What to expect from modeling to assist the design of plantain based systems?

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Models can do

- Exploration / optimization of processes
Models can do

- Exploration / optimization of processes

Optimize processes accounting for the constraints of the system
But models cannot go further than implemented processes
Efficient to deal with trade-offs between processes/outputs
Cropping systems are not a game of Lego

More, important when dealing with ecological processes compared to chemical regulations...
→ need to have a system approach
What issues to address with plantain crop model?

1. Explore new options of soil fertility management

2. Rethink the selection of plantain varieties to the production context

3. Optimize the exploitation of radiation and mineral resources in multispecies systems

...Not the pest and diseases issues for today...
Improve soil fertility
1. Explore new options of soil fertility management

• Issues:
  – Use new sources of nutrients (e.g. exogenous or endogenous organic matters)
  – Optimize crop rotations
  – Manage the plant (density, sucker selection)
1. Explore new options of soil fertility management

• Processes to implement in models

Adapted from Dorel et al 2008
1. Explore new options of soil fertility management

- Possible uses of models
  - Assess long-term scenarios of rotations and associations for yield and SOM building up (similarly to the ROTAT tool; Dogglioti et al. 2003 Eur J Agron.)
1. Explore new options of soil fertility management

• Explore trade-offs

- Effect on SOM
- Overall yield
- Nitrogen efficiency
- Select best trade-offs
- Field experiments
1. Explore new options of soil fertility management

• Data to acquire
  – Characterize residues mineralization and nutrient demand of main crops
  – Characterize soils....
Better use varieties
2. Rethink the selection of plantain varieties to the production context

• Issues:
  – Better choose varieties in plantain based cropping systems
  – Benchmark plantain varieties
2. Rethink the selection of plantain varieties to the production context

• Processes to implement in models
  – Growth and development of plantains: similar model as for desert banana but with different parameters
    • Development
    • Radiation interception
    • Conversion into biomass
    • Allocation to plant organs
    • Mineral resource exploitation
    • Effect of stresses

\[ \text{Radiation} \]
\[ \text{Dev} \]
\[ \text{Stress} \]
\[ \text{N soil} \]
\[ \text{LA} \]
\[ \text{Yield} \]
\[ \text{Biom vgt} \]
\[ \text{Roots} \]
2. Rethink the selection of plantain varieties to the production context

- Data to acquire
  - Characterize growth and development parameters of major varieties in multi-local experiments

→ huge experiments...
2. Rethink the selection of plantain varieties to the production context

- Explore with the model: N, water, radiation...

Example: Effect of the radiation context on bunch biomass
Optimize complex systems?
3. Optimize the exploitation of radiation and mineral resources in multispecies systems

• Issues:
  – What is the optimal management of plantains in multi-strata systems?
  – What system maximize ecosystem services?
3. Optimize the exploitation of radiation and mineral resources in multispecies systems

• 2 possible approaches:
  – Plantain based model ➔ account for other cultivated plants through available resources
  – Multi-crop model ➔ in which all cultivated plants are simulated
    • Non-spatially explicit
    • Spatially explicit
3. Optimize the exploitation of radiation and mineral resources in multispecies systems

Cultural practices efficiency
Resilience
One-crop yield
Multi-crop yield

Best trade-off depends on farmers’ objectives and production conditions
3. Optimize the exploitation of radiation and mineral resources in multispecies systems

- Use spatially explicit models to establish rule of spatial and temporal assemblage of cultivated plants to maximize ecosystem services (not only plantain yield...)

*From Chave et al. 1999*
Concluding remarks

• Many different model could be used (1 model for 1 question...)
  → Surely helpful to address the design of optimized rotation/association or to deal with spatial complexity

• Maximize the use of existing data

• Necessity to keep modeling approaches as close as possible to the field
Thank you for your attention!