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Effect of intercropping of broad bean (*Vicia faba* L.) with tansy phacelia (*Phacelia tanacetifolia* Benth.) on the occurrence of *Aphis fabae* Scop. and predatory *Syrphidae*

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Introduction

In plant protection programs greater attention is paid to the usage of non-chemical methods of limiting harmful agrophages. Intercropping of two crop plants which are not shared hosts for pests is considered to be one such method. The introduction of intercropping is to create more favourable conditions for beneficial species and inhibit pest development (WIECH, 1993).

Phacelia tanacetifolia Benth. is frequently used for intercropping, as its flowers may be the source of pollen and nectar for adults of beneficial insects. Tansy phacelia is the best yearly plant which is used by bees, but it can also be used as a fodder and protective cover crops (ZIMNA, 1959). High efficiency of sugars and pollen from one ha makes it attractive for insects (bees in particular) (JABŁOŃSKI, 2000; JABŁOŃSKI & SKOWRONEK, 1983).

The population of *Aphis fabae* Scopoli, 1763 is inhibited by parasite and predatory insects, among which predatory larvae of *Syrphidae* play an important role (HUREJ, 1982; WNUK, 1979; WOJCIECHOWICZ-ŻYTKO, 1998; 2000; 2006).

The aim of this paper is to determine the impact of *P. tanacetifolia* sown in broad bean crops (*Vicia faba major*) on the presence of *A. fabae* and predatory syrphid flies (*Syrphidae*).

Methods

The research was carried out in 2006-2007 in the Research Station of the Plant Protection Department of the Agricultural University in Mydlniki near the city of Krakow. The experiment was based on a method of blocks selected at random in four replications. Broad bean of the 'Hangdown Biały' cultivar was sown on 4 April, 2006 and 26 March, 2007 in spacing 30x50 cm on plots, the size of each of which was $25m^2$. The crops and fertilization were made in accordance with agrotechnical recommendation.

The following combinations were taken into consideration: control: broad bean in homogenous crop; broad bean with phacelia sown in the centre of the plot in a 0.5m wide row; broad bean with phacelia sown in the ridges of plot (in a 0.5m wide row), phacelia intercropped with broad bean (two rows of broad bean, one row of phacelia).

The observations of *A. fabae* Scop. on broad bean were carried out from the beginning of May until the end of June. Every week aphids and larvae of *Syrphidae* were counted on each plot, on 10 plants selected at random and marked. The collected larvae and pupae of syrphids were reared in a laboratory in order to obtain adults which were later identified with respect to their species. Meanwhile imagines of *Syrphidae* were captured from phacelia flowers for comparison.

Results and discussion

In 2006-2007 *A. fabae* was present on broad bean in a varied density. In 2006 the number of aphids was twice as small as in 2007. The infestation of broad bean by aphids in 2007 in homogenous crops was 30-40% greater than in fields where phacelia was sown (Tab. 1.).

The situation was different in 2006 when the number of aphids was the highest in a combination where phacelia was sown in the centre of the plot (39% of increase in comparison with the control). In both years of research the lowest number of aphids was registered in a combination of phacelia intercropped with broad bean (Tab. 1.).

Christerson (1995) provided similar results. In her research a decrease in *A. fabae* number was confirmed and an increase in the number of predatory insects on plots where sugar beet was intercropped with phacelia. Twardowski (2002) observed that aphids on beet were present in lower density if there were blossoming plants nearby. When cabbage was intercropped with clover a smaller number of cabbage aphid (*Brevicoryne brassicae* (Linnaeus 1758)) was registered (Wiech, 1993), and in plots where pea seeds was intercropped with white mustard the number of pea aphid (*Acyrthosiphon pisum* (Harris 1776)) was smaller (Wnuk & Wiech, 1996).

Table 1. Comparison *of Syrphidae* larvae occurrence in *Aphis fabae* colonies on broad bean depending on the way of cropping

Crop	2006					
	Total number of aphids	**Mean number of aphids/plant**	**Mean number of aphids/ plant in their maximum occurrence**	**Total number of Syrphid larvae**	**Mean number of Syrphid larvae/ plant**	**Predator to prey ratio**
Broad bean in homogenous crop	4375	62.5	140	19	0.27	1:230
Broad bean with phacelia sown in the centre of the plot	6076	86.8	250	24	0.34	1:253
Broad bean with phacelia sown in the ridges of plot	3087	44.1	175	29	0.41	1:106
Phacelia intercropped with broad bean	2576	36.8	110	24	0.34	1:107
Total	16114	57.5	168.7	96	0.34	1:168
2007						
Broad bean in homogenous crop	10251	113.9	350	72	0.8	1:143
Broad bean with phacelia sown in the centre of the plot	6516	72.4	210	72	0.8	1:90
Broad bean with phacelia sown in the centre of the plot	6480	72.0	250	99	1.1	1:65
Phacelia intercropped with broad bean	6093	6.7	209	108	1.2	1:56
Total	29340	81.5	254.7	351	0.97	1:84

In both years of research the number of *Syrphidae* larvae in colonies of *A. fabae* was registered to increase on broad bean intercropped with phacelia (Tab. 1.). In 2006 this increase amounted to 26-53% and in 2007 it was recorded only on broad bean with phacelia sown on the ridges and in intercrops of broad bean (37.5 and 50% respectively).

Hurej *et al*. (1998) claimed that phacelia sown in a mix with white mustard and coriander along a field of beets attracted more adult forms of *Syrphidae* than rows which were naturally weeded. Wiech (1993) recorded an important impact of white clover intercropped with cabbage on the increase of the number of eggs laid by aphidophagous *Syrphidae*. The impact of rows with blossoming plants in Brussels sprouts crops on the increase of eggs and larvae of *Syrphidae* as well as on a favourable numerical relation of the predator to its prey was confirmed by Kienegger & Kromp (2001) and Kienegger *et al*. (2003).

Numerical relation of the predator to its prey is interesting when counted for the whole period of aphid occurrence in both years of the observation (Tab. 1.). This situation was much better in 2007 since almost twice as many aphids were assigned to the predator as in the previous year. In both years of observation the broad bean plots intercropped with phacelia sown on the plot ridges and those intercropped with broad bean were most favourable for the activity of *Syrphidae*.

The fewer aphids assigned to the predator the more favourable the relation from the plant protection point of view. It has to be marked though that only those aphid colonies in which *Syrphidae* larvae were feeding were destroyed.

Among the *Syrphidae* that were reared the following species were registered: *Episyrphus balteatus* (De Geer 1776.), *Syrphus ribesii* (Linnaeus 1758.), *Syrphus vitripennis* Meigen 1822, *Sphaerophoria scripta* (Linnaeus 1758), *Sphaerophoria rueppelli* (Wiedeman 1830), *Scaeva pyrastri* (Linnaeus 1758) and *Melanostoma mellinum* (Linnaeus 1758). The first four species dominated in the predatory larvae of *Syrphidae*. From the phacelia flowers the same species were captured with the exception that it was *E. balteatus* that dominated constituting about 70% of all the captured syrphids.

The population dynamics relation of predator to its prey in both years of observation was similar (Fig. 1.). First aphids were registered in the beginning of May and their maximum number was reached in the end of May 2007 and in the beginning of June 2006. Similar periods of *A. fabae* occurrence was provided by Goszczyński *et al.* (1992) and Wojciechowicz-Żytko (1998).

Syrphids appeared in aphid colonies even with a three-week delay in relation to the presence of aphids. The conquer of aphid colonies by the *Syrphidae* larvae was much more intense in 2007 and in the period of their maximum appearance it amounted to 35-50% when in 2006 it reached only 25%. In 2006 the percentage of aphid colony with syrphid larvae was very similar in all the combinations while in 2007 the greatest infestation of aphid colonies was registered on broad bean intercropped with phacelia (Fig. 1.).

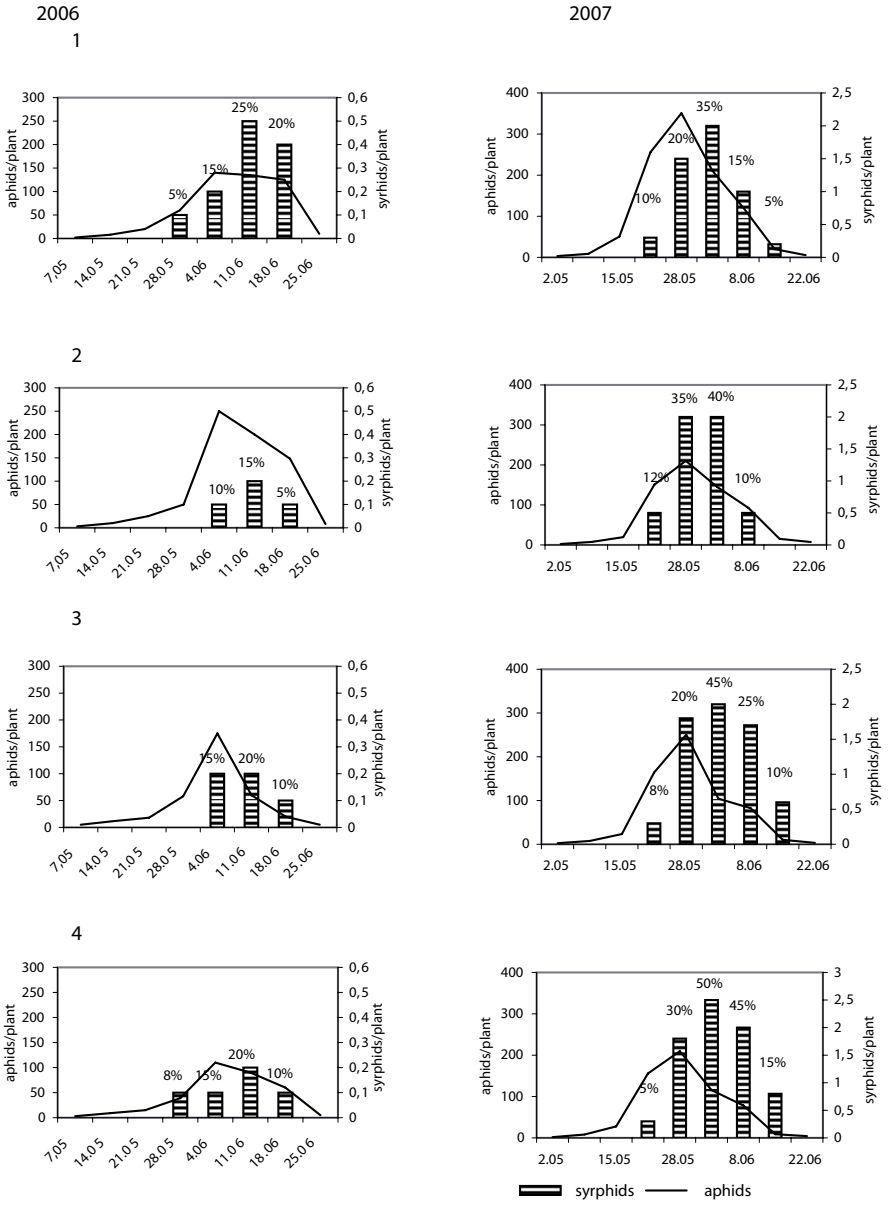

Fig. 1. Dynamics of *Aphis fabae* and aphidophagous *Syrphidae* on broad bean depending on the way of cropping and percent of colonies with *Syrphidae* larvae:

1. broad bean in a homogenous crop;
2. phacelia in the centre of plot;
3. phacelia on plot ridges;
4. phacelia intercropped with broad bean

The above research leads to a conclusion that the intercropping of broad bean with phacelia may influence the decrease of *A. fabae* population. Such influence was marked much clearer in years of numerous occurrence of *A. fabae*.

Conclusions

On the basis of observations it can be stated that:

1. The intercropping of broad bean with phacelia influenced the decrease in the number of aphids.
2. In combinations of broad bean intercropping with phacelia, more syrphid larvae feeding in *A. fabae* colonies were registered.
3. The numerical relation of predator to its prey was favourable from the plant protection point of view on plots where broad bean was intercropped with phacelia.

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Wpływ współrzędnej uprawy bobu (*Vicia faba* L.) z facelią (*Phacelia tanacetifolia* Benth.) na występowanie mszycy burakowej *Aphis fabae* Scop. i drapieżnych bzygowatych (*Syrphidae*)

Streszczenie

W latach 2006-2007 badano wpływ współrzędnej uprawy bobu z facelią na występowanie mszycy *Aphis fabae* Scop. i drapieżnych bzygowatych (*Syrphidae*). Stwierdzono mniej mszyc we współrzędnej uprawie bobu z facelią niż w uprawie jednorodnej. Więcej larw bzygowatych było w koloniach mszycy w kombinacjach z wysianą facelią. Stosunki liczbowe drapieżcy do ofiary były najkorzystniejsze z punktu widzenia ochrony roślin na poletkach bobu z facelią wysianą w miedzyrzędzia bobu.

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