

## **No-Till Practices and Banana Cropping Systems:** How Mechanization Can Contribute to a Sustainable Banana Production in the French West Indies?

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#### **GUADELOUPE & MARTINIQUE**

- TROPICAL CLIMATE: Rainfall => from 1300 to 6000 mm, average Temperature = 28-30 °C
- Andosoils, Ferrallitic soils, Vertisoils...

## Main exporting countries (Cavendish Banana) in 2016



## **INDUSTRIAL (Cavendish) BANANA ISSUES**



#### **ENVIRONMENTAL**

- Decreasing soil & water pollution due to chemical inputs
- Biodiversity conservation



#### **SOCIETY**

- Reconciliation between Society & Agriculture
- Quality of life & food quality improvement



#### **PRODUCERS**

- To maintain/increase productivity and to decrease production costs in order to generate higher profits



#### **RESEARCH & DEVELOPMENT**

- Food security
- Better understanding of agroecological processes in order to promote sustainable agriculture & biodiversity



## SUSTAINABLE BANANA PROJECT IN THE FWI

Funded by EU since 2008

- Partnership between CIRAD
  - French Technical Institute

Banana Producers Organization

#### **3 MAIN OBJECTIVES**

- To design innovative banana cropping systems and to provide support for their dissemination in order to reduce the use of pesticides;
- To monitor and to control emerging diseases (Black Leaf Streak);
- **To create resistant banana hybrids** to emerging diseases.



## Example of conventional banana cropping system & practices in the FWI

#### Banana (5 years) / Fallow / Banana (5 years)



# Cover Crops : a Key Component in the No-Till Banana Cropping Systems

Arachis pintoï + Bananas (Guadeloupe)

# **Multifunctionality of cover crops**





# **Nematodes Regulation**

## => 2 processes

## 1st - Sanitation during fallow period

- Installation of cover crops non-host of banana nematodes;
- Allelopathic effect.

## Multiplication rate of nematodes (*Radopholus Similis*) according to species



Dorel et al. 2016



## 2<sup>nd</sup> - Enhancing nematodes predation

Comparison of free-living soil nematodes communities :



## with cover crops





**BS**: Bare Soil

 $\rightarrow$  Cover crops increase predators populations

=> Positive effect on biodiversity and food webs



## Weevil borer control

In soil litter, general predators contribute to weevil borer control:

- Ants
- Earwigs...



#### Captures of ants Solenopsis geminata



# **Cover crops increase predators abundance**

Mollot et al. 2012



# Predators increase the predation rate of weevil borer eggs

Mollot et al. 2012

Weevil borer control by *Brachiaria decumbens* (Guadeloupe)

#### + pheromone traps

# Which specie is the best for banana?



# ALL OF THEM!

ADD species according to their COMPLEMENTARITY => Increase the functional biodiversity

protection

Soil

Organic

Matter.

Soil

**Biological** 

activity

Soil

structure



N fixation Nutrients recycling



#### Brachiaria R. + Crotalaria S. during fallow period (Guadeloupe)

#### Crotalaria

- ORGANIC NEMATICIDE
- N Fixation
- Drainage (Tap Root System)

Brachiaria

\* High vegetal biomass production (C, SOM)
\* Biological ploughing
\* Nutrients recycling (biological pump)



**Complexity gradient** 

**COVER\*** 

Cajanus, Centrosema...)

on LIVING COVER\*

**3- Banana Direct Planting** 





- Cover crops can be managed by mowing or rolling

- Biological tillage with legumes less efficient during fallow period

- Mechanization/labor required because of the cover crop management

![](_page_25_Picture_1.jpeg)

#### **ICS IV**

- Soils are permanently covered (before and after banana plantation)
- Efficient pests control (nematodes, weeds...), continuous soil fertility improvement
  - High technicity and Know-How required
  - Mechanization is highly required to sow and manage cover crops

# Part 2: Adoption of No-Till Banana Cropping Systems

## Monitoring : Adoption of No-Till Banana Cropping Systems

- Annual surveys (from 2012) among 570 banana producers in FWI for basic data
- Qualitative interviews (2017): perceptions of the advantages and limits of cover crops in banana cropping systems, constraints for adoption and dissemination, etc. => 109 interviews

![](_page_28_Figure_0.jpeg)

#### Number of farmers using Cover Crops in the FWI

![](_page_28_Figure_2.jpeg)

### Results

- Early stage of agro-ecological transition;
- Highest adoption levels are observed among largest-scale farms (access to mechanization);
- Adequate approach required in order to accompany medium and small-scale farms.

#### Source: UGPBAN, IT2, CIRAD

#### Results based on 109 interviews

## **Producers ' Point of View...**

![](_page_29_Figure_2.jpeg)

# For the « No-Till » producers What are the main constraints for extension? Farm organization (Labor Avaibality, Calendar, production costs) Lack of adapted equipments for cover crops management Topography

![](_page_29_Picture_4.jpeg)

## • For the "NON-Users" Why don't you adopt these systems?

Farm organization (Labor Avaibality, production costs...)

Technical issues (lack of knowledge, lack of equipment...)

#### Topography

No interest (not convinced, negative representation...)

Source: CIRAD, IT2

![](_page_30_Figure_0.jpeg)

![](_page_31_Figure_0.jpeg)

For being successful, adoption of such innovative systems requires a high level of integration: from the soil to the landscape, from research to private sector

![](_page_32_Picture_1.jpeg)

FALLOW with Crotalaria spectabilis + Brachiaria sp. (Guadeloupe)

![](_page_34_Picture_0.jpeg)

Rolling on *Crotalaria juncea* with a roller crimper before Banana planting (Martinique)

Crotalaria juncea + Desmodium ovalifolium + Bananas (Guadeloupe) Crotalaria juncea + Desmodium ovalifolium + Bananas (Guadeloupe)

Direct seeding of Pigeon Pea on Brachiaria sp. + Crotalaria sp. residues (Guadeloupe)

SA 7300

![](_page_39_Picture_0.jpeg)

Sesbania sp. + Desmodium ovalifolium + Bananas (Martinique)

Sesbania sp. + Desmodium ovalifolium + Bananas (Martinique)

Desmodium ovalifolium + Bananas (Martinique)

#### "Ace" buggy with mower (Martinique)

01 09 2017

"Ace" buggy with mower (Martinique)

meter

05 09 2017

Management of the cover crop (*Panicum maximum* cv. Mombaça) before bananas planting (Martinique)

Inter Row

**Banana Planting Row** 

and the

Bananas + Gmelina arborea + Brachiaria D. (Martinique)

#### Bananas + Gmelina arborea + Brachiaria D. (Martinique)

EE 904-PA

0.

**MOWING MACHINE** 

**SWATHING MACHINE** 

SWATHING machine for small tractor...

![](_page_49_Picture_0.jpeg)

![](_page_49_Picture_1.jpeg)

Preparation of Arachis repens cuttings by banana producers (Guadeloupe) Planting Arachis repens cuttings on brachiaria mulch with a modified vegetables planter (Martinique)

![](_page_51_Picture_0.jpeg)

Arachis repens + Bananas (Guadeloupe)

![](_page_51_Picture_2.jpeg)

Thank Yo