2013)

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 modeling 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. 4)

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

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References