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PREDATORY SYRPHIDS (*DIPTERA, SYRPHIDAE*) OCCURRING IN THE CABBAGE APHID (*BREVICORYNE BRASSICAE* L.) COLONIES ON DIFFERENT CABBAGE VEGETABLES

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Abstract: In 1993–1997 the occurrence of predatory syrphids in the cabbage aphid (*Brevicoryne brassicae* L.) colonies was observed on the nine different cabbage vegetables: savoy cabbage cv. Vertus, white cabbage cv. Amager, red cabbage cv. Langendijker, brussels sprout cv. Maczuga, cauliflower cv. Pionier, blue kohlrabi cv. Masłowa, white kohlrabi cv. Delikates, kale cv. Zielony Kędzierzawy and broccoli cv. Piast. The number of aphids as well as amount of aphidophagous *Syrphidae* feeding in their colonies on the different cabbage vegetables were compared. The species composition was also estimated. Eight species of *Syrphidae* were collected: *Episyrphus balteatus* (Deg.), *Sphaerophoria scripta* (L.), *S. rueppelli* (Wied.) *S. menthastri* (L.), *Metasyrphus corollae* (Fabr.), *Scaeva pyrastri* (L.), *Syrphus vitripennis* (Meig.), *Paragus quadrifasciatus* (Meig.). In the all years of observation the dominant species were *E. balteatus* (Deg.), *S. scripta* (L.) and *S. rueppelli* (Wied.). The highest number of syrphid larvae were collected from cabbage aphid colonies on the white and savoy cabbage.

Key words: *Brevicoryne brassicae* L., *Syrphidae,* cabbage vegetables, predators

INTRODUCTION

Dipteran larvae of the family *Syrphidae* are effective predators attacking aphids, including the cabbage aphid *Brevicoryne brassicae* L., a pest of various cruciferous vegetables. Syrphids should be considered as an important factor limiting aphid populations as an effect of their common occurrence, number of generations and high aphidophagous effectiveness of their larvae (Wnuk 1982; 1993). Study on the voracity of syrphid larvae were carried out by many authors. According to Wnuk and Fusch (1977), Sharma and Bhalla (1988), syrphid larvae feeding on cabbage aphids colonies consumed few hundreds aphids during their development. The aim

of this work was to compare the occurrence and composition of syrphid larvae feeding in the *Brevicoryne brassicae* L. colonies on the different cabbage vegetables.

MATERIAL AND METHODS

The experiment was carried out in 1993–1995 at the Agricultural Experimental Station in Mydlniki near Cracow (Poland). The following nine late cruciferous vegetables, varieties of *Brassica oleracea* L.: savoy cabbage cv. Vertus, white cabbage cv. Amager, red cabbage cv. Langendijker, brussels sprout cv. Maczuga, cauliflower cv. Pionier, blue kohlrabi cv. Masłowa, white kohlrabi cv. Delikates, kale cv. Zielony Kędzierzawy and broccoli cv. Piast (except 1993), were grown in plots of size 30 m^2 in four replications. Each plot comprised 90 plants (10 plants of each vegetable), planted in such a way, that the plants of the same kind never neighboured. No insecticide treatment was applied. Observations started when first winged forms of *Brevicoryne brassicae* appeared. Every 3–4 days, 12 plants (3 per plot from each variety) were inspected (totally 180). The plants examined for the presence of syrphids were also analysed to estimate the number of aphids during the season. Collected syrphid larvae and pupae were placed in Petri dishes. Larvae were daily fed on a diet of cabbage aphid. The emerged adults were classified to species based on Bańkowska key (1963). To evaluate the significance of differences Duncan test was used ($\alpha<0.05$). To assess the relation between quantity of the aphids and their predators correlation coefficients and regression coefficients were calculated.

RESULTS AND DISCUSSION

Syrphid larvae feeding in the cabbage aphid colonies were observed every year. According to Nawrocka (1972; 1988), *Syrphidae* as selective predators of aphid appeared on plants few days after infestation by aphids. Bombosch and Tokmakoglu (1966) noted that, the effect of predators depended on their occurrence time in aphid colonies. In 1993 first larvae were noted about 2 weeks after first aphids appearance, whereas in other years of observations single predatory syrphid larvae were observed at the same time as aphids (Fig. 1). The highest number of syrphid larvae was noticed during the maximum occurrence of aphids (Fig. 1). The signifi-

Table 1. Number and species composition of *Syrphidae* in the cabbage aphid (*Brevicoryne brassicae* L.) colonies in 1993–1995

Species of *Syrphidae*	Number of reared syrphids in year				%
	1993	1994	1995	Total	
Episyrphus balteatus (Deg.)	87	5	45	137	47.8
Sphaerophoria scripta (L.)	11	24	37	72	25.1
Sphaerophoria rueppelli (Wied.)	5	29	18	52	18.1
Metasyrphus corollae (Fabr.)	13	0	0	13	4.5
Scaeva pyrastri (L.)	3	0	6	9	3.2
Syrphus vitripennis Meig.	0	0	2	2	0.7
Sphaerophoria menthastri (L.)	0	1	0	1	0.3
Paragus quadrifasciatus Meig	0	1	0	1	0.3
Total	119	60	108	287	100

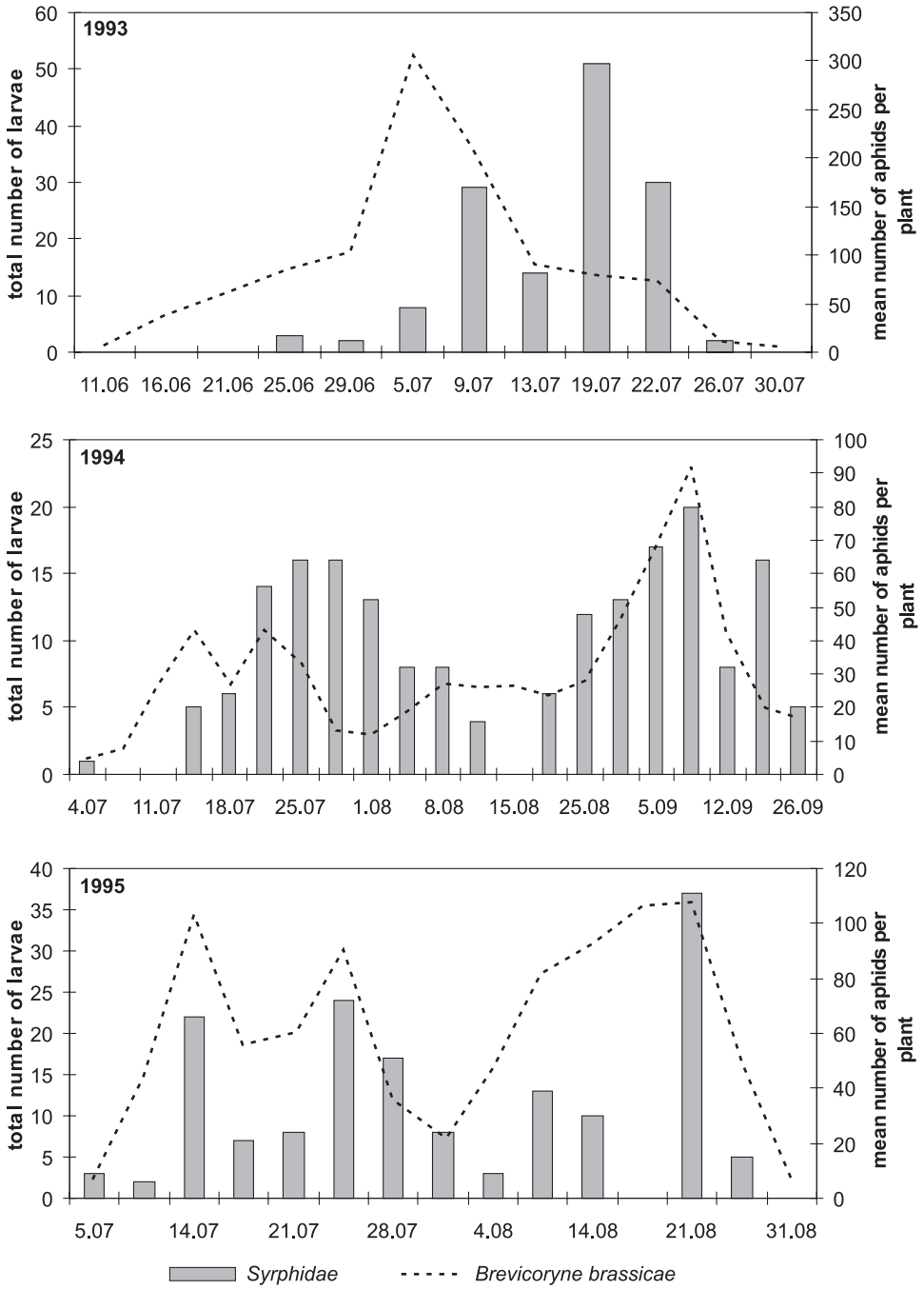

Fig. 1. Population dynamics of *Syrphidae* in *Brevicoryne brassicae* colonies in years 1993–1995 (total on all tested vegetables)

Table 2. Species and quantities of syrphids collected from colonies of the cabbage aphid (*Brevicoryne brassicae* L.) on the different cabage vegetables

Species of *Syrphidae*	Savoy cabbage	White cabbage	Blue cohlrabi	Kale	Cauli-flower	Brussels sprout	White cohlrabi	Red cabbage	Broccoli	Total	%
1993											
Episyrphus balteatus (Deg.)	25	28	7	6	6	8	3	4	–	87	62.6
Metasyrphus corollae (Fabr.)	6	4	–	–	–	–	1	2	–	13	9.4
Sphaerophoria scripta (L.)	3	1	–	1	2	1	2	1	–	11	7.9
Sphaerophoria rueppelli (Wied.)	1	2	–	–	–	1	–	1	–	5	3.6
Scaeva pyrastri (L.)	1	1	–	–	–	–	–	1	–	3	2.1
Parasitized larvae	5	5	1	1	1	2	3	2	–	20	14.4
Total	41 b	41 b	8 a	8 a	9 a	12 a	9 a	11 a	–	139	100
1994											
Sphaerophoria rueppelli (Wied.)	2	11	3	2	2	2	–	4	3	29	15.4
Sphaerophoria scripta (L.)	4	6	1	–	1	6	1	4	1	24	12.8
Episyrphus balteatus (Deg.)	–	–	–	1	–	1	–	1	2	5	2.7
Sphaerophoria menthastri (L.)	–	–	–	1	–	–	–	–	–	1	0.5
Paragus quadrifasciatus Meig	–	–	1	–	–	–	–	–	–	1	0.5
Parasitized larvae	9	7	7	3	4	8	5	4	5	52	27.7
Larvae dead during the rearing	12	12	10	3	4	6	12	6	11	76	40.4
Total	27 b	36 b	22 ab	10 a	11 a	23 ab	18 ab	19 ab	22 ab	188	100
1995											
Episyrphus balteatus (Deg.)	5	24	6	–	2	1	5	2	–	45	28.3
Sphaerophoria scripta (L.)	7	9	6	1	1	4	3	4	2	37	23.3
Sphaerophoria rueppelli (Wied.)	1	12	2	–	–	–	–	2	1	18	11.3
Scaeva pyrastri (L.)	–	3	1	–	–	–	2	–	–	6	3.8
Syrphus vitripennis Meig.	–	2	–	–	–	–	–	–	–	2	1.3
Parasitized larvae	10	21	2	1	4	4	2	4	3	51	32
Total	23 c	71 d	17 bc	2 a	7 ab	9 ab	12 ab	12 ab	6 a	159	100

Means followed by the same letter within a column are not significantly different ($\alpha<0.05$)

cant correlation coeficient between the number of cabbage aphid and syrphid larvae was noticed (Table 4).

During observation period 486 syrphid larvae and pupae were collected. Part of them were parasited, the other part (in 1994) died during the rearing (Table 2). The remaining 287 emerged adults were classified to eight species of *Syrphidae*; *Episyrphus balteatus* (Deg.), *Sphaerophoria scripta* (L.), *S. rueppelli* (Wied.) *S. menthastri* (L.), *Metasyrphus corollae* (Fabr.), *Scaeva pyrastri* (L.), *Syrphus vitripennis* (Meig.), *Paragus quadrifasciatus* (Meig.) (Table 1).

Table 3. Selected data concerning cabbage aphid (*Brevicoryne brassicae* L.) occurrence on different vegetables in 1993–1995

Vegetable	Savoy cabbage	White cabbage	Blue cohlrabi	Kale	Cauli-flower	Brussels sprout	White cohlrabi	Red cabbage	Broccoli
1993									
Mean number of aphids per plant during the season	88.9 bc	114.2 c	168.9 a	53.6 a	70 ab	106.5 c	92.9 bc	60 a	_
Maximum occurrence	5 VII	5 VII	5 VII	5 VII	5 VII	5 VII	5 VII	9 VII	_
Mean number of aphids per plant in period of max. infestation	281.9	349.4	485.4	164.3	293.6	332.4	371.8	165.2	_
Mean number of aphids per colony in period of max. infestation	111.4	127.9	117	88.2	80	50.6	130.2	103.5	_
1994									
Mean number of aphids per plant during the season	23.9 bc	20.5 ab	33.6 cd	11.8 a	24.4 bc	38.9 d	23.9 bc	43.8 d	25 bc
Maximum occurrence	8 IX	14 VII	14 VII	8 IX	5 IX	8 IX	5 IX	8 IX	8 IX
Mean number of aphids per plant in period of max. infestation	73.8	54.2	91.7	33.7	66.8	145.5	81.6	221.2	72.3
Mean number of aphids per colony in period of max. infestation	145.3	167.9	128.3	108.4	108.4	88	108	666.2	118
1995									
Mean number of aphids per plant during the season	48.5 bc	52.6 c	85.9 e	17.1 a	40.9 bc	90.4 e	35.8 b	78.3 d	39.1 b
Maximum occurrence	25 VII	14 VII	21 VIII	9 VIII	18 VIII	9 VIII	14 VII	14 VIII	18 VIII
Mean number of aphids per plant in period of max.infestation	100.2	89.4	180.8	49.5	102.5	165.8	82.8	135.6	106.3
Mean number of aphids per colony in period of max. infestation	156.4	158.6	187.3	101.4	107.4	94.7	68	350.1	120.3

Means followed by the same letter within a column are not significantly different ($\alpha<0.05$)

Table 4. Relations between the number of the aphid (*Brevicoryne brassicae* L.) and the predators

r (correlation coefficient)		Regression coefficient	Equation for regression line
r empiric	r theoretic		
0.34003	0.2457	0.0672	y = 6.7942 + 0.0672

The dominant species (Petrusewicz 1937) in all the years were *Episyrphus balteatus* (Deg.) and they constituted 47,8%, *Sphaerophoria scripta* (L.) (25,1%) and *S. rueppelli* (Wied.) (18,1%) (Table 1). Only in 1993 the dominant species was also *Metasyrphus corollae* (Fabr.). The remaining species did not occur every year and appeared sporadically only.

The significant role of these species in limiting the number of cabbage aphid was confirmed by other authors from Poland (Wnuk 1971; Malinowska 1973a, b; Nawrocka 1988; Wnuk and Wojciechowicz 1993; Wiech 1993), and from abroad (Pollard 1971; Starka 1976; Smith 1976a, b; Sanders 1980; Kartasheva and Dereza 1981; Zubkov et al. 1982; Radeva 1983; Sharma and Bhalla 1988).

The same species composition of syrphids with the domination of the same species was found in the research on the occurrence of *Aphis fabae* (Scop.) carried out by Wojciechowicz-Żytko (1998) in the same area.

It seems that the species composition of syrphids in a given area, even on the different vegetables is rather constant and the differences in the particular years are caused mainly by abiotic factors like weather conditions.

The comparison of number of syrphid larvae in the colonies of *Brevicoryne brassicae* on the analysed vegetables showed significant statistic differences (Table 2). According to Wnuk and Starmach (1977), syrphids prefer the plants heavily infested by aphids as the place for laying eggs. In the all years of observations, the highest number of larvae was noticed on savoy cabbage and white cabbage (Table 2), which were not the plants that were the most heavy infested by aphids (Table 3), still the colonies of aphids on these vegetables were large (Table 3), and according to some authors, the size of colonies was the factor attracting the syrphid female to lay eggs (Dixon 1959; Wnuk and Starmach 1977). According to Wnuk and Starmach (1977), the size of colonies was especially significant for such species as for example *Episyrphus balteatus*, which was dominant over all years of observations.

Kindlman and Ruzicka (1992) found that syrphid larvae did not feed on parasitized aphids, so their feeding did not limit the effectiveness of parasite *Diaeretiella rapae* (M'Int.), which in the case of *Brevicoryne brassicae* is a very important factor limiting its numerousness (Jankowska and Wiech 2003).

CONCLUSION

1. The largest number of syrphid larvae was noticed during the maximum occurrence of aphids.
2. In the *Brevicoryne brassicae* colonies on the cabbage vegetables, eight species of *Syrphidae* were found: *Episyrphus balteatus* (Deg.), *Sphaerophoria scripta* (L.),

S. rueppelli (Wied.) *S. menthastri* (L.), *Metasyrphus corollae* (Fabr.), *Scaeva pyrastri* (L.), *Syrphus vitripennis* (Meig.), *Paragus quadrifasciatus* (Meig.).

3. The dominant species were *E. balteatus* (Deg.), *S. scripta* (L.) and *S. rueppelli* (Wied.).
4. The highest number of syrphid larvae were collected from cabbage aphid colonies on the white and savoy cabbage.

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POLISH SUMMARY

DRAPIEŻNE BZYGOWATE (*DIPTERA, SYRPHIDAE*) WYSTĘPUJĄCE W KOLONIACH MSZYCY KAPUŚCIANEJ (*BREVICORYNE BRASSICAE* L.) NA RÓŻNYCH WARZYWACH KAPUSTNYCH

W latach 1993–1995 obserwowano występowanie drapieżnych larw bzygowatych (*Syrphidae*) żerujących w koloniach mszycy kapuścianej (*Brevicoryne brassicae* L.) na dziewięciu warzywach kapustnych: kapuście włoskiej Vertus, kapuście głowiastej białej Amager, kapuście czerwonej Langendijker, kapuście brukselskiej Maczuga, kalafiorze Pionier, kalarepie niebieskiej Masłowa, kalarepie białej Delikates, jarmużu Zielony Kędzierzawy oraz brokule włoskim Piast. Porównano liczebność mszyc na poszczególnych warzywach, a także liczebność żerujących w ich koloniach larw bzygowatych. Określono również ich skład gatunkowy. Stwierdzono obecność 8 gatunków *Syrphidae: Episyrphus balteatus* (Deg.), *Sphaerophoria scripta* (L.), *S. rueppelli* (Wied.) *S. menthastri* (L.), *Metasyrphus corollae* (Fabr.), *Scaeva pyrastri* (L.), *Syrphus vitripennis* (Meig.), *Paragus quadrifasciatus* (Meig.). Gatunkami dominującymi okazały się *E. balteatus* (Deg.), *S. scripta* (L.) i *S. rueppelli* (Wied.). Najwięcej larw znaleziono w koloniach *Brevicoryne brassicae* L. na kapuście białej i kapuście włoskiej.