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THE OCCURRENCE OF *SYRPHIDAE* IN *APHIS FABAE* SCOP. (*HEMIPTERA*) COLONIES ON BROAD BEAN INTERCROPPED WITH PHACELIA (PART II)

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Abstract: During the 2008–2009 time period, the effect of phacelia grown with broad bean on the presence of *Syrphidae* in colonies of *Aphis fabae* Scop. as well as the attractiveness of phacelia flowers for syrphid adults was researched. In *A. fabae* colonies, 9 *Syrphidae* species were collected. On plots with phacelia, less aphids and more syrphid larvae, compared to the homogenous crop, were observed. The dominant species were: *Episyrphus balteatus, Shaerophoria scipta*, *Syrphus ribesii* and *Epistrophe eligans*. Among the 9 species of *Syrphidae* collected from tansy phacelia flowers, the same species dominated as those noted in *A. fabae* colonies on broad beans intercropped with phacelia.
Sowing plants of value to *Syrphidae,* such as phacelia, is probably the ideal habitat management option for early occurrence of syrphids. Such a practice result in the reduction in crop damage by aphids.

Key words: hoverflies, black bean aphid, mixed cropping, *Vicia faba, Phacelia tanacetifolia*

INTRODUCTION

In recent years, more and more attention has been paid to the importance of biodiversity as an important factor limiting the occurrence of pests in the ecological infrastructure (Dąbrowski *et al*. 2008; Boczek *et al*. 2009; Olszak *et al*. 2009). Intercropping and mixed cropping may limit the number of pests. Such a practice inhibits pest development while creating favorable conditions for the development of beneficial insects. Reducing the number of pests in mixed cropping has several results: the presence of additional plants in cultivation may prove tempting or may prove to be a deterrent. Thus, the appropriate plant is more difficult to find (Wiech 1993; Wiech *et al*. 2009). *Phacelia tanacetifolia* – an important nectar and honey producing plant - is used to attract beneficial insects (Zimna 1959).

We did previous research about the impact of a mixed cultivation of beans with phacelia, on the beneficious insects, The previous research showed that fewer aphids and more predatory syrphid larvae were noted in the mixed cropping than in the homogeneous crop (Wnuk and Wojciechowicz-Żytko 2007). But no effect of phacelia on the occurrence of ladybirds (*Coccinelidae*) in *Aphis fabae*. Colonies (Wojciechowicz-Żytko and Wnuk 2009b) as well as on the harmfulness of *Sitona* sp. and *Bruchus rufimanus* was noted (Wojciechowicz-Żytko and Wnuk 2009a; Wnuk and Wojciechowicz-Żytko 2010).

Observations on the effects of phacelia grown with beans, on the occurrence of *A. fabae* and predatory syrphids were continued in the 2008–2009 time period. The additional catches of syrphids adults from phacelia flowers were taken into account.

The first aim of the research was to determine the impact of different kinds of cultivations of broad bean grown with phacelia, on the presence of *Syrphidae* in the colonies of *A. fabae* Scop. The second aim was to determine the attractiveness of phacelia flowers for the syrphid adults.

MATERIALS AND METHODS

The research was carried out in the 2008–2009 time period, at the Experimental Station of the Department of Plant Protection, the Agricultural University in Mydlniki near Krakow, Poland. The method of randomly selected blocks, in four replications, was applied. Broad beans of the Hangdown Biały cultivar, were sown in the following combinations: broad beans in a homogenous crop, broad beans and phacelia sown in the middle of the plot, broad beans with phacelia sown on the edges of the plot, and phacelia intercropped with broad beans. More information about broad bean cultivation can be found in our previous publications (Wojciechowicz-Żytko and Wnuk 2009b; Wnuk and Wojciechowicz-Żytko 2010).

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From April to July, *A. fabae* specimens, larvae and pupae of *Syrphidae* presented in aphid colonies were counted every 5–7 days on ten randomly selected broad bean plants of each plot. In 2008, after the 23rd of June it was impossible to conduct the observation due to hail which damaged the plants. Syrphid larvae were collected and reared in laboratory conditions to receive the adults. Syrphid adults were classified based on the Bańkowska (1963) and van Veen (2004) keys whereas larvae – on the Dušek and Láska (1961) and Goeldlin de Tiefenau (1974) keys.

In 2008, adults of *Syrphidae* were also collected from the flowers of phacelia during the blooming period. Samples were taken by means of a standardized sweeping net between 14–17 p.m. (30 min from each combination with phacelia) every 3 days from the end of May to the third decade of June. For each combination, nine samples were performed.

To assess the dependence of collected *Syrphidae,* the following domination classes were accepted: eudominants (ED) over 10%, dominants (D) – 5.1–10%, subdominants (SD) – 2.1–5%, recedents (R) – 1.1–2%, subrecedents (SR) – less than 1% (Dickler 1968).

The stability index was determined based on the frequency of the species in all samples. The following classes of constancy (stability) were adopted: I – random species (25%), II – accesory species (25–50%), III – constant species (51–75%), and IV – absolutely constant species (76–100%) (Trojan 1975).

RESULTS AND DISCUSSION

Differences in the infestation of broad bean plants by the black bean aphid (*A. fabae*) were registered in particular years of the observation and in various combinations. More aphids occurred in 2008, less numerous colonies were observed in 2009. The first aphids appeared on broad beans at the beginning of May in both years of observation (Fig. 1, 2). Similar periods of *A. fabae*

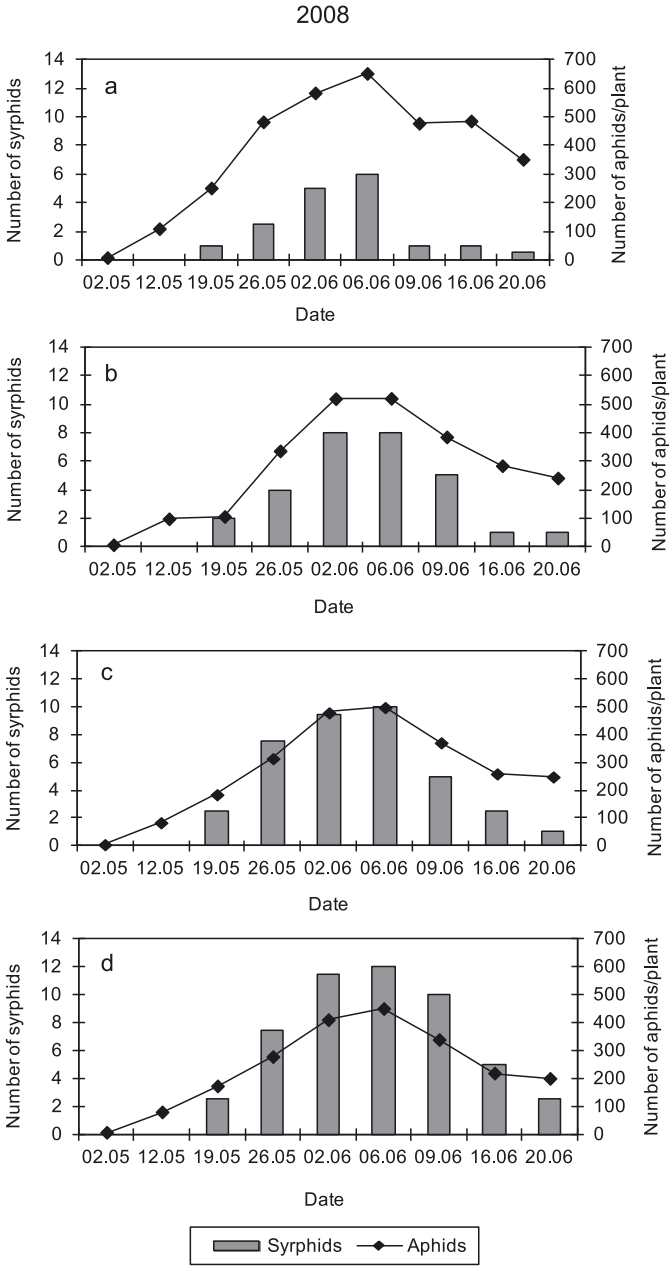

Fig. 1. Population dynamics of *A. fabae* and predatory *Syrphidae* on broad bean grown with phacelia (Mydlniki 2008)

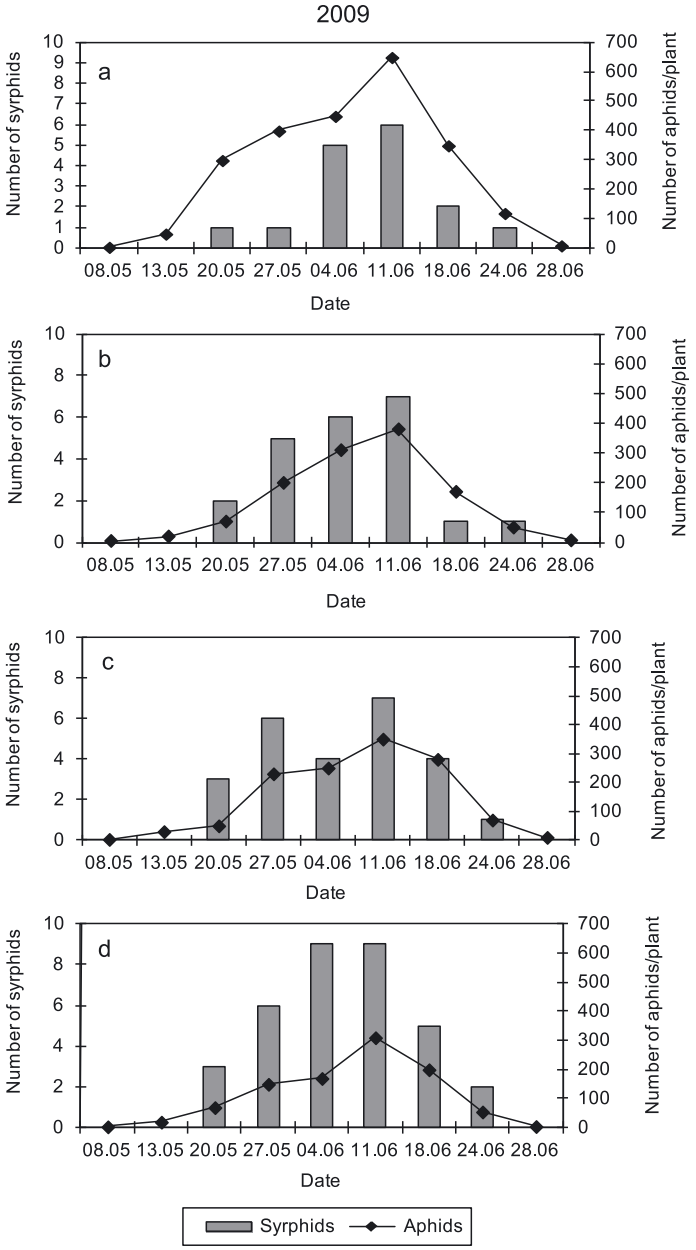

Fig. 2. Population dynamics of *A. fabae* and predatory *Syrphidae* on broad bean grown with phacelia (Mydlniki 2009)

occurrence were given by Goszczyński *et al*. (1992) and Wojciechowicz-Żytko (1998).

Smaller colonies were noted on plots with phacelia especially on plots where phacelia was intercropped with broad bean (Fig. 1). A similar dependency was observed by Wnuk and Wiech (1996) in the study of *Acyrthosiphon pisum* on intercropping peas with mustard, and by Wiech (1993) in the case of *Brevicoryne brassicae* (L.). Christerson (1995) observed a decrease in the number of *A. fabae,* in an intercropping of beet with phacelia.

Syrphids started to appeared in *A. fabae* colonies in the second decade of May, almost 2 weeks later than the first aphid colonies. They were most numerous at the beginning of June, during the maximum aphid appearance (Fig. 1, 2).

Among the *Syrphidae* species collected from the *A. fabae* colonies, the eudominants in 2008 were: *Episyrphus balteatus*, *Shaerophoria scipta* and *Syrphus ribesii*. They constituted more than 77% of all collected larvae (Table 1). In 2009, *Epistrophe eligans* was also a eudominant. These four species accounted for about 85% of all collected larvae. Larvae of these species were observed in aphid colonies from the second decade of May to the end of June. A similar period of occurrence was noted for the *S. ribesii* species. Larvae of *E. eligans* were mainly observed in May and then they left the aphid colonies looking for a place for their long-term winter diapause.

The occurrence of syrphid larvae in aphid colonies on broad beans in the different combinations are shown on tables 2 and 3. It is noticeable, that more syrphid larvae were found on the plots where beans were sown with phacelia compared to the homogenous crop. In most cases, more larvae were found in the plots where phacelia were intercropped with beans (3–4 times higher compared to the homogenous crop) and sown on the edge of plots (2–3 times higher) (Table 3). This was especially

Table 1. Syrphid larvae collected from the *A. fabae* colonies occurred on broad bean sown with phacelia (Mydlniki 2008–2009)

Species of *Syrphidae*	2008			2009			Total		
	number of specimens	percentage of species	dominance class	number of specimens	percentage of species	dominance class	number of specimens	percentage of species	dominance class
Episyrphus balteatus (Deg.)	74	45.4	ED	51	39.2	ED	125	42.7	ED
Sphaerophoria scripta (L.)	33	20.2	ED	26	20.0	ED	59	20.1	ED
Syrphus ribesii (L.)	19	11.7	ED	16	12.2	ED	35	12.0	ED
Epistrophe eligans (Harr.)	13	8.0	D	17	13.1	ED	30	10.2	ED
Syrphus vitripennis Meig.	16	9.8	D	8	6.2	D	24	8.2	D
Scaeva pyrastri (L.)	4	2.5	SD	8	6.2	D	12	4.1	SD
Eupeodes corollae (Fabr.)	2	1.2	R	3	2.3	SD	5	1.7	R
Melanostoma mellinum (L.)	1	0.6	SR	1	0.8	SR	2	0.7	SR
Sphaerophoria menthastri (L.)	1	0.6	SR	–	–	–	1	0.3	SR
Total	163	100.0	–	130	100.0	–	293	100.0	–

ED – eudominants; D – dominants; SD – subdominants; R – recedents; SR – subrecedents

Table 2. The occurrence of *Syrphidae* larvae (number of specimens) in *A. fabae* colonies occurred on broad bean sown with phacelia in different combinations (Mydlniki 2008–2009)

Species of *Syrphidae*	2008				2009			
	broad bean in homogenous crop	plots with phacelia			broad bean in homogenous crop	plots with phacelia		
		in the middle of the plot	on the edges of the plot	intercropped		in the middle of the plot	on the edges of the plot	intercropped
Episyrphus balteatus (Deg.)	10	15	17	32	9	11	14	17
Sphaerophoria scripta (L.)	2	7	12	12	4	6	7	9
Syrphus ribesii (L.)	–	4	6	9	1	3	5	7
Epistrophe eligans (Harr.)	2	3	3	5	3	6	4	4
Syrphus vitripennis Meig.	–	7	4	5	–	2	2	4
Scaeva pyrastri (L.)	1	1	1	1	2	2	1	3
Eupeodes corollae (Fabr.)	–	1	1	–	–	–	1	2
Melanostoma mellinum (L.)	–	–	–	1	–	–	–	1
Sphaerophoria menthastri (L.)	–	–	1	–	–	–	–	–
Total	15	38	45	65	19	30	34	47

Table 3. Effect of broad bean cultivation on the occurrence of aphidophagous syrphid larvae in *A. fabae* colonies (Mydlniki 2008–2009)

Combination		2008		2009	
		number of species	number of larvae	number of species	number of larvae
Broad bean in homogenous crop		4	15 a	5	19 a
Plots with phacelia	in the middle	7	38 b	6	30 b
	on the edges	8	45 b	7	34 b
	intercropped	7	65 c	8	47 c
Total		9	163	8	130

Means followed by the same letters in columns are not significantly different according to the Duncan test for p = 0.05

Table 4. The number of specimens of aphidophagus *Syrphidae* collected from flowers of phacelia intercropped with broad bean (Mydlniki 2008)

Species	Plots with phacelia			Total	Dominance		Class of stability
	in the middle	on the edges	intercropped		[%]	class	
Episyrphus balteatus (Deg.)	8	21	30	59	39.3	ED	III
Sphaerophoria scripta (L.)	14	18	12	44	29.3	ED	III
Syrphus ribesii (L.)	7	5	15	27	18.0	ED	II
Syrphus vitripennis Meig.	6	3	5	14	9.3	D	II
Epistrophe eligans (Harris)	1	–	1	2	1.3	SR	I
Eupeodes corollae (F.)	–	1	–	1	0.7	SR	I
Sphaerophoria menthastri (L.)	–	–	1	1	0.7	SR	I
Sphaerophoria rueppellii (Wied.)	–	–	1	1	0.7	SR	I
Scaeva pyrastri (L.)	–	–	1	1	0.7	SR	I
Total	36	48	66	150	100.0		

ED – eudominants; D – dominants; SD – subdominants; R – recedents; SR – subrecedents

evident in 2008, for two common species: *E. balteatus* and *S. scripta* (Table 2). In 2009, fewer larvae of *Syrphidae* were collected and differences in their number between the different combinations, were not so clear.

In homogenous plots, less syrphid species were found compared to the plots with phacelia (Table 3). This indicates the attractiveness of tansy phacelia for the syrphid adults. They fed on the phacelia pollen and then laid eggs on plants infested by aphids.

Taking into account only those three combinations with phacelia grown with broad bean, most aphidophagous larvae were collected from *A. fabae* colonies on plots with phacelia intercropped with beans. These data are very similar for both of the years under observation. The data suggest that the method of cultivation of broad bean with phacelia has a big impact on the attraction of *Syrphidae* – the best method is intercropping of both plants (Table 3).

Pollen is essential for sexual maturation of syrphid eggs. Thus, the provision of floral resources may enhance syrphid numbers in agricultural and horticultural landscapes with an appropriate flora (Irvin *et al*. 1999; Langoya and Rijn 2008; Sadeghi 2008). Kienegger and Kromp (2001) Kienegger *et al*. (2003), working on the impact of flower strips on pests and beneficious insects occurring on cabbage fields, confirmed the increase of eggs and larvae of *Syrphidae* as well as the favourable numerical relation of the predator to its prey. In the case of *A. fabae* on beet, Hurej *et al*. (1998) recorded that *Syrphidae* were the only group of predators which were attracted in larger numbers by blossoming mixed plants and weeds. In previous research, Wnuk and Wojciechowicz-Żytko (2007) found out that intercropping of broad bean with phacelia increases the number of syrphid larvae feeding in aphid colonies on broad bean.

Most syrphid adults were caught on phacelia flowers intercropped with beans (Table 4). They constituted 44% of all collected aphidophagous *Syrphidae*. On plots with phacelia sown on the edges, *Syrphidae* constituted 32%, on plots with phacelia in the middle – 24%. It is interesting that the least number of flies were caught on the plots where phacelia was sown in the middle. It is difficult to know whether the broad bean plants could be a barrier for syrphids visiting phacelia, or if other mechanism of finding the pollen are at work here too. On the other hand, it should be noted that most species of *Syrphidae* are good fliers, and this barrier should not be a major disadvantage for them. More important in this case, were the greater number of flowering plants on the plot, providing easier access for the approaching insects.

The dominant species were: *E. balteatus, S. scripta and S. ribesii*, which constituted over 86% of all collected aphidophagous *Syrphidae*. The first two species also showed the greatest constancy in visiting phacelia flowers (Table 4). Wnuk *et al*. (2009), received similar results regarding the predominant species collected from phacelia flowers grown in a homogeneous crop. Kelm *et al*. (2009) working on the attractiveness of flowers of some herbs for *Syrphidae*, recorded the dominance of *Sphaerophoria scripta*.

A comparison of the number of recorded syrphid larvae from aphid colonies to the number of syrphid adults collected from phacelia flowers, showed the similarity in species composition and dominance in both cases.

A. fabae is recorded as a main pest of broad bean. It regularly causes severe crop losses. In previous work, Wojciechowicz-Żytko (2000) found out that reduction in broad bean seed yield from the plots infested by *A. fabae* ranged from 68 to 93% in comparison to the control plots. So, the introduction of pollen sources, such as phacelia, around crop margins or in a central strip, may be a management option for early enhancement of syrphid populations. Such an action would bring a reduction in crop damage by aphids.

CONCLUSIONS

1. Cultivation of broad bean with phacelia significantly decreased the number of *Aphis fabae* feeding on bean plants.
2. In plots with phacelia, more aphidophagous syrphid larvae were found.
3. The species composition of syrphid larvae noted in *A. fabae* colonies as well as adults collected from phacelia flowers, was similar. This indicates that flies attracted by the flowers of tansy phacelia, lay eggs later in aphid colonies on broad bean plants intercropped with phacelia.
4. Intercropping phacelia with broad bean is one of the management options for early attraction of syrphid adults. The result is a reduction of damaged caused by the aphids.

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