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SEASONAL DYNAMICS, PARASITIZATION AND COLOUR POLYMORPHISM OF THE PEA APHID, *ACYRTHOSIPHON PISUM* (HARRIS) (APHIDIDAE, HOMOPTERA) ON ALFALFA IN THE SOUTH PART OF THE PANNONIAN AREA

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Abstract. Over the period 1992 to 1994, individuals of the pea aphid, *Acyrthosiphon pisum* were collected in the localities Kovilovo and Surčin near Belgrade, in order to analyze its seasonal dynamics, colour polymorphism and parasitization. Samples of pea aphid were collected by sweeping inside the field, and every sample contained ten subsamples.
Aphid parasites were obtained by rearing aphids. We found that parasite spectrum of the pea aphid in Yugoslavia includes four species: *Aphidius ervi, A. eadyi, A. picipes* and *Praon barbatum.* Dominant species was *A. ervi*.
We have also observed the influence of parasitization on the seasonal dynamics of the pea aphid. The greater the autumn parasitization of the pea aphid population, the greater the number of emerged parasites next spring which also means the greater the parasitization of the pea aphid population. If the autumn parasitization is low, the next spring parasitization of the population is also low.
Colour polymorphism is an important self-regulating mechanism of pea aphid population. We found that neither of the four parasite species showed preference to any colour form of pea aphids.

Key words: pea aphid, parasitoid, population density, colour forms.

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Introduction

The first faunistic investigations of aphids on alfalfa were carried out by Tanasijevic (1966) in Pannonian area of Federal Republic of Yugoslavia. He pointed out that during a vegetation period three aphid species lived on alfalfa: *Acyrthosiphon pisum* (Har.), *Therioaphis trifolii* (Mon.) and *Aphis craccivora* Koch. It was also found that *A. pisum* was more abundant than the two other species, and appeared on alfalfa during the whole vegetation period.

Among the most significant natural enemies of the pea aphid are their primary parasites belonging to the family Aphidiidae (Hymenoptera) (Starý 1962, 1972, 1974a, b, Starý *et al.* 1980, Hozak 1968, Jia-Hua Chen *et al.* 1990).

Green, red and yellow forms of the pea aphid are known. In North America only green form has been recorded (Harper *et al.* 1978), while in Europe in addition to the most abundant green form, there are also red and somewhat less frequent yellow ones. Individuals of the green form have the highest reproductive capacity. Relationships between these forms are various depending on many factors (Honek 1982).

The main goal of this paper was to observe the seasonal dynamics of the pea aphid and to estimate the influence of primary parasites on it.

Material and methods

Samples for analysis of seasonal dynamics were taken in the period 1992 to 1994, in the localities

Kovilovo and Surčin near Belgrade on a 50 ha of alfalfa fields. Samples were taken during the whole alfalfa season in 1992 and 1993 in the Kovilovo site, but in the whole season in 1993 and spring in 1994 in the Surčin site.

Sweep net of 30 cm in diameter was used for collecting samples. Sweepings were carried out inside the field, 100 m far from the field margin to avoid edge effect. Each sample consisted of ten subsamples (two rows of 5) 20 m apart. Each subsample consisted of ten strokes of the net (Hozak 1968, Starý 1970, Maiteki *et al.* 1986). Pea aphids were put into plastic bottles closed by gauze and were counted immediately in the field.

Primary parasites were obtained by rearing the collected pea aphids from which parasites emerged after a week or two. The percentage of population parasitization was given by the rate of mummified aphids (emerged and non-emerged) to the total number of aphids. We used Starý's (1974a, b) and Tobias's (1986) keys to determine the primary parasites.

In the Kovilovo site in 1992, coloured forms were separated immediately in the field and were reared in plastic bottles to obtain parasites and determine their preference for colour forms. Statistical test of colour preference was performed with *t*-test. *t*-values were calculated wit the following formula:

$$t = \frac{x_1 - x_2}{Sx_1 - Sx_2}$$

where x_1 and x_2 are the mean values of primary parasites preferring red and green forms, respectively, and Sx_1-Sx_2 is the standard error of difference of arithmetical means in basic set. Degree of freedom was 12, and the critical values of *t*-test are $t_{0.05}$=2.179 and $t_{0.01}$=3.055.

Results and discussion

Parasite spectrum and relative number of parasites

In 1992 in the studied localities, 374 parasites were obtained by rearing the pea aphid. The most frequent species was *Aphidius ervi* Hal. (62.8%), somewhat less frequent was *Praon barbatum* Mack. (26.6%), while *Aphidius eadyi* Starý and *A. picipes* Nees were relatively rare in the parasite spectrum of the pea aphid (8.3% and 2.7%, respectively; Table 1). In 1993, 94 parasites were obtained by rearing, 47.9% of which belonged to *A. ervi*, 33.0% to *A. eadyi*, 14.9% to *P. barbatum* and 4.2% to *A. picipes*. In 1994, the 78 reared parasites consisted of 87.2% *Aphidius ervi*, 9.0% *A. eadyi* and 3.8% *Praon barbatum. A. picipes* was not observed in the first months of that year.

Aphidius ervi was the most frequent in the parasite spectrum of the pea aphid (Table 1) which may mean that it is the best adapted species in the localities investigated.

Table 1. Number of the pea aphid parasitoids in the years studied.

	A. ervi		*A. eadyi*		*A. picipes*		*P. barbatum*	
	%	Σ	%	Σ	%	Σ	%	Σ
1992	62.8	235	8.3	31	2.7	10	26.2	98
1993	47.9	45	33.0	31	4.2	4	14.9	14
1994	87.2	68	9.0	7	0	0	3.8	3

Seasonal dynamics and parasitization of the pea aphid

The first aphids (fundatrices) were collected on 19th April at Kovilovo site in 1992 which means that they emerged at the end of March or at the beginning of April. There were several maximum values of population abundance in that year (Fig. 1). At the beginning of May the population density of the pea aphid rose gradually, but that trend was temporarily stopped by harvesting of alfalfa. By the end of June the population reached its maximum size (2003 individuals per 200 sweepings), whereas under the influence of sweeping and climatic factors (temperature, humidity) it later temporarily fell. In late July the abundance of the population rose up to 1368 individuals per 200 sweepings. In August the population abundance fell again to several tens of individuals, and in September it rose to 461.

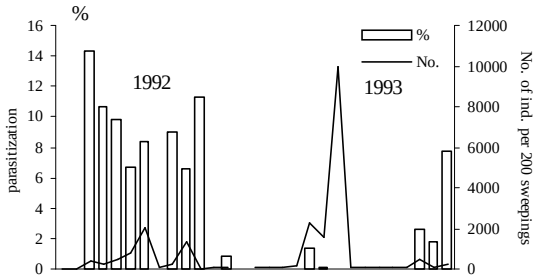

Fig. 1. Seasonal dynamics and rate of parasitization of the pea aphid at the Kovilovo site. Sampling dates in 1992: 19-Apr, 23-Apr, 10-May, 31-May, 08-Jun, 14-Jun, 21-Jun, 09-Jul, 15-Jul, 26-Jul, 16-Aug, 22-Aug, 13-Sep; those in 1993: 13-Apr, 19-Apr, 25-Apr, 02-May, 10-May, 28-May, 05-Jun, 03-Jul, 15-Jul, 13-Aug, 04-Sep, 14-Sep, 24-Sep, 14-Oct, 28-Oct

The first aphid parasites were gathered by sweeping on 19th April, while the parasitization of the aphid population was recorded at the beginning of May (14.3%; Fig. 1). Later in the season, the parasitization rate decreased gradually, since the parasite population could not follow the population

growth of pea aphid due to their lower reproductive capacity. This spring parasitization (14.3% in early May), however, is very significant, as it did not allow the rapid increase of the pea aphid population at the Kovilovo site in 1992. At the end of the season at the same site, the percentage of parasitization was very low, 0.8% on 13th September. Such a low autumn parasitization of the pea aphid population meant that only a small number of parasites would appear in the following spring, so that next spring (in 1993) the parasitization was hardly recorded (Fig. 1). That was one of the most important reasons for very quick growth of the pea aphid population next spring. On 5th June, 1993 over 10,000 individuals were recorded. At the end of the season a slight increase of parasitization was observed, the maximum parasitization rate was recorded on 28th October (7.7%). Similar situation was observed at the Surčin site in 1993 (Fig. 2). Spring parasitization was extremely low while the pea aphid population grew rapidly reaching the number of 6549 individuals in mid-May. It was only the end of the season when the parasitization increased gradually reaching its maximum value on 30th October (5.1%). The autumn increase in 1993, which was a few times larger than in the autumn 1992, implied that the parasitization would play more significant role in spring 1994 then did in spring 1993. In 1994 at the Surčin site the parasitization was recorded as early as the end of April (9.7%; Fig. 2), while the maximum number of pea aphids (612) was recorded on 23th May.

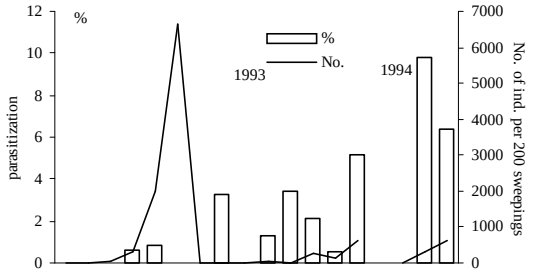

Fig.2. Seasonal dynamics and rate of parasitization of the pea aphid at the Surčin site. Sampling dates in 1993:15-Apr, 20-Apr, 26-Apr, 03-May, 11-May, 17-May, 12-Jun, 19-Jun, 16-Jul, 28-Jul, 07-Sep, 23-Sep, 10-Oct, 30-Oct; those in 1994: 15-Apr, 28-Apr, 23-May.

Hence, parasitization as a population regulating factor is the most important in spring when the abundance of pea aphid is relatively low and the parasite activity is the most effective, since the number of aphids is reduced at the very beginning and hinder their growth later. The spring parasitization of the pea aphid population depends on its autumn parasitization in the previous year. The greater the autumn parasitization, the greater the number of emerged pea aphid parasites in spring which also means the greater the number of parasitized pea aphids.

Seasonal dynamics of colour forms

At the Kovilovo site in the middle of April, 1992, the first collected samples of pea aphid were green and they belonged to fundatrix generation (Fig. 3). Red forms were firs recorded at the beginning of May reaching the rate of 46%. In 1992 when the population density was relatively low, the percentage of red form was relatively high during that year (47.3±8.4%). Next year the population size was relatively high, and the number of red forms gradually rose during the year. Similarly at the Surčin site in 1993, at large population size of pea aphids the percentage of red forms was relatively low (Fig. 4).

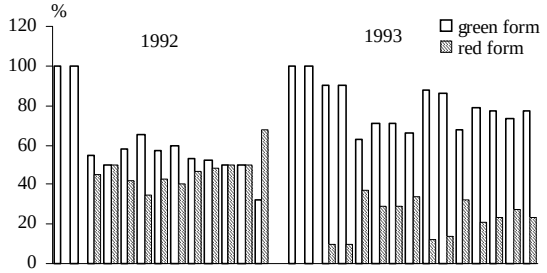

Fig. 3. Seasonal dynamics of colour forms of the pea aphid at the Kovilovo site. Sampling dates are the same as on Fig. 1.

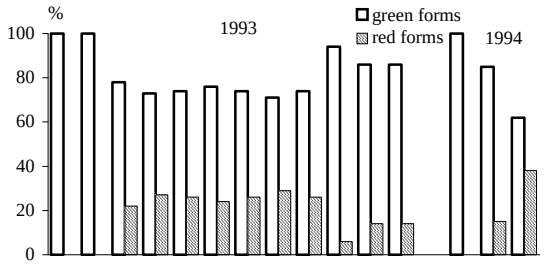

Fig. 4. Seasonal dynamics of colour forms of the pea aphid at the Surčin site. Sampling dates are the same as on Fig. 2.

In our opinion, colour polymorphism is an important self-regulatory mechanism of pea aphid population as population maintains its size near optimal level favouring red forms which have lower fecundity than the green forms. But in years when the number of pea aphids is relatively high (1993) the percentage of red forms should be relatively low.

Parasitization of colour forms

One of the factors that may influence the relationship between colour forms of pea aphids is the parasitization. The green form is generally more parasitized (Table 2) which is understandable as it is more frequent than the red form. Using *t*-test, we pointed out that there was no preference of *A. ervi* (*t*=0.537), *A. picipes* (*t*=0.787), *A. eadyi* (*t*=0.194) and *P. barbatum* (*t*=0.444) to any colour forms.

Table 2. Preference of pea aphid parasitoids to different colour forms in the Kovilovo site (1992).

	A. ervi		*A. eadyi*		*A. picipes*		*P. barbatum*	
date	green	red	green	red	green	red	green	red
10.5.	15	19	-	1	-	1	7	5
31.5.	10	10	-	-	-	-	3	1
8.6.	7	5	2	-	3	-	4	5
14.6.	6	6	1	2	-	-	9	8
21.6.	61	31	4	3	2	2	4	6
15.7	3	1	-	-	-	-	3	4
26.7.	18	16	-	-	1	-	17	11

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