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The occurrence of Coccinellidae /Coleoptera/ in *Aphis fabae* Scopoli, 1763 /Hemiptera, Aphidoidea/ colonies on broad bean intercropped with phacelia**

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Abstract

In years 2006-2008 the impact of different kinds of broad bean and phacelia crops on the occurrence of Coccinellidae in *Aphis fabae* colonies was researched. In all the years of the observations a smaller number of *A. fabae* specimens was recorded on phacelia fields, especially those with the cultivation of intercropped plants. In *A. fabae* colonies, larvae and adults of the following species were recorded: *Coccinella septempunctata* L., *Adalia bipunctata* L., *Propylaea quatuordecimpunctata* (L.). *C. septempunctata* was the most numerous, amounting to 46-79% of all the registered ladybirds.

In 2006 most ladybirds were recorded on control plots and in the remaining years no impact of broad bean intercropping with phacelia on the number of ladybirds was recorded.

Introduction

Mixed cropping and intercropping may control the number of pests by means of both, hampering their development and the formation of favourable

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conditions for beneficious species development. The decrease in number of harmful insects in multiple cropping has several results: the presence of additional plants in a crop may be tempting or repulsive and thus the plant proper is more difficult to find (Wiech, 1993). *Phacelia tanacetifolia* is used to tempt beneficious insects (Fig. 1). It is considered to be an important nectar and honey producing plant. It is also useful for bees. Apart from its usefulness for bees, phacelia may also be used in agriculture as fodder, protective and covering plant (Zimna, 1959). High sugar and pollen production out of 1 ha of land, put it on a high place among plants attracting insects (mainly bees) to its flowers (Jabłoński, 2000; Jabłoński & Skowronek, 1983).

The aim of the research was to determine the impact of different kinds of cultivations of broad bean grown with phacelia on the presence of Coccinellidae in the colonies of *Aphis fabae* Scopoli, 1763.

Material and methods

The research was carried out in the years 2006-2008 in an experimental station of the Department of Plant Protection of the Agricultural University in Mydlniki near Krakow, applying the method of blocks selected at random in four repetitions. Broad bean of the "Hangdown Biały" cultivar was sown in spacing 30x50 cm on the plots, 25 m^2 each. Broad bean and phacelia were sown simultaneously at the end of March 2007, and the beginning of April in 2007 and 2008. The following combinations were considered: broad bean in a homogenous crop, broad bean and phacelia sown in the middle of the plot, broad bean and phacelia sown on the edges of the plot and phacelia intercropped with broad bean.

From April to July, *A. fabae* specimens and larvae and adults of Coccinellidae present in aphid colonies were counted every 7 days on ten randomly selected broad bean plants of each plot.

Results and discussion

Differences in broad bean plants infested by black bean aphid (*A. fabae*) were registered in particular years of the observation and in different combinations. The aphids appeared in greatest numbers in 2008 whereas its colonies had a smaller number in 2006 (Tab. 1). First aphid specimens appeared on broad bean in the beginning of May in all the years of the observation, the maximum number was attained at the end of May (2007) and the beginning of June (2006 and 2008). Colonies, the number of which ranged between 140-650 specimens, were registered then. From mid-June the number of aphids deci-

mated even up to their total disappearance at the end of June. Similar periods of *A. fabae* occurrence were provided by Goszczyński *et al.* (1992) and Wojciechowicz-Żytko (1998).

In all the years of the research a less extensive infestation of plants by *A. fabae* was registered on plots with phacelia, especially those with intercropped cultivations. A similar dependency was recorded by Wnuk & Wiech (1996) in their research on *Acyrthosiphon pisum* (Harris, 1776) on intercropping of peas with charlock. Wiech (1993) also found such dependence for *Brevicoryne brassicae* (Linnaeus, 1758) in an intercropped cultivation. Christerson (1995) observed a decrease in the number of *A. fabae* specimens in an intercropping of beet with phacelia while Twardowski (2002) recorded fewer aphids on beet growing near blossoming flowers. Jankowska (2007) in an intercropping of white cabbage with marigold and tagetes recorded a significant decrease in *B. brassicae* aphid number on cabbage grown with marigold in comparison with homogenous cultivation. A fall in the number of aphids on cabbage intercropped with shamrock was recorded by Wiech & Wnuk (1991) and Lehmus *et al.* (1999). Takahirva & Coaker (1982) point out to the role played by visual stimuli in finding host plants. They state that in a homogenous crop the soil of intercrop contrasts with the host plant which makes it more visible and attractive to aphids flying on. On the other hand, chemical stimuli also play a very significant role. The proximity of plants which are not hosts to aphids may mask the scent of the host plant making it more difficult to find it (Tahvanainen & Root, 1972; Perrin & Philips, 1978; Utah & Coaker, 1984).

The role of intercropping may be compared to the amounts of weeds found in the crops. And in a red beet crop with a varied amount of weeds it was observed that black bean aphid was recorded in a smaller number on weeded fields than on fields that were gradually weeded out (Wnuk & Pobożniak, 1999; 2004; Pobożniak & Wnuk, 2003).

Coccinellidae started to appear in *A. fabae* colonies in the beginning of May 2008 at the same time as the first aphid colonies, and in 2006 and 2007 – in mid-May (a few days later than aphids) (Tab. 1, Fig. 2). They were most numerous during the maximum aphid appearance.

Because of the fact that Coccinellidae appear in early spring in *A. fabae* colonies and destroy first fundatricae they ought to be counted among important groups of predators regulating aphid populations (Hodek *et al.*, 1965; Narkiewicz-Jodko, 1966; Wengris, 1968; Ciepielewska, 1991; Wojciechowicz-Żytko, 1998, 1999). Olszak (1978) and Olszak & Niemczyk (1986) stated that ladybirds are present in largest numbers in orchards in early spring and in the summer on vegetables. Aphid development initially has a slightly quicker course than in the case of ladybirds, though in mid-summer there is balance in this ratio (Barczak, 1988).

In *A. fabae* colonies the presence of larvae and adults of the following species was recorded: *Coccinella septempunctata* L., *Adalia bipunctata* L. *Propylaea quatuordecimpunctata* (L.) (Tab. 2, Fig. 3). *C. septempunctata* was the most numerous as it amounted to 46-70% of all the registered ladybirds (Fig. 3).

Figure 1. *Phacelia tanacetifolia*

Figure 2. Larvae of Coccinellidae

Table 1. Mean number of aphids and Coccinellidae on broad bean intercropping of broad bean with phacelia (Mydlniki 2006-2008)

Date of observa-tion	Broad bean in homogenous crop		Broad bean and phacelia in the middle of the plot		Broad bean and phacelia on the edges of the plot		Intercropping of phacelia with broad bean	
2006								
	aphids	ladybirds	aphids	ladybirds	aphids	ladybirds	aphids	ladybirds
07.05	2	0	3	0	5	0	3	0
14.05	8	0	10	0	12	0	9	0
21.05	20	0.4	25	0.2	18	0.1	15	0.2
28.05	60	0.3	50	0.1	58	0.1	39	0.2
04.06	140	0.2	250	0.1	175	0.2	110	0.1
11.06	135	0.3	200	0.1	60	0.1	90	0.1
18.06	125	0.4	148	0.2	20	0.3	60	0
25.06	10		8	0	5	0	5	0
average	62.5	0.3	86.8	0.1	44.1	0.2	41.3	0.2
2007								
02.05	3.1	0	2.3	0	2.5	0	1.8	0
08.05	8.6	0	7.7	0	7.6	0	8.1	0
15.05	50.6	2.5	19.5	1.3	23.3	1.8	27.7	0.3
22.05	255.7	3	150.8	4	163.9	2.3	155.7	3.5
28.05	350.8	4	210.3	2	250.3	3	209.6	3.3
02.06	210.6	2	145.3	3	104.3	3	115.5	2.8
08.06	120.5	1.5	92.8	2	82.5	1.5	78.3	3
15.06	20.1	0.8	15.3	0.5	10.2	0	8.8	1.2
22.06	5.5	0	7.2	0	3.3	0	4.2	0
average	11.9	2.3	72.4	2.1	72.0	2.3	67.7	2.4
2008								
02.05	7	0.2	6.5	0.1	5.5	0.2	7	0.2
12.05	108.8	0.4	97.8	0.5	85	0.5	80.5	0.4
19.05	250	0.7	106.3	0.7	186.3	0.6	173.6	0.7
26.05	481.3	1.1	336.3	1.1	316.3	1.1	278.8	1.1
02.06	581.8	1.8	518.8	1.8	481.3	1.7	410	1.8
06.06	650.3	1.9	520.2	1.7	500.1	1.8	450.8	1.8
09.06	475.8	1.9	385.3	2	373.8	1.8	338.8	1.9
16.06	483.8	2.3	283.8	2	261.3	2.0	219.3	2.2
20.06	350.5	1.2	240.8	1.5	250.3	1.3	200.3	1.5
average	376.6	1.3	277.3	1.3	273.3	1.2	239.9	1.3*

*In result of hailstorm (23.06) and the devastation of experiments no further observations in 2008

BARCZAK (1988), CIEPIELEWSKA (1991), WOJCIECHOWICZ-ŻYTKO (1998, 1999) also included the following species which dominated in *A. fabae* colonies on beet and broad bean: *C. septempunctata*, *C. quinquepunctata*, *A. bipunctata* and *P. quatuordecimpunctata*.

BARCZAK *et al.* (1996) observed the domination of *A. bipunctata* and *C. septempunctata* in *A. fabae* colonies on evonymus which was its winter host.

In 2006 the largest number of ladybirds was recorded on control plots (broadbeari in homogenous crop) where the number of aphids per one plant was the highest and in the remaining years no influence in intercropping of broad bean with phacelia on the number of ladybirds was observed (Fig. 4).

Table 2. Coccinellidae in numbers in *Aphis fabae* colonies on broad bean intercropping with phacelia (Mydlniki 2006-2008)

Species of *Coccinellidae*	Broad bean in homogenous crop		Broad bean with phacelia in the middle of the plot		Broad bean with phacelia on the edges of the plot		Inetrcropping of phacelia with broad bean		Total	
Specimens in numbers and in %										
2006										
	numbers	%	numbers	%	numbers	%	numbers	%	numbers	%
Coccinella septempunctata	7	63.6	3	42.9	0	0	1	25	11	45.8
Propylaea quatuordecimpunctata	4	36.4	3	42.9	1	50	2	50	10	41.7
Adalia bipunctata	0	0	1	14.2	1	50	1	25	3	12.5
Total	11	100	7	100	2	100	4	100	24	100
2007										
Coccinella septempunctata	13	68.4	11	55	18	81.8	15	75	57	70.4
Propylaea quatuordecimpunctata	2	10.5	8	40	4	18.2	2	10	16	19.7
Adalia bipunctata	4	21.1	1	5.0	0	0	3	15	8	9.9
Total	19	100	20	100	22	100	20	100	81	100
2008										
Coccinella septempunctata	27	55.1	25	52.1	29	67.4	32	68.1	113	60.4
Propylaea quatuordecimpunctata	6	12.2	11	22.9	4	9.3	7	14.9	28	15.0
Adalia bipunctata	16	32.7	12	25.0	10	23.3	8	17.0	46	24.6
Total	49	100	48	100	43	100	47	100	187	100

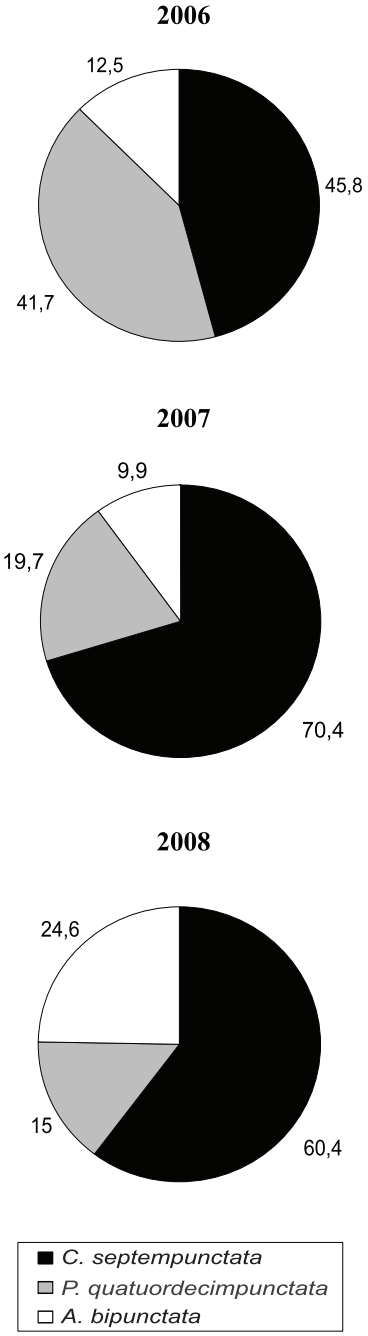

Figure 3. The species of ladybirds in *Aphis fabae* colonies on broad bean – percentage share (Mydlniki 2006-2008)

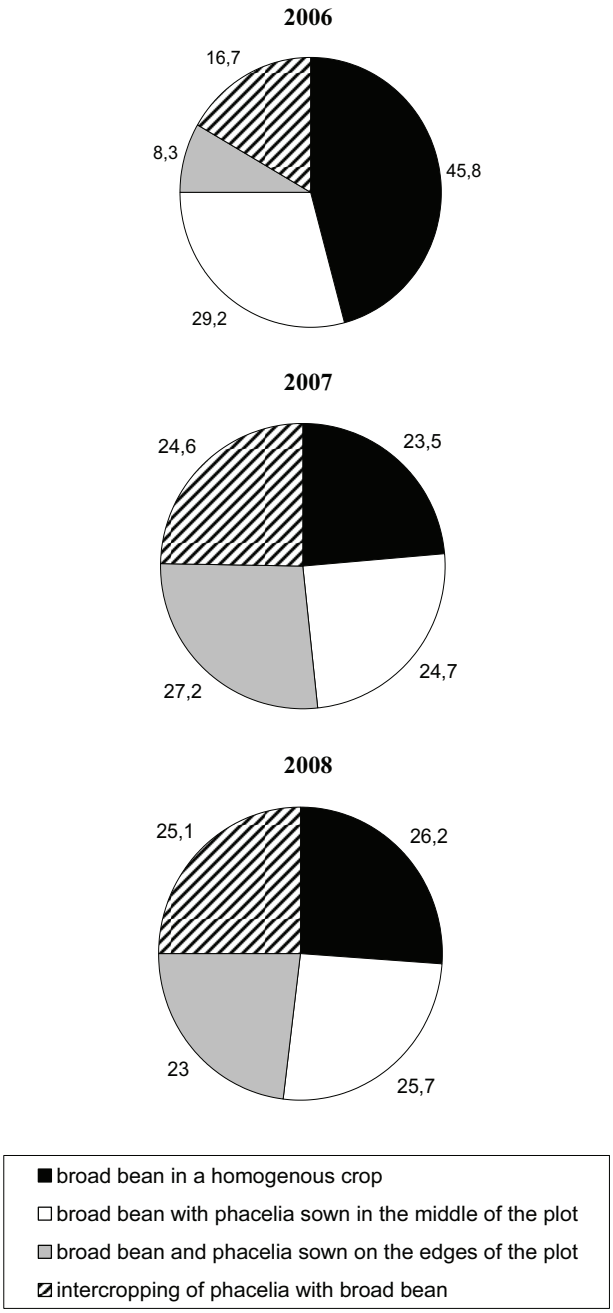

Figure 4. Ladybirds in *Aphis fabae* colonies on broad bean in different method of cultivation with phacelia – percentage share Mydlniki (2006-2008)

In intercropping of cabbage with shamrock and common bean WIECH (1993) observed that ladybird larvae in cabbage aphid (*B. brassicae*) colonies appeared in larger numbers on cabbage grown without accompanying plants. This points out to a tendency of Coccinellidae to be guided when choosing a place to lay eggs by aphid colony size and the absence of other plants (shamrock or beans) on the fields facilitates the penetration of cabbage plants which are grown within equal distance from each other.

Many authors point out to an increasing importance of Coccinellidae in the check of *A. fabae* populations feeding on different crop plants (CIEPIELEWSKA, 1991; KORDAN & CIEPIELEWSKA, 1998, WOJCIECHOWICZ-ŻYTKO, 1998, 1999, POBOŻNIAK WNUK, 2003). JANKOWSKA (2005) observed innumerous presence of Coccinellidae (*C. septempunctata* and *A. bipunctata*) in cabbage aphid colonies on different cabbage vegetables. Little impact of Coccinellidae on the check of *B. brassicae* populations was confirmed in research by NAWROCKA (1984) and GADOMSKI *et al.* (1998).

In beet crops with a varied amount of weeds it was observed that the number of predators controlling aphids was greatest in places where aphid number was larger, i.e. on fields with no weeds (it concerned larvae and adult Coccinellidae and syrphid larvae). Meanwhile, the effectiveness of predatory insects in small aphid colonies on beet with a higher amount of weeds increased (WNUK & POBOŻNIAK, 1999; 2004 and POBOŻNIAK & WNUK, 2003).

KIENEGGER & KROMP (2001), KIENEGGER *et al.* (2003) when studying the impact of flower strips on pest and beneficious insect occurrence on cabbage fields did not observe any differences in numbers of either adults or Coccinellidae larvae in homogenous and intercropped cultivations. HUREJ *et al.* (1998) in their research on the effectiveness of blossoming flower strips in attracting of predators of *A. fabae* observed scarce presence of ladybirds on both, weeded and control fields. They recorded that Syrphidae were the only group of predators which were attracted in larger numbers by blossoming mixed plants and weeds. A large impact of phacelia intercropping with broad bean on attracting predatory syrphids was also confirmed by WNUK & WOJCIECHOWICZ-ŻYTKO (2007).

Conclusions

1. Intercropping of broad bean and phacelia may influence the decrease in *A. fabae* numbers. Such an impact is marked in years during which black bean aphid occurred in large numbers.
2. In *A. fabae* colonies on broad bean the occurrence of 3 ladybird species was confirmed. In all the years of research *C. septempunctata* dominated.
3. No significant impact of phacelia on Coccinaellidae occurrence was registered.

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Występowanie biedronkowatych /Coleoptera, Coccinellidae/ w koloniach *Aphis fabae* Scopoli, 1763 /Hemiptera, Aphidoidea/ w uprawie bobu z facelią

Streszczenie

W latach 2006-2008 badano wpływ różnego sposobu uprawy bobu z facelią na występowanie biedronkowatych w koloniach mszycy *Aphis fabae*. We wszystkich latach badań zanotowano mniejsze opanowanie roślin przez mszycę *A. fabae* na poletkach z facelią, zwłaszcza na tych ze współrzędną uprawą. W koloniach *A. fabae* stwierdzono występowanie larw i postaci dorosłych następujących gatunków: *Coccinella septempunctata* L., *Adalia bipunctata* L., *Propylaea quatuordecimpunctata* (L.). Najliczniej występowała *C. septempunctata*, która stanowiła od 46 - 70% wszystkich stwierdzonych biedronek.

W 2006 r. najwięcej biedronek zaobserwowano na poletkach kontrolnych (z jednorodną uprawą bobu) natomiast w pozostałych latach nie stwierdzono wpływu uprawy bobu z facelią na liczbę występujących biedronek.