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THE EFFECTIVENESS OF APHIDOPHAGOUS SYRPHID LARVAE (*DIPTERA, SYRPHIDAE*) IN THE CONTROL OF *APHIS FABAE* SCOP. (*HOMOPTERA, APHIDODEA*) ON BROAD BEAN

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Abstract. In the research of voracity of syrphid larvae it was found that the number of aphids *Aphis fabae* Scop. eaten by larvae oscillated between 300-800 specimens depending on the syrphid species. Larvae of *Syrphus ribesii* (L.) appearred to be the most voracious. It was found that predator-prey ratio from 1:25 to 1:50 was the most effective at *Episyrphus balteatus* (Deg.) and *Sphaerophoria scripta* (L.) larvae in *Aphis fabae* control on broad bean.

Key words: *Syrphidae, Aphis fabae*, voracity, predator-prey ratio

I. INTRODUCTION

Aphis fabae Scop. is the main pest of beetroot, broad bean, field beans and poppy regularly causing severe crop losses either through direct feeding or as a virus vector. Aphidophagous syrphid larvae are the main predatory group reducing population of *Aphis fabae*. The effectiveness of these predators depends on many factors e.g. the number of preys eaten by predators and the predator-prey ratio (Niemczyk 1973).

Study on the effectiveness was carried out on 6 common syrphid larvae which occurred in *Aphis fabae* colonies on broad bean: *Episyrphus balteatus* (Deg.), *Sphaerophoria scripta* (L.), *Syrphus ribesii* (L.), *Syrphus vitripennis* Meig., *Metasyrphus corollae* (Fabr.) and *Epistrophe eligans* (Harris) (Wojciechowicz-Żytko 1998a; 1998b).

Predation efficiency of larvae of *E. balteatus* and *S. scripta* against *A. fabae* was also investigated.

II. MATERIALS AND METHODS

Adults of 6 common *Syrphidae* species (mentioned above) collected from the wild flowers were separately reared in the clear, plastic cages (ϕ 90 cm) in the greenhouse. The top of each cage was covered with muslin for ventilation. The broad bean plants infested with *A. fabae* colonies, dishes with water, water with sugar and hazel pollen (essential for the maturation of the eggs – Chambers 1980; Gilbert 1986; Wnuk 1975), were placed in the cages. The daylight was supplemented by fluorescent lighting for 14 hours per day.

After the eggs had been laid by syrphid females on the broad bean plants, they were collected from these rearing and raised separately in Petri dishes covered with wet tissue-paper. Each larva, which hatched from egg, was daily fed with a specific number of aphids which always exceeded the number consumed on that day. Initially it was 10-20 aphids per day increased to about 300 specimens. Daily consumption was calculated as a difference between the amount of aphids being supplied every day and the amount of alive aphids which have not been eaten till the next day. All experiments were conducted in laboratory, in 10 replications each, at temperature 21°C, relative humidity 80% and 14-hour photo-period.

Study on the most profitable predator-prey ratio in *A. fabae* colonies controled by larvae *E. balteatus* and *S. scripta* was carried out in the greenhouse.

Broad bean plants were singly grown in the plastic cages (ϕ 50 cm). The first stage of development larvae of *E. balteatus* and *S. scripta* were placed separately on the broad bean plants on which there were already colonies of 25, 50, 100 and 200 aphids. The control broad bean plants without aphid colonies were also grown. The experiment was carried out in 5 replications.

III. RESULTS AND DISCUSSION

Data related to voracity of *Syrphidae* larvae under investigation are presented in Figs. 1 and 2, Tabs. 1 and 2.

Larvae in the first and second stages of development ate small amounts of aphids (Fig. 1) but from the 4th-5th day the increase prey consumption was observed. The maximum of voracity of *S. scripta* larvae was recorded between the 9th -11th day of their development,

Table 1

Number of *Aphis fabae* Scop. aphids eaten by syrphid larvae

Syrphidae species	Number of larvae	Development period (days)	Number of eaten aphids		Standard variations (σ)	Mean error of arithmetic average	Variability factor % (v)
			variations	average for 10 specimens			
Sphaerophoria scripta (L.)	9 1	11 12	190-288 306	238,7	22,76	2,16	9,53
Episyrphus balteatus (Deg.)	10	10	395-428	412,1	55,24	5,52	13,40
Metasyrphus corollae (Fabr.)	7 3	10 11	448-487 469-515	470,7	61,86	6,10	13,14
Syrphus vitripennis Meig.	8 2	10 11	550-604 541-591	569,3	64,69	6,47	11,36
Epistrophe eligans (Harris)	8 2	9 10	644-721 681-710	689,9	81,81	8,53	11,86
Syrphus ribesii (L.)	6 4	10 11	700-822 709-836	774,6	88,55	8,68	11,43

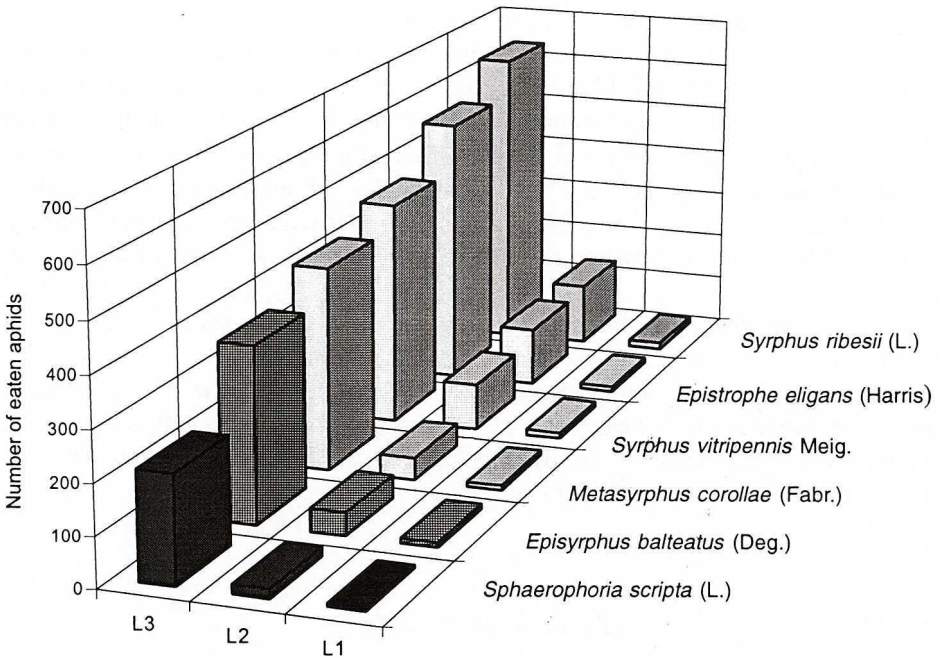

Fig. 1. Number of *Aphis fabae* Scop. eaten by larvae of *Syrphidae* in various stages of development

E. balteatus and *M. corollae* between 8th-9th day, *S. ribesii*, *S. vitripennis* and *E. eligans* between 7th-9th day. The maximum of daily consumed aphids ranged from 80 (*S. scripta*) to 250 (*S. ribesii*) specimens (Fig. 2). After the maximum voracity lasting 2-3 days the decrease of aphids consumption by larvae was observed and next day or two before pupation larvae stopped feeding (Fig. 2). Sometimes syrphid larvae did not completely extracted captured aphid but discarded it and sought for another prey so the number of destroyed aphids was much greater.

Table 2

Time necessary for destroying the various *Aphis fabae* colonies by syrphid larvae on broad bean

Syrphidae species	Predator-prey ratio	Number of days for destroing aphid colonies	Time necessary for destroing one aphid (in days)
Sphaerophoria scripta (L.)	1:25	4	0.16
	1:50	7	0.14
	1:100	9	0.09
	1:200	colony has been not destroyed	–
Episyrphus balteatus (Deg.)	1:25	3	0.12
	1:50	5	0.10
	1:100	6	0.06
	1:200	10	0.05

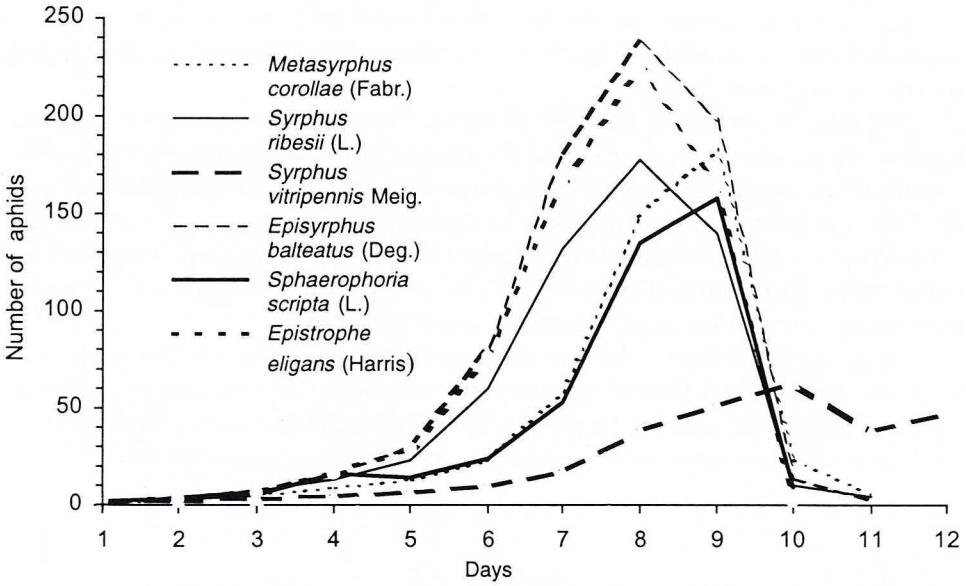

Fig. 2. Average number of *Aphis fabae* eaten daily by syrphid larvae

Larvae of *S. scripta* and *E. balteatus* in the first and second instar ate 1,6-2,7% and 8-17,6% all consumed aphids respectively. Larvae of the third stage eating 80,8-89,4% of total eaten aphids appeared to be the most voracious due to its mobility, searching ability and high nutrient demand (Fig. 1).

The voracity comparison suggested, that it depended also on the size of larvae: the smallest larvae of *S. scripta* ate 190-300 aphids during their life, the largest – *S. ribesii* about 800. Larvae of *E. balteatus* and *M. corollae*, of intermediate size, consumed about 400-500 aphids during their larval development (Tab. 1, Fig. 2).

Data of other authors working on syrphids voracity (Adams et al. 1987; Barlow 1979; Cornelius and Barlow 1980; Wnuk 1979) are different even though the same aphids and larvae were studied due to the fact that the larval feeding capacity depended also on many factors affecting the developmental rate e.g. temperature and humidity (Natskova 1985; Sundby 1966).

Barlow and Whittingham (1986), Rotheray and Martinat (1984), Leir and Barlow (1982) reported that starved larvae captured prey more quickly than unstarved and older (except these just before pupation) sooner than younger ones.

The effectiveness of predators depended on the predator-prey ratio. In the greenhouse experiment the time necessary for destroying the various size *A. fabae* colonies by larvae of *E. balteatus* and *S. scripta* was studied. Also the most profitable predator-prey ratio was found to estimate the abundance of predators necessary for preventing a further increase of aphids population. These data were compared with the development of *A. fabae* colonies on broad bean plants without syrphid larvae (Tab. 2).

Initially syrphid larvae were not very efficient due to small voracity of larvae in first and second stage of development but the total number of daily consumed aphids increased with the larval growth (Tab. 2).

Predator-prey ratio from 1:25 to 1:50 were the most effective in case of *S. scripta* larvae as the *A. fabae* colonies were destroyed from 4 to 7 days respectively. Aphid colonies of 200 specimens were only inhibited. In case of *E. balteatus* larvae the best predator-prey ratio was the same but time necessary for destroying aphid colonies was shorter (3 and 5 days respectively). The largest aphid colonies (200 specimens per plant) were also controlled but the time prolonged till 10 days. Wnuk (1979) found out that the most profitable predator-prey ratio for larvae of *E. balteatus* was 1:50 and less.

Taking into consideration the time necessary for destroying one aphid by syrphid larva, it was found that this time was shorter in the larger aphid colonies than in smaller. In more abundant aphid colonies the predator and prey contact was more frequent than in smaller colonies contributed on the same plant area (Wnuk and Langer 1984).

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EFEKTYWNOŚĆ DRAPIEŻNYCH LARW *SYRPHIDAE* W ZWALCZANIU MSZYCY *APHIS FABAE* SCOP. NA BOBIE

STRESZCZENIE

Żarłoczność larw *Syrphidae* w początkowym okresie ich życia (1 i 2 faza rozwojowa) jest niewielka i wynosi do 20% ogółu zżeranych ofiar. Maksimum żarłoczności przypada na 3 fazę rozwojową larwy – może ona wtedy zjadać 80-100 mszyc dziennie.

Najmniejsze spośród obserwowanych larwy *Sphaerophoria scripta* (L.) zjadały 190-300 mszyc *Aphis fabae* Scop. w ciągu swojego życia, a największe larwy *Syrphus ribesii* (L.) około 800. Larwy *Episyrphus balteatus* (Deg.) i *Metasyrphus corollae* (Fabr.), pod względem wielkości pośrednie między wyżej wymienionymi gatunkami, zżerały od 400 do 500 mszyc.

Doświadczenia, na roślinach bobu, nad ustaleniem korzystnego stosunku liczbowego drapieżcy do ofiary (*Aphis fabae* Scop.) u larw *E. balteatus* i *S. scripta* wykazały, że najlepsze efekty w ograniczaniu mszyc można uzyskać przy stosunku liczbowym drapieżcy do ofiary wynoszącym 1:25-1:50.