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BENEFICIAL AND PEST INSECTS ASSOCIATED WITH TEN FLOWERING PLANT SPECIES GROWN IN QUÉBEC, CANADA

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INTRODUCTION

Once an insect pest has reached damaging levels in a crop, curative methods are quite limited in organic production. Therefore, insect pest management efforts in organic agriculture production have to be focused on preventative approaches such as cultural and conservation biological control (Zehnder et al. 2007).

Habitat manipulation is one tool which can help to make the agroecosytem favourable to natural enemies and unfavourable to insect pests. Habitat manipulation brings biodiversity in the agroecosystem which contributes to its resilience to insect pests attacks. Consequently, there has been a growing interest in research to develop and get a better understanding of means to provide natural enemies with resources which will enhance their presence and activity within a crop. The use of flowering strips which may provide food source (pollen and nectar) and shelter for beneficial insects may contribute to increase predator or parasitoids' fitness and make them more effective biological control agents (Gurr et al. 2004).

OBJECTIVES

This 3-year study looked at the attractiveness of ten flowering plant species to natural enemies, focusing on beneficial predatory Coccinellids as a first step. Insect pests might be attracted to some of these plant species acting as a trap crop or alternatively as a reservoir of pests which could be harmful to the adjacent crops. Consequently, abundance of insect pest species and groups, such as the tarnished plant bug (*Lygus lineolaris*) and flea beetles, was also included.

MATERIAL AND METHODS

EXPERIMENTAL SITE:

Organic Agriculture Innovation Platform located in Saint-Bruno-de-Montarville, Québec, Canada

EXPERIMENTAL DESIGN:

10 plant species: see Table 1

Plot size: 2.4m x 3m

2010: 4 replicates; 2011: 3 replicates and 2012: 3 replicates

Randomized Complete Block Design (RCBD)

SAMPLING:

Weekly sampling with yellow sticky traps (size: 23 cm x 14 cm) and sweep net

Sampling techniques and periods: see Table 2

DATA:

- **Plant stage, density and biomass***
- **Number of beneficial insects :**
  - Coccinellid species abundance (see Table 3)
    - Coccinellid adults and larvae
  - *Orius* spp.*, Syrphids*, Hymenoptera*
- **Number of insect pests:**
  - Tarnished plant bug (*Lygus lineolaris*)
  - Flea beetles (Chrysomelidae: Alticinae)
  - Aphids (Aphididae)*
  - Leafhoppers (Cicadellidae)*
  - Thrips (Thysanoptera)*

The GLIMMIX procedure of SAS was used to fit a generalized Poisson mixed model for overdispersed count data. Treatment fixed effect and random effects of year and blocks were accounted for in the model. Tests of treatment effect were carried out using Wald tests.

* Data not presented

Table 1. Plant species studied in 2010, 2011 and 2012.

Scientific names	Common names	Families
Achillea millefolium 'Colorado'	Yarrow	Asteraceae
Coriandrum sativum 'Santo monogerm'	Coriander	Apiaceae
Cosmos bipinnatus 'Sensation mix'	Cosmos	Asteraceae
Lobularia maritima 'Easter Bonnet mix'	Sweet alyssum	Brassicaceae
Medicago sativa	Alfalfa	Fabaceae
Petunia grandiflora 'Ultra mix'	Petunia	Solanaceae
Phacelia tanacetifolia	Lacy phacelia	Hydrophyllaceae
Sinapsis alba	White mustard	Brassicaceae
Tagetes patula 'Bonanza mix'	Marigold	Asteraceae
Tropaeolum majus 'California giant'	Nasturtium	Tropaeolaceae

Table 2. Sampling techniques and periods for 2010, 2011 and 2012 experimentation.

	2010	2011	2012
	June 17 - September 18	June 23 - August 18 and August 25 - September 2	June 14 - September 7
	14 sampling dates (exceptions: coriander up to August 20 10 sampling dates; mustard and alyssum up to August 12 9 sampling dates)	9 sampling dates	12 sampling dates
	June 23 - August 12	June 30 - August 18	June 14 - September 7
	8 sampling dates (exception: mustard, June 23 - August 5 7 sampling dates)	7 sampling dates	12 sampling dates

Table 3. Coccinellids species found on the ten plant species studied in 2010, 2011 and 2012.

	Scientific names	Common names	Ab.
	*Coleomegilla maculata*	Pink spotted lady beetle	CM
	*Coccinella septempunctata*	Seven-spotted lady beetle	CS
	*Cycloneda munda*	Polished Lady Beetle	CyM
	*Harmonia axyridis*	Multicolor Asian lady beetle	HA
	*Hippodamia spp.*	-	HSpp
	*Propylea quatuordecimpunctata*	Fourteen-spotted lady beetle	PQ
	*Psyllobora vigintimaculata*	Twenty-spotted lady beetle	PV

RESULTS AND DISCUSSION

- Yellow sticky traps captured a higher number of coccinellids than the sweep net as has been previously reported (Schmidt et al. 2008) (Figure 1).
- Six species constitute nearly 100 % of the Coccinellidae assemblage with the three dominant species being: *Coleomegilla maculata, Harmonia axyridis* and *Propylea quatuordecimpunctata*. Treatment effect was significant (F=15.16, p<0.0001) (Figure 1).
- There were twice as many Coccinellidae captured in *T. patula, T. majus, C. bipinnatus* or *A. millefolium* compared to *S. alba* (for all contrasts, p<0.0001), and there were twice as many insects trapped in *T. patula* compared to *L. maritima* (p<0.0001) (Figure 1). As nectar is an important food source for many Coccinellidae (Hagen 1962), this likely reflects the high nectar loads and secretion rates associated with *T. patula* and *T. majus* as reported by Comba et al. (1999). Ambrosino et al. (2006) also observed higher number of Coccinellidae visits in *C. sativum* and *Fagopyrum esculentum* compared to *L. maritima* and *P. tanacetifolia* (Figure 2).
- Coccinellid larvae were occasionally caught with the sweep net. Captures varied between years, in terms of number, date and associated plant species. Plant species in which larvae were consistently found were *C. sativum, M. sativa, T. patula* and *A. millefolium*. These larvae were also found in *S. alba, P. tanacetifolia* and *C. bipinnatus* plots. The presence of larvae indicates that adult coccinellid females oviposited in these plant species. Coccinellid larvae feed on aphids and adult females lay their eggs near aphid colonies. However, in this study, there is no apparent link between the number and timing of aphids captured with the sweep net or the yellow sticky traps and the occurrence of coccinellid larvae.
- **For insect pest species**, use of the sweep net showed significant captures of *L. lineolaris* (F=51.42, p<0.0001) and flea beetles (F=23.56, p<0.0001).
- *L. lineolaris* had a clear preference for *P. tanacetifolia* (Figure 3). After this, the presence of this economically important pest species was highest on *S. alba, C. sativum. A. millefolium* and *C. bipinnatus* compared to *L. maritima, P. grandiflora, T. majus* and *T. patula* (for all contrasts, p<0.0001).
- Flea beetle captures were highest on *S. alba, T. majus* and *L. maritima*, two of these being Brassicaceae species which is an economically important family of flowering plants (Figure 4).
- These results emphasize the importance of rigorous selection of plant species as suggested by Winkler (2005). It is essential to consider not only the attractiveness of a flowering species to beneficial insects but its potential to act as a reservoir for pest insects that can contribute to pest problems. Flowering strips, therefore, can serve to support beneficial insect populations and also serve as trap plants for insect pests and by both means contribute to crop pest control.

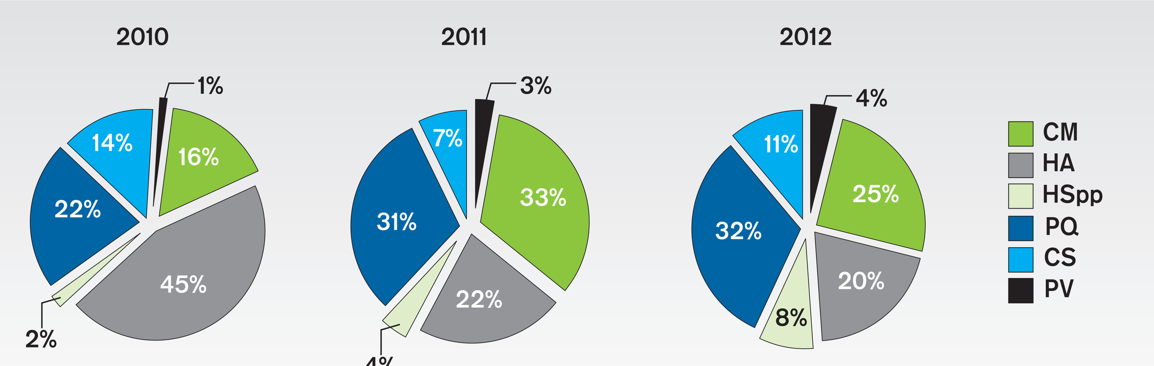

Figure 1. Coccinellid species composition on the ten plant species studied in 2010, 2011 and 2012.

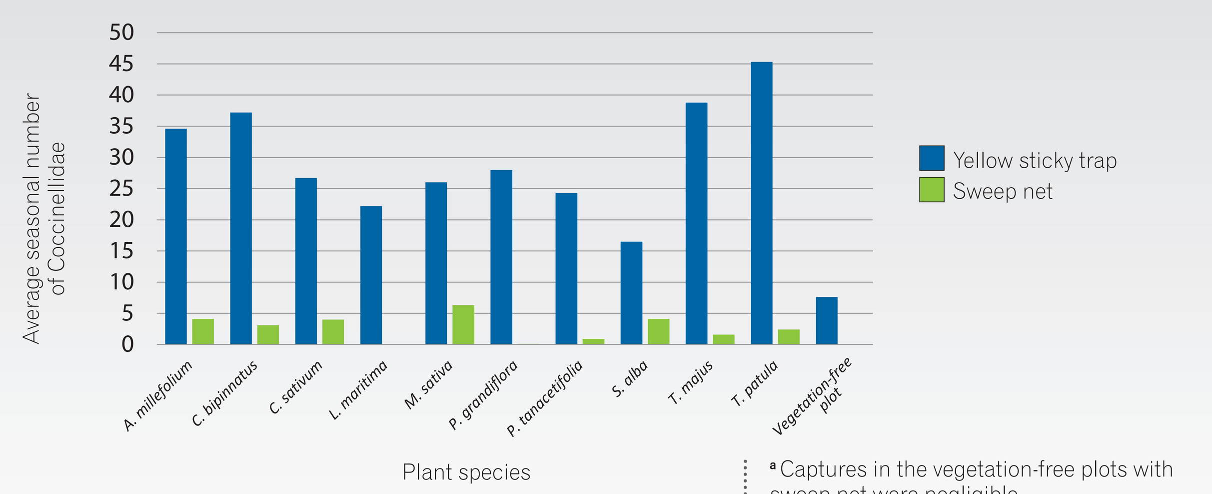

Figure 2. Average seasonal number of Coccinellidae captured with yellow sticky traps and sweep net in the ten plant species studied in 2010, 2011 and 2012, and in vegetation-free plots in 2012. [a, b, c]

[a] Captures in the vegetation-free plots with sweep net were negligible.
[b] For yellow sticky trap data, the relative standard errors of estimated means are 18 %, except for the vegetation-free plot treatment (28 %).
[c] For sweep net data, the relative standard errors of estimated means vary between 25 % and 30 %, except for *P. grandiflora* and *L. maritima*, for which abundance was negligible.

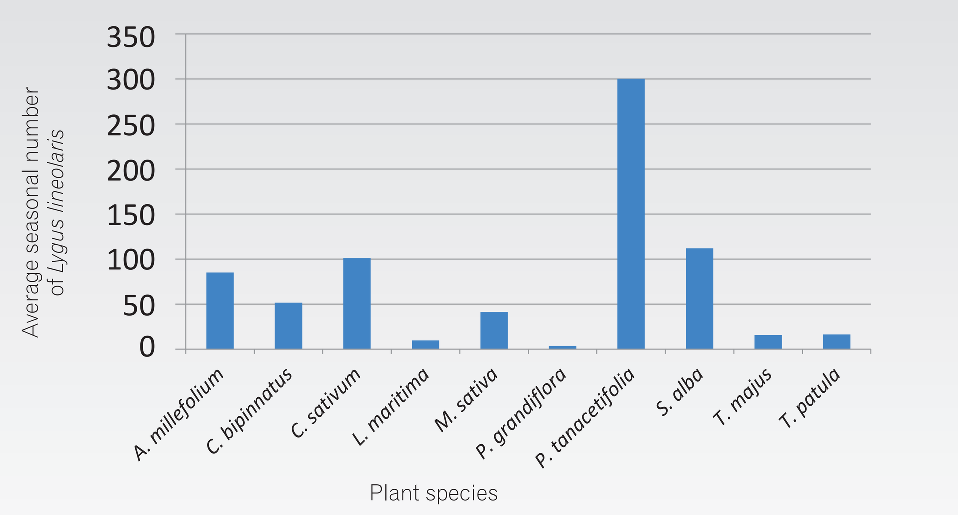

Figure 3. Average seasonal number of tarnished plant bug, *Lygus lineolaris* captured with sweep net in ten plant species in 2010, 2011, and 2012 and in vegetation-free plots in 2012. [a, b]

[a] Captures in the vegetation-free plots with sweep net were negligible.
[b] Relative standard errors of estimated means are 30 %.

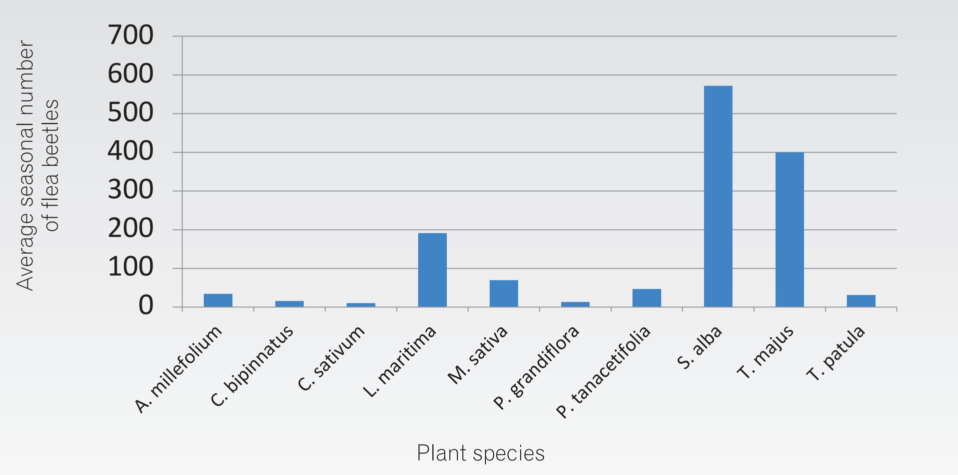

Figure 4. Average seasonal number of flea beetles captured with sweep net in ten plant species in 2010, 2011, and 2012 and in vegetation-free plots in 2012. [a, b]

[a] Captures in the vegetation-free plots with sweep net were negligible.
[b] Relative standard errors of estimated means are 30 %.

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