Impact of intercrops spatial arrangement on the distribution of trophic resources for parasitoids and the biological control of aphids

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Social-economic context

Accompanying producers in the transition from massive pesticides use to alternative solutions for crop protection is one of the main objectives of current applied research in the agricultural field. Monocultural crops lack plant diversity, resulting in a deficiency in resources for natural enemies and, subsequently, a low biological regulation of crop pests. Providing the adequate food or alternative host resources, intercropping has a high potential in establishing a controlled plant diversity to foster biological control of pests by enhancing natural enemies populations in the field.

This France-Chile shared-PhD focuses on cereal-leguminous intercropping for aphid control by parasitoids (pictures A & B).

Scientific context

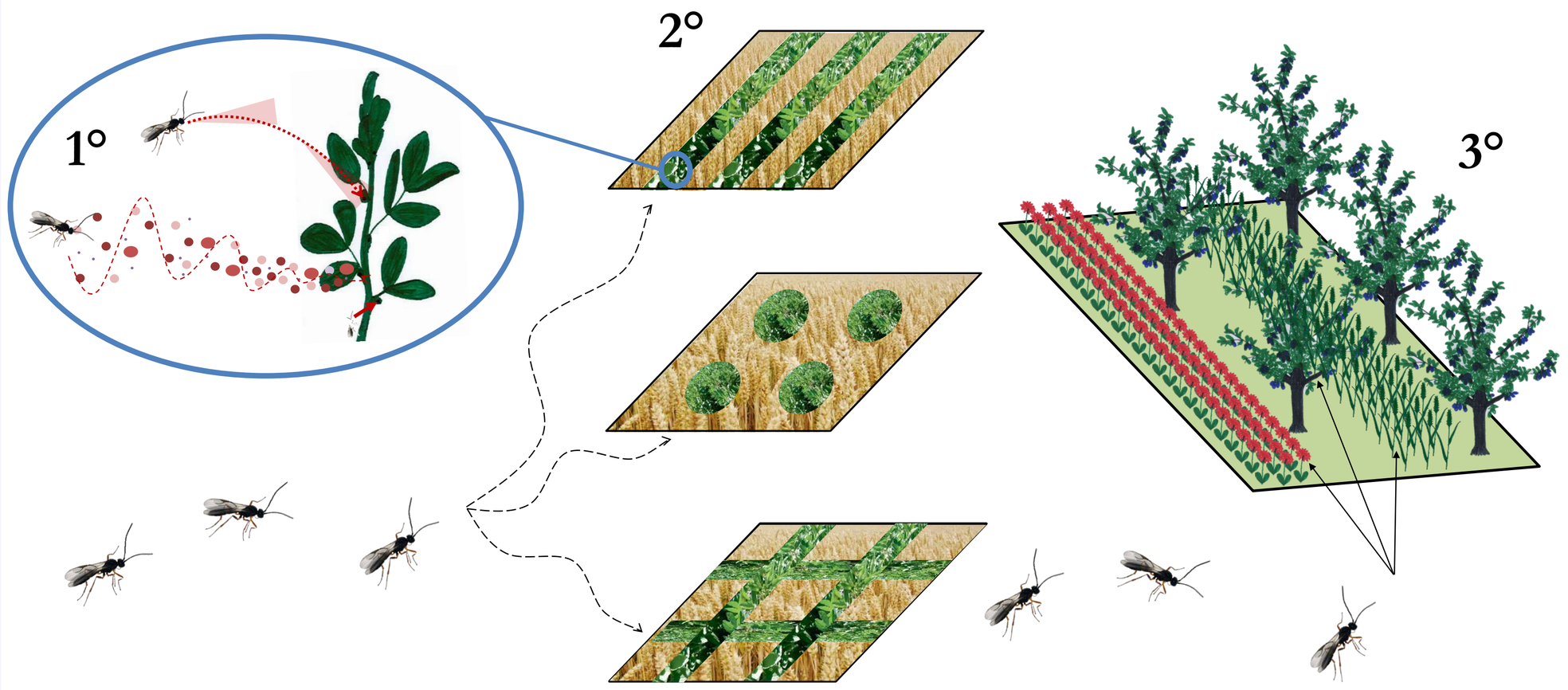
- ❖ Parasitoids usefulness as biological control agents has been well established over the years, but their efficiency in the field, against aphid pests in particular, varies strongly.
- ❖ The relative spatial distribution of trophic resources in the environment influences parasitoids choices. In order to optimize their fitness and according to their internal state, parasitoids are constantly facing a trade-off between searching for hosts or searching for food (Sirot & Bernstein 1996, Desouhant et al. 2005, Wäckers et al. 2005).
- ❖ If parasitoids are provided with both food and hosts in the same spatial area, the time they spend to find these resources and move from one to the other will probably decrease (Jamont et al. 2014).

The spatial arrangement of intercropping can play a major role in maximizing the interface areas between both crops, and therefore reducing the distance between resources in addition to making them more accessible.

Objectives

This PhD aims at determining the optimal spatial arrangement of intercrops for parasitoids activity, considering 3 scales for the studies:

1. On the plant-scale, in laboratory conditions, we want to elucidate the **type(s) of cues**, whether olfactory, gustatory or visual, that **parasitoids use to locate the extrafloral nectar**, at both short and long distances.
2. On the field-scale, we want to establish **which spatial arrangement suits best the control of aphids by parasitoids** in a cereal-leguminous intercropping system (considering the development of a spatially explicit model simulating parasitoids movement and parasitism activity).
3. On a broader scale, we want to evaluate the **potential complementarity** between two alternative methods that **are intercropping and field margin management**, in a plum-tree orchard-intercropping system.



Current studies

- ❑ Impact of the distance host-nectar on the nectar uptake frequency by parasitoids in laboratory conditions (picture C)
- ❑ Characterization of the extrafloral nectar release of *Vicia faba* L. and its potential induction by sap-eating aphids (picture D)
- ❑ Small-scale estimation of the 'reactive distance' by parasitoids to extrafloral nectaries and extrafloral nectar (picture E)

Planned studies

- ❑ Localisation of hosts by parasitoids according to hosts spatial distribution in wheat mesocosm
- ❑ Parasitoids activity in a plum-tree orchard provided with alternative hosts and/or nectar sources
- ❑ Modelling the parasitism rate of *Aphidius ervi* depending on the spatial arrangement of cereal-leguminous intercrops

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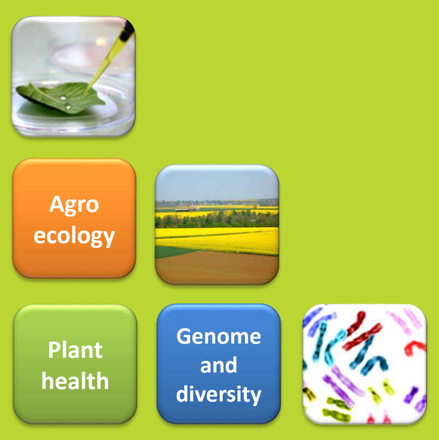

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