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Antagonistic effects of shade on the epidemiological mechanisms driving coffee berry disease

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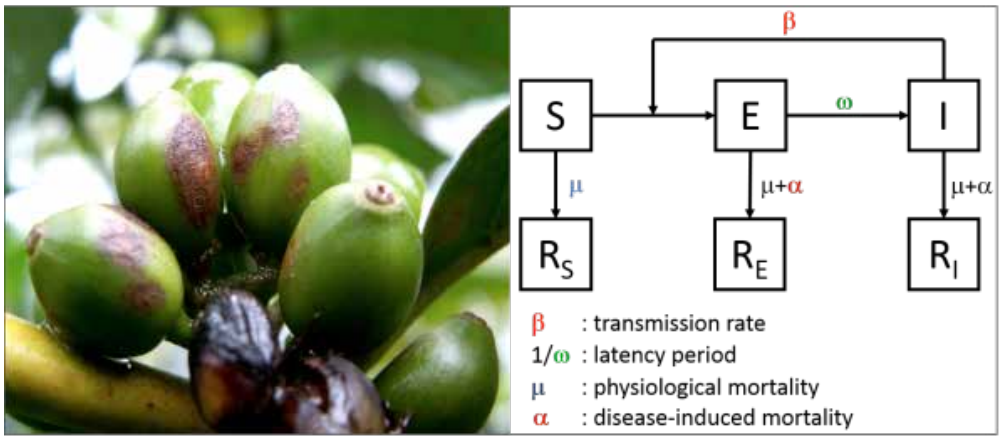
Coffee berry disease (CBD) is widespread in Africa and has been responsible for massive yield losses of *Coffea arabica*. Shade trees are one of the promoted strategies to control CBD because they are supposed to reduce disease dispersal through rainsplash[1]. Nevertheless, data collected over two consecutive years in West Cameroon showed that shade did not necessarily reduce the disease incidence and could even increase it. The objective of our study was to determine the epidemiological mechanisms and environmental covariates involved in the differences between epidemics observed under shade and full sun cropping systems. For this purpose, we developed a Susceptible - Exposed - Infectious - Removed (SEIR) model, some of the parameters being function of environmental covariates. This model was combined with a probabilistic model of observation via a mechanistic-statistical approach and parameters were estimated in a Bayesian framework. According to our model, temperature and relative humidity were the main environmental variables explaining differences in disease transmission between shade and full sun. Our results show that shade treatment exhibits antagonistic effects on epidemiological mechanisms, notably it reduces disease transmission but also the latency period. This suggests that depending on the local climatic conditions, one specific mechanism may be fostered, thereby explaining the variability in shade efficacy described in the literature.



Left: symptoms of coffee berry disease caused by Colletotrichum kahawae; right: Susceptible - Exposed - Infectious - Removed model (SEIR) where the disease transmission rate and the latency period are function of environmental covariates.

Keywords: SIR model, Colletotrichum kahawae, Bayesian inference, Mechanistic-statistical approach, Agroecological crop protection.

References:

1. Mouen Bedimo et al., 2010, Plant Pathology, 59, 324–329