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Expertise of the scientific community

Agronomy
Crops and cropping systems

Number 12

Effects of shade trees on pests and diseases of Arabica coffee

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▲ Top – *Unshaded rust-infected coffee plantation in Papua New Guinea.*

Bottom – *Shaded coffee plantation in Costa Rica: shading reduces rust-related risks.*

Arabica coffee *(Coffea arabica)* may be monocropped, generally in intensive cropping systems. It is often grown under shade in agroforestry systems ranging from simple associations of two woody species to complex systems resembling natural ecosystems. The susceptibility of modern cropping systems, especially to pests and diseases, has partly been attributed to the loss of biodiversity. The present study revealed how shaded coffee cropping enables better pest and disease control.

Shade trees modify the microclimate and soil quality in coffee plantations. These modifications can alter pest and disease development through direct effects on their life cycle, or indirect effects via coffee defence mechanisms and stimulation of trophic chains. However, growing coffee under shade does not always reduce the pest and disease outbreak risk. The effects may vary depending on the organisms and their needs. Microclimate modifications that are unfavourable for coffee berry disease *(Colletotrichum kahawae)* development could, conversely, be conducive to the development of American leaf spot disease *(Mycena citricolor)* and the bark beetle *(Hypothenemus hampei)*. Contrasting effects have also been noted in the same organism at different stages in its life cycle. Shade trees thus tend to reduce the berry load on coffee trees, in turn reducing their susceptibility to coffee rust *(Hemileia vastatrix)*, while creating leaf moisture and temperature conditions suitable for fungus germination and penetration. Shade tree management for pest and disease control should thus be planned by taking all of the pests present into account, while seeking the shading balance point at which interesting ecological control mechanisms are stimulated and any negative effects are minimized.

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Towards sustainable horticultural cropping systems in developing countries

The global food balance and security are highly dependent on horticulture. The overall challenge is to achieve sufficient horticultural production to fulfil the growing world demand, to facilitate the socioeconomic development of farmers in developing countries, while preserving the environment and reducing risks for human health and ecosystems.

In this setting, the two scientific priorities of the **internal research unit** (UPR) ***Agroecological Functioning and Performances of Horticultural Cropping Systems*** (HortSys, CIRAD) are: (i) gaining insight into and modelling the agroecological functioning of horticultural cropping systems, especially with respect to pest and disease dynamics within agrosystems, and (ii) enhancing the capacity to assess the performance of systems according to various criteria, to change these systems so that they will be more sustainable, and to develop new systems.

The unit's overall objective is to contribute to establishing the scientific foundations for the agroecology of horticultural systems while making effective use of this knowledge according to ecological intensification principles in order to design sustainable horticultural cropping systems for developing countries. This involves addressing key global agriculture and food issues by developing current horticultural systems so that they will be more productive but less dependent on chemical inputs, thus reducing human health risks and environmental impacts.

Operationally, the unit aims to generate knowledge and develop methods for designing sustainable horticultural cropping systems that are highly productive while requiring fewer chemical inputs. The hypothesis put forward is that this objective could be achieved through better knowledge and use of biological interactions and regulations in horticultural cropping systems. Knowledge required for mobilizing the agricultural systems, ecology and crop protection disciplines is developed and implemented in a range of ecological,

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▶ Presentation page 8