Study of a Flowering Strip and its Impact on Natural Enemies of Lepidopteran Pests of Organic Cole Crops in Québec – First Results

J. Boisclair[1]*, G. Richard[1] and T. Boislard[1]

1. Organic Agriculture Innovation Platform, Research and Development Institute for the Agri-Environment (IRDA), Saint-Bruno-de-Montarville, Que., Canada.

* **josee.boisclair@irda.qc.ca**.

Introduction

Organic cole crop production has many challenges among which the control of a few species of Lepidopteran pests: diamondback moth (*Plutella xylostella* L.), imported cabbageworm (*Pieris rapae* L.) and cabbage looper (*Trichoplusia ni* Hübner). Very few tools are available to control these caterpillars in organic cabbage production. The use of flowering strips adjacent to crops contribute to the functional biodiversity of an agroecosystem. This management strategy offers more plant resources such as pollen and nectar, as well as shelter to natural enemies. Laboratory and field experimentation conducted in Switzerland at the Research Institute of Organic Agriculture (FiBL) have led to the development of the following flowering mix "FiBL Flowering strips 2012/1" to be used in cole crops against some Lepidopteran pests (Géneau et al. 2012). This study is looking at the potential use of this flowering mix as a biological approach to cole crop protection against caterpillars in Québec.

Objectives

The main objective of this 3-year project is to determine the potential of the « FiBL flowering plant mix 2012/1 » to encourage the presence and activity of natural enemies of Lepidopteran pests of cole crops in Québec.

In 2015, the objectives were to determine optimal establishment (growth and flowering periods) conditions of the « FiBL flowering plant mix 2012/1 » comprised of *Fagopyrum esculentum* Moench, *Centaurea cyanus* L., *Vicia sativa* L. and *Ammi majus* L. under Québec climatic conditions and to verify the presence of natural enemies of Lepidopteran pests of cole crops in the flowering mix.

In 2016-2017, this study will evaluate the impact of the flowering mix on pest abundance, parasitism rate of larvae and pupae of Lepidopteran pests of cabbage and damage on cabbage at increasing distances from the flowering strip will be evaluated.

Material and Methods

Experimental site: Organic Agriculture Innovation Platform – IRDA (Saint-Bruno-de-Montarville, QC)

Experimental Design:
FiBL Flowering strips 2012/1
2 seeding dates: May 29 and June 10
2 seeding rates: 60 kg/ha (FiBL recommendation) and 90 kg/ha
2 soil types: loamy sand and clay with organic residues
Plot size: 3 m x 5 m
Randomized Complete Block Design (RCBD) with four replicates
Cabbage (cv Lennox) were transplanted on June 15 to encourage natural enemies of Lepidopteran pests.

Data:

Flowering strip development

- Growth stages
- Percentage ground cover
- Biomass at 50% flowering
- Weed pressure: density and biomass of monocots and dicots

Ammi majus | *Centaurea cyanus* | *Fagopyrum esculentum* | *Vicia sativa*

Table 1. Common names, scientific names, seeding rates and number of seeds of the four plant species in « FiBL flower mix 2012 » at recommended rate.

Common names	Scientific names	Recommended FiBL rate = 60 kg/ha	
		g/m²	number of seeds/m²
False Queen Anne's Lace	*Ammi majus*	0.08	112
Cornflower	*Centaurea cyanus*	0.27	57
Buckwheat	*Fagopyrum esculentum*	1.10	31
Common Vetch	*Vicia sativa*	4.50	87

Insect sampling with sticky trap and vacuum

- Abundance and diversity of beneficial insects predators and parasitoids

Table 2. Main Lepidopteran pests on cole crops in Québec, their common parasitoids and their parasitized host stages.

INSECT PESTS	PARASITOIDS	HOST STAGE
Diamondback moth	*Diadegma insulare* *Microplitis plutellae*	larva
	Diadromus subtilicornis	pupa
Imported cabbageworm	*Cotesia* sp.	larva
	Pteromalus puparum	pupa

D. insulare | *P. rapae* and *Cotesia* sp. | *P. rapae* pupa | *P. xylostella*

Results

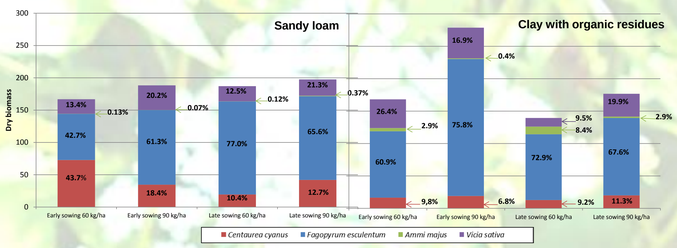

Figure 1. Dry biomass and percentage of dry biomass for each flowering plant species sampled from two sowing dates and for two sowing rates at 50% flowering of *Ammi majus* in two soil types, Saint-Bruno-de-Montarville, 2015.

Even though a large number of seeds of *Ammi majus* were sown, *A. majus* was in very small number (data not presented) and its biomass was negligible (Fig. 1). Buckwheat was the most vigorous species of the mix. Flowering mix sown in May covered the ground sooner that the one sown in June in both soil types (Fig. 2). May sowing seemed to favor a better development of the plant mix. Weeds were very abundant in the plots reaching up to 25% of total dry biomass (data not presented).

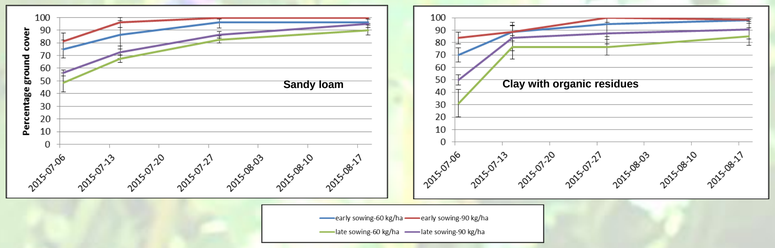

Figure 2. Mean percentage of ground cover of the flowering plant mix for two sowing dates and two sowing rates in two soil types, Saint-Bruno-de-Montarville, 2015.

Table 3. Flowering period and abundance of the main Hymenopteran parasitoids of *Plutella xylostella* and *Pieris rapae* captured by vacuuming the flower mix sown early in sandy loam.

Plant species*	17/7	23/7	30/7	5/8	13/8	19/8	26/8	2/9
Ammi majus								
Centaurea cyanus								
Fagopyrum esculentum								
Vicia sativa								
Parasitoids								
Diadegma insulare				1	5	5	5	9
Diadromus subtilicornis								1
Cotesia sp.	2			2	2	2		
Microplitis plutellae								1
Pteromalidae	1	17	7	4	18	31	22	40

*The purple lines indicate the flowering period.

Table 4. Flowering period and abundance of the main predatory groups of Lepidopteran pests of cole crops captured by vacuuming the flower mix sown late in sandy loam.

Plant species*		17/7	23/7	30/7	5/8	13/8	19/8	26/8	2/9
Ammi majus									
Centaurea cyanus									
Fagopyrum esculentum									
Vicia sativa									
Predator species and groups	**Stage**								
Harmonia axyridis	Adult	4	3	2	1		4	3	3
	Larva				2	2		2	1
Coleomegilla maculata	Adult		1	1			5	3	7
	Larva			2	2	1	4	1	
Coccinella septempunctata	Adulta					1			
	Larva								
Propylea quatuordecimpunctata	Adult		2	1			2	1	
	Larva								
Hippodamia sp.	Adult			1		1	2	1	1
	Larva				1				
Chrysopidae	Adult		1		1	12	11	3	
	Larva					1		2	
Orius spp.	Adult	41	29	51	18	25	83	83	104
	Larva			5	5	23	14	24	49
Nabidae	Adult			1	1	2		1	5
	Larva				1		2		3
Syrphidae	Adult	1	2	1	5	5		2	

*The purple lines indicate the flowering period.

Conclusions

- *P. xylostella* most important parasitoids have been retrieved in the flower strip : *D. insulare*, *D. subtilicornis* and *M. plutellae*. In Godin and Boivin study (1998), these three parasitoids have been shown to reach respectively up to 34.1%, 12.8% and 24.4% parasitism rates.
- Other parasitoids have also been collected from the flower mix as well as many predatory insect groups such as some predatory bugs of the genus *Orius*.
- These observations are showing that the « FiBL flowering mix 2012/1 » may act as a shelter and is offering plant resources for parasitoids and predators of the caterpillars attacking cole crops.
- The 2015 observations about the flower mix development and the abundance of Hymenopteran parasitoids in the early sowing of the flower mix indicates that sowing soon, when late frost is not a threat, should be favored for our 2016 and 2017 experimentation.

References

Géneau, C.E., F.L. Wäckers, H. Luka, C. Daniel et O. Balmer. 2012. Selective flowers to enhance biological control of cabbage pest by parasitoids. Basic and Applied Ecology 13:85-93.

Godin C. et G. Boivin. 1998. Lepidopterous pests of Brassica crops and their parasitoids in southwestern Quebec. Environmental Entomology 27:1157-1165.

Acknowledgements

This project is conducted through the Volet 4 of the Program Prime-Vert 2013-2016 and is funded by the Québec Ministry of Agriculture, Food and Fisheries.

Thanks to : numerous IRDA students, trainees, and IRDA agricultural workers for their collaboration to the project, Agriculture and Agri-Food Canada taxonomists : José L. Fernández-Triana and Andrew Bennett for their expertise in Braconids and Ichneumonids identification and Mario Fréchette, from the Diagnostic Laboratory of MAPAQ for its expertise.