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Expertise of the scientific community

Agronomy
Crops and cropping systems

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For these populations, the 'ecological intensification' challenge is to produce more, more regularly, through greater use of ecosystem services. For the unit's researchers, processes involved in crop production must be considered from different angles in order to come up with alternative cropping strategies.

With this new approach, the 'soil-plant-atmosphere' unit is considered as a biological system that is favourable to limited (or even nil) application of pesticides, chemical fertilizers and irrigation. The crop field is also considered as an open social system with respect to the functioning of farms and production subsectors.

UPR SCA is organized in five research teams:

■ **CARABE** (**Characterization and Integrated Management of Biotic Risks for Cultivated Ecosystems**) studies the effects of farming practices and cropping systems—as factors responsible for variations in the spatiotemporal availability of resources (trophic, habitat)—on pest and disease control and regulation.

■ **QUALITE** (**Product Quality Elaboration and Management**) **focuses on agricultural product** (**raw and processed**) characterisation and quality development processes. It also studies management of this product quality via stakeholders' practices on field, landscape and industry scales.

■ **ADEMES** (**Decision Support, Spatial Organization and Production Chain Economics**) complements this approach on the spatialization and organization of supply areas. These activities include fibre (cotton) and sugar (sugarcane) production, while encouraging openings in favour of energy subsectors (sugarcane and *Jatropha*).

■ **CESCA** (**Knowledge and Modelling of Annual Cropping System Functioning**) aims to design and assess annual cropping systems that meet ecological sustainability, economic viability and social equity imperatives. The biophysical aspect of practices (conservation agriculture, pest regulation, livestock-crop integration, etc.) is studied in interaction with the social sciences and humanities.

■ **SCRiD** (**Sustainable Farming and Rice Cropping Systems**) conducts research in Madagascar with the aim of developing rainfed rice-based cropping systems in close collaboration with national agricultural research agencies and the *Université d'Antananarivo.* •••

Modelling the functioning of a tropical agrosystem: an application to banana plantations

Modification of overall agrosystem functioning is required for cropping system (CS) innovation. A system approach to relationships between plants, pests and the environment is needed to understand and describe the functioning of these new systems, which are more complex than systems in which inputs are massively used. This system-based representation of agrosystem functioning is a model that can be customized according to the values of the studied variables. This genuine CS design support tool can also be used to represent CS functioning.

The SIMBA model simulates banana plantation functioning and performance and enables multicriteria assessment of virtual or real CSs. It can be customized according to different variables (climatic and soil data, initial parasitic nematode population levels) and enables simulation of banana growth and yield, pest development dynamics, soil moisture and nitrogen levels and the growth and effects of cover crops and weeds. Moreover, it evaluates the environmental risks of the simulated systems. It accounts for variations in the structure of banana stands during cropping cycles. Inclusion of the parasite component in the model, in interaction with the stand growth and structure, the soil status and nematicide treatments, is crucial for simulating the agroenvironmental performance of modelled banana plantations.

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It facilitates studies on certain ecological mechanisms and the development and optimization of new control strategies (crop rotations, cover crop based systems, etc.).

The spatial inter- and intra-plot organization and spatialization of protection resources are key elements for pest control. Because of its moderate dispersion potential, the banana weevil is a good example for studying the effects of different CS spatial organizations on its epidemiology. The COSMOS model simulates the weevil's movements, reproduction and mortality, in interaction with the banana tree, crop residue, cover plants and pheromone traps. It enables trapping optimization and proposes plantation landscaping arrangements to limit the development of weevil populations.

These new tools should help predict performances in terms of production and the properties of different emerging communities in banana plantations, e.g. their stability and resilience.

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▲ *Banana*/Neonotonia wightii *(legume) association.*