les dossiers
d'**AGROPOLIS**
INTERNATIONAL
Expertise of the scientific community
Special Partnership Issue

Agroecological transformation for sustainable food systems

Insight on France-CGIAR research

Number 26
September 2021

Functions and ecosystem services of agroforestry

Trees are pivotal in the agroecological management of coffee pests and diseases

The presence of trees within and in the vicinity of coffee stands impacts pest and disease development. **Trees may stimulate three agroecological pathways: (i) they modify the physical environment and directly or indirectly curb pest and disease development by enhancing the development of natural enemies or changing the physiology of crop plants; (ii) they modify the biological environment and favor natural enemies (birds, certain arthropods and microorganisms); and (iii) they create physical barriers that hamper pest and pathogen movement.** It is essential to gain insight into these different pathways so as to be able to effectively use trees as a lever in the agroecological management of pests and diseases of coffee or other crops.

▲ Croton *windbreaks in coffee plots under Inga tree shade, Apaneca, Salvador.* © *J. Avelino*

Some diseases are almost absent in coffee-based agroforestry systems because the trees regulate extreme ambient temperatures (e.g. brown eyespot disease caused by *Cercospora coffeicola*). Shade trees help regulate fruit load on coffee trees, while avoiding imbalances conducive to the development of other diseases such as dieback, associated with *Colletotrichum* spp., or coffee leaf rust caused by *Hemileia vastatrix*. Trees host predators of insect pests, such as birds and ants, while providing moist and shady conditions that are favorable for fungal natural enemies (*Beauveria bassiana* and *Lecanicillium lecanii*). In this way, trees enable the regulation of the coffee berry borer (*Hypothenemus hampei*) and rust. Moreover, tree windbreaks help avoid coffee blight caused by *Phoma costarricensis*, which penetrates coffee leaves via wounds inflicted by cold winds. Finally, the presence of forest stands in coffee landscapes reduces the impact of coffee berry borer, probably by making it harder for this pest to access resources during non-fruit bearing periods. Trees can have complex and sometimes unwanted impacts on pests and diseases, some of which are unstable due to interactions with the environment. Moreover, not all trees are equivalent. A current research challenge is to identify trees with functional traits that will help curb unwanted impacts while maintaining the sought-after effects.

Contacts

Jacques Avelino (PHIM, CIRAD, France), jacques.avelino@cirad.fr

Fabienne Ribeyre (PHIM, CIRAD, France), fabienne.ribeyre@cirad.fr

Bernard Dufour (PHIM, CIRAD, France), bernard.dufour@cirad.fr

For further information

• Avelino J., Allinne C., Cerda R., Willocquet L., Savary S., 2018. Multiple-disease system in coffee: from crop loss assessment to sustainable management. *Annual Review of Phytopathology*, 56: 611-635.

• Avelino J., Ten Hoopen G.M., DeClerck F.A.J., 2011. Ecological mechanisms for pest and disease control in coffee and cacao agroecosystems of the Neotropics. *In* Rapidel B. *et al.* (eds): *Ecosystem services from agriculture and agroforestry measurement and payment*. e Earthscan: 91-117.

Rubber agroforestry systems in Kalimantan, Indonesia

A survey was conducted by CIRAD in 2019 on the evolution of rubber agroforestry system (RAS) trial plots that had been set up in the 1990s in West Kalimantan as part of the Smallholder Rubber Agroforestry Project[3]. In 1994, most farmers relied mainly on jungle rubber, i.e. a seedling-based agroforestry system with low crop productivity (500 kg/ha/year) but high biomass and biodiversity. Most farmers wanted access to clonal rubber planting material to improve land productivity (expected yields of up to 1,800 kg/ha/year) while retaining the advantages of their agroforestry practices.

...cont'd