Pestic. Phytomed. (Belgrade), 37(3), 2022, 77–83
DOI: https://doi.org/10.2298/PIF2203077J

UDC 632.7:591.526:633.31(497.11)
Review paper

Aphids (Hemiptera: Aphididae) on alfalfa in Serbia: seasonal dynamics and pest status

Ivana Jovičić[1]*, Anđa Radonjić[2] and Olivera Petrović-Obradović[2]

[1]Institute of Pesticides and Environmental Protection, Banatska 31b, 11080 Belgrade - Zemun, Serbia
[2]University of Belgrade, Faculty of Agriculture, Nemanjina 6, 11080 Belgrade - Zemun, Serbia
**Corresponding author: ivana.jovicic@pesting.org.rs*

Received: 3 November 2022
Accepted: 24 November 2022

SUMMARY

Alfalfa (*Medicago sativa*) is the most important forage legume and one of the most widely grown crops in Serbia. Aphids (Hemiptera: Aphididae) are one of the most significant groups of pests of that crop. Three aphid species, *Acyrthosiphon pisum*, *Aphis craccivora* and *Therioaphis trifolii*, are considered as important pests of alfalfa in Serbia. The most abundant of them, *T. trifolii*, is more adapted to warmer temperatures and it is the predominant aphid species during summer months, while *A. pisum* is prevalent during the spring period. In warmer climates, an increasing abundance of *T. trifolii* and decreasing populations of *A. pisum* have been observed in alfalfa in Serbia. On the other hand, *A. craccivora* is a minor pest of alfalfa, which rarely occurs in high numbers. The present paper synthesizes the existing knowledge about these three aphid pests of alfalfa, including their morphology, biology, seasonal dynamics, pest status and effects of temperature on their development.

Keywords: *Acyrthosiphon pisum, Aphis craccivora, Therioaphis trifolii, Medicago sativa*

INTRODUCTION

Alfalfa, *Medicago sativa* L., is a major forage crop worldwide (Michaud et al., 1998). Regarding the area on which it is grown in Serbia, alfalfa ranks sixth among leading crops after corn, wheat, sunflower, soybeans and barley. The Serbian Province of Vojvodina is the most important alfalfa production region. Over the past 20 years, alfalfa fields in Serbia have contracted drastically from 190,000 hectares in 2000 to 105,000 in 2020 (Statistical Office, 2022). Alfalfa is generally grown in monoculture for several years under conditions of low agrotechnology, representing a suitable habitat for numerous insects. Of over 100 harmful species of insects that feed on alfalfa, about 20 are considered pests that are able to cause yield losses (Berg & Boyd, 1984; Kereši et al., 2005). Some aphid species are considered as significant pests of alfalfa and one of the causes of area reduction of its cultivation in Serbia.

Aphids (Hemiptera: Aphididae) constitute a group of plant-feeding insects which includes about 5000 species described worldwide (Blackman & Eastop, 2022; Favret, 2022), while 393 aphid species are present in Serbia (Tomić & Petrović-Obradović, 2022). Some aphid species are serious agricultural pests. Of their total number, 450 species are able to develop on cultivated plants, while about 100 of them can cause direct and significant damage (Blackman & Eastop, 2007).

APHIDS AS ALFALFA PESTS

Aphids are among the most devastating insect pests of alfalfa worldwide, especially in North and South America, the Middle East and Australia. In those parts of the world, some populations can reach abundance that exceeds harmfulness thresholds, leading to considerable production losses (Jones & Ferris, 2000; Berberet et al., 2009; Rakhshani et al., 2009; Ximenez-Embun et al., 2014). These hemipterans cause a worldwide economic impact of about 25% on alfalfa production (He & Zhang, 2006; Ryalls et al., 2013). Twenty-two aphid species and two subspecies have been reported as potential inhabitants of alfalfa (Blackman & Eastop, 2022), while four of them: *Acyrtosiphon kondoi* Shinji, *Acyrthosiphon pisum* (Harris), *Aphis craccivora* Koch and *Therioaphis trifolii* (Monell), are considered to have the most devastating impact (Pons et al., 2005; Berberet et al., 2009; Rakhshani et al., 2009; Ximenez-Embun et al., 2014).

All of these most important aphid species have been reported on alfalfa in Europe (Coeur d'Acier et al., 2010; Blackman & Eastop, 2022). In Mediterranean countries, alfalfa aphids occur throughout the growing season, often reaching abundance that results in yield losses (Tremblay & Pennacchio, 1988; Lykouressis & Polatsidis, 1990; Pons et al., 2005).

Aphids cause direct damage to alfalfa by feeding on its leaves, petioles, flower stalks and stems. After forming dense colonies on plants, they cause wilting and ultimately decay of alfalfa plants. These insects are also able to transmit plant viruses. *Alfalfa mosaic virus* (AMV, genus *Alfamovirus*, family *Bromoviridae*) and *Cucumber mosaic virus* (CMV, genus *Cucumovirus*, family *Bromoviridae*) are the most frequent alfalfa viruses worldwide (Bol, 2010; García-Arenal & Palukaitis, 2010), and in Serbia (Bulajić et al., 2010). Both viruses belong to a group of nonpersistent viruses. The most important vectors of these viruses are *A. pisum*, *A. craccivora*, *T. trifolii,* and several polyphagous aphid species, such as *Aphis fabae* Scopoli, *A. gossypii* Glover, *A. spiraecola* Patch and *Myzus persicae* (Sulzer) (Gildow et al., 2008; Bol, 2010; García-Arenal & Palukaitis, 2010), almost all of which are found on alfalfa (Blackman & Eastop, 2022).

In Serbia, three aphid species are considered the most damaging on alfalfa: *A. pisum*, *A. craccivora* and *T. trifolii* (Tomanović et al., 1996; Petrović-Obradović & Tomanović, 2005; Jovičić et al., 2016). *Acyrthosiphon kondoi,* an invasive species in Europe, has only been detected in Greece and France so far (Coeur d'Acier et al. 2010), but not in Serbia (Jovičić & Petrović-Obradović, 2016). Understanding of the seasonal dynamics, biology and ecology of aphid species is needed to develop future management practices. Seasonal dynamics of three aphid species on alfalfa in Serbia were studied during 2011-2013 in fields in Ovča (South Banat) and Progar (Srem) (Jovičić et al., 2016; Jovičić et al., 2022).

Acyrthosiphon pisum – pea aphid

The species is a large aphid, pale green or pink with long antennae, legs, siphunculi and cauda (Figure 1). *Acyrthosiphon pisum* inhabits about 20 genera in the family Fabaceae and it is a major pest of alfalfa and peas (Blackman & Eastop, 2000). The pea aphid is considered one of the 14 aphid species of the greatest agricultural importance (Blackman & Eastop, 2007). The species is monoecious and holocyclic in temperate climates worldwide (Blackman & Eastop, 2022). Originally a Palaearctic species (Blackman & Eastop, 2022), *A. pisum* is a well-known pest of alfalfa in Europe (Lykouressis & Polatsidis, 1990; Pons et al., 2005; Meseguer et al., 2021), North America (Cuperus et al., 1982), South America (Grez et al., 2014; Ximenez-Embun et al., 2014), the Middle East (Rakhshani et al., 2009) and Australia (Julier et al., 2004). The species rapidly develops dense colonies on the growing parts of alfalfa, i.e. stems and leaves. The infested plants wilt, leaf tops become paler and lower leaves turn yellow and shed. This aphid is a vector of more than 30 viruses, which may cause serious crop losses, and the most important viruses for alfalfa are AMV and CMV (Blackman & Eastop, 2007; Bol, 2010; García-Arenal & Palukaitis, 2010). Based on research conducted in Minnesota, USA, the harmfulness threshold for this species is the presence of 1-2 aphids per alfalfa stem on average (Cuperus et al., 1982). *Acyrthosiphon pisum* populations have periodic fluctuations. Many factors, such as host-plant quality, weather conditions or presence of natural enemies, affect their seasonal dynamics (Kindlman & Dixon, 2010).

Figure 1. *Acyrthosiphon pisum*: apterous viviparous females (photo I. Jovičić)

The first specimens of *A. pisum* appear on alfalfa plants in Serbia at the beginning of April (Jovičić et al., 2016). Maximum population density of 2.34 specimens per alfalfa stem was noted in South Banat and 1.13 specimens per stem in Srem in the middle of May 2012. Fast decline and low population density, i.e. lower than harmfulness threshold for this aphid, were found in our study to occur from June to October, except in South Banat in June 2013 (Table 1). Low abundance of this cold-adapted species during the summer months is associated with negative effects of high temperatures. Also, deterioration of alfalfa plant quality had a negative impact on population abundance of this species (Jovičić et al., 2022). In years with mild summer, as it was in 2012, the species can reach a second peak during October, so that the recorded abundance in South Banat rose above harmfulness threshold with 1.71 specimens per alfalfa stem. Its population density exceeded harmfulness threshold (1 specimen per 1 alfalfa stem or more) several times during the growing season (Table 1): in South Banat at the end of April (2011), in Srem in mid-May of 2011 and 2012, and in South Banat in May (2011, 2012 and 2013), mid-June (2013) and mid-October (2011). The monitoring of aphid flight activity on alfalfa in Serbia revealed a low number of *A. pisum* in yellow water traps (Jovičić et al., 2017). Tomanović et al. (1996) showed in their research in Vojvodina Province nearly three decades ago that *A. pisum* was more frequent than the other two aphid species. In studies carried out in several other European countries (Greece, Italy and Spain), *A. pisum* reached its maximum abundance during two periods, spring and autumn (Tremblay & Pennacchio, 1988; Lykouressis & Polatsidis, 1990; Pons et al., 2005). However, updates on potential changes in the abundance of *A. pisum* populations on alfalfa in European countries are not available.

Table 1. Dates when the abundance of *A. pisum* exceeded harmfulness threshold and recorded specimen numbers per alfalfa stem in Srem and South Banat 2011–2013 (Jovičić et al., 2016; Jovičić et al., 2022).

Locations			
Srem		South Banat	
Date	[1]No.	Date	[1]No.
2011			
12 May	1.04	30 April	1.09
		10 May	1.22
		20 May	2.32
		19 October	1.71
2012			
19 May	1.13	18 May	2.34
2013			
		10 May	2.28
		17 June	1.08

[1] No. - Number of *A. pisum* specimens per alfalfa stem
* Harmfulness threshold for *A. pisum* is 1-2 aphids per alfalfa stem on average

Aphis craccivora – black legume aphid or cowpea aphid

Aphis craccivora is a small aphid, shiny black in color (Figure 2). This polyphagous species has a wide range of host plants but prefers those in the family Fabaceae (Blackman & Eastop, 2000). The biology of this species has not been completely clarified. It is anholocyclic almost everywhere, but sexual phase has been reported in Germany, India and Argentina (Blackman & Eastop, 2000). In research all over the world, it has been described as a pest of alfalfa but not as the most important one (Pons et al., 2005; Berberet et al., 2009; Rakhshani et al., 2009; Ryalls et al., 2013; Meseguer et al., 2021). It feeds on alfalfa stems and is strongly ant-attended. Rarely, the species can form dense colonies on individual alfalfa plants or in smaller oases (Berberet et al., 2009; Grez et al., 2014). The aphid has a cosmopolitan distribution but is not very common in the cool temperate climate. Edwards (2001) suggests that *A. craccivora* has a potential to become more destructive on alfalfa as the climate change progresses. The species is a vector of several viruses, including AMV (Bol, 2010) and CMV (Gildow et al., 2008). Its harmfulness threshold is the average presence of 3 individuals per alfalfa stem (Berberet et al., 2009). *Aphis craccivora* rarely occurs on alfalfa in Serbia during the growing season (Jovičić et al., 2016). Dense colonies of this species on individual alfalfa plants were recorded only once during our three-year research, and it was in Srem on 19 July 2012. However, aphid flight monitoring on alfalfa in Serbia showed that *A. craccivora* was very

abundant in water traps and potentially a very important vector of alfalfa viruses (Jovičić et al., 2017). The reason why this species flies over alfalfa fields bu t rarely lands to form colonies on plants will be the focus of future research.

Figure 2. *Aphis craccivora:* apterous (left) and alate (right) viviparous females (photo I. Jovičić)

Therioaphis trifolii – spotted alfalfa aphid or yellow clover aphid

The species is a small, pale, yellow-greenish aphid with rows of pigmented tubercles with capitate hairs on the dorsal side of the abdomen (Figure 3). It feeds on many Fabaceae plants but is an important pest only of the *Trifolium* and *Medicago* genera (Blackman & Eastop, 2022). In Northern and Central Europe, it is a monoecious and holocyclic species (Blackman & Eastop, 2000; Petrović-Obradović & Tomanović, 2005), while being usually anholocyclic in warmer areas (Sunnucks et al., 1997). *Therioaphis trifolii*, originally a Palearctic species, spreads throughout the South-Western USA (after 1950), Australia (approximately 1977), South Africa (after 1980), and Japan (after 1980) (Blackman & Eastop, 2000). The species was first recorded in Australia in 1977 (Passlow, 1977), and only a few years after its introduction it became the most significant pest of alfalfa on that continent (Sunnucks et al., 1997). Its feeding on the underside of alfalfa leaves leads to local symptoms, primarely to the chlorosis of leaf nerves in the apical part of plants, while general chlorosis, necrosis and wilting occur due to toxins in aphid saliva (Berg & Boyd, 1984; Madhusudhan & Miles, 1998). According to research conducted by Hughes et al. (1987) in Australia, the harmfulness threshold for *T. trifolii* is 1 aphid on average per alfalfa stem in the initial stages of development or 4 aphids per alfalfa stem in the growth stage of early flowering. The species is a vector of several viruses: AMV (Bol, 2010), CMV (Gildow et al., 2008) and *Red clover vein mosaic virus* (RCVMV) (Blackman & Eastop, 2000).

Figure 3. *Therioaphis trifolii:* an alate viviparous female and a small larva (photo I. Jovičić)

The first specimens of *T. trifolii* on alfalfa in Serbia can be found at the beginning of April (Jovičić et al., 2016). The species abundance was found in our research to exceed the harmfulness threshold (4 aphids per alfalfa stem in the growth stage of early flowering) at the end of August and the beginning of September (2012) in Srem, and the end of July and August (2011, 2012 and 2013) and beginning of September (2012) in South Banat (Jovičić et al., 2022) (Table 2). Maximum population densities, 3.69 and 5.37 specimens per alfalfa stem, were observed in August (2012) in South Banat.

Table 2. Dates when the abundance of *T. trifolii* exceeded harmfulness threshold, and the recorded number of specimens per alfalfa stem in Srem and South Banat in 2011–2013 (Jovičić et al., 2016; Jovičić et al., 2022).

Locations			
Srem		South Banat	
Date	[1]No.	Date	[1]No.
2011			
		22 July	1.64
2012			
		24 July	1.14
18 August	3.88	3 August	3.69
7 September	1.05	24 August	5.37
18 September	1.22	3 September	1.64
2013			
		29 July	1.31
		19 August	1.79
		29 August	1.29

[1] No. - Number of specimens of *T. trifolii* per alfalfa stem
* Harmfulness threshold for *T. trifolii* is 1 aphid per alfalfa stem on average in the initial stages of development or 4 aphids per alfalfa stem in the growth stage of early flowering

Populations of *T. trifolii* on alfalfa in Serbia are well-adapted to high air temperatures, so that the species reached its maximum density during the hot and dry

summer months, when the other two species were practically absent (Jovičić et al., 2016). In a research conducted nearly three decades ago, *T. trifolii* was not reported as a significant pest of alfalfa in Northern Serbia (Tomanović et al, 1996). The most recent study of Jovičić et al. (2022) suggested an increased abundance of this species under warmer conditions. High temperatures and dry weather are optimal for increasing abundance of *T. trifolii* populations and they are some of the reasons for the prevalence of *T. trifolii* over *A. pisum* on alfalfa in Serbia. In Greece, Lykouressis & Polatsidis (1990) found that *T. trifolii* had population peaks during summer months from July to mid-September. It is important to note that *T. trifolii* produces a high number of winged forms, and it is one of the most abundant aphid species in yellow water traps, and a very important potential vector of alfalfa viruses (Jovičić et al., 2017).

ACKNOWLEDGMENT

This research was funded by grants 451-03-68/2022–14/200214 and 451-03-68/2022-14/200116 of the Ministry of Education, Science and Technological Development, Republic of Serbia.

REFERENCES

Berberet, R.C., Giles, K.L., Zarrabi, A.A., & Payton, M. E. (2009). Development, reproduction, and within-plant infestation patterns of *Aphis craccivora* (Homoptera: Aphididae) on alfalfa. *Environmental Entomology, 38*(6), 1765-1771. Doi: 10.1603/022.038.0630

Berg, G., & Boyd, M. E. J. (1984). *Insects in Lucerne: A guide to identification and control of insects in lucerne.* Carrum Downs, Victoria, Australia: Grassland Society of Victoria.

Blackman, R.L., & Eastop, V.F. (2000). Aphids on the world's crops. An identification and information guide. (2nd ed). Chichester, UK: John Wiley & Sons.

Blackman, R. L., & Eastop, V. F. (2007). Taxonomic issues. In H.F. van Emden & R. Harrington (Eds.), *Aphids as crop pests* (pp 1-29). Wallingford, UK: CAB International. Doi: http://dx.doi.org/10.1079/9780851998190.0001

Blackman, R.L., & Eastop, V.F. (2022). *Aphids on the world's plants: An online identification and information guide.* Retrieved from: http://www.aphidsonworldsplants.info/

Bol, J. F. (2010). Alfalfa mosaic virus. In B.W.J. Mahy & M.H.V. van Regenmortel (Eds.), Desk encyclopedia of plant and fungal virology (pp 85-91). Amsterdam, Netherlands: Elsevier.

Bulajić, A., Vučurović, A., Stanković, I., Ristić, D., Ivanović M., & Krstić, B. (2010). Razvijanje metode za određivanje učestalosti zaraze virusom mozaika lucerke u usevu semenske lucerke (Development of method for assessing AMV incidence in alfalfa seed crop) (pp 77-78). In *Book of Abstracts, X National Conference of Plant Protection*, Zlatibor, Serbia.

Coeur d'Acier A., Perez Hidalgo, N., & Petrović-Obradović, O. (2010). Aphids (Hemiptera, Aphididae). In A. Roques, J.Y. Rasplus, C. Lopez-Vaamonde, W. Rabitsch, M. Kenis, & W. Nentwig (Eds.), *BioRisk*, 4 *(Alien terrestrial arthropods of Europe)* (435-474). Doi: https://doi.org/10.3897/biorisk.4.57

Cuperus, G.W., Radcliffe, E.B., Barnes, D.K., & Marten, G.C. (1982). Economic injury levels and economic thresholds for pea aphid, *Acyrthosiphon pisum* (Harris), on alfalfa. *Crop Protection*, *1*(4), 453-463. Doi: https://doi.org/10.1016/0261-2194(82)90026-6

Edwards, O.R. (2001). Interspecific and intraspecific variation in the performance of three pest aphid species on five grain legume hosts. *Entomologia Experimentalis et Applicata*, *100*(1), 21-30.

Favret, C. (2022). *Aphid species file*. Version 5.0/5.0. Retrieved from: http://Aphid.SpeciesFile.org

García-Arenal, F., & Palukaitis, P. (2010). Cucumber mosaic virus. In B.W.J. Mahy & M.H.V. Van Regenmortel (Eds.), *Desk encyclopedia of plant and fungal virology* (pp 8171-176). Amsterdam, Netherlands: Elsevier.

Gildow, F.E., Shah, D.A., Sackett, W.M., Butzler,T., Nault, B.A., & Fleischer, S.J. (2008). Transmission efficiency of *Cucumber mosaic virus* by aphids associated with virus epidemics in snap bean. *Phytopathology, 98*(11), 1233-1241. Doi: 10.1094/PHYTO-98-11-1233

Grez, A.A., Zaviezo, T., & Gardiner, M.M. (2014). Local predator composition and landscape affects biological control of aphids in alfalfa fields. *Biological Control, 76*, 1-9.

He, C.G., & Zhang, X.G. (2006). Field evaluation of lucerne (*Medicago sativa* L.) for resistance to aphids in northern China. *Australian Journal of Agricultural Research, 57*(4), 471-475. Doi: https://doi.org/10.1071/AR05255

Hughes, R.D., Woolcock, L.T., Roberts, J.A., & Hughes, M. A. (1987). Biological control of the spotted alfalfa aphid, *Therioaphis trifolii* f. *maculata*, on lucerne crops in Australia, by the introduced parasitic hymenopteran *Trioxys complanatus*. *Journal of Applied Ecology*, *24*(2), 515-537. Doi: https://doi.org/10.2307/2403890

Jones, R.A.C., & Ferris, D.G. (2000). Suppressing spread of alfalfa mosaic virus in grazed legume pasture swards using insecticides and admixture with grass, and effects of insecticides on numbers of aphids and three other pasture pests. *Annals of Applied Biology, 137*(3), 259-271. Doi: https://doi.org/10.1111/j.1744-7348.2000.tb00067.x

Jovičić, I., & Petrović-Obradović, O. (2016). Potencijalna opasnost od pojave invazivne vaši *Acyrthosiphon kondoi* Shinji, 1938 (Hemiptera: Aphididae) na lucerki u Srbiji (Potential occurrence and danger of invasive aphid *Acyrthosiphon kondoi* Shinji, 1938 [Hemiptera: Aphididae] on alfalfa in Serbia). *Biljni lekar* (*Plant Doctor*), *44*(2), 134-140.

Jovičić, I., Radonjić, A., & Petrović-Obradović, O. (2016). Aphids (Hemiptera: Aphididae) on alfalfa and their coccinellid predators in Serbia: seasonal abundance. *Acta Zoologica Bulgarica*, *68*(4), 581- 587.

Jovičić, I., Radonjić, A., & Petrović-Obradović, O. (2017). Flight activity of aphids as potential vectors of viral infection of alfalfa in Serbia. *Pesticides* & *Phytomedicine*, *32*(3-4), 173-179. Doi: https://doi.org/10.2298/PIF1704173J

Jovičić, I., Vujadinović, M., Vuković, A., Radonjić, A., & Petrović-Obradović, O. (2022). Effects of temperature on *Acyrthosiphon pisum* and *Therioaphis trifolii* (Hemiptera: Aphididae) abundance in alfalfa crops: A case study in northern Serbia. *Journal of Agricultural Sciences (Belgrade)*, *67*(3), 269-283. Doi : https://doi.org/10.2298/JAS2203269JDoi:10.2298/JAS2203269J

Julier, B., Bournoville, R., Landré, B., Ecalle, C., & Carré, S. (2004). Genetic analysis of lucerne (*Medicago sativa* L.) seedling resistance to pea aphid (*Acyrthosiphon pisum* Harris). *Euphytica, 138*(2), 133-139.

Kereši, T., Jasnić, S., & Konstantinović, B. (2005): Pregled i značaj štetočina, bolesti i korova lucerke i deteline (Overview and importance of pests, diseases and weeds of alfalfa and clover). *Biljni lekar* (*Plant Doctor*)*, 33*(5), 492-496.

Kindlmann, P., & Dixon, A. F. G. (2010). Modelling population dynamics of aphids and their natural enemies. In P. Kindlman, A.F.G. Dixon & J.P. Michaud (Eds.), *Aphid biodiversity under environmental change. Patterns and processes* (1-20). New York, NY: Springer Science and Business Media.

Lykouressis, D.P., & Polatsidis, C. P. (1990). Seasonal abundance of *Acyrthosiphon pisum* (Harris) (Homoptera: Aphididae) and *Therioaphis trifolii* (Monell) (Homoptera: Callaphididae) on lucerne in central Greece. *Entomologia Hellenica, 8*, 41-46.**Doi:** https://doi.org/10.12681/eh.13980

Madhusudhan, V.V., & Miles, P.W. (1998). Mobility of salivary components as a possible reason for differences in the responses of alfalfa to the spotted alfalfa aphid and pea aphid. *Entomologia Experimentalis et Applicata, 86*(1), 25-39. Doi: https://doi.org/10.1046/j.1570-7458.1998.00262.x

Meseguer, R., Levi-Mourao, A., & Pons, X. (2021). Species complex and temporal associations between coccinellids and aphids in alfalfa stands in Spain. *Insects*, *12*(11), 971.

Michaud, R., Lehman, W.F., & Rumbaugh, M.D. (1988). World distribution and historical development. In. A.A. Hanson, D.K. Barnes & R.R. Hill (Eds.), Alfalfa and alfalfa improvement. (Agronomy series, 29) (pp 25-91). Madison, USA: American Society of Agronomy.

Passlow, T. (1977). The spotted alfalfa aphid, a new pest of lucerne. *Queensland Agricultural Journal 103*, 329-330.

Petrović-Obradović, O., & Tomanović, Ž. (2005). Biljne vaši-štetočine lucerke i deteline (Aphids: Pests of alfalfa and clover). *Biljni lekar (Plant Doctor), 33*(5), 534-538.

Pons, X., Núñez, E., Lumbierres, B., & Albajes, R. (2005). Epigeal aphidophagous predators and the role of alfalfa as a reservoir of aphid predators for arable crops. *European Journal of Entomology, 102*(3), 519-525. Doi: 10.14411/eje.2005.074

Rakhshani, H., Ebadi, R., & Mohammadi, A.A. (2009). Population dynamics of alfalfa aphids and their natural enemies, Isfahan, Iran. *Journal of Agricultural Science and Technology*, *11*, 505-520.

Ryalls, J.M., Riegler, M., Moore, B.D., & Johnson, S.N. (2013). Biology and trophic interactions of lucerne aphids. *Agricultural and Forest Entomology, 15*(4), 335-350. Doi: https://doi.org/10.1111/afe.12024

Statistical Office of the Republic of Serbia (2022). Retrieved from: www.stat.gov.rs

Sunnucks, P., Driver, F., Brown, W.V., Carver, M., Hales, D.F., & Milne, W.M. (1997). Biological and genetic characterization of morphologically similar *Therioaphis trifolii* (Hemiptera: Aphididae) with different host utilization. *Bulletin of Entomological Research 87*(4), 425-436. Doi: https://doi.org/10.1017/S0007485300037433

Tomanović, Ž., Brajković, M., Krunić, M., & Stanisavljević, L. (1996). 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. *Tiscia*, 30, 45-48.

Tomić, M., & Petrović-Obradović, O. (2022). *Periphyllus californiensis* (Shinji, 1917) and *Tinocallis saltans* (Nevsky, 1929) (Hemiptera; Aphididae), two alien aphid species new to the fauna of Serbia. *Acta Entomologica Serbica*, *27*(2). Doi: https://doi.org/10.5281/zenodo.7271290

Tremblay, F. & Pennacchio, F. (1988). Population trends of key aphids and of their main natural enemies in an alfalfa ecosystem in southern Italy. In E. Niemczyk, & A.F.G. Dixon (Eds.), Ecology and effectiveness of Aphidophaga (pp 261-265). Hague, Netherlands: SPB Academic Publishing.

Ximenez-Embun, M.G., Zaviezo, T., & Grez, A. (2014). Seasonal, spatial and diel partitioning of *Acyrthosiphon pisum* (Hemiptera: Aphididae) predators and predation in alfalfa fields. *Biological Control*, 69, 1-7. Doi: https://doi.org/10.1016/j.biocontrol.2013.10.012

Biljne vaši (Hemiptera: Aphididae) na lucerki u Srbiji: sezonska dinamika i štetnost

REZIME

Lucerka je najvažnija krmna leguminoza i jedan od najčešće gajenih useva u Srbiji. Biljne vaši (Hemiptera: Aphididae) su jedne od ekonomski najznačajnijih štetočina ove gajene biljke. Tri vrste biljnih vaši: *Acyrthosiphon pisum*, *Aphis craccivora* i *Therioaphis trifolii* se razvijaju i nanose štete na usveima lucerke u Srbiji. Najbrojnija vrsta *T. trifolii*, prilagođena višim temperaturama, je dominantna tokom letnjih meseci, dok je *A. pisum*, vrsta prilagođena nižim temperaturama, dominantna tokom proleća. Takođe, u Srbiji je, usled povećanja temperatura, registrovan porast brojnosti vrste *T. trifolii* i smanjenje brojnosti *A. pisum*. *Aphis craccivora* je ekonomski manje značajna vaš na lucerki koja se retko javlja u većoj brojnosti. Ovaj rad objedinjuje postojeće podatke o tri vrste biljnih vaši koje su štetne na lucerki, uključujući njihovu morfologiju, biologiju, sezonsku dinamiku, štetnost, kao i uticaj temperature vazduha na njihov razvoj.

Ključne reči: *Acyrthosiphon pisum, Aphis craccivora, Therioaphis trifolii, Medicago sativa*