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Original Scientific paper

PEACH APHID *MYZUS PERSICAE* (SULZER) ON TOBACCO

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ABSTRACT

Aphids appear in all tobacco producing regions in Macedonia.
Observations were made on tobacco plants in the region of Prilep during the growing season in 2011-2013, applying the method of 20 tobacco stalks and the method of Davies. Field treatments were carried out for aphid control with: Acetamiprid -0.02%, Imidacloprid -0.03%, 78083 leaf aphids Thiamethoxam -0.02%, Chlorpiriphos -0.15%, Lambda-cyhalothrin -0.025 and Methomyl -0.06%.
The *Myzus persicae* population grew from 79630 in 2011 to 93414 in 2012 and declined to 74440 in 2013, or 247484 on 600 tobacco stalks. According to the method of Davies, 78083 leaf aphids were registered. The maximum incidence of aphids was within 1th and 20th of August.
Applied Neonicotinoides showed excellent effectiveness in aphid control and contact insecticides gave good aphid control. Growers should use insecticides only when necessary. To avoid the possibility of resistance, a change of chemicals during the same growing period is recommended.
Keywords: tobacco, *Myzus persicae*, population dynamics, control

ПРАСКОВАТА ВОШКА MYZUS PERSICAE (SULZER) НА ТУТУНОТ

Лисните вошки се појавуваат во сите тутунопроизводни реони во Македонија.
Набљудувањата беа извршени во регионот на Прилеп, за време на вегетацијата на тутунот во текот на 2011-2013, со апликација на метод на 20 страка тутун и метод на Davies. За контрола на лисните вошки беа поставени полски опити со: Acetamiprid -0.02%, Imidacloprid -0.03%, Thiamethoxam -0.02%, Chlorpiriphos -0.15%, Lambda-cyhalothrin -0.025 и Methomyl -0.06%.
Популацијата на *Myzus persicae* од 79630 во 2011, порасна до 93414 во 2012 и опадна до 74440 во 2013 или вкупно беа утврдени 247484 лисни вошки на 600 тутунски страка. Според методот на Davies беа утврдени вкупно 78083 лисни вошки. Максималната појава на лисните вошки беше од 1 до 20 август.
Аплицираните неоникотиноиди покажаа инзвонредна ефикасност во контрола на вошките, а конатактните инсектициди дадоа добра заштита. Тутунопроизводителите треба да ги применуваат инсектицидите кога е неопходна контролата на лисните вошки. За да се избегне можноста за појава на резистентност, се препорачува смена и ротација на инсектицидите во текот на истата вегетацијата.
Клучни зборови: тутун, *Myzus persicae,* популациона динамика, контрола

INTRODUCTION

The green peach aphid, *M. persicae*, is a highly polyphagous species, colonizing over 500 species of host plants from at least 40 different families (Blackman and Eastop, 2000, cit. Srigiriraju, 2008; Grigorov, 1979). In field conditions of Macedonia, it has a holocyclic life cycle where the sexual phase is completed on a peach and asexual phase occurs on tobacco and other secondary host species (Janusevska, 2001; Krsteska, 2007).

The aphid attack commercial varieties of *Nicotiana tabacum* L. and forms large, dense colonies at the growing points and on the youngest leaves (Helmut and Harrington, 2007).

Aphid diet causes damages on tobacco leaves and reduction of carbohydrates, soluble sugars and glucoses. The aphids may also cause water stress and reduced growth rate of tobacco plant. They deposit honeydew on tobacco leaves resulting in the subsequent growth of a black sooty mold. Contamination of tobacco plant with aphids, or with aphid honeydew, also causes loss and reduces leaf quality. *M. persicae* is vector of several important plant viruses (Todoroski, 1965; Todoroski and Maceljski, 1983; Srigiriraju et al., 2010; Maric and Camprag, 1982).

M. persicae has high potential for reproduction and development. In tobacco biocenosis in the region of Prilep high quantities of this aphid wepe recorded. Due to the unsuitable climate conditions in 2003, the number of its generations on tobacco was reduced to 8, while in 2004 and 2005 there were 10 generations of *M. persicae* (Krsteska, 2007).

Early in the season, aphid infestations are often spotty and if such plants or areas are treated in time, serious damage can be prevented later in the season. In some cases, use of insecticides for other, more damaging insects leads to outbreak of green peach aphid. Inadvertent destruction of beneficial insects is purported to explain this phenomenon, but aphid resistance to some types of insecticide may also be involved (Srigiriraju, 2008). *M. persicae* develop resistance to many insecticides (Harlow, 1990; Kerns et al., 1998; Silva et al., 2012; Eleftherianos et al., 2008).

The main goal of the investigations was to perform analysis of population dynamics of aphids in tobacco fields and their control.

MATERIAL AND METHODS

Investigations were carried out during 2011-2013, on tobacco plants in Prilep. The observations were made with application of the following methods:

a. Method of survey of 20 randomly selected tobacco stalks infested with aphids. Tobacco stalks were sampled from the whole area of the trial at 10-days interval, starting from June 1, up to the end of September. The investigationss were performed on parts of tobacco (leaves, tobacco flowers, seed capsules). 10 checks were made by this method in each of the three years of investigations, i.e. 200 stalks per year, or 600 stalks in total. The investigation included a total of 17603 tobacco leaves (5837 in 2011, 5849 in 2012 and 5917 in 2013).

b. Method of Davies - survey of 100 randomly selected tobacco leaves infested with aphids. Tobacco leaves were sampled from the whole area of the trial at 10-days interval, during tobacco vegetation. 10 checks were made by this method in each of the three years of investigation, i.e. 1000 leaves per year, or 3000 leaves in total.

Field trials were carried out in the Experimental field of Tobacco Institute-Prilep for aphids control with 6 insecticides of different chemical classes.

The treatments included:

1. Acetamiprid (Bubastar 20 SP) -0.02% (neonicotinoid)
2. Imidacloprid (Confidor SL 200) -0.03% (neonicotinoid)
3. Thiamethoxam (Actara) -0.02% (neonicotinoid)
4. Chlorpyriphos (Pyrinex 48 EC) -0.15% (organophosphate)
5. Lambda-cyhalothrin (King) - 0.025% (pyrethroid)
6. Methomyl (Metomyl 90-SP) -0.06% (carbamate)
7. Untreated control
8. The chemicals were applied foliary, with knapsack sprayer, at 20°C. The treatment included 400 tobacco plants in flowering stage. The treatments and the untreated check were set up in a randomized complete block design with four replications. The border rows of the foliar treatments were left untreated.
9. Effectiveness of the applied insecticides was estimated 1, 4, 7, 11, 15 and 21 days after application.
10. Climate conditions are important factors for development of tobacco and aphids. Data presented in Table 1 were obtained from the meteorology station of Scientific Tobacco Institute in Prilep.

Table 1. Climate conditions in the Prilep region

Year	Meteorological factors	Decade	May	Jun	July	August	Septem.	X / ??
2011	**Mean decade air temperature (°C)**	**I**	11,3	18,5	19,4	20,7	21,1	
		II	13,6	18,3	24,4	22,2	21,0	
		III	16,5	18,8	20,00	22,5	16,0	
	Mean monthly air temperature (°C)		**13,9**	**18,5**	**21,3**	**21,9**	**19,6**	**19,1**
	Precipitations (mm)	**I**	20,0	31,0	8,0	9,0	/	
		II	32,0	20,0	/	1,0	23,0	
		III	11,0	/	9,0	1,0	15,0	
	Total precipitations (mm)		**63,0**	**51,0**	**17,0**	**11,0**	**38,0**	**180,0**
2012	**Mean decade air temperature (°C)**	**I**	16,2	19,1	24,2	23,9	20,9	
		II	13,6	21,6	23,7	21,6	17,3	
		III	13,9	22,1	24,8	23,3	18,1	
	Mean monthly air temperature (°C)		**14,6**	**20,9**	**24,3**	**23,0**	**18,8**	**20,3**
	Precipitations (mm)	**I**	6,0	/	/	14,0	/	
		II	56,0	/	/	6,0	23,0	
		III	49,0	20,0	12,0	/	/	
	Total precipitations (mm)		**111,0**	**20,0**	**12,0**	**20,0**	**23,0**	**186,0**

2013	**Mean decade air temperature (°C)**	**I**	17,4	16,0	20,3	24,6	20,0	
		II	16,2	20,6	20,9	23,3	15,6	
		III	15,7	20,4	23,9	20,9	15,5	
	Mean monthly air temperature (°C)		**16,4**	**19,0**	**21,7**	**22,9**	**17,0**	**19,4**
	Precipitations (mm)	**I**	33,0	24,0	11,0	/	/	
		II	11,0	11,0	/	1,0	21,0	
		III	3,0	16,0	/	8,0	14,0	
	Total precipitations (mm)		**47,0**	**51,0**	**11,0**	**9,0**	**35,0**	**153,0**

RESULTS AND DISCUSSIONS

During investigation of the species of Aphididae family, tobacco was attacked only by *Myzus persicae* Sulzer (Photo 1).

The body in apterous aphid is oval and 1.5 to 2.6 mm long. The wingless aphids may occur in light green, dark green, orange or red color (Photo 2). This color morphism in *M. persicae* results from the presence of a series of glycosides in the aphid hemolymph (Blackman, 1974).

Photo 1. Aphids on tobacco

Photo 2. Apterous aphids with several distinctive colors

Nymphs are greenish or yellowish, and they go through four stages during development, and the duration of each stage is in average two days. Redish eyes of young progeny, often easily observable in the abdomen of the mother.

Photo 3. Female, with immatures

As aphid densities increase winged forms are produced to aid dispersal. Alate aphids have a black head and black-redish thorax, and a yellowish green abdomen with a large dark patch dorsally (Photo 3).

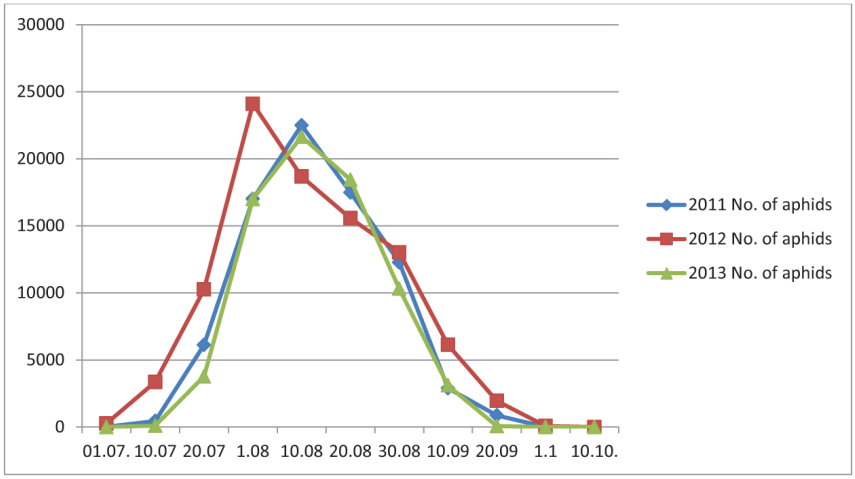
iological state of the plant.

Following the dynamics of the population of aphids in the Prilep tobacco producing region during 2011-2013, we concluded that the aphids can be observed on tobacco

Photo 3. Occurrence of alate aphid in aphid colony

During the summer, *M. persicae* developed many parthenogenic generations of apterous aphids on tobacco, which depends primarily on temperature fluctuations and precipitation, as well as the phys-

plants from early July to the end of September. Individual samples were found until early October. The most intensive attack of aphids on tobacco occurs from the end of July to mid-August (Graph. 1).



Graph. 1. Dynamics of the population of aphids in tobacco production region in Prilep

Table 2 shows the numerical coverage of leaf aphids in accordance with the Method of 20 stalks. Between 2011 and 2013 a survey of leaf aphids was conducted on 600 stalks containing 17603 tobacco leaves. The population of leaf aphids grew from 79630 in 2011 to 93414 in 2012 and declined to 74440 in 2013 or, in total, 247484 over the years.

Table 2. Quantitative representation of aphids 2011 - 2013
Method: survey of 20 tobacco stalks

Date	N⁰ of tobacco leaves 2011	N⁰ of aphids 2011	N⁰ of tobacco leaves 2012	N⁰ of aphids 2012	N⁰ of tobacco leaves 2013	N⁰ of aphids 2013
01.07	332	17	317	267	329	
10.07	368	451	361	3360	365	98
20.07	521	6121	522	10254	519	3775
01.08	628	17003	586	24098	603	16995
10.08	653	22498	639	18679	673	21648
20.08	710	17491	716	15573	722	18435
01.09	724	12275	764	13023	785	10311
10.09	678	2890	663	6128	681	3107
20.09	615	873	668	1956	647	71
01.10	608	11	613	76	593	-
Total	**5837**	**79630**	**5849**	**93414**	**5917**	**74440**

In the first year of investigation (2011), aphid population was very low at the beginning (17 aphids /sample) and maximum density was achieved in August 10 (22498 aphids/sample). In the peak period, average temperature of 22.2 ^{0}C and precipitations of 9 mm were recorded. The aphid population showed a declining trend from the mid-September, due to gradual decrease in temperature.

In the second year of investigation (2012), the infestation of aphids on tobacco started from the first week of July and the maximum incidence was achieved in the first decade of August (24098 aphids/ sample), at 23.9 ^{0}C mean temperature and 14 mm

precipitations. After the second week of September, aphid density declined with the decrease of temperature.

In 2013, aphids were present from the second decade of July to September 20 and maximum population was recorded in August 10 (21648 aphids/sample).

Table 3 gives numerical presentation of leaf aphids according to the Method of 100 tobacco leaves infested with aphids. Over the years, 3000 tobacco leaves were tested and 78083 aphids were recorded. Peak period of aphid population is from early August to mid-August.

Table 3. Quantitative presentation of aphids, 2011-2013
Method: survey of 100 tobacco leaves

Date	N° of aphids		
	2011	**2012**	**2013**
01.07	53	54	
10.07	764	811	143
20.07	1231	3262	925
01.08	5083	9143	3206
10.08	8321	8148	8249
20.08	6078	6021	7054
01.09	2174	3067	1702
10.09	136	1189	556
20.09	117	213	210
01.10	52	121	
Total	**24009**	**32029**	**22045**

During tobacco growing season in 2011-2013 there were quantitative differences in aphids occurrence depending on climate conditions. Beside the climate conditions, parasites and predators limit the number of insects per plant. Some cultural practices as weed control, inter-row cultivation and use of recommended nitrogen rates may help delay infestations of aphids or reduce the aphid populations in tobacco. However, insecticides play a major role in aphid control, alone or within the IPM program.

For successful aphid control higher attention should be paid to monitoring. Tobacco leaves should be regularly checked for aphid colonies, but yellow traps and water pan traps can be also used in monitoring of aphid population.

According to our investigations, treatments are recommended if the populations reach economic threshold levels, i.e., when at least 10 of 100 plants are infested with small aphid colonies. Remedial treatments are recommended if the TGPA populations reach economic threshold levels, i.e., when at least five of 50 plants are infested with 50 or more aphids on any one leaf (Semtner, 2007, cit. Srigiriraju, 2008).

Aphids have developed resistance to many insecticides and they are more difficult to control.

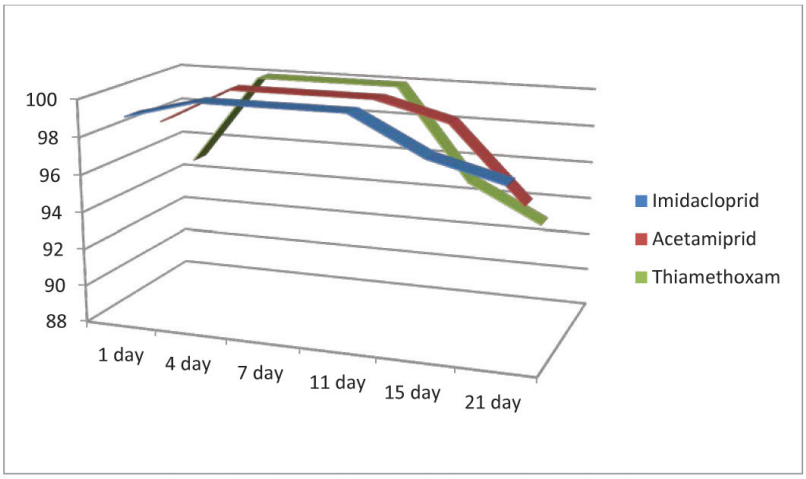
The extensive use of one insecticide during tobacco vegetation creates conditions that favor the fast development of *M. persicae* resistance.

The first report of resistance in this species dates back to 1955 from Anthon, with resistance now reported to most classes of insecticide, including the organophosphates, carbamates, pyrethroids, cyclodienes, and neonicotinoids (Bass et al., 2014).

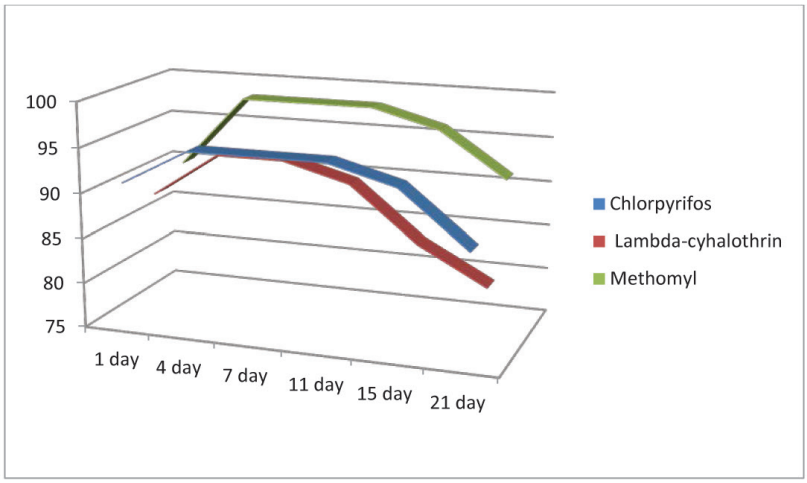
The green peach aphid, *M. persicae*, has

developed resistance to at least seventy different synthetic compounds and different insecticide resistance mechanisms have been reported worldwide (Silva et al., 2012). Eleftherianos, 2008, reported strong resistance to pyrethroid insecticides in the peach-potato aphid, *M. persicae.*

Field trials were conducted to evaluate the performance of various chemical classes for aphid control on tobacco, in order growers to rotate insecticides during vegetation (Graph. 2 and 3).



Graph. 2. Efficacy of Neonicotinoides against leaf aphids



Graph. 3. Efficacy of contact insecticides against leaf aphids

Neonicotinoides: Imidacloprid, Acetamiprid and Thiamtexam provide effective long-lasting protection of aphids, because of their systemic nature. They reached 100 % effectiveness, visible from the first check 24 hours after application. The efficacy is excellent up to the 21st day. Contact insecticides Chlorpyrifos (organophosphate), Lambda-cyhalothrin (pyrethroid) and Methomyl (carbamate) gave good aphid control, 95 %, 90 % and 98 % respectively. The aphids usually feed on young leaves, flowers and top of the stem. They are often found on the underside of tobacco leaves and are difficult to kill with contact insecticides, therefore careful application of insecticides with knapsack sprayer is necessary.

The insecticides were also applied in field trial in Chile and, according to Silva et al. 2012, *M. persica*e has been chemically controlled by the application of almost all classes of insecticides, including neonico-

tinoids, pyrethroids, organophosphates and carbamates.

Aphid control with insecticides on tobacco is necessary. The number of treatments depends on the density and intensity of the attack of leaf aphids. To avoid the possibility of resistance, a change of chemicals during the same growing period is recommended. Growers must apply insecticides only when essential for control, using correct label rates and application procedures and avoiding unnecessary or excessive spraying.

According to Srigiriraju, 2008, the control of *M. pesricae* presents a special challenge to tobacco growers because aphids develop resistance to many insecticides and the facts is that many of the insecticides have been withdrawn from use due to environmental safety or poor performance.

Foster et al. 2007, cit. Srigiriraju, 2008, explain that the extensive use of imidacloprid and other neonicotinoids on tobacco and the reduced availability of insecticides with other modes of action (rotation with neonicotinoids) could create conditions that favor the development of neonicotinoid resistance in *M. persicae.*

Tobacco growers are relying on a few insecticides for control of aphids but the list of insecticides authorized for use on tobacco must be expanded.

CONCLUSIONS

During investigation of fauna species of the Aphididae family it was stated that tobacco was attacked only by *M. persicae*.

From the analyses conducted between 2011 and 20013 to determine the number of leaf aphids in the region of Prilep, it can be concluded that there was variable quantitative coverage.

In 600 tobacco stalks tested the population of leaf aphids grew from 79630 in 2011, to 93414 in 2012 and declined to 74440 in 2013 or, in total, 247484 aphids were counted over the years. According to the method of Davies, in 3000 tobacco leaves a total of 78083 leaf aphids were recorded. In all years, the maximum incidence of aphids was between 1 st and 20 th of August.

For successful management of aphids greater attention should be paid to monitoring. Tobacco leaves should be checked regularly for aphid colonies and treatments are recommended when the populations reach economic threshold levels.

Insecticides play a major role in keeping this pest under control. Development of insecticide resistance in field populations must be avoided.

It can be concluded that *M. persicae* has been successfully controlled by the application of all classes of insecticides applied in field trial. Neonicotinoides showed excellent effectiveness in aphid control and contact insecticides gave good aphid control.

To avoid the possibility of resistance, rotation of chemicals during the same growing season is recommended.

Growers should apply insecticides only when essential for the control, using a correct label rates and application procedures and avoiding unnecessary or excessive spraying.

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