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CBB-ABM: a simulator to explore the management of the coffee berry borer multiple spatial scales

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Abstract

Climate change may impact the life cycle (e.g., number of annual generations) and distribution range of insect pests, increasing the risk of total crop losses and compromising the food sovereignty of smallholders. This has sparked interest in adaptive management that considers multiple spatial scales and the possible effects of climate change. Coffee berry borer (CBB; *Hypothenemus hampei*, Coleoptera: Curculionidae: Scolytinae) is a pest that affects coffee berries and causes the main economic loss for coffee farmers. The CBB management is difficult and usually focuses on the plot scale. We present an agent-based model that simulates the CBB dynamics, with a bottom-up approach that connects agents and entities to the whole system. The objective of the tool is to explore several CBB management scenarios considering multiple spatial scales (plant, plot, and surrounding landscape) as well as their environmental setting. The simulator was parameterized based on literature review, fieldwork and participatory workshops with farmers, technicians, and researchers from various institutions in Costa Rica and Nicaragua. The simulator includes information on CBB and coffee fruits dynamics, landscape context, main management practices and climatic conditions. The tool can be used to generate scenarios with different spatial configurations of the landscape (coffee-dominated, heterogeneous, or forest-dominated landscapes), coffee systems (with shade trees or full sun), as well as to evaluate management practices and climate parametrization. It is also a participatory simulation tool where management decisions can be virtually tested through interactive games. Thus, this tool aims to support technicians and farmers in exploring coordinated management alternatives at a landscape scale. This approach can be applied to evaluate pests in other crops and support farmers management decisions.