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POPULATION DYNAMICS OF APHIDOPHAGOUS HOVERFLIES ON TOBACCO PLANTS

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Abstract

During the faunistic studies of hoverflies on the tobacco in the Prilep area in 2003-2005, we registered 10 aphidophagous species of the Syrphidae family: *Sphaerophoria scripta* Linnaeus, *Sphaerophoria rueppelli* Wiedemann, *Scaeva pyrastri* Linnaeus, *Episyrphus balteatus* De Geer, *Eupeodes corollae* Fabricius, *Syrphus ribesii* Linnaeus, *Paragus quadrifasciatus* Meigen, *Paragus testaceus* (*bicolor* group) Meigen, *Paragus* (*Pandasyophthalmus*) *tibialis* Fallén, *Melanostoma mellinum* Linnaeus. Aphidophagous hoverflies are important natural regulators of the aphid population on tobacco.

KEY WORDS: aphidophagous hoverflies, aphids, tobacco

Introduction

Predatory types of hoverflies are important insects to humans. They are useful pollinators in their adult stage and present a natural enemy of plant pests, especially of aphids in their larval stage. Numerous studies of aphidophagous hoverflies point out their importance in biological battles (GILBERT, 1980; ANČEV, 1980; ŠIMIĆ, 1987; VUJIĆ, 1987; SIMOVA-TOŠIĆ *et al.*, 1989; VUJIĆ & GLUMAC, 1994; VUJIĆ & RADENKOVIĆ, 1995; LAZAREVSKA, 1998; SPEIGHT, 2000; JANUŠEVSKA, 2001; KRSTESKA, 2007). Predatory hoverflies, preserving their own kind, control the population of phytophagous insects. Aphidophagous hoverflies are important natural regulators of the aphid population on tobacco.

Material and Methods

The analyses were carried out on tobacco plants in the Prilep area during the period of 2003-2005. We undertook the following methods for hunting hoverflies:

- the examination of 20 tobacco stalks;
- the examination of 100 tobacco leaves;
- the yellow water vessels method; and
- the insect-catcher method.

Material was collected by the different methods throughout the growth season of the tobacco, from the seeding of the tobacco culture until the end of October.

After analysis of the material, graphs of the population dynamics of the studied species were made. These parameters were obtained by verifying the number of studied species in the time unit, which in our research was set up for a period of ten days. According to the population dynamics slope, the time of tobacco biocoenosis appearance, maximum numbers and population decrease are determined for each of the species individually.

By examining 20 tobacco stalks and 100 tobacco leaves, we established population dynamics of leaf aphids on the tobacco plants. In addition, for the three-year period we made climate graphs according to Walter.

Results and Discussion

Tobacco (*Nicotiana tabacum* L.) bears great social, economic and traditional significance for the F.Y.R. of Macedonia. The Prilep production area is characterized by arid summer months and proportionally high air temperatures during the vegetation period, conditions which lead to the successful production of small-leafed aromatic tobacco plants (Fig. 1).

Figure 1. Tobacco plant in the Prilep area (Photo: V. Krsteska)

The climate graphs listed present the agro-climatic characteristics for the period of 2003-2005 in the Prilep area. Analysis of the climate diagram (Fig. 2) shows that the dry period in 2003 continued throughout the tobacco vegetation period. In terms of the total amount of rain and its occurrence during the tobacco vegetation season, analysis shows that this was the driest year in the period of our studies. The maximum average monthly air temperature, registered in August, was 31°C. For the year, the highest absolute temperature was 37°C, measured on July 17th.

According to the climate diagram (Fig. 3), compared to 2003 the dry period in 2004 was much shorter. And compared to all other studied years, 2004 had the most rain during the tobacco vegetation period. Further, the greatest amount of rain during the tobacco vegetation period was in June. The maximum average monthly air temperature was 28.2°C, registered in July. The highest absolute temperature was 35.8°C, measured on July 9th.

The climate diagram (Fig. 4) shows that in 2005 rains at the beginning of August terminated the dry period during the tobacco vegetation season. The maximum average monthly air temperature was registered in July at 29.4°C. The highest absolute temperature was 37.0°C, measured on August 3rd.

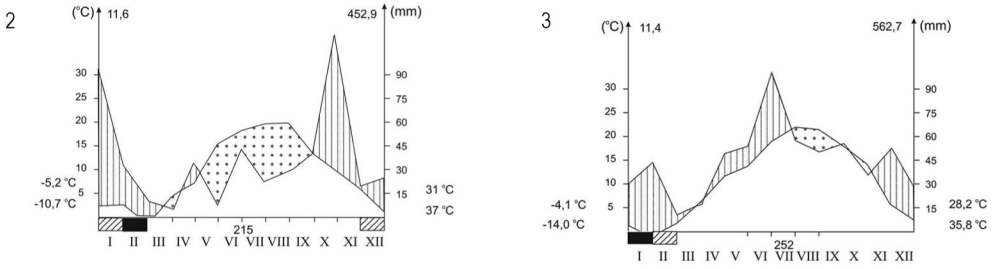
The average climate conditions for all three years of study (2003-2005) are presented in the climate diagram (Fig. 5). The data show that in July and August the air temperature was higher than 20°C, which means that in the intensive growth phase, the temperature met the needs of normal tobacco growth and development.

Rains are also an important factor contributing to the tobacco yield and its quality. Rains are the most variable factor in Prilep production area, and directly influence the stability of the tobacco production. The studies conducted over the years showed that it is necessary to water the tobacco in order to obtain a stable tobacco production and to eliminate detrimental effects from the drought during the warmest months in the year.

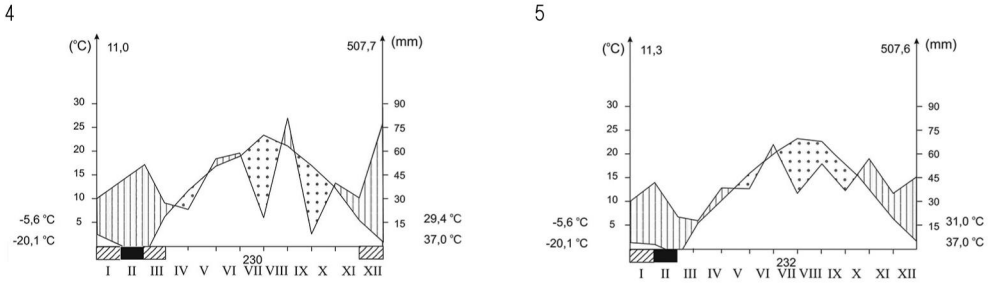
Climate conditions in the Prilep tobacco production are suitable for tobacco since it is among the group of plants that prefer a warm climate. However, factors that are optimal for tobacco plant development (temperature, precipitations and insolation) are also favorable for the development of aphids, which frequently hinder the realization of the planned yield and quality of tobacco.

On the other hand, good climate conditions and a strong occurrence of tobacco leaf aphids provide a wealth of aphidophagous predatory and parasite species. In the climate conditions of the Prilep area, hoverflies are present in great numbers from April until October. During sunny days, adults are present in different plant flowers from morning until evening. The presence of aphidophagous hoverflies and the intensity of their appearance in certain phytocenosis always indicate the presence of leaf aphids.

During the vegetation period and due to climate conditions, different numbers of partenogenetic generations of wingless aphids develop on the tobacco (Fig. 6). The number of partenogenetic generations depends mostly on temperature variations and rains as well as on physiological plant condition. Given an average temperature of 20-25°C, the development of one generation lasts 10-12 days.



Figures 2 & 3. Climate diagrams for the years of 2003 (2) and 2004 (3).



Figures 4 & 5. Climate diagrams for the year of 2005 (4) and the period 2003-2005 (5).

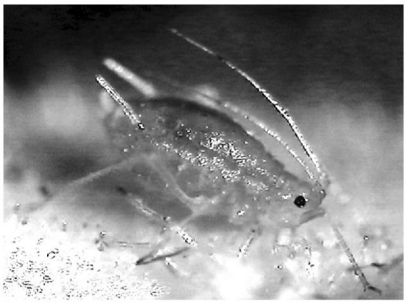


Figure 6. Wingless *M. persicae* on tobacco leaf (Photo: V. Krsteska)

During our studies in 2003 there were disadvantageous climate factors that caused a reduction in the number of generations of leaf aphids on tobacco plants. Due to a long and warm autumn in 2004 and in 2005, tobacco leaf aphids were present until the beginning of October. Following the population dynamics of tobacco leaf aphids in the period of 2003-2005, we have concluded that tobacco aphids appear at the beginning of July and are present on the tobacco culture until the 10th or 20th of September. Certain samples are present until the beginning of October. The most intensive attack of tobacco leaf aphids occurs in the

period from July 20th until the middle of August when the leaf mass and the blooming intensity of tobacco are at their peaks. (Tab. I).

Table I. Dynamics of population of aphids

Year	Method	Date of control									
		1. 7.	10.7.	20.7.	1.8.	10.8.	20.8.	1.9.	10.9.	20.9.	1.10.
2003	100 tob. leaves			225	1108	5249	4013	937	16		
	20 tob. stalks		47	3795	14218	15009	10493	4086	1103	15	
2004	100 tob. leaves	34	705	4262	8006	7108	4021	3067	1189	204	11
	20 tob. stalks	139	3218	10749	22694	19178	10045	8374	3582	1028	79
2005	100 tob. leaves	42	904	1991	5083	5792	4018	2533	1281	107	
	20 tob. stalks	290	7400	9200	28870	23010	12578	9543	3128	1031	54

During the faunistic studies of hoverflies on the tobacco in the Prilep area in 2003-2005, we registered 10 aphidophagous species of the Syrphidae family: *S. scripta*, *S. rueppelli*, *S. pyrastri*, *E. balteatus*, *E. corollae*, *S. ribesii*, *P. quadrifasciatus*, *P. testaceus*, *P. tibialis*, *M. mellinum*.

The species whose larvae eat vegetative aphids have great significance in biocoenosis as bio-regulators of aphids. Aphidophagous species are divided into two groups: obligate and facultative. During our studies we verified 9 obligate aphidophagous species: *S. scripta, S. rueppelli, S. pyrastri, E. balteatus, E. corollae, S. ribesii, P. quadrifasciatus, P. testaceus,* and *P. tibialis*. Obligate aphidophagous species develop normally only when fed with vegetative aphids. These species are fed a wide range of leaf aphids. The crucial moment for an adult to lay the biological potential is in the presence of food for their larvae, which means the presence of colonies of leaf aphids. We confirmed one facultative aphidophagous species, *M. mellinum,* during our studies. The larva of this species prefers leaf aphids, but if necessary for the completion of its development it is fed rotten vegetation material (rotten leaves). It often uses the soil cover for hunting other arthropods.

On the basis of the material found, we performed an analysis of the population dynamics for each aphidophagous species of the Syrphidae family (subfamily Syrphinae) on tobacco plants individually.

1. *Sphaerophoria scripta* Linnaeus, 1758 (Fig. 17) belongs to the tribe Syrphini.

The S. scripta species was confirmed in great numbers in each year of study and by all study methods. The highest percentage of this species was present in the hoverflies fauna in tobacco entomocoenosis. The population dynamics of *S. scripta* show that the species is present in the tobacco biocoenosis from the beginning of June until the end of September. The population was highest in August in each year of study. The population reached its highest level of density on August 20th (Fig. 7).

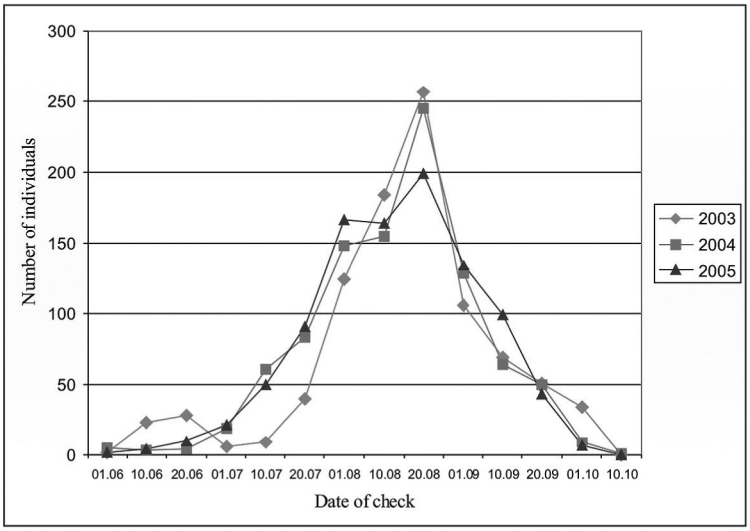


Figure 7. Population dynamics of *S. scripta* (2003-2005)

2. *Sphaerophoria rueppelli* Wiedemann, 1830 (Fig. 18) belongs to the tribe Syrphini.

The S. rueppelli species was confirmed in great numbers in each year of study and by all study methods. The biggest number of these species was present in 2004 and the smallest in 2005. The population dynamics of *S. rueppelli* show that this species is present in the tobacco biocoenosis from June 1st until the end of September. In 2003 and 2004 the population was greatest in August, while in 2005 it reached its peak from August 20th until September 10th. The population reached its highest level of density on August 20th. *S. rueppelli* is numerous in tobacco entomocoenosis, but less than *S. scripta* (Fig. 8).

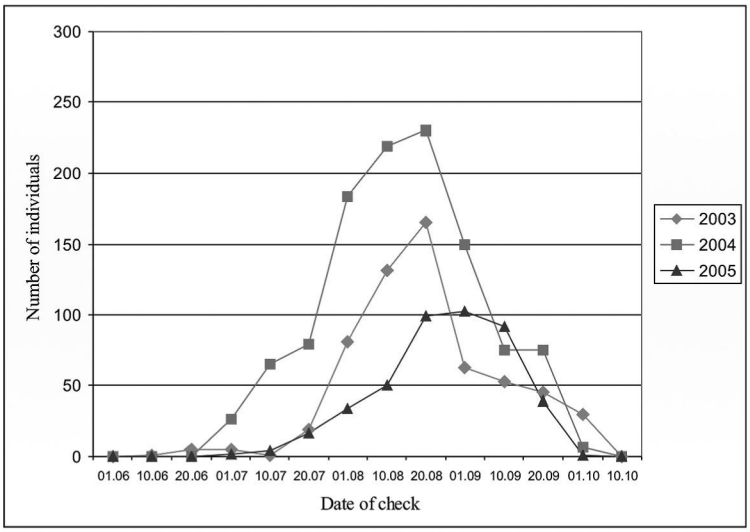


Figure 8. Population dynamics of *S. rueppelli* (2003-2005)

3. *Scaeva pyrastri* Linnaeus, 1758 (Fig. 19) belongs to the tribe Syrphini.

The S. pyrastri species was confirmed in great numbers in each year of study and by all study methods. The population dynamics of *S. pyrastri* show that this species is present in the tobacco biocoenosis from the beginning of July until the end of September. The population was highest from August 1st until September 20th, 2005 and from August 10th until September 20th in 2004, with its maximum on August 20th in both studied years. There was a very low level of population density in 2003; its maximum was on August 10th (Fig. 9).

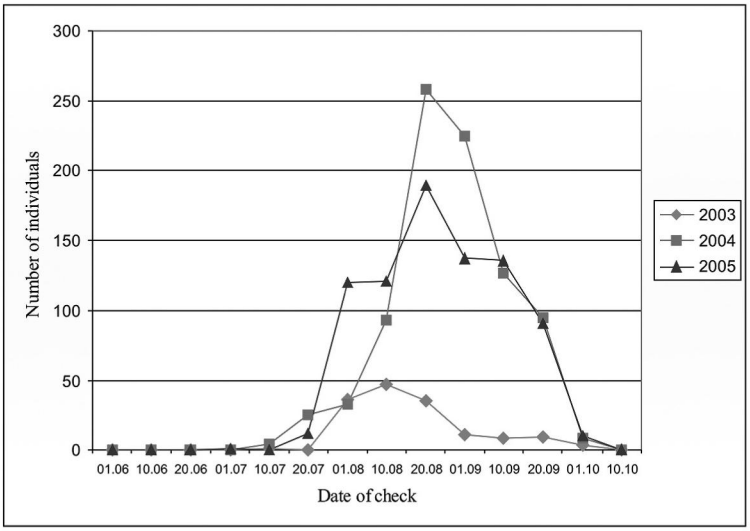


Figure 9. Population dynamics of *S. pyrastri* (2003-2005)

4. *Episyrphus balteatus* De Geer, 1776 (Fig. 20) belongs to the tribe Syrphini.

E. balteatus species was confirmed in all years of study and by all study methods. The population dynamics of *E. balteatus* show that this species is present in the tobacco biocoenosis from the beginning of July until the end of September. The species was least numerous in 2003, with its maximum on August 20th and a rapid population decrease on September 1st. There are two peaks in the population of *E. balteatus* in 2004, on August 20th and on September 10th. In 2005 the population reached its highest level of density on August 20th (Fig. 10).

5. *Eupeodes corollae* Fabricius, 1794 (Fig. 21) belongs to the tribe Syrphini.

The E. corollae species was confirmed in each year of study and by all study methods. The population dynamics of *E. corollae* show that this species is present in the tobacco biocoenosis for a shorter time period, from July 20th until September 20th. The population reached its highest level of density on August 20th, 2005. There are two peaks in this year, on August 20th and again on September 10th. The lowest level of population density was in 2004, with two peaks, one on August 20th and the second on September 20th. In 2003 *E. corollae* species is most numerous on September 1st, followed by a rapid disappearance of the population (Fig. 11).

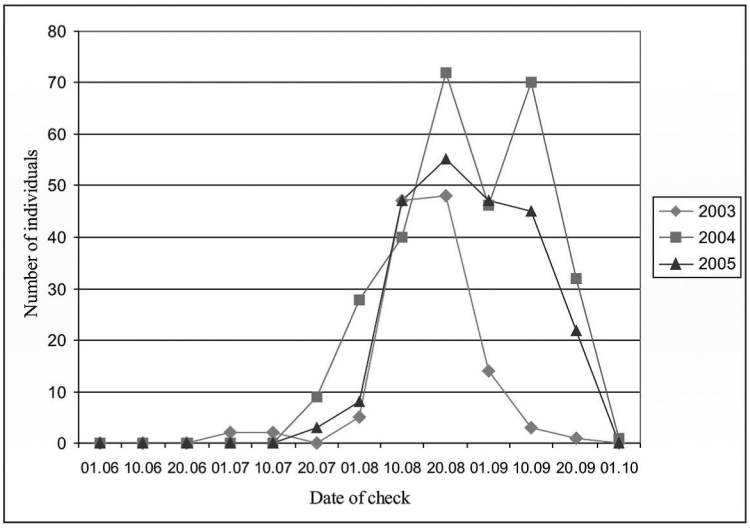


Figure 10. Population dynamics of *E. balteatus* (2003-2005)

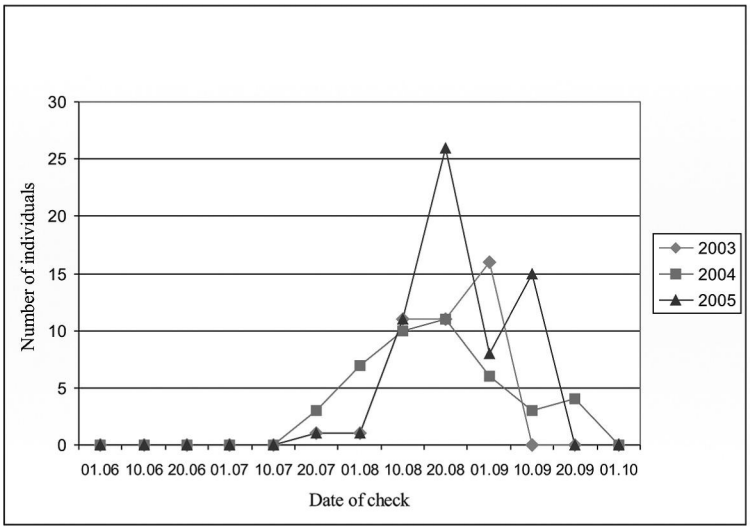


Figure 11. Population dynamics of *E. corollae* (2003-2005)

6. *Syrphus ribesii* Linnaeus, 1758 (Fig. 22) belongs to the tribe Syrphini.

According to the literature data, *S. ribesii* is present mostly in forest residences. Its presence near tobacco plants is probably due to the number of evergreen trees around the studied area of the Tobacco Institute. This species was verified only by the insect-catcher method during 2004 and 2005. The population dynamics of *S. ribesii* shows that this species has a variable presence in the tobacco biocoenosis in the middle of July, in very low numbers. The species was not found in 2003. As an oligovoltine species that develops two

generations a year, *S. ribesii* is present on tobacco plants in the middle of July when the tobacco bears small colonies of leaf aphids, so the small number in this period results from a low presence of their hosts, i.e. leaf aphids, at that time (Fig. 12).

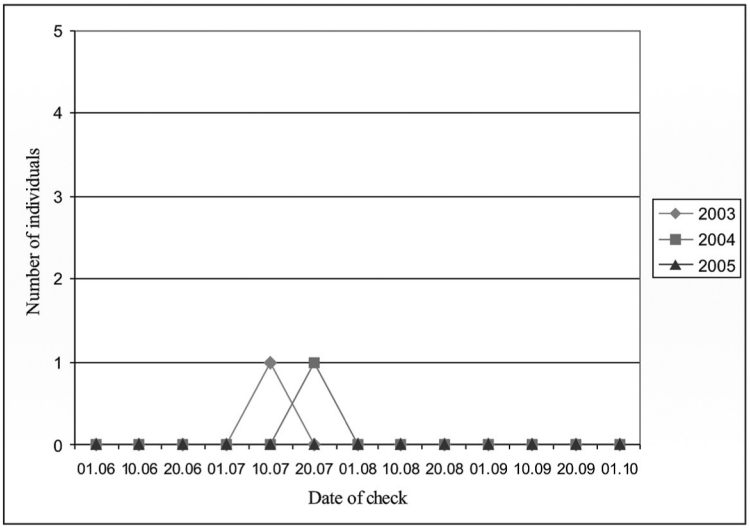


Figure 12. Population dynamics of *S. ribesii* (2003-2005)

Generally, the number of the above-mentioned predatory species depends on the number of leaf aphids and climate factors.

7. *Paragus quadrifasciatus* Meigen, 1822 (Fig. 23) belongs to the tribe Paragini.

The presence of this species was established by examining 20 tobacco stalks and 100 tobacco leaves, and by the insect-catcher method. The population dynamics of *P. quadrifasciatus* show that this species was present in the tobacco biocoenosis for a shorter time in 2003 and 2005, from August 1st until September 1st. The population reached its highest level of density on August 20th in both years. In 2004 the population had two peaks, the first on July 10th and the second on September 1st. *The P. quadrifasciatus* species was not detected at the control examinations from August 1st until August 20th. The number of this predatory species depends on the number of leaf aphids. As a representative of species that develop best in xerophilous and thermophilous conditions, climate factors play a more significant role in the development of this species (Fig. 13).

8. *Paragus testaceus* (*bicolor* group) Meigen, 1822 (Fig. 24) belongs to the tribe Paragini.

This species was confirmed only by the insect-catcher method. The population dynamics of *P. testaceus* show first, that in the middle of July this species is present in the tobacco biocoenosis in very small numbers, and secondly, its presence fluctuates. This species was not detected in 2005. Adults appear in the middle of July when small colonies of leaf aphids on tobacco plants exist; it is probably for this reason that the species is low in number. As a representative of species that develop best in xerophilous and thermophilous conditions, climate plays a more significant role in the development of this species (Fig. 14).

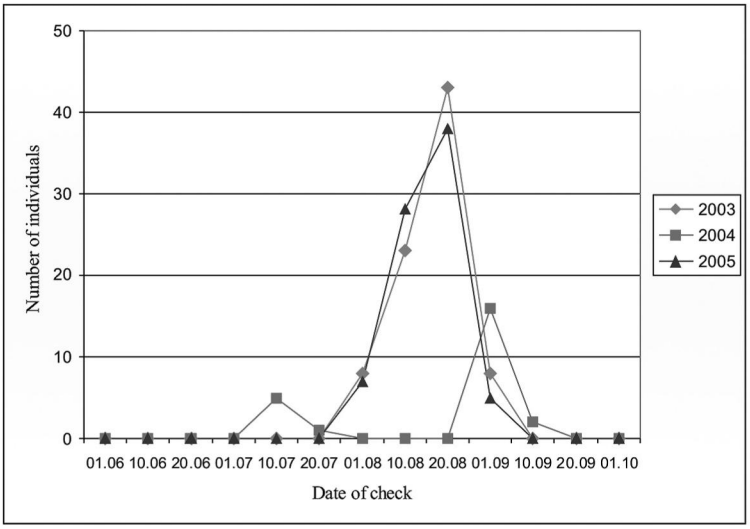


Figure 13. Population dynamics of *P. quadrifasciatus* (2003-2005)

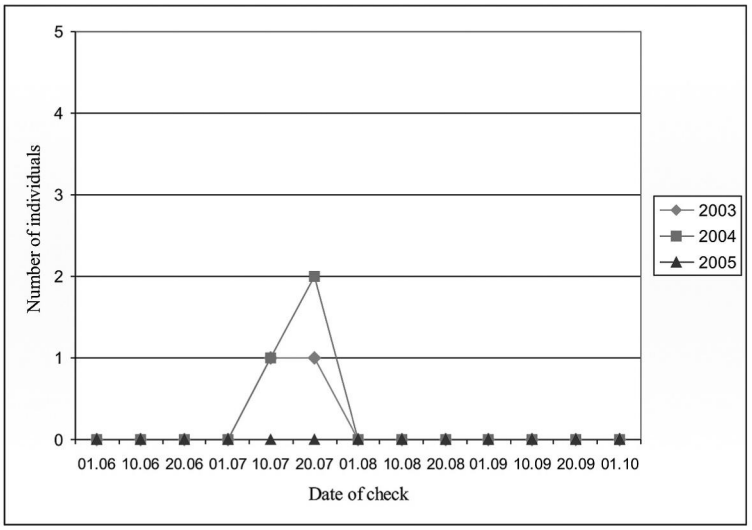


Figure 14. Population dynamics of *P. testaceus* (2003-2005)

9. *Paragus* (*Pandasyophthalmus*) *tibialis* Fallén, 1817 (Fig. 25) belongs to the tribe Paragini.

This species was confirmed only by the insect-catcher method in all three years of the study. The population dynamics of *P. tibialis* show both that this species is present in small numbers in the tobacco biocoenosis from June 10th until the end of September, and that its presence fluctuates. In 2003 it appeared for a very short time from August 20th until September 10th. Since the adults are adjusted to xerophilous and thermophilous conditions, the species appears only in small numbers in tobacco biocoenosis. Although leaf aphids are numerous in this period, climate factors play the crucial role (Fig. 15).

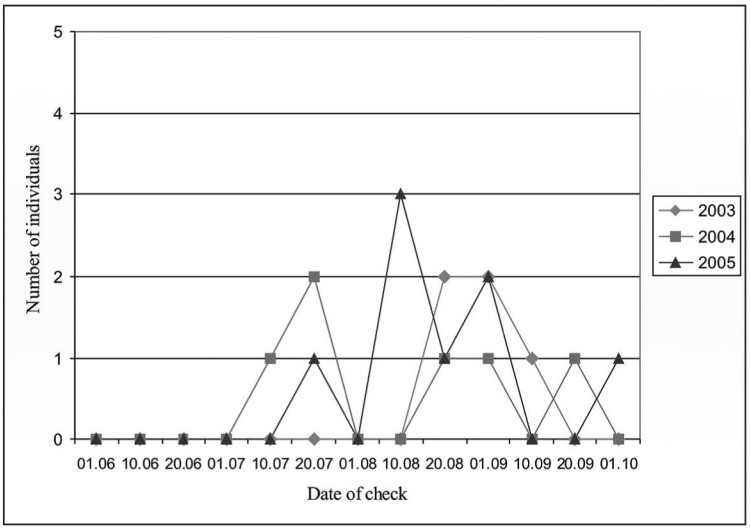


Figure 15. Population dynamics of *P. tibialis* (2003-2005)

10. *Melanostoma mellinum* Linnaeus, 1758 (Fig. 26) is a facultative aphidophagous species that belongs to the tribe Bacchini.

Pursuant to the literature data, *M. mellinum* females choose among vegetative hosts no matter what the aphids' occurrence. In these cases, the capability of larvae to find aphids is the key factor. There are crop plants and industrial cultures among tobacco plants on the Institute's experimental field. This species was confirmed only by the insect-catcher method in all three years of study. The population dynamics of *M. mellinum* show the presence of this species in the tobacco biocoenosis from June 1st until September 30th in 2003 and 2004, while the last entities were registered on September 10th 2005. In 2003 *M. mellinum* had two peaks in population development: on June 10th, when its population was at its maximum, and again on September 20th. No entities of this kind were discovered at three control checks between July 10th and August 1st, 2003. In 2004 the population density maximum of *M. mellinum* was on August 1st. Control checks on June 10th, July 1st, and September 1st, 2004 showed no presence of this species. In 2005 the species was present at the beginning of June, with its maximum density on June 20th. After that there were no records of *M. mellinum* until September 10th, 2005 (Fig. 16).

Conclusions

The presence and intensity of the appearance of aphidophagous hoverflies in certain phytocenosis always indicate the presence of leaf aphids.

We registered 10 aphidophagous species of the Syrphidae family during the faunistic studies of hoverflies on the tobacco in the Prilep area in 2003-2005: *S. scripta*, *S. rueppelli*, *S. pyrastri*, *E. balteatus*, *E. corollae*, *S. ribesii*, *P. quadrifasciatus*, *P. testaceus*, *P. tibialis* and *M. mellinum*.

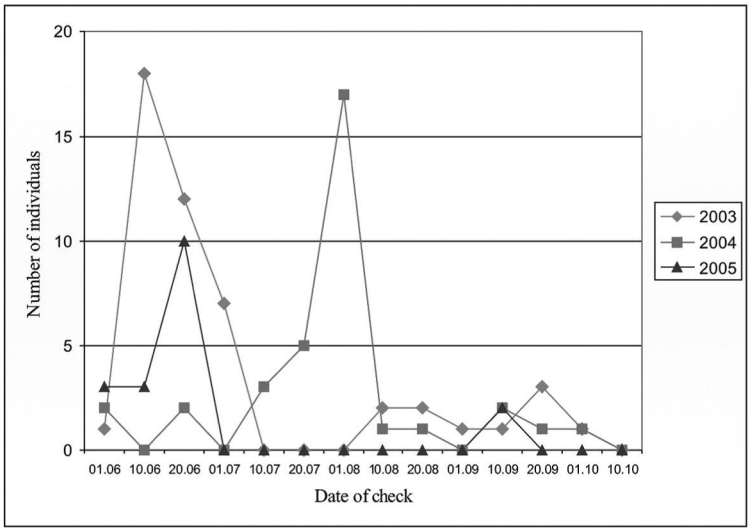
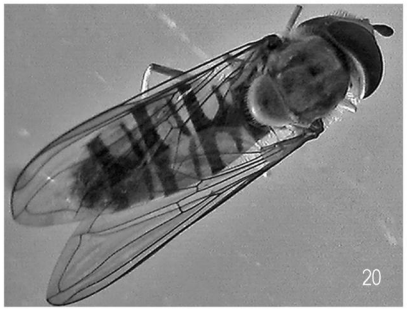
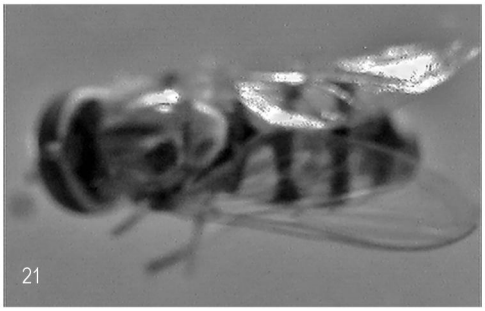


Figure 16. Population dynamics of *M. mellinum* (2003-2005)

Figures 17 & 18. *S.scripta*, female (17) and *S. rueppelli*, female (18) (Photo: V. Krsteska)



Figures 19 & 20. *S. pyrastri*, male (19) and *E. balteanus*, female (20) (Photo: V. Krsteska)



Figures 21 & 22. *E. corollae*, female (21) (Photo: V. Krsteska) and *S. ribesii*, male (22)

Figures 23 & 24. *P. quadrifasciatus*, female (23) and *P. testaceus*, male (24) (Photo: V. Krsteska)

Figures 25 & 26. *P. tibialis*, male (25) and *M. mellinum*, male (26) (Photo: V. Krsteska)

We concluded that the presence of aphidophagous species in tobacco plants is different in different years, depending on climate conditions, and especially on the presence of their hosts, i.e. leaf aphids.

Since 10 predatory hoverflies are determined in the tobacco entomocoenosis, their bio-regulatory function in agro-biocoenosis should be taken into consideration.

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ПОПУЛАЦИОНА ДИНАМИКА АФИДОФАГНИХ ОСОЛИКИХ МУВА НА ПЛАНТАЖАМА ДУВАНА

ВЕСНА КРСТЕСКА

Извод

Дуван за Б.Ј.Р. Македонију има велико социјално, економско и традиционално значење. За производно подручје Прилепа карактеристична је, више или мање, изражена аридност у летњим месецима и сразмерно високе температуре воздуха у току вегетационог периода што условљава успешну производњу ситнолисног и ароматичног дувана. Фактори који су оптимални за развој дувана (температура, влажност и инсолација) исто тако погодују развићу лисних ваши, које се често јављају као лимитирајући фактор у остваривању планираног приноса и квалитета дувана. Са друге стране, повољни климатски услови и велика бројност лисних ваши дувана, пружају основу за развој богате фауне афидофагних предатора и паразита. Афидофагне осолике муве су важни природни регулатори бројности лисних ваши дувана.

У току фаунистичких испитивања сирфида на дувану на територији Прилепа (током сезона 2003-2005) утврдили смо присуство десет афидифагних врста из породице Syrphidae: *S. scripta*, *S. rueppelli*, *S. pyrastri*, *E. balteatus*, *E. corollae*, *S. ribesii*, *P. quadrifasciatus*, *P. testaceus*, *P. tibialis* и *M. mellinum*.

Можемо закључити да је присуство афидофагних врста осоликих мува на дувану различито током различитих година и да зависи од климатских фактора. Посебан значај у условљавању разноврсности и бројности афидофагних осоликих мува има бројност њихових домаћина, лисних ваши.

S. scripta, *S. rueppelli* и *S. pyrastri*, утврђени су у великом броју у свим испитиваним годинама и употребом свих метода.

Пошто је у ентомоценози дувана утврђено присуство десет врста предаторских сирфида, не би требало занемарити њихову улогу биорегулатора у агробиоценозама овог типа.

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