Simulating pruning responses in a 3D model of cocoa trees

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Introduction

• Pruning is a recommended potentially yield-enhancing practice in cocoa cultivation.
• The impact of pruning on tree architecture and functioning is complex to measure and predict.
• Functional-structural plant (FSP) models can be used to disentangle the instant and long-term effects of pruning on tree functioning and they can help designing effective pruning strategies in term of modality, intensity and timing.

• Detailed information on cocoa branching patterns in response to pruning are missing, but are required in order develop a FSP model of cocoa and to improve cocoa pruning effectiveness.

Aims: Understanding cocoa branching pattern in response to pruning and develop a FSP model of cocoa trees able to simulate effect of formation pruning on cocoa architecture and biomass accumulation.

Methods

Calibration experiment

• We applied five pruning treatments including a control to 2 years old trees in an experimental field in Côte d'Ivoire (Fig 1).
• Before pruning and after the first flush, number and position of lateral branches were measured.
• We estimated the probability of branch emergence as a function of position along a branch (rank) using generalized mixed effect models

Results of calibration experiment

• Emergence of new branches during a flush cycle is concentrated in the section of the primary branch that had developed before the last flushing event.
• The pattern of branch emergence was modified by the different pruning treatments, but it also varied among plants and branches.
• Probability of branch emergence decreased with the number of secondary branches already present on a primary branch.

Upcoming work and outlook

• The model performance will be evaluated using data from a formation pruning experiment on cocoa trees in Côte d'Ivoire.
• The cocoa FSP model potentially serves as a tool to address relevant issues in cocoa production, such as optimal pruning practice and planting design.
• It could be used for screening promising trial options and for ideotyping plant structure for breeding purposes.

• The 3D visual output makes the model a potential communication tool for academic and non-academic audience

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