les dossiers
d'AGROPOLIS INTERNATIONAL

Expertise of the scientific community

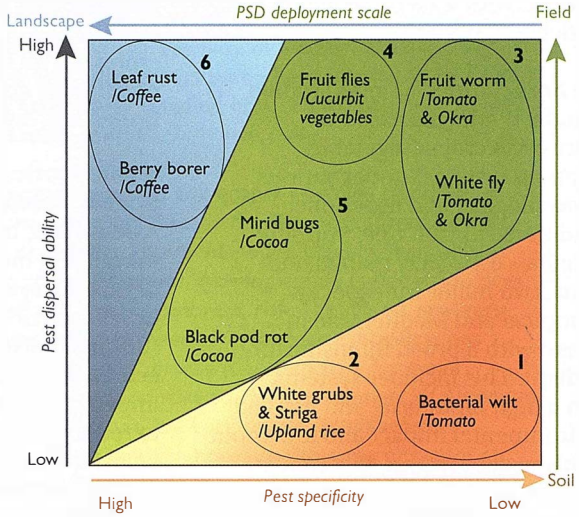
Agronomy
Crops and cropping systems

Number 12

OMEGA 3 project—ecological mechanisms of pest and disease management optimized to sustainably improve agrosystem productivity

High specific plant diversity (DVS) is typical of natural ecosystems, which are affected to a much lesser extent by biological attacks than cultivated ecosystems. Such attacks are generally (but not always) controlled when DVS is introduced in these latter ecosystems. CIRAD, in collaboration with its partners in tropical regions, is analysing the impacts on pathogens of enhancing DVS in agrosystems under various spatial and temporal conditions, in order to determine ecological regulation processes that could be utilized to reduce the need for chemical pesticide treatments.

The following factors are studied over a range of pests and diseases (differing in terms of their host specificity and dispersal capacity), plants and DVS implementation conditions and scales: allelopathic effects of cover crops on white grubs and *Striga* infecting rainfed rice in DMC systems in Madagascar; allelopathic effects and disruption of the sanitizing plant cycle in rotations on bacterial wilt of tomato in Martinique; the diversion effects of trap plants on tomato moths in Niger and Martinique; the diversion effects of a food-biological insecticide attractant mixture on cucurbit flies in Réunion; the effects of woody species associations on mirid bugs and black pod rot of cocoa in agroforestry systems in Cameroon; and the effects of landscape fragmentation on coffee leaf rust and berry borers in agroforestry systems in Costa Rica. Experimental studies on these suspected effects have already generated several results. Based on formalization of the studied ecological processes, decision rules could be drawn up to develop mechanistic models to predict the impacts of DVS enhancement on pests and diseases according to their life cycle traits—which is a prerequisite for developing innovative pest-resistant cropping systems.



▲ *Representation of the project case studies according to the pest life cycle traits and DVS implementation scales.*

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Banana, plantain and pineapple—agrosystem functioning under ecological intensification conditions

The internal research unit (UPR) ***Banana, Plantain and Pineapple Cropping Systems*** **(CIRAD)** aims to gain insight into the functioning of agrosystems under ecological intensification conditions via three models of crops of major socioeconomic importance:

- Dessert banana production (the unit's main model) for export is still based on intensive monocropping with very high chemical input use. The negative environmental impacts of these crops have to be reduced to ensure the sustainability of these crops.
- The pineapple intensive cropping model supplements that of banana.
- Plantain is the third model crop of the unit. Plantain for self-consumption is grown in low-yielding conventional extensive cropping systems.

The performances of these cropping systems—which generate staple foods in many developing countries—must be improved to enhance food security in a setting of high population growth.

These models are unique because of the type of crop (tropical semiperennial) and scope of intensification that they represent (monocropping to multispecies cropping systems).

The UPR has two main objectives:

- to carry out research in order to gain insight into the functioning of intensive tropical monocrop agrosystems so as to transform them into more sustainable cropping systems in which ecological processes overcome the need for chemical inputs

- to design, develop and assess —with the participation of production stakeholders— innovative environment-friendly cropping systems that are tailored to the socioeconomic imperatives of local cropping.

The unit conducts three main lines of research:

- **Dynamics of pests and communities under ecological intensification conditions.** The research is focused mainly on the impacts of spatial layouts of cropping systems on the dynamics of pest and disease development on intra- and extra-plot (landscape) scales, starting from the simplest systems (a single crop and variety) for subsequent case studies on multi-variety and -species mixtures.

The unit also studies trophic links between pathogens and other species present—this research is approached as an integrated system of interactions between plants, pests and diseases and other communities within the agroecosystem.

- **States of the environment and agrosystem functioning under ecological intensification conditions.** The research is focused on determining how ecological intensification practices (use of cover crops, exogenous organic matter input) help improve the soil