

Developing agro-ecological management options for sustainable banana cropping systems

With 134 million tons produced worldwide, banana is the fourth food product after rice, wheat and corn while being the first fruit production. Consumer demand for dessert and cooking bananas is regularly increasing, which requires the development of new production methods to make the crop safer for natural resources as well as for human health and welfare.

Cirad has developed a set of skills for diagnosing existing banana cropping systems, and also for designing and then assessing innovating ones.

Acting with the diverse stakeholders of the banana value chain, Cirad produces scientific and technical knowledge along with cross-cutting competences on biodiversity use, integrated crop protection, agroecology and agronomy. It therefore generates innovating strategies and techniques intended to reduce the use of artificial inputs (synthetic pesticides and fertilizers) and to increase the sustainability and the productivity of banana cropping systems.

> CIRAD'S KNOW HOW

■ Integrated crop protection

- **To manage soilborne pathogens (and mainly plant-parasitic nematodes)**



Cirad has defined practical strategies relying upon the basic principle of coupling soil cleansing (sanitizing fallows or crop rotations) with the use of certified healthy banana vitroplantlets.

These strategies are implemented in the framework of crop rotations or associations with ecosystemic service plants that are non-host to the main plant-pathogenic nematodes. Adapted numeration methods for nematode populations during sanitizing periods or in producing banana fields have also been set up.

- **To control the black weevil *Cosmopolites sordidus***



Cirad has refined the monitoring and the biological control of that pest with pheromone-pitfall trapping. Special recommendations have also been depicted to optimize the density and spatial arrangements of traps, while predictive models have been built up to describe and anticipate the dynamics and dispersal of the black weevil.

- **To manage Black Leaf Streak and Sigatoka diseases and alleviate their impacts**

Cirad has designed an effective biological forecasting system and a set of options to provide an integrated management of these diseases.

Furthermore, Cirad has also designed a reliable laboratory method based on conidia germination to monitor fungicide resistance in *Mycosphaerella fijiensis* and *M. musicola* populations responsible for these leaf streak diseases. Expert capacities can then be mobilized in Cirad teams to fight these foliar diseases.



Banana vitroplantlets in a weaning nursery

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Defoliation practice and pheromone trap

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Ecosystemic service plant
Crotalaria retusa

> WHAT CIRAD OFFERS

- A diversified set of expertise and competences on the functioning of banana cropping systems.
- Adapted agroecological management
- Cross cutting capacities of diagnostics and training



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Ecosystemic service plant
Crotalaria spectabilis

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■ Agronomy and agroecology

- **To drive an optimal mineral fertilization of bananas**, Cirad has set up and developed a technical soil-plant referential. Cirad is currently taking into account the nutrients provided by ecosystemic service plants while also assessing the value of local organic matter sources.
- **Diagnosing and hierarchizing the main biotic or abiotic constraints limiting yield and productivity in banana fields** : Cirad has defined and experienced an adapted methodology for diagnostic surveys.
- **As an alternative to soil mechanical tilling**, Cirad promotes the biological ploughing mediated by ecosystemic service plants.
- **Promoting ecosystemic service plants selected for favorable functional traits are also used by Cirad to benefit from biodiversity** : Cirad has defined and experienced an adapted methodology for diagnostic surveys.
- **To avoid an extensive use of herbicides**, Cirad has developed a set of options including ecosystemic service plants, bagasse mulches, gyro-mulching of spontaneous weeds.



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Cover of an ecosystemic service plant in a banana plantation

Cirad also uses various tools and strategies **to design innovative sustainable cropping systems that are well fitted to local contexts**. Other tools are employed and continuously improved for assessing the environmental, social and economic performances of banana systems. About environmental impacts, Cirad has skills for crisis management of chronic pollution.

■ Fruit quality

- **For preventing fruit ripeness on arrival and optimizing yield**, Cirad has set up and generalized for growers a prediction system.
- **To manage post-harvest diseases while limiting fungicide use** Cirad has defined a set of well adapted practices in the field and at the packing station.
- **To differentiate products**, Cirad is able to stress links between fruit quality and production zones as it was done for instance for "mountain bananas" produced in elevated zones of the French West Indies.