4th World Congress on Agroforestry

20-22 May 2019
Montpellier, France

Book of Abstracts

L22_O.02

Analysis of the interactions of shade trees on coffee leaf diseases and coffee yield in complex agroforestry systems

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In complex coffee-based agroforestry, quantifying interactions within the agrosystem that impact on coffee disease regulation and on coffee yield is a major stake to design sustainable cropping systems. To this end, we analyzed the interaction network between shade trees, coffee trees (Catimor variety), coffee foliar diseases complex (CFDC; majority of *Mycena citricolor*) and soil characteristics. The system is characterized by 40 variables measured in 60 plots spread on three farms (monitored for 2 years) in Nicaragua. We used Partial Least Square Path Modeling (PLSPM) to study the network interaction. We built 6 blocks with the more significant variables of each component: shade trees (shade percentage, species), soil (Cation Exchange Capacity, P), CFDC (incidence, severity), coffee trees age and size, coffee growth and coffee yield. The second part of the PLSPM was performed between blocks. Shade trees, mostly the shade percentage, had direct positive effects on CFDC and soil quality, and negative effects on coffee growth and yield. Shade had also an indirect negative effect on coffee trees by increasing CFDC, which impedes coffee growth and yield. Soil variables being negatively related to CFDC, shade had an indirect effect on coffee trees. Reducing excessive shade cover seems to be a solution to enhance positive impacts of shade trees on coffee yield. Overall, shade management requires an analysis of trade-offs between soil quality, diseases regulation and yield gains.

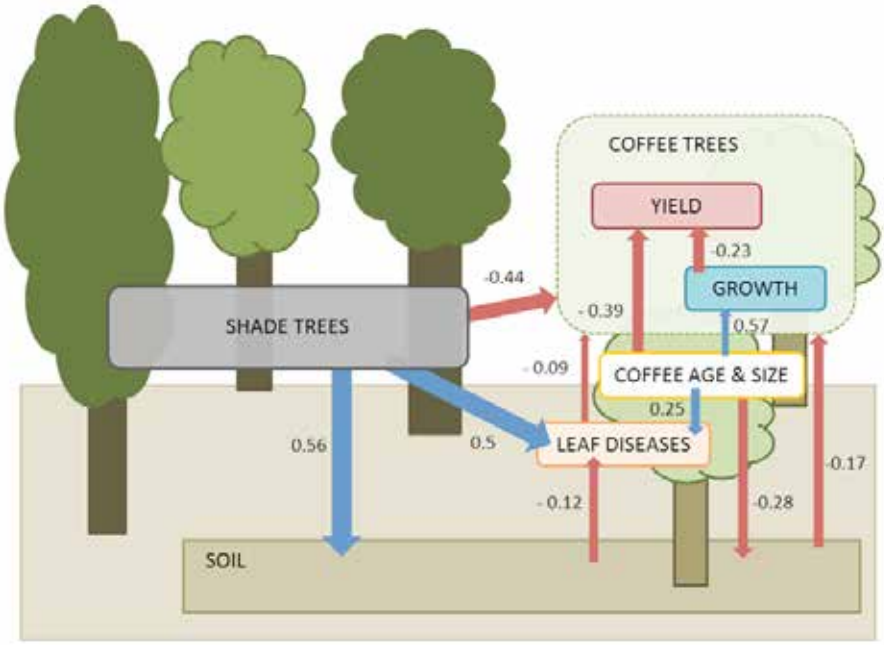

Figure 1. Results of PLSPM model showing direction and quantifying all interactions inside this coffee-based agroforestry network. Blue arrow represents positive effect, red arrow negative effect, associated with their own regression coefficient.

Keywords: disease regulation, ecological process, trade-off, structural equation modeling.