Pest-regulating service of the coffee berry borer (*Hypothenemus hampei*) in agroforestry systems

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Introduction

- Plant diversity can provide **different regulation pathways** (bottom up, top down) to control pest populations and reduce damage and losses induced
- Regulation pathways in agroforestry systems (AFS) involve **complex interaction networks**
- Regulation of **the Coffee Berry Borer** (CBB, the world's most important coffee pest) relies on the effects of environment conditions and of predator communities (***Fig.1***)
- **Global effects difficult to summarize :** necessity to have a good knowledge on the involved pathways and a powerful statistical analysis, to take into account all the possible interactions

How does plant diversity associated to complex AFS regulate CBB in these triple interaction network (pest- predator- environment)?

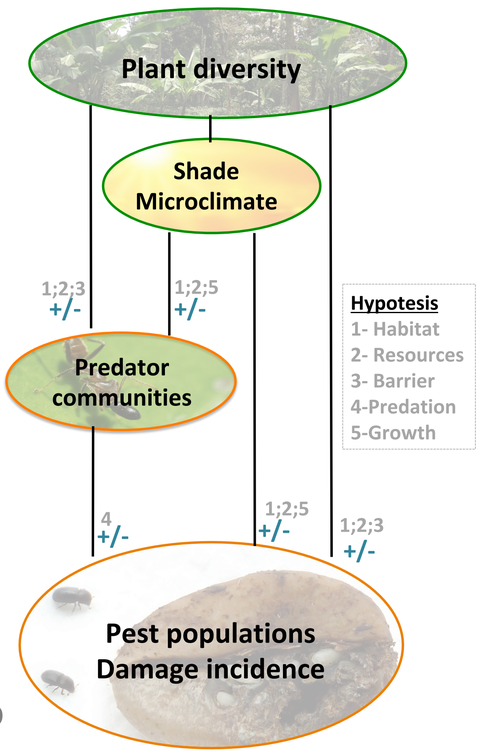

Fig.1 *Main pathways involved in regulation prrocesses via the effect of plant diversity in agroecosystems*

Material and methods

Knowledge of pathways involved in regulation processes ***(Fig. 1)*** and on bio-ecology of the pest = **Conceptual map of the pest regulation**

Structural Equation Modeling (SEM) to evaluate the links between the AFS components involved in the pest regulation

Ecological indicators evaluated in 49 plots (local scale) in 3 farms (global scale*):

- Composition of biodiversity:
  - **Global Sp Richness** : Farm Tree Specific Richness *
  - **Local Sp Richness** : Plot Tree Specific Richness
  - **Density** : Coffee density
  - **G1-G2**: Abundance of two groups of ant predators (**G1**: numerical dominant Solenopsis species and **G2**: Diversified ant predator species; 6sp)

- Structure of biodiversity :
  - **Tree area**: Occupied tree surface areas

- Microclimate :
  - **MaxT°**: Maximum temperature

- Pest populations :
  - **AdCBB**: Adult populations before coffee fruiting period
  - **IniCBB**: Initial CBB fruit infested proportion
  - **PeakCBB**: CBB fruit infested proportion during the peak of coffee production

Results & discussion

- **Increasing global and local plant richness** impacts ant predator populations in a different way depending of ecological requirement of species within the communities
- **A high coffee density** could have a negative effect on the abundance of the diversified predator group through homogeneization of resources and loss of habitats

Ambrosia Symbiosis

- **Increasing global richness within the farms,** could increase the number of CBB infested fruits through its buffer **effect on maximum temperature**
- **More shade tree areas at local scale** could prevent CBB displacement from trees to trees and reduce the number of CBB infested fruits
- **Initial population** of CBB is a good indicator of the infestation rate at the end of the production season

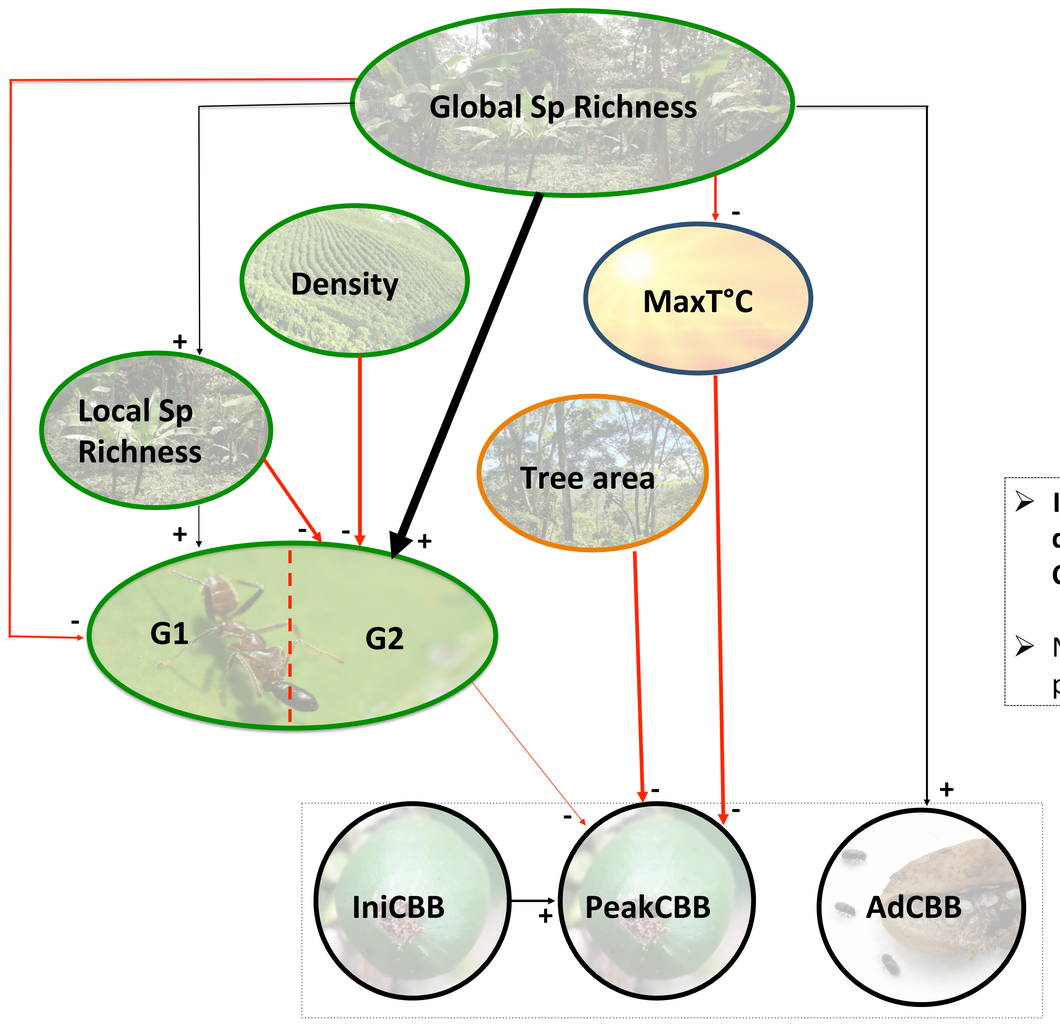

Fig.2 *Representative summary of the global pathway model results showing the effects of environmental conditions on CBB, on the abundance of 2 groups of predatory ants and on biotic interactions between these 2 communities.* The thickness of the arrows is proportional to the strength of the effect

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- **Increasing abundance of the diversified predator group reduces CBB infested fruits**
- No effect of the most abundant predator species on CBB

- **The increase in plant richness has antagonistic effects on predator communities and on CBB regulation depending on spatial scales**
- **A higher abundance of the diversified predator group reduces the number of CBB infested fruits**
- **SEM a powerful statistical tool to integrate interaction analysis in SAF**

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