24-Agent-based models for an interdisciplinary approach of pest management (the potato tuber moth in Ecuador)

François Rebaudo[1] and Olivier Dangles[1,2]
[1] IRD, UR 072, Laboratoire Évolution, Génomes et Spéciation, UPR 9034, CNRS, 91198 Gif-sur-Yvette Cedex, et UP11, 91405 Orsay Cedex, France ; [2] Pontificia Universidad Católica del Ecuador, Facultad de Ciencias Exactas y Naturales, Laboratorio de Entomología, Quito, Ecuador
Email: francois.rebaudo@ird.fr

Worldwide, the theory and practice of agricultural extension system have been dominated for almost half a century by Rogers' "diffusion of innovation theory". In particular, the success of integrated pest management (IPM) extension programs depends on the effectiveness of IPM information diffusion from trained farmers to other farmers, an important assumption which underpins funding from development organizations. Here we developed an innovative approach through an agent-based model (ABM) combining social (diffusion theory) and biological (pest population dynamics) models to study the role of cooperation among small-scale farmers to share IPM information for controlling an invasive pest. The model was implemented with field data, including learning processes and control efficiency, from large scale surveys in the Ecuadorian Andes. Our results predict that although cooperation had short-term costs for individual farmers, it paid in the long run as it decreased pest infestation at the community scale. However, the slow learning process placed restrictions on the knowledge that could be generated within farmer communities over time, giving rise to natural lags in IPM diffusion and applications. We further showed that if individuals learn from others about the benefits of early prevention of new pests, then educational effort may have a sustainable long-run impact. Consistent with models of information diffusion theory, our results demonstrate how an integrated approach combining ecological and social systems would help better predict the success of IPM programs. This approach has potential beyond pest management as it could be applied to any resource management program seeking to spread innovations across populations.

25-Ocelet modelling language and simulation tool: possible applications in pest management?

Danny Lo Seen [1], Pascal Degenne [1] , Valérie Soti [2] , and Annelise Tran [3]
[1] Cirad, UMR TETIS, Montpellier; [2] Cirad, UR SCA, Montpellier; [3] Cirad, UR AGIRS, Montpellier
Email: danny.lo_seen@cirad.fr

Modelling spatial dynamics may be used to gather understanding on how insect populations develop in a given environment. Hypotheses and independent knowledge inferred from ground observations can be confronted for consistency, and the mechanisms requiring finer descriptions can also be identified. Different scenarios of pest management can then be simulated and the possible consequences of the measures taken assessed. However, spatial dynamics are expressions of multiple and complex ongoing processes, and their modelling at different temporal and spatial scales remains a challenging task. Various approaches have been proposed to address this, including cellular automata, agent-based systems, discrete event systems, system dynamics and geographic information systems, each displaying specific benefits in some domains of application, and weaknesses in others.
In this area of research, we are exploring an approach based on the manipulation of graphs (mathematical object expressing a set of entities, some of which are linked) that are employed here in an innovative way for modelling landscape dynamics. Concepts essential for modellers had to be identified and formally defined. A modelling computer language (called Ocelet) was then developed, together with the grammar and syntax needed to manipulate these concepts, the compiler, and the environment/interface for building models and running simulations. Ocelet is thus both a modelling language and a simulation tool. To illustrate its usage, two case studies possibly pertinent for pest management are presented: 1) the dissemination of a pathogen among neighbouring agricultural plots, and 2) temporary pond and mosquito population dynamics for understanding Rift Valley Fever (RVF) occurrence.