

EPITAG – EPIdemiological modelling and control for Tropical AGRiculture



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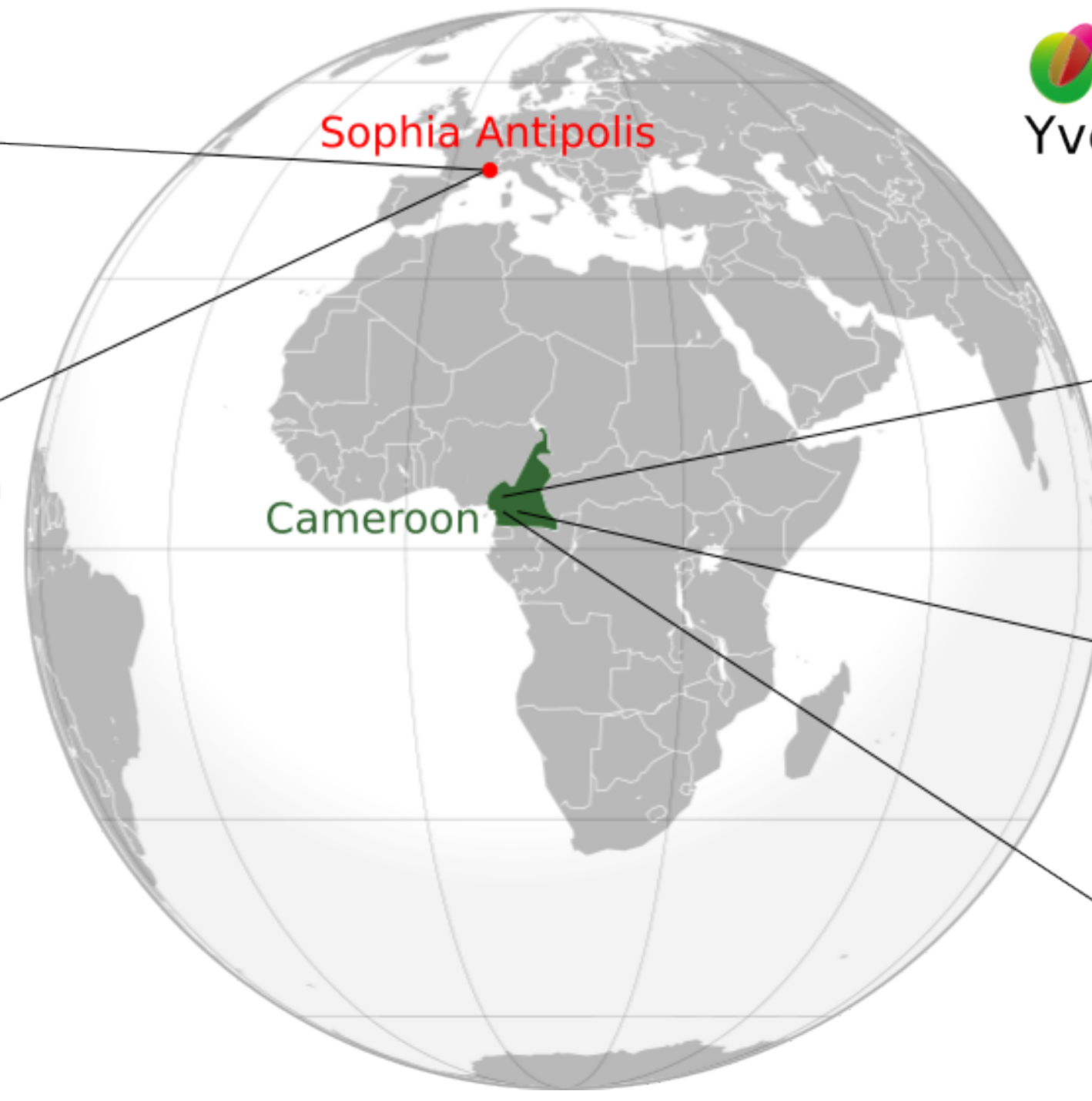
Samuel BOWONG (Univ. Douala, Cameroon)



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

- 2017–2024 *Inria* Associate Team, part of LIRIMA (renewed in 2020 and restarted in 2022 due to Covid pandemic)
- 2022–2024 INRAE support through TSARA programme
- and AMBASSADE DE FRANCE AU CAMEROUN and INSTITUT FRANÇAIS support

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Univ. Yaoundé I Jean Jules TEWA

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Context

- Population & food demand are increasing
 “By 2050, global agricultural production must increase by 70% [...] to meet the demand from a population of 9 billion” [FAO]
- Crop pests and diseases threaten food security
 20–40% of crop yields destroyed every year
- Agriculture is a major sector for employment and revenues
 Cameroon: 62% of the working population, 30% of exports, 15% of GDP
- ➔ Controlling crop pests is a major issue

Chemical pesticides:

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

➔ Need for sustainable environmentally-friendly control methods



Aim

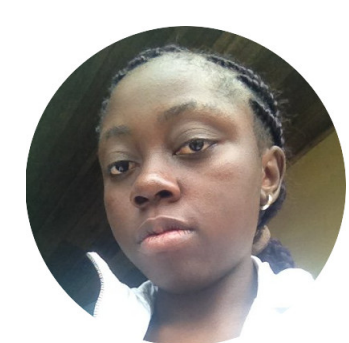
Study, mathematically and numerically, the epidemiology and sustainable management of tropical crop diseases, with a focus on Cameroon, using tools from dynamical systems and control theory



Challenges

- Relevance of our models ⇒ collaboration with field experts
- “Small data”: scarce, heterogeneous, often qualitatively known

Joint supervision of PhD students from Cameroon with a background in applied mathematics



Cocoa plant mirids

Myriam DJOUKWE TAPI, Univ. Douala, 2020
 [Mathematical Methods in the Applied Sciences, 2018; Nonlinear Analysis: Real World Applications 2020]
 Lecturer Univ. Douala



Plantain plant-parasitic nematodes

Israël TANKAM CHEDJOU, Univ. Yaoundé I, 2022
 [Mathematical Biosciences 2020; Applied Mathematics and Computation 2021; JIMIS 2021]
 Postdocs Univ. Cambridge, INRAE Rennes; Lecturer Univ. Yaoundé I



Coffee berry borers (CBB)

Yves FOTSO FOTSO, Univ. Dschang, 2022
 [Mathematical Methods in the Applied Sciences 2021; Applied Mathematical Modelling 2022; Journal of Optimization Theory and Applications 2023]
 Postdoc INRAE Rennes; Lecturer Univ. Dschang

cf. illustration ↓



Coffee leaf rust

Clotilde DJUIKEM, Univ. Côte d'Azur, 2023 (Inria grant)
 [Mathematical Modelling of Natural Phenomena 2021; Mathematical Biosciences 2023; Journal of Mathematical Biology, in revision 2023]
 ATER Univ. Côte d'Azur; Postdoc Univ. Manitoba, Canada



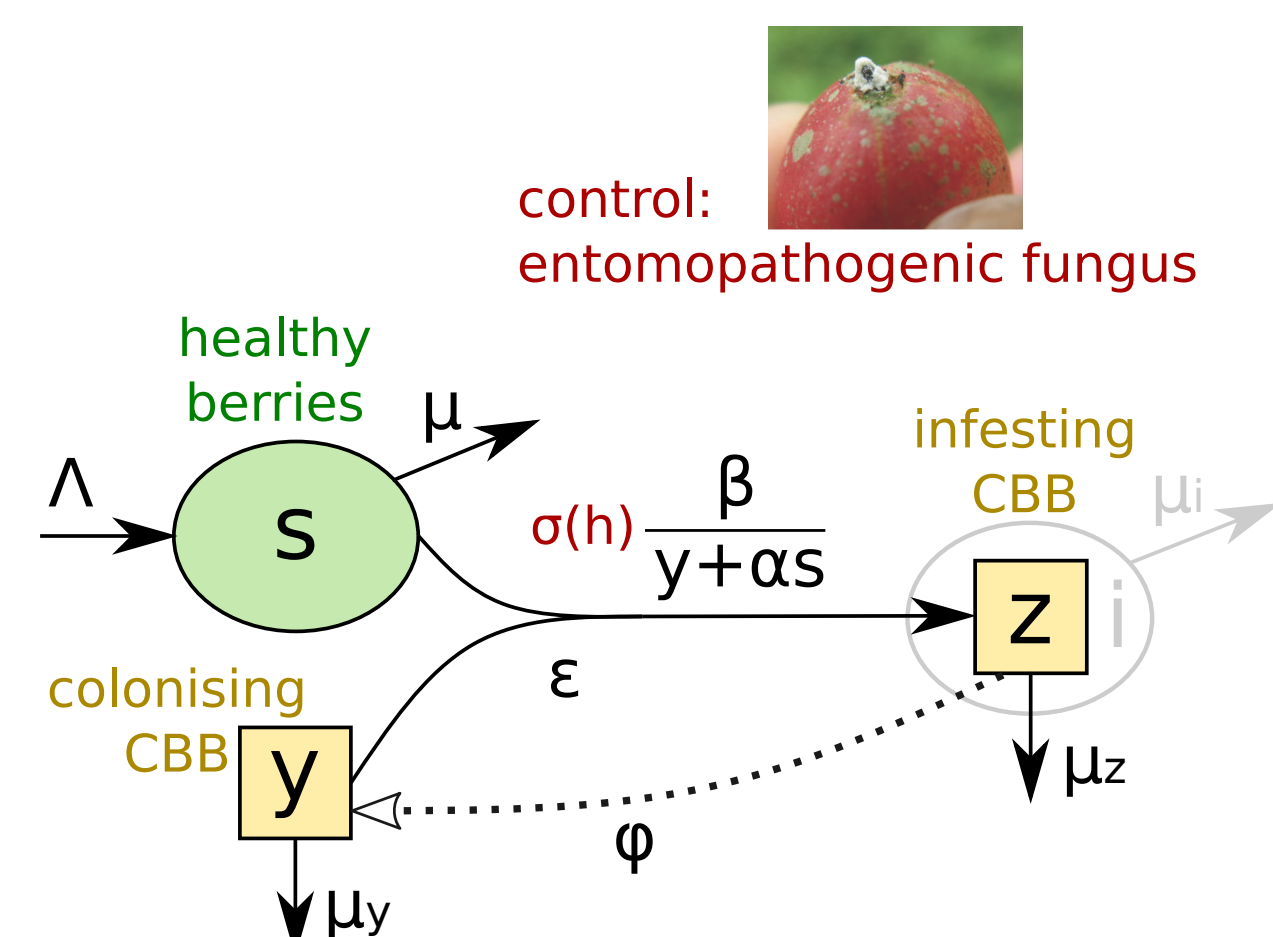
Cabbage diamondback moth

Aurélien Vanes KAMBEU YOUNBI, Univ. Dschang, ongoing
 Development and analysis of a self-financing model for cabbage crop including pest control

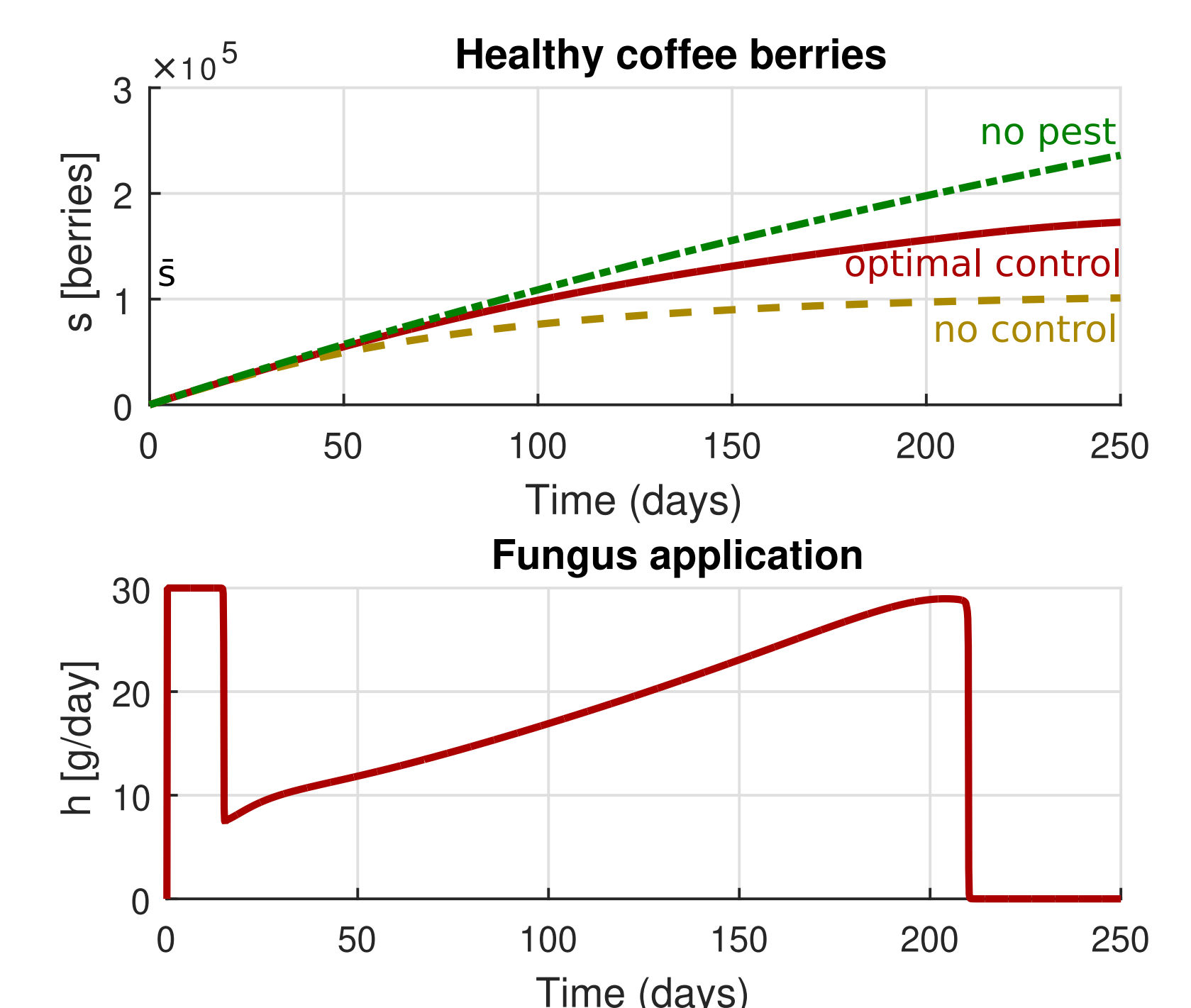


Plantain plant-parasitic nematodes

Frank Bagio KEMAYOU MANGWA, Univ. Douala, ongoing
 Mathematical modelling and analysis of *Radopholus similis* impact on plantain production



$$\begin{cases} \dot{S} = \Lambda - \sigma(v) \beta \frac{SY}{y + \alpha S} - \mu S & \text{new berries} \\ \dot{Y} = \varphi Z - \varepsilon \beta \frac{SY}{y + \alpha S} - \mu_Y Y & \text{emergence} \\ \dot{Z} = +\sigma(v) \varepsilon \beta \frac{SY}{y + \alpha S} - \mu_Z Z & \text{infestation} \\ \dot{v} = -\gamma v + h(t) & \text{mortality} \\ & \text{decay} \quad \text{control} \end{cases}$$



Activities

Student visits from Cameroon

- 2017–2019: 3 students/year, 3- to 5-month stays
- 2020–2022: 1 student (mostly during Covid lockdown)
- 2023–2024: 2 students/year, 3- to 5-month stays

Dissemination actions

- EPITAG workshops: Yaoundé, Dec. 2017 & Dschang, Nov. 2023
 Aims: bring together EPITAG scientists; present the team and foster interest in its research topics
- LIRIMA Scientific Days: Tunis 2017 & Yaoundé 2019
- AgriNumA Agriculture Numérique en Afrique Symposium (#DigitAG, LIRIMA, Cirad): Montpellier, France, 2018 & Dakar, Senegal, 2019

Support

- Inria, Associate Team programme, 2017–2024
- INRAE, TSARA programme, 2022–2024
- French Embassy in Cameroon, SCAC, 2023–2024
- Inria CORDI PhD grant, 2019–2022
- AUF, Collège doctoral régional Mathinbio, 2018–2020
- EMS-Simons for Africa programme, 2018
- IRD, UMMISCO
- CIRAD

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