

**FIRST RECORDS OF THE OAK LACE BUG *CORYTHUCHA ARCUATA* (SAY, 1832) (HEMIPTERA: TINGIDAE) IN NORTH MACEDONIA**

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Abstract – The oak lace bug *Corythucha arcuata*, a Nearctic species, was first reported in Europe in 2000 in northern Italy. Since then it has spread to many European countries and regions, and there have been records of several recent outbreaks. We report the first find of *C. arcuata* in North Macedonia, one adult specimen, several nymphs and an egg cluster on a symptomatic leaf of *Quercus petraea* from the vicinity of Skopje, in July 2019. After inspecting additional 17 locations throughout North Macedonia we registered 3 more finds of the insect. We registered an egg cluster and nymphs on *Q. robur* var. *fastigiata*, and an egg cluster on *Q. cerris*, both in urban settings of Skopje. The only record further from Skopje was of an adult and nymphs registered on *Q. petraea*, some 25 km southeast, along a major road route. Although scarce and in low density, these few finds of *C. arcuata*, as well as recent records of its rapid expansion in Turkey, Bulgaria, Romania and outbreaks in Hungary and Russia, suggest that this insect pest will be found more consistently on a wider area in North Macedonia, and it potentially poses a health risk for oak species in the country.

KEY WORDS: Invasive species, alien species, *Quercus* spp., North Macedonia

Izvešček – PRVE NAJDBE HRASTOVE ČIPKARKE, *CORYTHUCHA ARCUATA* (SAY, 1832) (HEMIPTERA: TINGIDAE) V SEVERNI MAKEDONIJI

Hrastova čipkarka (*Corythucha arcuata*), nearktična vrsta, je bila v Evropi prvič opažena leta 2000 v severni Italiji. Od tedaj se je razširila v mnoge evropske države in območja, poročali so o več nedavnih izbruhih. Poročamo o prvi najdbi vrste *C. arcuata* v Severni Makedoniji, enem odraslem primerku, več ličinkah in skupini jajčec na značilno poškodovanem listu vrste *Quercus petraea* iz bližine Skopja, julija 2019. Ob pregledu dodatnih 17 lokacij po Severni Makedoniji smo zabeležili še tri najdbe.

Našli smo skupino jajčec in ličinke na vrsti *Q. robur* var. *fastigiata* in skupino jajčec na vrsti *Q. cerris*, oboje v urbanem okolju Skopja. Edina najdba izven Skopja so bili odrasel primerek in ličinke na vrsti *Q. petraea*, kakšnih 25 km jugovzhodno, ob glavni cesti. Čeprav redke in majhne gostote, nove najdbe vrste *C. arcuata*, ob nedavnih poročilih o hitrem širjenju v Turčiji, Bolgariji, Romuniji in izbruhih na Madžarskem in v Rusiji, kažejo na bodoče pogostejše pojavljanje tega žuželčjega škodljivca v večjem območju v Severni Makedoniji in postane lahko nevaren za zdrave hrastovih vrst v državi.

KLJUČNE BESEDE: Invazivne vrste, tujerodne vrste, *Quercus* spp., Severna Makedonija

Introduction

A Nearctic species, the oak lace bug *Corythucha arcuata* (Say, 1832) (Heteroptera: Tingidae), is one of 68 species of the genus *Corythucha* registered in the Western hemisphere and one of 49 registered in the USA (Neal and Douglass 1990). In its natural range in the USA there have been numerous early records of its presence in eastern (Gibson 1918) and central US, and west to Iowa (Osborn and Drake 1917) and southern Canada (Still *et al.* 1974; Emond and Still 1974).

Although it was first recorded in Europe in 2000, it was immediately obvious from the large areas of spread in the regions of Lombardy and Piedmont in Italy, that the insect was already present several years prior to its discovery (Bernardinelli and Zandigiacomo 2000). In 2002 it was reported in Switzerland (Forster *et al.* 2005) and already as far away as eastern parts of Turkey (Mutun 2003). In 2005 a find was reported in Iran (province of West Azarbayjan) (Samin and Linnavuori 2011); in 2012 it was recorded in Bulgaria (Dobрева *et al.* 2013); in 2013 in Croatia (Hrašovec *et al.* 2013), Hungary (Csóka *et al.* 2013) and Serbia (Pap *et al.* 2015); in 2015 in Russia (Karpun *et al.* 2018) and Romania (Don *et al.* 2016), and in 2016 in Slovenia (Jurc and Jurc 2017). For Bosnia and Herzegovina there are nearly simultaneous two first records in 2017, in June (Glavendekić and Vuković Bojanović 2017) and August (Dautbašić *et al.* 2018), while in Slovakia the oak lace bug was first recorded in 2018 (Zúbrik *et al.* 2018).

Reports of rapid expansion and larger areas of invaded territories in Italy (Bernardinelli 2007), Turkey (Mutun *et al.* 2009; Küçükbaşmacı 2014), Bulgaria (Simov *et al.* 2018), Romania (Chireceanu *et al.* 2017), and outbreaks in Hungary (Csepelényi *et al.* 2017) and Russia (Neimorovets *et al.* 2017; Karpun *et al.* 2018) further underline the invasiveness and importance of this species and its potential to become a serious threat to oak forests in Europe and further.

Regarding plant hosts, *Quercus* spp., in particular species of the white oak group, are considered as the main hosts of *C. arcuata*. In the USA it has been registered on *Q. macrocarpa* (Drake and Ruhoff 1965) and as early as the beginning of the 20th century was considered as a serious pest on this host, causing discoloration and nearly total destruction of the leaves (Osborn and Drake 1917). This same tree species has also been reported as host in Canada (Still, Tidsbury, and Melvin 1974; Drake and

Ruhoff 1965). Other species reported as hosts in USA are *Q. muehlenbergii*, *Q. prinoides* and *Castanea americana (dentata)*, and in Canada *Q. alba*, *Q. acuminata*, *Q. prinus* and *Q. rubra* (Drake and Ruhoff 1965).

In Europe, the oak lace bug has been registered on *Q. robur*, *Q. pubescens*, *Q. petraea*, presumed hybrids of *Q. robur* and *Q. petraea* (Bernardinelli and Zandigiaco 2000), *Q. macranthera* and *Q. alba* (Csóka, Hirka, and Somlyai 2013), *Malus sylvestris* and *Ulmus minor* (Hrašovec *et al.* 2013).

In the Krasnodar region of Russia adults, nymphs and fifth-instar cases have been documented from the following species: *Q. hartwissiana*, *Q. pedunculiflora*, *Q. petraea*, *Q. pubescens*, *Q. robur*, *Prunus avium*, *Acer laetum* and *Robinia pseudoacacia* (Neimorovets *et al.* 2017).

Furthermore, Bernardinelli (2006) performed trials under controlled conditions in order to investigate plant host preference of the insect pest, as well as suitability of several plant hosts. In the trials, first instar nymphs were reared into adults on leaves of various plant species: *Q. pubescens*, *Q. petraea*, *Q. robur*, *Q. cerris*, *Rubus ulmifolius* and *Rubus idaeus* had the highest survival rate into adulthood (51–72%), while less than 25% reached adulthood on *Castanea sativa*, *Rosa canina* and *Rubus caesius*. In these same trials *C. arcuata* did not complete its life cycle when reared on leaves of *Q. suber*, *Q. ilex*, *Acer campestre*, *A. pseudoplatanus*, *A. platanoides*, *A. negundo* and *Malus domestica* and surprisingly on *Q. rubra*.

Also through trials in controlled conditions it has been presented that adults of *C. arcuata* avoid foliage grown under water deficit, when presented with a choice (Connor 1988). This finding could explain the environmental conditions for occurrence of outbreaks and might be used for prognosis and preventive control purposes.

Pure oak forests in the Republic of North Macedonia cover 289.973 ha (29,3%) of the 988.835 ha total area of forests (Statistical review – Forestry, 2013), and additionally oaks are in large percentage in 297.207 ha of mixed forests. The most prominent are *Q. petraea*, *Q. frainetto*, *Q. pubescens* and *Q. coccifera*, at least by volume of standing stock (Trajkov *et al.* 2016), with lesser presence of *Q. robur*, *Q. cerris*, *Q. ilex* and *Q. macedonica*. Since most of these species have been registered as hosts of *C. arcuata* and because of the fast spread in neighboring countries, our aim was to establish whether this alien insect species is present in Macedonia, and if so, to which extent, both in area coverage and in population density.

Materials and methods

Since the first record in July 2019 of a single adult specimen of *C. arcuata* near Skopje, until Sept 20th we inspected various sites of oak stands throughout North Macedonia. In total, we inspected 18 locations with occurrence of species of *Quercus*. We visually inspected oak leaves for general pathological symptoms and for symptoms specific for lace bug damage on the upper side, as well as for symptoms on the underside of leaves, specific for presence of egg clusters (Figure 1), adult specimens (Figure 2), nymphs and excrements (Figure 3) of oak lace bugs. For each visited location we recorded geographical coordinates. Finds with presence of specimens, or suspected



Fig. 1: Egg cluster of *C. arcuata* (photo Velian Jagev)



Fig. 2: Adult specimen of *C. arcuata* (photo Velian Jagev)

presence (eggs) were carefully collected and sealed in plastic bags and brought to the laboratory for detailed examination. Morphological identification was performed using various stereomicroscope magnifications (Zeiss, Stemi 305). Documentation photos of adults, nymphs and egg clusters were taken with Zeiss Axiocam 105 color camera.

Identification was based on the key of Forster *et al.* (2005) as well as on helpful notes in other references (Dobrova *et al.* 2013; Jurc and Jurc 2017; Hrašovec *et al.* 2013).

Specimens are stored in the entomological laboratory of prof. Nacheski at the Faculty of Forestry in Skopje.

Results and discussion

During an inspection of a mixed forest stand near Skopje with large presence of oak species, a single adult specimen, several nymphs and an egg cluster of *C. arcuata* were registered and collected from a leaf of *Quercus petraea* (41.928179°N, 21.521489°E; leg. Srebrova, 15.07.2019).

Additionally, in the timeframe of our research (15th July – 20th September 2019) we report of 3 other finds. We collected one living and one dead adult specimen on *Q. petraea* located on the road A1 E75 between Skopje and Veles (41.816788°N,



Fig. 3: Tar-like fecal deposit droplets, nymph and nymph molt of *C. arcuata* (photo Velian Jagev)

21.674875°E). We found 1 egg cluster of *C. arcuata* on a tree of *Q. robur* var. *fastigiata* within the arboretum of the Faculty of Forestry in Skopje (42.002590°N, 21.459605°E) and a single egg cluster on *Q. cerris* in urban setting in Skopje (41.991317°N, 21.444813°E).

All three oak species on which we have recorded presence of this alien insect pest are also mentioned by other authors as ones frequently infested, or pointed as main hosts (Bernardinelli 2006; Bernardinelli and Zandigiacomo 2000; Mutun, Ceyhan, and Sözen 2009; Dobрева *et al.* 2013; Hrašovec *et al.* 2013; Dautbašić *et al.* 2018).

All other inspections did not result in finds of this alien invasive insect pest, despite frequent observation of symptoms similar to ones of *C. arcuata*, which is discoloration and pale or chlorotic leaves.

Assaying physiological responses and biochemical parameters of *Q. robur*, Nikolić *et al.* (2019) infer that the rate of photosynthesis, transpiration and stomatal conductance were lowered in plants infested by *C. arcuata* by 59, 22 and 36%, respectively, when compared to non-infested plants, and that concentrations of photosynthetic pigments were also affected. This potential for damage to plant hosts, as well as its fast spread, tendency for outbreaks, the wide range of host and ecological preferences, designates *C. arcuata* as a very serious threat for oak species in Europe and Asia, with wide ranging environmental and economic implications. Furthermore, increase of frequency of stress events and adverse environmental factors due to global climate change, could be predisposing factors for easier spread and establishment of *C. arcuata* in populations of various oak species. On the other side, stress induced by oak lace bugs, especially in outbreak incidences, could be an additional factor for decline of oak populations and is a field for research in itself.

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