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EPIDEMIOLOGICAL MODELLING AND CONTROL FOR TROPICAL AGRICULTURE

Project key information

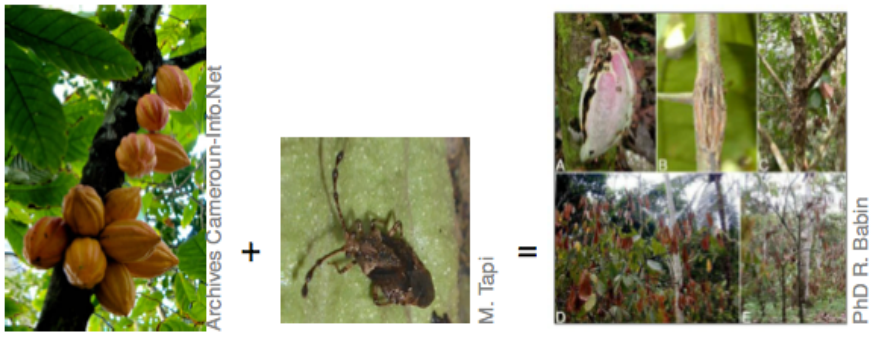
Project leaders: Samuel BOWONG (UMMISCO, Cameroon) and Suzanne TOUZEAU (INRIA Biocore)
Project duration: 36 months
Starting date: January 2021
Total budget: 30 K€

Partner institutions

University of Yaounde 1-Cameroon/UMMISCO, University of Douala-Cameroon/UMMISCO, University of Dschang-Cameroon/UMMISCO, University of -Burundi

Context

According to the Food and Agriculture Organization (FAO), pests, along with pathogens and weeds, destroy 40% of the food supply and cash crops every year. Under the combined action of disease, attacks by pests and weed competition, it is estimated that 50% of the world production is lost before or after harvest. Therefore, efficient and effective fight against these pests and pathogens is required. Cameroon's tropical climate is very favorable to agriculture. With ca 13% of agricultural land, this sector represents 30% of the country export revenues and 21% of its GDP. It employs almost 60% of the working population and 90% of the rural households. The main cash crops are cocoa (5th largest producer), coffee and cotton. Food crops include bananas/plantains, cassava, yam, maize, sorghum, millet, etc. According to IRAD, a sustainable development of agriculture is promoted in Cameroon, to ensure food security, reduce the poverty and preserve the environment. Controlling crop pests and pathogens is hence a major issue in Cameroon. For instance, outbreaks of cocoa mirids, banana/plantain plant-parasitic nematodes and coffee berry borers are common in Cameroon. Pesticides can be applied, but they have a high financial and environmental cost. Alternative methods, such as biological control and plant resistance should be explored. In this context, the use of mathematical models is particularly relevant. Models are not only used to formalise and integrate knowledge, but also to help design efficient strategies for integrated pest management. A field approach would be costly and time-consuming, especially on perennial plants such as cocoa and coffee trees. We will focus on three pathosystems: cocoa plant mirids, coffee berry borers and plantain plant-parasitic nematodes..



Objectives

The main objective of this proposal is to mathematically and numerically study the epidemiology and management of crop diseases in Cameroon and Sub-Saharan Africa. Our approach is to model and study plant–parasite population dynamics, in order to

- understand the plant-parasite interactions,
- identify the relevant parameters,
- predict the evolution of damages, and
- provide efficient control strategies to limit the damages.

As specific objectives, we study or plan to study the population dynamics of cocoa plant mirids, plantain plant-parasitic nematodes and coffee berry borers

A: [Jesus, Agron Sustain Dev 2014]; B: M. MacClure, Univ. Arizona; C: [Zhang, EJPP 2012]

[Burbano, JIS 2011]

Specific challenges

One of the challenge of the project is to ensure the relevance of our models. So it is important to closely involve the “end users” (specialists with field or experimental experience, epidemiologists, entomologists, etc.) in our approach. They will review our results with a critical eye, suggest changes and improvements, and finally validate them or exploit them further. To ensure the relevance of our models, “end users” will be closely associated.

Expected results

- Representation of the (spatio-)temporal evolution of damages caused by mirids in cocoa plot, based on the knowledge and data collected by CIRAD and IRAD. We plan to deduce/test/compare different (bio)control strategies to reduce the pest population and, hopefully, the damages.
- Development of a model describing plantain plant-parasitic nematode damages in a plantation, incorporating plant resistance and biological control.
- Development of a model representing coffee berry borer damages in various agroforestry systems.
- Building on the existing models, we will represent several control strategies and assess their efficiency.