

# EPITAG EPIdemiological modelling and control for Tropical AGriculture



Suzanne TOUZEAU (INRAE, *Inria*) &



Samuel BOWONG (Univ. Douala)



French & Cameroonian researchers and students, with a background in **applied mathematics**, and an interest in **crop diseases**



Ludovic MAILLERET  
Suzanne TOUZEAU



Frédéric GROGNARD



Sophia Antipolis

Cameroon



Yves DUMONT



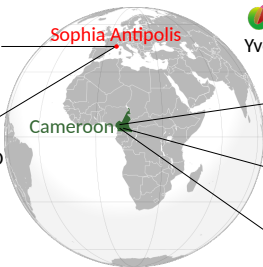
Univ. Dschang  
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Univ. Yaoundé I  
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Samuel BOWONG

- 2017–2024 *Inria* **Associate Team**, part of (renewed in 2020, restarted in 2022 due to pandemic)



- 2022–2024 **INRAE** support through **TSARA** programme and support



## Context

- Population & food demand are increasing
- Crop pests & diseases threaten food security  
*20–40% of crop yields destroyed every year*
- Agriculture provides employment & revenues  
*Cameroon: work 62%, exports 30%, GDP 15%*

➔ Controlling crop pests is a major issue

Chemical pesticides:

- negative impact on health & environment
- variable effectiveness, pest resistance
- high financial and labour costs

➔ Sustainable eco-friendly alternatives

SUSTAINABLE  
DEVELOPMENT  
GOALS



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Epidemiology and management of tropical crop diseases, with a focus on Cameroon, using tools from **dynamical systems** and **control theory**



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## Main activities

- **Joint supervision of PhD students** from Cameroon  
student visits in France: 2–3 students/year, 3- to 5-month stays (except 2020-2022)
- Dissemination actions: **EPITAG workshops** (Yaoundé, Dec. 2017, *Dschang, Nov. 2023*), LIRIMA Scientific Days (Tunis 2017, Yaoundé 2019), AgriNumA Symposium, etc.



### Cocoa plant mirids

**Myriam DJOUKWE TAPI**

Univ. Douala, 2020

Lect. Univ. Douala



### Plantain plant-parasitic nematodes

**Israël TANKAM CHEDJOU**

Univ. Yaoundé I, 2022

Pdocs Univ. Cambridge, INRAE Rennes;

Lect. Univ. Yaoundé I



### Coffee berry borers

**Yves Fotso Fotso**

Univ. Dschang, 2022

Pdoc INRAE Rennes; Lect. Univ. Dschang



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### Coffee leaf rust

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Univ. Côte d'Azur, 2023 (*Inria grant*)

ATER UniCA; Pdoc Univ. Manitoba, Canada



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### Cabbage diamondback moth

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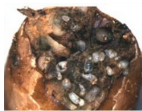
**Support:** *Inria* Associate Team & CORDI grant, *INRAE* TSARA programme, *French Embassy* in Cameroon, *AUF* Collège doctoral régional Mathinbio, *EMS* Simons for Africa, *IRD* UMMISCO, *CIRAD*

**More on EPITAG:** <https://team.inria.fr/epitag/>

# Focus: Coffee Berry Borers [FOTSO FOTSO et al.]

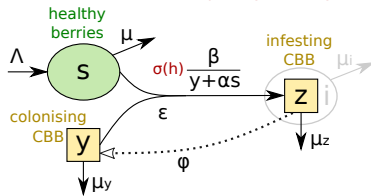


Uccao Cameroun



[Burbano, JIS 2011]

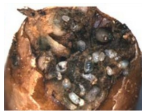
control:   
entomopathogenic fungus



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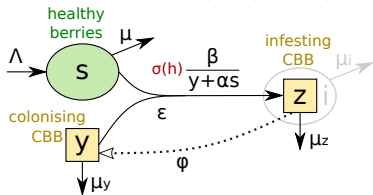


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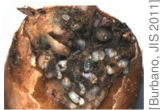


$$\begin{cases}
 \dot{s} = \begin{matrix} \text{new berries} \\ \Lambda \end{matrix} - \sigma(v) \beta \frac{sy}{y + \alpha s} - \mu s & \begin{matrix} \text{infestation} \\ \text{mortality} \end{matrix} \\
 \dot{y} = \begin{matrix} \text{emergence} \\ \varphi z \end{matrix} + \epsilon \beta \frac{sy}{y + \alpha s} - \mu_y y & \\
 \dot{z} = +\sigma(v) \epsilon \beta \frac{sy}{y + \alpha s} - \mu_z z & \\
 \dot{v} = -\gamma v + h(t) & \leftarrow \begin{matrix} \text{fungus load} \\ \text{decay} \quad \text{control} \end{matrix}
 \end{cases}$$

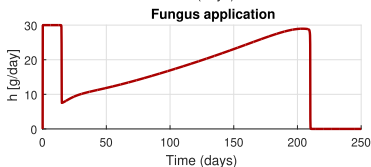
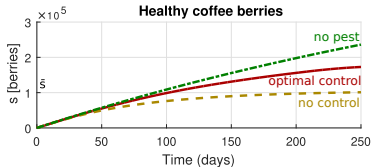
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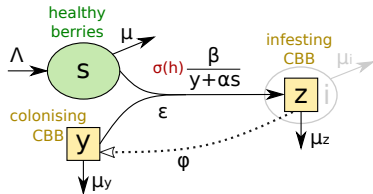
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