Introducing cover crops in the Caribbean banana fields: Which determinants for adoption of innovative banana cropping systems in the French West Indies and Dominican Republic?

Hoa TRAN QUOC (CIRAD)
L. Gervais, M. Hery, K. Vincent, G. Gandini, R. Le Guen, D. Dural, M. Dorel

Promusa Symposium 2016
Agropolis - Montpellier
**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
2 projects : 2 contrasted situations

**SUSTAINABLE BANANA PROJECT since 2008 :**
⇒ Partnership between Cirad/IT2/UGPBAN

**Main objective:** To design and to accompany the transfer of innovative banana cropping systems in order to reduce the use of pesticides

**BAM PROJECT since 2015 :**
⇒ Partnership between Cirad/JAD (Producers Organization)

**Main objective:** To design and to adapt productive and sustainable organic banana cropping systems by introducing cover crops

<table>
<thead>
<tr>
<th>General</th>
<th>Limiting factors</th>
<th>Conventional Banana Cropping Systems</th>
</tr>
</thead>
<tbody>
<tr>
<td>T. Area = 7800 ha T. Producers = 560</td>
<td>• High production costs • Labor unavailability</td>
<td>• Banana (5 y)/ Fallow (6 to 12 months) / Banana (5 y) • Banana (5 y) / Sugar Cane (4 y) / Banana (5 y)</td>
</tr>
<tr>
<td>T. Area = 8250 ha T. Producers = 910</td>
<td>• No Treasury for smallholders • Drought conditions</td>
<td><strong>Lowland perennial</strong> (organic and none organic) banana systems with irrigation (mainly by flooding)</td>
</tr>
</tbody>
</table>

Mao Valverde Province
Soil fertility degradation
• Weed dissemination
• Low soil fertility improvement
• Low/slow soil sanitization

Main agronomical constraints

Example of conventional banana cropping system & practices in the FWI

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

5 years

Chemical and/or mechanical destruction
Spontaneous fallow (6 to 12 months)
Soil tillage
Planting on bare soils

Soil fertility degradation
Weed pressure
Use of pesticides for banana production in the FWI

Quantity of used Active Substances (AS) per year

- >100 000T: Herbicides > 63 000T
- Herb. > 46 500T
- 2008-2015: ≈ 30% off (herbicides)
- <50 000T: Herb. > 33 500T
- 3.5 kg AS/ha/year

Source: IT2, CIRAD
Part 1
Cover crops: a key component in the innovative banana cropping systems

Arachis pintoï + Bananas (Guadeloupe)
Various cover crops-based banana cropping systems in the FWI

**Conventional Cropping systems**
1. Natural fallow
2. Banana on bare soils

**Innovative CS I**
1. Natural fallow
2. Banana on bare soils
3. Banana + perennial LIVING COVER*
   * A. pintoï + Crotalaria sp.
   * D. heterocarpon + Crotalaria sp.
   * Arachis + Desmodium + Sesbania sp.
   * C. cajan + Desmodium
   * N. wightii, P. phaseoloides
   * Drymaria cordata...

**Innovative CS II**
1. Improved fallow*
   * Brachiaria sp. + Crotalaria sp.
   * Brachiaria sp. + C. cajan
   * Brachiaria sp. + S. guianensis
2. Banana Direct Planting on MULCH*
   * Brachiaria sp. + Annual legumes
   * Brachiaria sp. + Perennial legumes (Arachis, Desmodium...)

**Innovative CS III**
1. Improved fallow*
   * Annual: C. pascuorum, S. guianensis
   * Perennial: N. wightii, P. phaseoloides, A. pintoï + Crotalaria sp., D. heterocarpon + Sesbania sp...
2. Banana Direct Planting on LIVING COVER*
3. Banana Direct Planting on LIVING COVER*

**Innovative CS IV**
1. Improved fallow*
2. Second perennial cover* on MULCH
   * Perennial legumes (Arachis, Desmodium...) + Annual legumes (Crotalaria, Sesbania, Cajanus, Centrosema...)
3. Banana Direct Planting on LIVING COVER*

Complexity gradient
Various cover crops-based banana cropping systems in the FWI

Conventional CS
- Chemical and/or mechanical destruction
- Spontaneous fallow
- Soil tillage
- Planting on bare soils

ICS I
- Field leveling
- Does not require high technicity
- Could be realized in many situations
- Low improvement of soil fertility and slow soil sanitation
- Soils are not protected before banana plantation

Living cover under bananas
Various cover crops-based banana cropping systems in the FWI

- Good soil fertility improvement and soil sanitation
- Soils are protected BEFORE banana plantation
- Easy to do

- Mulch degradation leads to weed pressure increase
- Herbicides are required to control perennial grasses (Brachiaria)
Various cover crops-based banana cropping systems in the FWI

ICS II
- N supply, efficient weeds control
- Soils are protected before and after banana plantation
- Cover crop can be destructed by cutting or rolling

ICS III
- Improved fallow (Mix of legumes species)
- Banana Direct Planting on Living Cover
- Living Cover management

ICS III
- Biological tillage less efficient during fallow period
- Technicity required because of cover crop management
Various cover crops-based banana cropping systems in the FWI

- Soils are permanently covered (before and after banana plantation)
- Efficient pests control (nematods, weeds...), continuous soil fertility improvement
- High technicity and how to do required
- Mechanization is highly required to sow and manage cover crops
Part 2: Adoption of cover crops-based banana cropping systems

*Cajanus cajan* (Pigeon Pea) + Bananas (Guadeloupe)
Monitoring: adoption of cover crops

• **Annual surveys** (from 2012 to 2015) among 560 banana producers in Guadeloupe & Martinique for basic data (Area with vegetal cover, used species, cover crop management modes, etc.)

• **Qualitative interviews** (2016, in progress): perceptions of the benefits and constraints of cover crops in banana cropping systems, constraints for adoption and dissemination, etc.
**Results**

**Area w/ vegetal covers in the FWI**

- Surface with spontaneous & selected species
- Surface with "exogenous" species

**Species distribution (2015)**

- Brachiaria sp.: 27%
- Crotalaria sp.: 14%
- Legumes (Arachis, Desmodium, Cajanus, Neonotonia, Centrosema...): 6%
- Spontaneous species (Drymaria, Cleome, Impatiens...): 53%

**Use of vegetal covers**

- 42% Under bananas
- 58% Fallow period

**Species used under bananas**

- Exogenous species are mainly used during fallow period
- Local and spontaneous species are used under bananas

**Technicity required to plant adapted exogenous species under bananas**

- 9% of total Area

Source: UGPBAN, IT2, CIRAD
**Results**

**Distribution of “Adopting” farms according to REFERENCE (~ w/ Farm Size)**

- Farms REF>1000T: 41%
- Farms 500T<REF<1000T: 7%
- Farms REF<500T: 52%

**Number of farms using cover crops in the FWI**

- 2012: 72, 12%
- 2013: 90, 15%
- 2014: 97, 17%
- 2015: 114, 21% of total producers

**Distribution of Area with covers according to REFERENCE**

- Farms REF>1000T: 82%
- Farms 500T<REF<1000T: 14%
- Farms REF<500T: 4%

**Adoption Rate according to REFERENCE**

- Farms REF>1000T: 14%
- Farms 500T<REF<1000T: 9%
- Farms REF<500T: 77%

Source: UGPBAN, IT2, CIRAD
Who are adopting what?

**Who are adopting what?**

Distribution of “Adopting” farms according to REFERENCE

- Farms REF>1000T
- Farms 500T<REF<1000T
- Farms REF<500T

**Large-scale Farms**
- Access to mechanization
- Available treasury

**Medium-scale Farms**
- Yes/No access to mechanization
- Few available treasury

**Small-scale Farms**
- No access to mechanization
- Few available treasury
- No fallow period
- Specific incentives for cover crops

**Innovative CS I**
- By using cuttings (Arachis, Drymaria...)
- Preservation of spontaneous cover
- Weed management by mowing strategy

**Innovative CS II** (A FEW FOR THE MOMENT)

**Innovative CS III** (A VERY FEW FOR THE MOMENT)

**Innovative CS IV** (A FEW FOR THE MOMENT)

+ Weed management by mowing strategy
+ Preservation of spontaneous covers
Why do banana producers use cover crops?

- To reduce the use of herbicides
- To improve soil structure
- To control nematodes
- To enhance soil biological activity
- To improve soil fertility (chemical...)
- To protect the soils against erosion
- Others

Frequency of answers (n=22)

- Up to 1500 €/ha/1st Cycle
- Sensitized to soil fertility, soil capital

Why do banana producers not want to use cover crops?

- Constraints related to labor unavailability
- Constraints related to treasury availability
- Lack of communication & Capacity building
- Size farms & Topography
- Lack of labor force
- Access to mechanization
- Lack of cash
- Lack of information/technical support
- Lack of surface for fallow
- Topography not adapted
- Lack of knowledge
- Others

Frequency of answers (n=14)

Source: Survey 2016 in progress (CIRAD, IT2, UGPBAN)
Producer’s point of view

Why do banana producers would like to experiment cover crops?

- Soil Fertility Improvement
- Soil Protection
- Soil Biological Activity Improvement
- Pests Control (Insects)
- Soil Moisture Conservation
- Weeds Control
- Production Costs decreasing
- Others

Frequency of answers (n=28)

Source: Survey 2015 (CIRAD)
Example of Lowland Perennial (organic or NOT) Banana System in Mao Valverde Province

Irrigation system (w/ dikes) by flooding

Shade (>80%)

No more banana row
The 1st Feed Backs

- **Technical constraints**
  - Implementation of cover crop:
    - *under shade of an established banana field (high banana density)*;
    - *due to irrigation system (flooding)*;
    - *due to banana residues management*
  - Management of the cover crop in order to limit competition with bananas due to soil & drought conditions

- **Social and economical constraints for adoption**
  - Difficult access to vegetal material;
  - Unavailable funding for smallholders;
  - Ability of extension agents to accompany producers???
Conclusions

• Early stage of agro-ecological transition but the dynamic is real in FWI!

• Highest adoption levels are observed among largest-scale farms which have the capacity to invest and to mechanize the planting & management of cover crops

• BUT cover crops-based banana cropping systems can be an acceptable option even in a context of small-scale farming and/or difficult topography

• More efforts with adequate approach should be made in order to promote ICS among medium and small-scale farms with more appropriate incentives for those categories

• Technical innovations must be accompanied by organizational and institutional innovations: e.g. establishment of a “Special Unit” (involving CIRAD, IT2, UGPBAN) dedicated to the support of the dissemination of ICS.
Fallow with *Crotalaria juncea* + *Brachiaria sp.*
(Guadeloupe)
Fallow with *Cajanus cajan* (Martinique)
Direct seeding of *Cajanus cajan* + *Arachis pintoï* on *Brachiaria sp.* + *Crotalaria sp.* residues (Guadeloupe)
Crotalaria spectabilis. + Bananas (Guadeloupe)
Sesbania sp. + Desmodium heterocarpon + Bananas (Martinique)
Arachis pintoï + Bananas (Guadeloupe)

Residues management
Neonotonia wightii + Bananas (Dominican Republic)
spontaneous (*Drymaria cordata*) + Bananas (Guadeloupe)

Residues management
Spontaneous cover (*Microtea debilis*) + Bananas (Martinique)
Thank you!