Gembloux Agro-Bio Tech
Université de Liège

Functional & Evolutionary Entomology

FREEDOM TO RESEARCH

Species diversity and abundance of aphids and their natural enemies in a crop association

Thomas Lopes[1*], Séverin Hatt[1, 2], Petr Starý[3], George Japoshvili[4, 5], Frédéric Francis[1]

[1]Functional and Evolutionary Entomology, Gembloux Agro–Bio Tech, University of Liège, Passage des Déportés 2, B–5030 Gembloux, Belgium ; [2]AgricultureIsLife.be, Gembloux Agro–Bio Tech, University of Liège, Passage des Déportés 2, B–5030 Gembloux, Belgium ; [3]Laboratory of Aphidology, Institute of Entomology, Biology Centre, The Czech Academy of Sciences, Branišovská 31, 37005 České Budějovice, Czech Republic ; [4]Institute of Entomology, Agricultural University of Georgia, Agmashenebeli Alley #240, Tbilisi, Georgia ; [5]Invertebrate Research Center, Agladze #26, Tbilisi, Georgia

***e-mail:** tlopes@doct.ulg.ac.be

Introduction

Previous study (Lopes *et al*., 2015):

- Aphids were significantly more abundant on pea plants grown in pure stands, compared with a wheat-pea mixture. Contrarily to what was expected, their natural enemies were not significantly more attracted by the association.
- Herbivore-induced plant volatiles (e.g. methyl salicylate - MeSA) can be interesting to attract aphid natural enemies. Combining the mixture with MeSA releasers could potentially maximise aphid control.

Objective for this study: determine the effect of a wheat-pea mixture combined with a MeSA releaser on aphids and their natural enemies, and compare it with pure stands.

But also: since aphid parasitoids from the subfamily Aphidiinae (Braconidae) and genus *Aphelinus* (Aphelinidae) have been poorly studied in Belgium (especially in terms of species diversity), we wanted to report new species records and establish the first national checklist.

Materials and methods

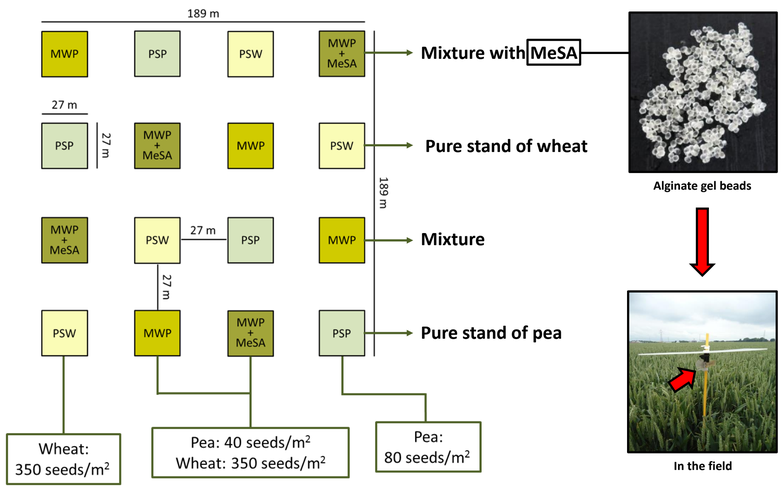
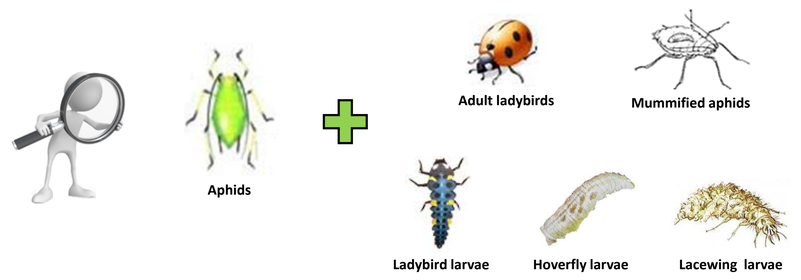


Fig. 1 Experimental design

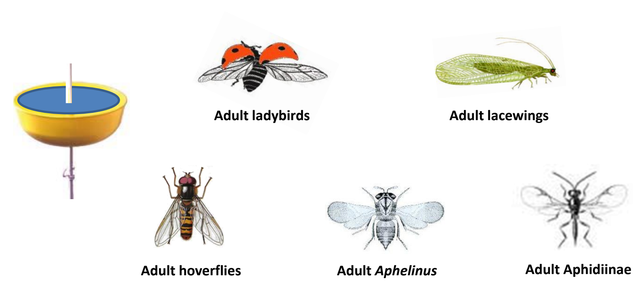
Each week from 2013 and 2014 growing seasons:

Observations on pea plants and wheat tillers



30 plants or tillers were randomly selected in each plot

Insect trapping and identification



A single trap was placed in the middle of each plot

Results

Observations on pea plants and wheat tillers

Pea plants:

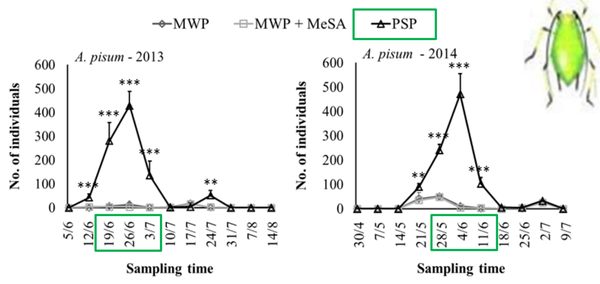


Fig. 2 Seasonal occurrence and abundance (mean number per treatment and week ± SEM) of *Acyrthosiphon pisum* (Harris) observed on pea plants in 2013 and 2014 growing seasons. **Populations were significantly denser in the pure stand of pea compared with the mixture (with and without MeSA).**

Wheat tillers: Few aphids and their natural enemies were observed

More natural enemies on pea plants in the mixture (with and without MeSA)?

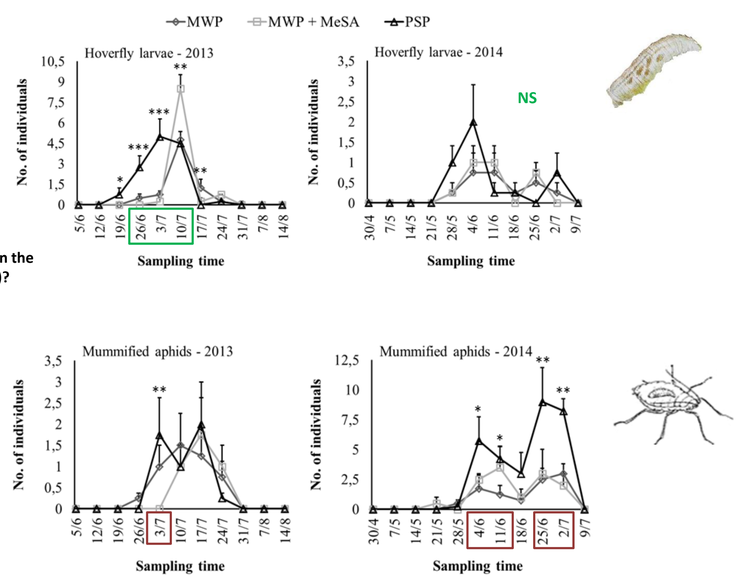


Fig. 3 Seasonal occurrence and abundance (mean number per treatment and week ± SEM) of aphid natural enemies observed on pea plants in 2013 and 2014 growing seasons.

- Hoverfly larvae were significantly more abundant in the PSP compared with the mixture (with and without MeSA) in 2013. However, when populations reached their highest density (two weeks after the *A. pisum* infestation peak), significantly higher numbers of individuals were observed in the MWP + MeSA compared with the other treatments.
- No significant differences were observed between treatments in 2014.

Few were observed.

- No significant differences were observed between treatments in 2013 for aphid mummies , except on July 3.
- They were significantly more abundant in the PSP compared with the mixture (with and without MeSA) in the 2014 season, but also when their highest density was observed (June 25).

Insect trapping and identification

Table 1 Total numbers of adult beneficials (with means per treatment and week ± SEM) trapped in 2013 and 2014 growing seasons.

	Treatments							
	2013				2014			
Trapped species	PSP	PSW	MWP	MWP + MeSA	PSP	PSW	MWP	MWP + MeSA
Hoverflies								
Episyrphus balteatus (De Geer)	160	125	149	140	28	90	52	38
Eupeodes corollae (Fabricius)	27	19	18	25	1	6	2	4
Eupeodes luniger (Meigen)	1	0	1	0	0	0	0	0
Melanostoma mellinum (Linnaeus)	8	10	8	20	5	6	2	9
Melanostoma scalare (Fabricius)	0	1	1	0	0	1	3	8
Platycheirus clypeatus (Meigen)	0	0	1	0	0	0	0	0
Platycheirus peltatus (Meigen)	2	0	0	1	0	0	0	0
Scaeva pyrastri (Linnaeus)	1	0	2	1	0	0	0	0
Sphaerophoria scripta (Linnaeus)	89	83	110	85	5	11	6	3
Syrphus ribesii (Linnaeus)	1	0	0	0	0	0	0	0
Syrphus vitripennis Meigen	0	2	0	0	2	0	2	0
Mean hoverflies	**7.2 ± 1.5a**	**6.0 ± 1.0a**	**7.3 ± 1.5a**	**6.8 ± 1.5a**	**1.0 ± 0.3a**	**2.9 ± 0.9b**	**1.7 ± 0.5ab**	**1.6 ± 0.4ab**
Ladybirds								
Coccinella septempunctata Linnaeus	6	8	7	4	12	2	10	5
Harmonia axyridis (Pallas)	20	4	5	1	35	7	10	10
Propylea 14-punctata (Linnaeus)	10	5	3	3	2	11	8	4
Mean ladybirds	**0.9 ± 0.2a**	**0.4 ± 0.1b**	**0.4 ± 0.1b**	**0.2 ± 0.1b**	**1.2 ± 0.3a**	**0.5 ± 0.1b**	**0.7 ± 0.2b**	**0.5 ± 0.1b**
Lacewings								
Chrysopa phyllochroma Wesmael	0	0	1	0	0	0	0	0
Chrysoperla carnea (Stephens)	10	19	26	21	11	23	23	30
Mean lacewings	**0.3 ± 0.1a**	**0.5 ± 0.1a**	**0.7 ± 0.2a**	**0.5 ± 0.2a**	**0.3 ± 0.1a**	**0.6 ± 0.2a**	**0.6 ± 0.1a**	**0.8 ± 0.2a**
Parasitoids								
Aphelinus abdominalis (Dalman)	0	0	0	0	2	0	1	2
Aphelinus asychis Walker	0	0	0	0	1	0	0	0
Aphelinus daucicola Kurdjumov	0	0	0	0	1	0	2	0
Aphidius avenae Haliday	0	1	2	1	2	11	12	3
Aphidius ervi Haliday	3	4	1	0	5	2	2	1
Aphidius rhopalosiphi De Stefani-Perez	0	4	0	0	0	3	2	1
Aphidius uzbekistanicus Luzhetzki	0	0	0	2	0	0	0	0
Binodoxys angelicae (Haliday)	0	0	0	0	1	0	1	0
Ephedrus plagiator (Nees von Esenbeck)	1	2	0	1	0	0	0	0
Praon volucre (Haliday)	2	2	1	7	9	4	1	2
Toxares deltiger (Haliday)	2	0	1	0	0	0	0	0
Trioxys auctus (Haliday)	0	0	0	1	0	0	0	0
Mean parasitoids	**0.2 ± 0.1a**	**0.3 ± 0.1a**	**0.1 ± 0.1a**	**0.3 ± 0.1a**	**0.5 ± 0.1a**	**0.5 ± 0.1a**	**0.5 ± 0.1a**	**0.2 ± 0.1ab**

Hoverflies were the main adult beneficials trapped.

No significant differences were observed between the PSP and the mixture (with and without MeSA).

Few ladybirds, lacewings, and parasitoids were trapped.

Some of these parasitoid species were never recorded in Belgium.

Aphidiinae and *Aphelinus* Belgian checklist

After doing a systematic review of the literature, we found 31 Aphidiinae and 7 *Aphelinus* species recorded in Belgium up to now. New recorded species are marked in red:

Aphidiinae (Braconidae)

- *Aphidius asteris* Haliday
- *Aphidius avenae* Haliday
- *Aphidius colemani* Viereck
- *Aphidius eadyi* Starý, Gonzalez & Hall
- *Aphidius ervi* Haliday
- *Aphidius frumentarius* Latteur
- *Aphidius matricariae* Haliday
- *Aphidius rhopalosiphi* de Stefani–Perez
- *Aphidius rosae* Haliday
- *Aphidius smithi* Sharma & Subba Rao
- *Aphidius urticae* Haliday
- *Aphidius uzbekistanicus* Luzhetzki
- *Diaeretiella rapae* (M'Intosh)
- *Adialytus ambiguus* (Haliday)
- *Lysiphlebus fabarum* (Marshall)
- *Lysiphlebus testaceipes* (Cresson)
- *Monoctonus crepidis* (Haliday)
- *Binodoxys angelicae* (Haliday)
- *Binodoxys heraclei* (Haliday)
- *Trioxys auctus* (Haliday)
- *Ephedrus cerasicola* Starý
- *Ephedrus lacertosus* (Haliday)
- *Ephedrus persicae* Froggatt
- *Ephedrus plagiator* (Nees)
- *Toxares deltiger* (Haliday)
- *Dyscritulus planiceps* (Marshall)
- *Praon abjectum* (Haliday)
- *Praon barbatum* Mackauer
- *Praon exsoletum* (Nees)
- *Praon gallicum* Starý
- *Praon volucre* (Haliday)

***Aphelinus* (Aphelinidae)**

- *Aphelinus abdominalis* (Dalman)
- *Aphelinus asychis* Walker
- *Aphelinus chaonia* Walker
- *Aphelinus daucicola* Kurdjumov
- *Aphelinus fusciscapus* (Förster)
- *Aphelinus hordei* Kurdjumov
- *Aphelinus mali* (Haldeman)

Discussion

- The mixture can reduce aphid infestations on pea plants (very low abundances compared with the pure stand). Their lower density in the mixture may have favoured a physical obstruction and visual camouflage by wheat. The latter may also have contributed to mask pea plant odours.
- Aphid natural enemies were not particularly attracted by MeSA. Its emission from alginate beads was certainly limited by the high rates of relative humidity observed in both seasons (Heuskin *et al*., 2012). However, the mixture without MeSA is sufficient to reduce aphid populations at very low levels.
- Parasitoids are important natural enemies for conservation biological control in Wallonia. However, further investigations are needed to better assess species diversity, especially for the genus *Aphelinus*, which is still not well studied in Belgium. It is hoped this study will stimulate further research on this topic

Lopes T., Bodson B. & Francis F. (2015) Associations of Wheat with Pea Can Reduce Aphid Infestations. *Neotropical Entomology* 44, 286–293.

Heuskin S., Lorge S., Leroy P., Haubruge E., Bera F., Brostaux Y., Wathelet J-P. & Lognay G. (2012) A Semiochemical Slow-release Formulation in a Biological Control Approach to Attract Hoverflies. *Journal of Environment and Ecology* 3(1), 72–85.