ALIEN SPECIES OF JUMPING PLANT LICE (HEMIPTERA: PSYLOYEEA) IN SERBIA

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Five species of invasive jumping plant-lice have been determined from Serbia. Two species were introduced into Europe from other continents (Acizzia jamatonica (Kuwayama) and Trioza neglecta Loginova, 1978), while the following three species Calophya rhois (Löw, 1877), Homotoma ficus (Linnaeus, 1758) and Cacopsylla pulchella (Löw, 1877) are originally European, having extended their habitat from the Mediterranean Basin to the North of Europe. Distribution, morphology and biology of the determined species of jumping plant-lice are studied in this manuscript.

Key words: Psylloidea, jumping plant-lice, Serbia, alien species

INTRODUCTION

Psyllids or jumping plant-lice are small sup-sucking insects, 1-10 mm long. Together with white flies, aphids and scale insects they constitute suborder Sternorrhyncha within the order Hemiptera. They usually develop on woody dicotyledons (Burckhardt, 1994), except for several species from genus Livia, developing on monocotyledons. Most species have very restricted host plant ranges. More than three-quarters of psyllid species are free-living in larval stages, while other develop in open or closed galls. Australian species from subfamilies Spondyliaspidaeae, Pachypsyllinae and Macrocorsinae build waxy coverings, called lerps.

Damage on plants can be induced either directly by sap-sucking, or by the excretion of honey-dew while feeding, which is suitable for sooty mold development. Several species of jumping plant-lice are vectors of bacterial or viral pathogens, such as phytoplasma in the first place, so they pose a potential danger for cultivated plants. Small body size and unobtrusive colour enables them to be transferred over longer distances by wind or with host plant.

They are distributed in all biogeographical regions, with the highest diversity in tropical and southern temperate regions (Burckhardt and Bassett, 2000). There have been 3850 species of jumping plant-lice described in the world so far (Malenovsky, et. al., 2012). In Europe 282 species have been registered, among which 14 have been determined as invasive. From family Psyllidae, 11 species have been determined and from family Trioziidae three species (Mifsud et. al., 2010).
MATERIAL AND METHODS

The fauna of jumping plant-lice (Psylloidea) was investigated in the period from 2000 to 2011 in Serbia. Jumping plant-lice were collected from different localities. Most of the investigated localities were agro-biocoenoses, settlements and ruderal habitats. Adults were collected by an exhaustor and larvae of different developmental stages were collected together with damaged plants.

Collected larvae were reared in laboratory conditions in Petri dishes until eclosion of adults. Both adults and a part of five-instar larvae were fixed in 70% ethyl alcohol for further analysis.

Nymphs and adults, as well as some body parts of adults, were enlightened in 10% KOH. Permanent slides were made in Canada balsam and used for determination. All examined material is kept in the Entomology collection, Department of Entomology and Agricultural Zoology, Faculty of Agriculture, University of Belgrade, Serbia.

The nomenclature and classification follow the Burckhardt (2009).

RESULTS AND DISCUSSION

Family: Calophyidae Vondraček, 1957

1) *Calophya rhois* (Löw, 1877)


*Calophya rhois* is a Mediterranean species introduced into Central Europe, the Great Britain and China. It develops on *Cotinus coggygria* Scop.. Young adults are whitish. Later, head and thorax become red-brown, while abdomen is whitish to light brown with grey tergites (Fig. 1). Overwintering adults are red-brown. Younger larvae are yellow, changing colour until dark brown (Fig. 2). Freshly laid egg is milky white, later becoming dark brown. While feeding, larvae cause curling and bending of leaves inwards, developing a kind of a gall. Besides, larvae also feed on branches, excreting a large amount of honeydew, suitable for the development of sooty mold. It overwinters in adult stage on other plants, most probably conifers. It has two generations per year.
Family: **Homotomidae**

2) **Homotoma ficus** (Linnaeus, 1758)


**H. ficus** is native to Central and southern Europe and the Middle East, feeding on *Ficus carica* L. However, it has been introduced together with the host plant into other countries outside the original distributional range, too. Hodkinson and White (1979) registered it from the Great Britain. Burckhardt and Mühlethaler (2003) reported its presence from Switzerland. According to Mijušković (1999) and Seljak (2006) **H. ficus** is also present in coastal regions of Slovenia, Croatia and Montenegro. Halperin et. al. (1982) and Gencer et. al. (2007), registered fig psylla in the USA (California), too. It is an alien species to North America (Hollis and Broomfield, 1989). In Serbia, **Homotoma ficus** was determined for the first time on fig (*Ficus carica*) in Belgrade area in 2008 (Jerinić-Prodanović, 2011a).

**Adult.** Body light green in freshly moulted specimens, later becoming darker, light green-brown to yellow-brown with dark brown abdominal tergites. Antennae densely covered with long setae, light brown, segments 9-10 dark brown. Forewing light brown with dark brown spots. (Fig. 3).

**Larva.** First instar with yellow body. Fifth-instar bright green with whitish wing pads (Fig. 4); dorsum and body margin densely covered with simple setae. **Egg** is oval in shape, with pedicel situated ventrally and long terminal filament. Recently laid eggs light yellow, later becoming bright yellow.

The fig psylla has one generation per year. It overwinters in the egg stage on the host plant. Larvae of **H. ficus** start hatching in March. While feeding, larvae excrete honeydew which is usually wrapped in wax, so their presence can be recognized by wax secretion in the form of drops or threads on leaves. Eclosion of adults was registered at the end of May. During summer (June to August), adults were found on fig mostly on lower sides of the leaves. Copulation was observed at the end of August and during September, first laid eggs were registered in September. Eggs were laid near leaf buds and in the folds of the bark in small groups.
Family: *Psyllidae* Löw, 1878

3) *Acizzia jamatonica* (Kuwayama, 1908)

- **Researched material:** Beograd – Bežanijsko groblje, 22.05.2010. (J, I, 10♀ 10♂), leg. D.Smiljanić; Lugavčina, 27.07.2010. (J. L, a large number of adults), leg. O. Petrović-Obradović; Šid, 15.08.2010. (J. L₁ - L₅, a large number of adults), leg. G. Prodanović; Vašica, 15.08.2010. (J. L), leg. G. Prodanović; Zemun – Banatska, 3.05.2010. (I, 2♀, 3♂) 01.07.2010. (J. L, a large number of adults), leg. D. Jerinić-Prodanović; 23.07.2010. (J. L₁ – L₅, a large number of adults), leg. D. Jerinić-Prodanović; Zemun – Naselja Nova Galenika, 10.08.2010. (J. L₁ – L₅, a large number of adults), leg. D. Jerinić-Prodanović.

*Acizzia jamatonica* is an East-Asian species, until 1980 known only in Japan. It was then registered in South Korea in 1983, in Taiwan in 1984 and in China in 1992 (Lauterer et al. 2011). In 2001 it was registered for the first time in Europe, in the North of Italy. After this record, it was registered in other European countries as well (France, Slovenia, Switzerland, Hungary, Bulgaria, Serbia, Greece, Slovakia) (Seljak, 2006; Šimala et al., 2006; Vétek Redei, 2009; Vétek et al., 2009; Mifsud et al., 2010). Since 2006, its presence has also been registered in Southeast part of the USA (Mifsud et al., 2010).
Young adults are light green (Fig. 5). Thorax with visible light brown stripes. Antennae, legs and wing nervature light brown. Older adults become darker. Summer generations of adults have this colour, while overwintering adults are light to dark brown with visible red eyes.

Eggs elongated, dark yellow to orange, with a tail-like appendage at one end, and at the other a stinger inserted into leaf tissue.

Larvae (L₁) are light yellow, almost transparent. The colour changes, so the larvae of the final stage (L₅) are light green with light brown antennae, rudiments of wings and legs. The apices of antennae and legs dark brown, eyes pink (Fig. 6).

*Acizzia jamatonica* is a monophagous species feeding exclusively on *Albizzia julibrissin* (Durazz), having become a popular decorative plant species in gardens and parks in Serbia.

The damage on plants is caused by larvae and adult specimens sap-sucking on leaves, flowers and young legumes. Stronger infestation leads to yellowing and premature leaf falling. They also cause secondary damages on infested plants, manifested as honeydew excretion and appearance of sooty mold on the excreted honeydew. Besides, larvae excrete large amounts of wax secretions, which altogether reduces decorative value of infested trees.

*Acizzia jamatonica* has more than two generations per year. Šimala et al. (2006) indicate that there are at least four overlapping generations at Croatian sea coast and Lauterer et al. (2011) indicated up to four generations in Slovakia and Greece. In our conditions, *A. jamatonica* overwinters in adult stage outside the host plant, on other plants (literature data indicate that it overwinters on conifers e.g. Lauterer et al., 2011). Adults fly on the host plant in March, where they copulate and lay eggs around buds (Lauterer et al., 2011.). Later they lay eggs along the leaf edges. During vegetation all stages of development are present. At the end of September and throughout October, overwintering adults are visible, staying on the plant, depending on the temperature, until the middle of November, and then leaving to other plants to overwinter.

4) *Cacopsylla (H.) pulchella* (Löw, 1877)

Researched material: Belgrade (ulica Đorđa Vajferta, 08.05.2010. (eggs, L₂ - L₅, a large number of adults), leg. D. Jerinić-Prodanović, 21.05.2010. (L₂, L₃, adults), leg. G. Prodanović, 18.06.2010. (last instar skin), leg. G. Prodanović; Botanicka basta garden, 11.05.2010. (eggs, L₂, L₃, L₄, L₅, a large number of adults), leg. D. Smiljanić; Kalemegdan, 11.05.2010. (eggs, L₂, L₃, L₄, L₅, a large number of adults), leg. D. Smiljanić, 07.06.2010.
(L₂ - L₅, a large number of adults), leg. D. Smiljanić; Novi Beograd (Univerzitetsko naselje), 27.05.2010. (L₂ - L₅, 1♀), leg. D. Jerinić-Prodanović, 04.06.2010. (L₃ - L₅), leg. D. Jerinić-Prodanović, 17.06.2010. (L₅, 1♂), leg. D. Jerinić-Prodanović, Zemun (Gradski park), 08.05.2010. (1♀, 1♂), leg. D. Jerinić-Prodanović.

*C. pulchella* is probably a Mediterranean species. It has been registered in Western Mediterranean (Italy, France, Greece) and Asia Minor, from where it has been introduced into other countries, such as: the Great Britain, Switzerland, Austria, Ukraine, Slovenia, Hungary (Klimaszewski, 1973; Halperin et al. 1982; Burckhardt and Mühlethaler, 2003; Seljak, 2006; Ripka, 2008). It is a monophagous species, feeding on Judas tree *Cercis siliquastrum* (Burckhardt, 1999). Judas tree (*Cercis siliquastrum*), originating from Western Mediterranean, is often grown as a decorative species in city parks (Šilić, 1990). In Serbia, *Cacopsylla pulchella* was determined for the first time on Judas tree (*C. siliquastrum*) in Belgrade area in 2010 (Jerinić-Prodanović, 2011b).

Adults of *C. pulchella* are green-brown. There are orange stripes on the thorax. Abdomen is dark brown and intersegmental membranes are red-orange. There are dark brown spots on forewings (Fig. 7). Larva of the final stage is light green with semitransparent wing rudiments (Fig. 8).

*C. pulchella*’s feeding and honeydew secretion are harmful. The attacked leaves become yellow and then necrotize (Rapisarda and Belcari, 1997). Besides honeydew, larvae also excrete wax secret in the form of fibres.

We have determined that it has one generation per year in Serbia and that it overwinters on other plants. Adults were determined in the first decade of April 2010 on *C. siliquastrum* and the first adults of new generation in the first decade of May. *Cercis siliquastrum* stays on host plant until the second half of June. Eggs are laid on the same place near leaf nerves. In the beginning, eggs have milky white colour and as they grow older, they become intensively yellow. After hatching, larvae are placed on the back of leaves. In Italy (Toscana), Rapisarda and Belcari (1997) found that *C. pulchella* can develop three generations per year, but Burckhardt (1999) found in Switzerland (Basel) that it has one generation per year. It overwinters as an adult on conifers (Burckhardt, 1999).

![Figure 7. Adult of *C. pulchella* (Orig.)](image1)

![Figure 8. Fifth instar larva of *C. pulchella* (Orig.)](image2)
Family: **Triozidae** Löw, 1878

5) **Trioza neglecta** Loginova, 1978


*Trioza neglecta* is originally from Southeast and Central Asia, but it was introduced into Europe (Loginova, 1978). Today it is distributed in Georgia, Armenia, Azerbaijan and Iran, expanding across Russia, Ukraine, Moldova, Bulgaria, Romania and parts of former Yugoslavia, together with host plant *Elaeagnus angustifolia* L., into the countries of Central Europe (Slovakia, the Czech Republic, Austria) (Lauterer and Malenovsky, 2002).

The adults of *T. neglecta* are light green. Antennae yellow-green, the last two segments black. Thoracic tergites with wide yellow to light brown stripes, abdomen with three black spots (Fig. 9). First-instar yellow, with colour changing to green-blue with silver reflection in the last stage of development (L₃). Wing rudiments whitish (Fig. 10).

In our conditions, *T. neglecta* has two generations per year. Lauterer and Malenovsky (2002) indicated that in the Czech Republic there are also two generations per year. The first generation is the least numerous and its adults appear in June and July, while the second generation is a little more numerous. Larvae can be found throughout September until the middle of November. During our investigations, we found a small number of adults in October, while in summer we also found larvae of lower stages of development (L₂). Lauterer and Malenovsky (2002) found overwintering adults on host plant in April, and therefore concluded it overwinters in adult stage.

**REFERENCES**


