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## NEW DATA ON THE WHITEFLIES (INSECTA: HEMIPTERA: ALEYRODIDAE) OF MONTENEGRO, INCLUDING THREE SPECIES NEW FOR THE COUNTRY

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### Abstract

Collection data on nine species of whitefly collected in the coastal and central regions of Montenegro during October 2012 are presented. Three species are recorded from Montenegro for the first time: *Aleuroclava aucubae* (Kuwana), *Aleurotuba jelinekii* (Frauenfeld) and *Bemisia afer* (Priesner & Hosny) complex. Two of the species, *A. aucubae* and *B. afer* complex were found in Tološi, on *Citrus* sp. and *Laurus nobilis*, respectively. *Aleurotuba jelinekii* was found in Podgorica on *Viburnum tinus*.

KEY WORDS: Whiteflies, Aleyrodidae, Montenegro

### Introduction

Whiteflies comprise a single family, Aleyrodidae, which currently contains 1556 extant species in 161 genera (Martin & Mound, 2007). Fifty-six species occur outdoors in Europe and the Mediterranean basin (Martin *et al.*, 2000). All whiteflies are phytophagous and have three developmental stages: egg, larval (with four larval instars) and adult. Many species are economically important plant pests of outdoor crops, ornamentals and indoor plantings. Feeding by immature whiteflies reduces plant vigor by depletion of plant sap, and foliage becomes contaminated with eliminated honeydew on which black sooty mold grows, thereby reducing the photosynthetic area and lowering the aesthetic appearance of ornamentals. Adults of a small number of species, most notably *Bemisia tabaci* (Gennadius), are important vectors of plant viruses (Jones, 2003). Three species of whitefly, *Aleurocanthus woglumi* Ashby, *A. spiniferus* (Quaintance) and *B. tabaci*, are regulated within the European Union.

The whiteflies of Montenegro appear to be largely unknown outside the country; for example, recent catalogues of world (Evans, 2008) and European fauna (Burckhardt, 2012) list no whitefly species for Montenegro. There are, however, a number of recent publications recording whiteflies from Montenegro, for example, *Aleurothrixus floccosus* (Maskell) by Radonjić & Hrnčić (2003), *Aleyrodes elevatus* Silvestri by Velimirović (1992), *Bemisia tabaci* (Gennadius) by Hrnčić *et al.* (2008, 2012), *Dialeurodes citri* (Ashmead) by Mijušković (1999), and *Trialeurodes vaporariorum* (Westwood) by Radonjić & Hrnčić (2011, 2012). Of the five countries/territories that border Montenegro, only Croatia has a recently published comprehensive checklist of whitefly fauna, listing 31 species (Šimala & Milek, 2008).

National checklists are essential as baseline data from which faunistic changes, due to factors such as international trade and climate change, can be monitored and accurately assessed. Exotic plant pests are regularly dispersed among countries as a consequence of trade, and whiteflies are one of the arthropod groups most commonly transported. They are also among the most successful groups of insects in terms of invading new geographical areas (Pellizzari & Dalla Monta, 1997; Misfud *et al.*, 2010; Malumphy & Badmin, 2012). Some species, such as *B. tabaci* and *T. vaporariorum*, have become cosmopolitan due to anthropogenic activities. Climate change will also influence the distribution of whiteflies in Europe and the Mediterranean, as species once restricted to more southerly latitudes are likely to expand their range northwards. Milder winters mean that winter mortality rates of some species will decrease and they may start breeding earlier in the year. Changes in regional faunas and phenology have implications for agricultural and horticultural industries, and for the environment.

The purpose of this communication is to present collection data on whiteflies found by the authors in coastal and central regions of Montenegro during October 2012, as part of an EU-funded Twinning Project aimed at strengthening the administrative capacity of the Phytosanitary Directorate of Montenegro; and to report the presence of three species from Montenegro for the first time.

## Materials and Methods

Visual inspections were made of fruit and vegetable crops, and of ornamental plants in urban parks and at a commercial nursery, in coastal and central regions of Montenegro between 1-5 October 2012. Samples were collected in 70% ethanol and puparia were slide-mounted following standard published methods (Martin, 1987) and identified using diagnostic keys, primarily provided by Martin *et al.* (2000), at the Food and Environment Research Agency (FERA), UK. The nomenclature used follows Martin & Mound (2007). Slide-mounted specimens have been deposited at FERA.

## Results

Twenty samples of whiteflies containing nine species assigned to seven genera were collected from seven localities in three municipalities. Three of the species, *Aleuroclava aucubae* Kuwana, *Aleurotuba jelinekii* (Frauenfeld) and *Bemisia afer* (Priesner & Hosny) complex, are reported from Montenegro for the first time.

*Aleuroclava aucubae* (Kuwana) – aucubae whitefly (Fig. 1)

This species is native to the East Palaearctic (Japan, Taiwan, and China) and has been introduced to the USA (California) (Evans, 2008), northern Italy in 2006 (Pellizzari & Šimala, 2007 – misidentified as *Aleuroclava guyavae* (Takahashi)) and Slovenia (Seljak, 2012). It is polyphagous and has been recorded

feeding on plants belonging to 15 families, including the economically important genera *Citrus* sp., *Ficus* sp., *Juglans* sp. and *Prunus* sp. However, it has not been recorded damaging cultivated plants (Pellizzari & Šimala, 2007).

Material examined: Podgorica Municipality: Tološi, nursery, sparse (1 or 2 puparia per leaf), on *Citrus* sp. produced in Montenegro, grown under protection (together with a heavy infestation of *Dialeurodes citri*), 3.x.2012.

#### *Aleurothrixus floccosus* (Maskell) – woolly whitefly (Fig. 2)

This species is native to the Neotropical region but is now found throughout the warmer parts of the world, wherever citrus is grown. It is restricted to indoor plantings in cooler regions, such as Northern Europe. It was recorded from Montenegro by Radonjić & Hrnčić (2003) and from Croatia by Šimala & Milek (2008). It is broadly polyphagous, feeding on 20+ plant families, and exhibits a strong preference for citrus. It is a serious pest of citrus in the Mediterranean and large populations have been observed in Bar Municipality, where it is spreading in a citrus orchard in Bar Polje.

Material examined: Bar Municipality: Bar Polje, abundant all stages, on *Citrus reticulata*, 1.x.2012.

#### *Aleurotuba jelinekii* (Frauenfeld) – viburnum whitefly (Fig. 3)

This species is native to the Mediterranean and has been introduced to the USA. It is one of the most common whiteflies found across Europe (Martin *et al.*, 2000). It was recorded from Croatia by Šimala & Milek (2008), and from the former Yugoslavia by Evans (2008). It is mainly restricted to *Viburnum tinus* but has also been recorded on *Arbutus unedo*, *Arctostaphylos* sp., *Myrtus communis* and *Viburnum* spp.

Material examined: Podgorica Municipality: Podgorica – Preko Morače, abundant immatures on *Viburnum tinus*, 3.x.2012.

#### *Bemisia afer* (Priesner & Hosny) complex (Fig. 4)

*Bemisia afer sens. lat.* appears to be an assemblage of taxa that display pronounced phenotypic variation, most notably in the lengths of dorsal setae and the development of dorsal sculpturing that varies from granular elevations to star-shaped tubercles (Gill & Brown, 2012; Hernandez-Suarez *et al.*, 2012). The puparia of *B. afer* most commonly found in the Mediterranean region, particularly on plants with smooth leaves, exhibit relatively little variation compared to *B. afer* puparia observed from the Canary Islands and sub-Saharan Africa. The *Bemisia afer* complex occurs throughout the warmer parts of the world and is found outdoors as far north as the north of England (Malumphy, 2003). It was recorded from Croatia by Šimala & Milek (2008). It is highly polyphagous, feeding on plants belonging to 50+ families (Evans, 2008; Hernandez-Suarez *et al.*, 2012).

Material examined: Podgorica Municipality: Tološi, nursery, abundant, on *Laurus nobilis* produced in Montenegro, grown under protection (together with *Trialeurodes lauri*), 3.x.2012.

#### *Bemisia tabaci* (Gennadius) complex – tobacco whitefly (Fig. 5)

*Bemisia tabaci sens. lat.* appears to be an assemblage of taxa that displays pronounced phenotypic variation, in a manner similar to that of the *B. afer* complex. There is increasing biological and molecular evidence to support the hypothesis that *B. tabaci* is a complex of cryptic species, and according to De Barro *et al.* (2011), there are at least 24 morphocryptic species that are only distinguishable at the molecular level. The *Bemisia tabaci* complex may be native to India, but the evidence is inconclusive and it is now cosmopolitan. It was recorded from Montenegro by Hrnčić *et al.* (2008, 2012), Bosnia and Herzegovina by Ostojčić *et al.* (2010),

and Croatia by Šimala & Milek (2008). It is broadly polyphagous, feeding on plants belonging to 80+ plant families. It is the vector of more than 100 plant viruses (Jones, 2003) and is the most economically important whitefly pest in most parts of the world.

Material examined: Bar Municipality: Bar, Secondary Agricultural School greenhouses, several adults on *Cucurbita* sp. and unidentified herbaceous weeds, 1.x.2012; Budva Municipality: Lastva Grbaljska, abundant, all stages, but mostly adults, on *Solanum melongena*, 2.x.2012; Podgorica Municipality: Podgorica, Park Petrovića, adults and nymphs on herbaceous weeds, 5.x.2012; Sastavci, 6 pupal cases on *Sonchus oleracea*, 5.x.2012; Tološi, nursery, adults on *Paulownia* sp., moderate infestation of adults and immatures on *Hibiscus* sp., 3.x.2012.

#### *Dialeurodes citri* (Ashmead) – citrus whitefly (Figs 6-7)

*Dialeurodes citri* is native to Asia but is now found throughout the warmer parts of the world (IIE, 1996). It was recorded from Montenegro by Mijušković (1999) and from Croatia by Šimala & Milek (2008). It is broadly polyphagous, feeding on plants belonging to 30+ families, with a strong preference for citrus (Martin *et al.*, 2000; Misfud *et al.*, 2010). It is an economic pest of citrus in parts of the Mediterranean.

Material examined: Bar Municipality: Bar, Center of Subtropical Cultures, sparse, adults on *Citrus* sp., 1.x.2012; Podgorica Municipality: Tološi, nursery, massive populations causing considerable chlorosis and leaf distortion on *Citrus* sp. (together with *A. aucubae*) and *Gardenia* sp. produced in Montenegro, grown under protection, and a large population on *Viburnum* sp. plants, growing outdoors, 3.x.2012.

#### *Siphoninus phillyreae* (Haliday) – ash whitefly (Fig. 8)

This species is native to the Mediterranean region (Martin *et al.*, 2000) and has been introduced to Macaronesia, Africa, the Middle East, Asia, Pacific region, North America and South America. It was recorded from Montenegro by Škaljac *et al.* (2013), from Croatia by Šimala & Milek (2008), and from the former Yugoslavia by Mikloš (1987). It is polyphagous, feeding on 12+ families, with a preference for Oleaceae, Punicaceae and Rosaceae. It is an infrequent agricultural pest in the Mediterranean region on apple, olive, and pear, including Croatia (Žanić *et al.*, 2007). In Egypt, it is the most important pest of pomegranate, and has proved to be an important pest of ash, olive, pear, pomegranate and woody ornamental plants in many areas where it has been introduced (Malumphy, 2010). It is locally common on ash in North America, and frequent on ash in southern England, yet it was not found on *Fraxinus* sp. in Montenegro despite many trees being examined.

Material examined: Bar Municipality: Bar, Secondary Agricultural School greenhouses, abundant but patchy, on *Punica granatum*, 1.x.2012; Podgorica Municipality: Lješopolje, adults on *Pyrus communis*, 3.x.2012.

#### *Trialeurodes lauri* (Signoret) (Fig. 9)

This species occurs widely in the Mediterranean, and has been recorded from Croatia by Šimala & Milek (2008), and from the former Yugoslavia by Evans (2008). It has been observed in Montenegro for many years, although there appear to be no published records of its presence in the country. It develops on *Laurus nobilis* and less frequently on *Arbutus andrachne*, *A. unedo* (Martin *et al.*, 2000) and *Myrtus communis* (Malumphy *et al.*, 2007).

Material examined: Podgorica Municipality: Podgorica, Bulevar Revolucije, abundant on *Laurus nobilis*, 3.x.2012; Tološi, nursery, abundant on *L. nobilis* (together with *B. afer*), 3.x.2012.

*Trialeurodes vaporariorum* (Westwood) – glasshouse whitefly (Fig. 10)

This species is native to North America but is now cosmopolitan. It was recorded from Montenegro by Radonjić & Hrnčić (2011, 2012), Albania by Balliu & Cota (2007), Bosnia-Herzegovina by Kohnić *et al.* (2006), Croatia by Šimala & Milek (2008) and Serbia by Perić *et al.* (2009). It is one of the most polyphagous of all whitefly species and a vector of plant pathogenic viruses (Jones, 2003).

Material examined: Bar Municipality: Bar, 3 adults on *Sonchus oleracea*, 1.x.2012; Podgorica Municipality: Tološi, nursery, adults, eggs and first instars on *S. oleracea*, 3.x.2012.

## Discussion

Nine species were detected in 20 samples of whiteflies collected over five days in Montenegro in October 2012. Three species are recorded for the first time from Montenegro: *Aleuroclava aucubae*, *Aleurotuba jelinekii* and the *Bemisia afer* complex. Approximately 40% of the species collected are non-native introductions, although this is likely due to mainly non-native plants being examined. It is most probable that recent introductions of non-native whiteflies into Montenegro (such as *A. aucubae*, *Aleurothrixus floccosus* and *A. jelinekii*) have been through the trade of ornamental plants, which are in continuous demand for private gardens and landscaping for tourist developments. There are many other whitefly species present in neighboring countries, such as Croatia (Šimala & Milek, 2008), that have not yet been recorded from Montenegro, and collecting whiteflies in Montenegro's large karst region is likely to reveal the presence of many more native species.

Two whitefly species were found at very high densities: *Aleurothrixus floccosus* on *Citrus reticulata* in Bar Polje and *Dialeurodes citri* on *Citrus* sp., *Gardenia* sp. and *Viburnum* sp. in Tološi. However, the whitefly species that has the greatest potential for economic impact on agricultural and horticultural industries is the *Bemisia tabaci* complex, as it is a vector of a large number of plant pathogenic viruses. The *Bemisia tabaci* complex was found in three municipalities, on field crops, protected ornamentals and on herbaceous weeds growing in urban parks.

Two of the most interesting finds were *Aleuroclava aucubae* and the *Bemisia afer* complex. These whiteflies were only detected when citrus and bay laurel leaves were examined in the laboratory. The puparia of *A. aucubae* are black and relatively conspicuous, but they were overlooked in the field as they occurred at low densities and were hidden amongst a huge number of *Dialeurodes citri* puparia on citrus leaves. In a similar way, the *B. afer* complex specimens were overlooked as they occurred together with the much more common *Trialeurodes lauri* on bay laurel leaves. *Aleuroclava aucubae* is polyphagous, and in Europe it is only known from northern Italy and Slovenia. The *Bemisia afer* complex occurs widely in the Mediterranean, and is mostly restricted to plants with smooth leaves. However, neither *A. aucubae* nor the *B. afer* complex are likely to have a significant impact on cultivated plants in Montenegro.

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Figure 1. *Aleuroclava aucubae* puparium.



Figure 2. *Aleurothrixus floccosus* puparia.



Figure 3. *Aleurotuba jelinekii* puparia.



Figure 4. *Bemisia afer* puparia.



Figure 5. *Bemisia tabaci* puparia.



Figure 6. *Dialeurodes citri* puparia.





Figure 7. *Dialeurodes citri* adults.



Figure 8. *Siphoninus phillyreae* puparia.



Figure 9. *Trialeurodes lauri* puparium.



Figure 10. *Trialeurodes vaporariorum* puparium.

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НОВИ ПОДАЦИ О ЛЕПТИРАСТИМ ВАШИМА  
(INSECTA: HEMIPTERA: ALEYRODIDAE) У ЦРНОЈ ГОРИ,  
УКЉУЧУЈУЋИ НАЛАЗ ТРИ НОВЕ ВРСТЕ

CHRIS MALUMPHY, САЊА РАДОЊИЋ, СЊЕЖАНА ХРНЧИЋ И МИЛОРАД РАИЧЕВИЋ

Извод

У раду су представљени резултати налаза девет врста лептирастих ваши које су сакупљене у централном и приморском дијелу Црне Горе током октобра 2012. Три врсте су утврђене по први пут: *Aleuroclava aucubae* (Kuwana); *Aleurotuba jelinekii* (Frauenfeld) и комплекс *Bemisia afer* (Priesner & Hosny). Двије врсте, *A. aucubae* и комплекс *B. afer*, нађене су у Толошима-Подгорица на цитрусима (*Citrus* sp.) и ловору (*Laurus nobilis*). *A. jelinekii* је утврђена у Подгорици на *Viburnum tinus*.

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