of EOs were also investigated on plants and on two entomophagous insect species used in biological control applications (i.e. *Nesidiocoris tenuis* and *Aphidius colemani*). Finally, we assessed the potential activation of plant defenses mediated by EOs and the cascading effects on the related food networks. Most of the assayed EOs caused significant mortality on insect pests and the estimated lethal concentrations varied significantly. Fennel and anise EOs caused significant mortality on *T. absoluta*, while garlic was the most effective against *A. gossypii*. Although most EOs had negligible toxicity on tomato and sweet pepper plants, they showed a changing selectivity towards tested predators and/or parasitoids. Foliar applications of garlic and peppermint EOs activated defense signalling pathways and triggered different behavioral responses on pests and natural enemies in olfactory trials. Our findings disclose new advances in the current understanding of EOs for plant protection strategies in the Integrated Pest Management framework of modern cropping systems.

Keywords: botanicals, glasshouse pest, horticultural crops, IPM, nanomaterial, plant defense

OC443. The long and challenging road to capitalize on plant-based extracts from the lab to the field

P. Silvie*[1,6], M. Fazolin[2], L. do Prado Ribeiro[3], P. A. Marchand[4] , F. Tchuwa[5], P. Martin[6], A. Mkindi[7]
[1]*IRD Montpellier, France*
[2]*EMBRAPA Acre, Brazil*
[3]*EPAGRI-CEPAF Chapecó-SC, Brazil*
[4]*ITAB Paris, France*
[5]*Bunda College, Lilongwe University of Agriculture and Natural Resources, Lilongwe, Malawi*
[6]*CIRAD Montpellier, France*
[7]*The Nelson Mandela African Institution of Science and Technology, Arusha, Tanzania*

*Corresponding author: pierre.silvie@cirad.fr

Negative impacts of chemical pesticide, social demand (healthier food), organic farming organization, rising costs of inputs linked to oil market and their importation (in Africa), and the circular economy approach are a few arguments/opportunities that underlie the roll-out of alternative solutions, including botanicals. Technology readiness levels (TRLs) offer a means to rate relevance of these solutions in the process from plant identification and local knowledge to large-scale use of plant extracts. Options range from do-it-yourself (homemade preparations)- often based on smallholders' traditional know-how- to application of commercial input formulations. The constraints to be overcome vary in scope: technical (biomass availability/sustainability, extraction, chemical analysis, standardization, formulation), societal (grower and consumer perception/acceptability, labour demand, gender issue), and regulatory (adaptation, environmental/ecotoxicological aspects). The following are a few examples of TRL ratings in terrestrial insect management: aqueous extracts of *Tephrosia vogelii* in Malawi and Tanzania (TRL 4-5), organic extracts in Brazil (Annonaceae, TRL 3-4), essential oils of *Piper borbodense* in Réunion (TRL 3-4) and of *Piper aduncum* in the western Amazon (TRL 5-6). In Brazil, the use of commercial formulations (Orobor, Orange Power, etc.) derived from agroindustrial residue processing (orange oil) is an example of a TRL 9 rating. Potential solutions are presented to foster individual or collective (e.g. in African villages) usage (blends, mixtures with chemical pesticides, quality control) and the pathway towards certification. In particular, the creation of specific regulatory categories (e.g. basic substance) within the framework of the European regulation EC n°1107/2009 could help facilitate the adoption/use of plant-based extracts.

Keywords: botanicals, agroecology, protection, pests