

FORWARD : Looking For an effective biocontrol agent in apple ORchards by comparing two earWig's species: an AlteRnative to pesticiDes



Apple orchards are highly treated crops, in which synthetic (e.g., organophosphorus, neonicotinoids and pyrethroids) and natural (e.g., spinosyns family) products are among the most heavily sprayed insecticides in integrated pest management (IPM) and organic programs respectively. These compounds are toxic to non-target arthropods and induce adverse side effects on the environment. In the European context of reducing the use of pesticides, and in order to enhance agroecology principles, the development studies of biocontrol agents are of prime importance. In this context, earwig can be considered as promising biocontrol agents in Biological control programs. Earwig species are effective generalist predators of several soft-bodied insect pests in apple orchards. Moreover, they are well-known to exhibit multiple forms of maternal care. Sublethal effects of pesticides on maternal care have been recently suggested to be of central importance because the resulting alterations in offspring could shape the long-term efficiency of pesticide use, and the maintenance and population dynamics of non-target organisms.

In southern France, two species of earwigs are commonly encountered in apple orchards: (1) European earwig *Forficula auricularia* (Dermaptera: Forficulidae): the most studied species on which data on the lethal, physiological, biochemical and behavioral effects (including maternal care) of many pesticides commonly applied in orchards are available and (2) *Forficula pubescens*: a specific species from southern Europe for which little is known. This latter species is more sensitive to pesticide application than *F. auricularia* and could be mainly found in abandoned or organic orchards.

This internship project is at the interface of agroecology and ecotoxicology issues and aims at comparing the sensitivity of these two earwig species to the biopesticide "Spinosad" commonly used in organic orchards. The objectives are to participate in the development of alternative practices in apple orchards, to sustain organic practices and to promote biocontrol.

The research questions are the following:

1. Which earwig species present the best life-history indicators under optimal rearing conditions?
2. Does the exposure of earwigs to Spinosad modify their metabolic pathways, limiting thus their maternal care and offspring's survival and development according to species-specific responses?

This project will create strong links with regional growers involved in the development of alternative practices in organic apple orchards for a sustainable production. From a scientific point of view, it will help us to better understand the ecosystem-services provided by natural enemies and the potential modifications caused by pesticide pressure on their physiological and behavioral responses.

This work will allow the student to carry out the following activities:

- Laboratory rearing of both studied earwigs sampled from organic apple orchards and comparing their life history traits, such as female fecundity, survival, development time and appearance date of each earwig life stage;
- Laboratory experiments to test biochemical and behavioral responses of different life stages of both earwig species after Spinosad exposure;
- Analysing data and writing a scientific report.