Zeitschrift: Mitteilungen der Schweizerischen Entomologischen Gesellschaft = Bulletin de la Société Entomologique Suisse = Journal of the Swiss Entomological Society

Herausgeber: Schweizerische Entomologische Gesellschaft

Band: 82 (2009)

Heft: 3-4

Artikel: Taxonomy of psyllids (Hemiptera, Psylloidea) associated with apple and stone fruits in Central and Southern Europe

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DOI: https://doi.org/10.5169/seals-402993

MITTEILUNGEN DER SCHWEIZERISCHEN ENTOMOLOGISCHEN GESELLSCHAFT
BULLETIN DE LA SOCIÉTÉ ENTOMOLOGIQUE SUISSE
82: 253–257, 2009

Taxonomy of psyllids (Hemiptera, Psylloidea) associated with apple and stone fruits in Central and Southern Europe

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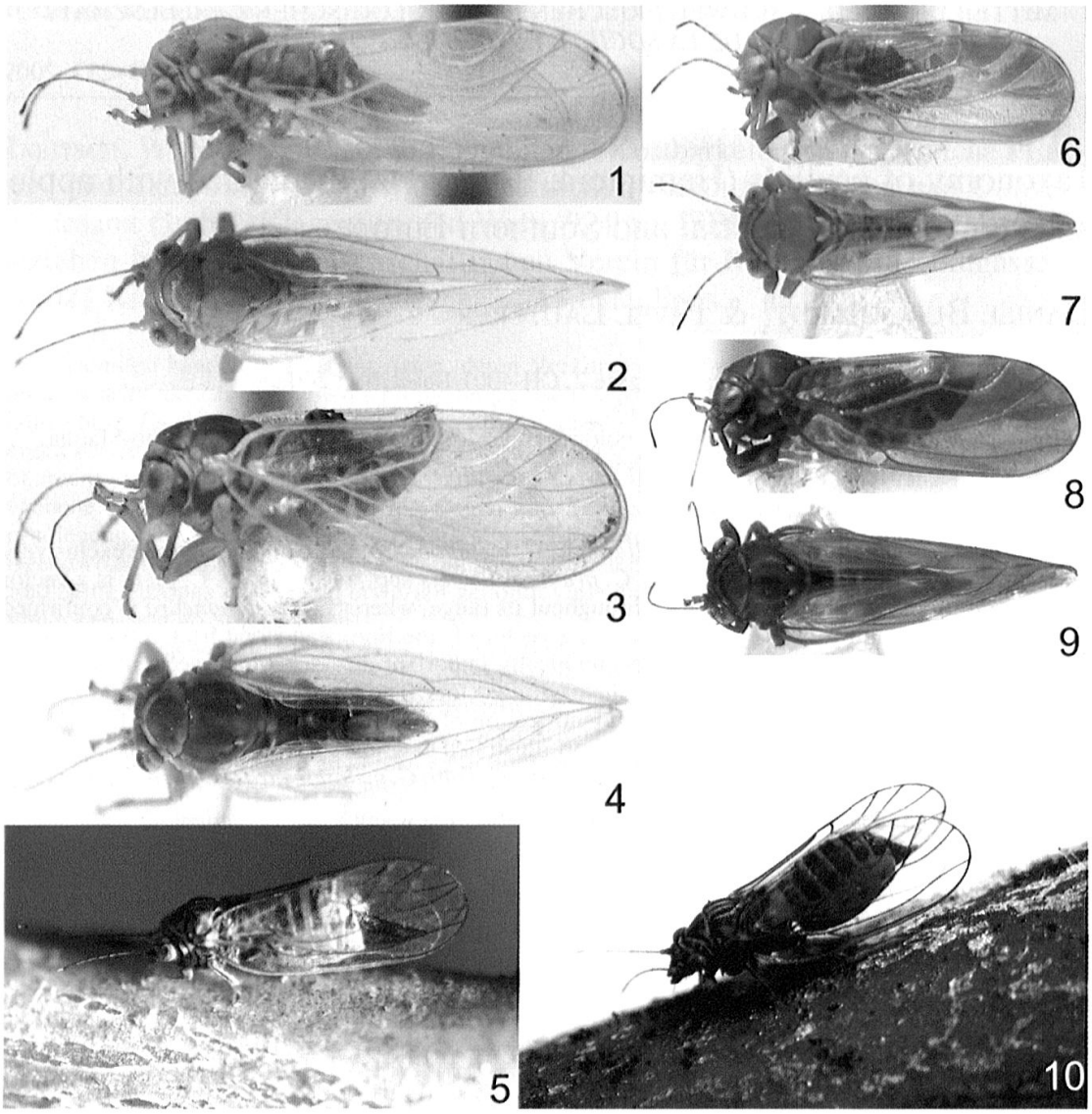
In Central and Southern Europe *Cacopsylla mali*, *C. melanoneura* and *C. picta* develop exclusively or occasionally on apple, *Malus* spp., and *C. pruni* on *Prunus* spp., respectively. *C. picta* is a vector of apple proliferation phytoplasma (AP) throughout its range, whereas *C. melanoneura* is confirmed as vector of AP only for NW Italy. *C. pruni* is a vector of the European stone fruit yellows phytoplasma (ESFY). AP and ESFY are both economically important diseases which necessitate control measures which is best done by managing the psyllid vectors. The monitoring of the psyllid populations in the orchards necessitates a correct identification of the vectors which can be difficult for a non-specialist. As a help for the practitioner short illustrated diagnoses are provided for the European psyllid species associated with apple and *Prunus* spp.: *C. mali*, *C. melanoneura*, *C. picta* and *C. pruni*.

Keywords: *Cacopsylla mali*, *Cacopsylla melanoneura*, *Cacopsylla picta*, *Cacopsylla pruni*, *Malus*, *Prunus*, phytoplasma, apple proliferation, European stone fruit yellows, Europe, identification.

INTRODUCTION

Phytoplasmas are responsible for big economic losses in the plant growing industry worldwide (Lee *et al.* 2000). In Central and Southern Europe the phytoplasma '*Candidatus* Phytoplasma mali' is the causal agent of apple proliferation (AP) and '*Candidatus* Phytoplasma prunorum' of European stone fruit yellows (ESFY), respectively (Seemüller & Schneider 2004). Psyllids of the genus *Cacopsylla* are known vectors of these causal agents (or phytoplasmas). AP is transmitted in Central Europe by *C. picta* and in Italy by *C. picta* and *C. melanoneura* (Frisinghelli *et al.* 2000, Tedeschi *et al.* 2002). The vector of ESFY is *C. pruni* (Carraro *et al.* 1998).

As phytoplasmas are difficult to control, the management of their vectors by monitoring the vector populations is generally one of the strategies applied in commercial orchards. This necessitates a correct identification of the vector species which can be difficult for a non-specialist. Burckhardt (2007) designed an electronic key which is focused on the Central European *Cacopsylla* spp. developing on Rosaceae. Jarausch *et al.* (2009) showed that in regular collections in apple orchards three species were particularly abundant: *C. mali*, *C. melanoneura* and *C. picta*. All three develop exclusively or occasionally on apple. Similarly *C. pruni* was, by far, the most abundant species on *Prunus* spp. Here we provide short illustrated diagnoses of the adults of the four species associated with apple and *Prunus* spp. intended for the practitioner. In particular we describe the variation of coloration found in young and mature specimens.



Figs 1–10. *Cacopsylla* spp. associated with apple and *Prunus* spp., adult habitus. 1, 3, 5, 6, 8, 10, Lateral view; 2, 4, 7, 9, dorsal view. — 1–4. *C. mali*: 1, 2. summer coloration; 3, 4. autumn coloration. — 5. *C. melanoneura*; overwintered coloration. — 6–9. *C. pruni*: 6, 7. summer coloration. 8, 9. overwintered coloration. — 10. *C. picta*, overwintered coloration. Photos 1–4, 6–10 by L. Dembický; 5 by D. Burckhardt.

MATERIAL AND METHODS

The morphological terminology follows Ossiannilsson (1992). The habitus photographs were taken from dry mounted or live specimens. The drawings and photographs of morphological structures were prepared from slide mounted material.

DIAGNOSES

The four Central European species associated with apple and *Prunus* spp., viz. *Cacopsylla mali*, *C. melanoneura*, *C. picta* and *C. pruni*, can be identified with the printed key by Ossiannilsson (1992) or the electronic key by Burckhardt (2007). Here we provide illustrated diagnoses for the four species which should help the practitioner to recognise the species.

Cacopsylla mali (Schmidberger)

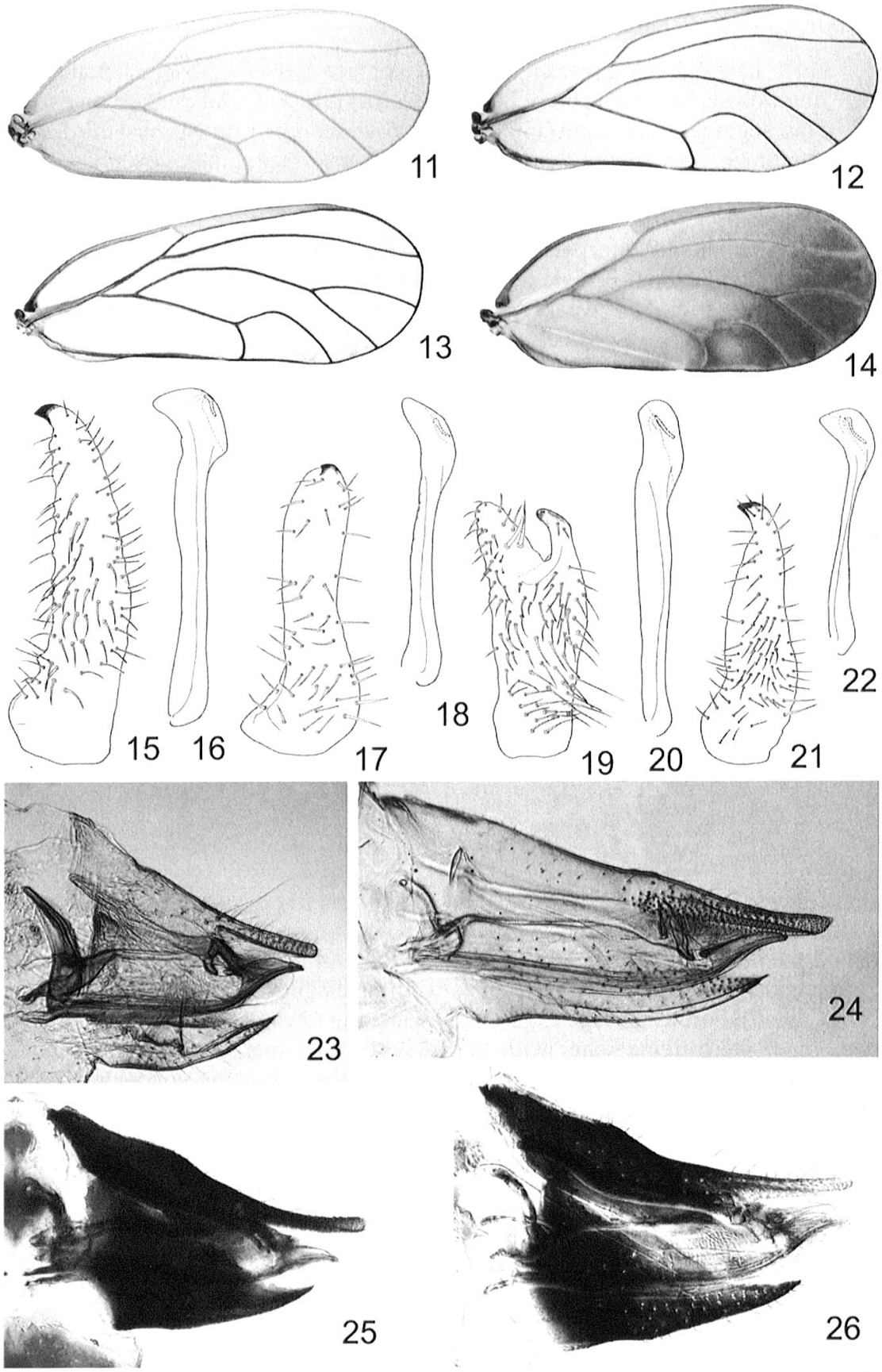
Body light green (Figs 1, 2), only in September–November some females and rarely males with the dorsal part of body brownish (Figs 3, 4). Antenna green except for the last segments. Forewing (Fig. 11) weakly widening towards apical third, with light membrane; pterostigma short, evenly tapering; surface spinules evenly spaced, forming regular squares, veins concolorous with membrane. Paramere (Fig. 15) lamellar, evenly tapering to apex which forms a single tooth-like sclerotised process, which is curved anteriad. Distal segment of aedeagus (Fig. 16) with hook-shaped apical dilatation. Female terminalia (Fig. 23) short, cuneiform; dorsal margin of proctiger straight or weakly concave, apex blunt; ventral margin of subgenital plate strongly curved. Eggs clear to greyish, laid singly on 1–2 year old branches on wrinkled bark and around buds during late summer and autumn.

Cacopsylla melanoneura (Foerster)

Body after last moult green with brownish portions, a few days later becoming red brown, during overwintering changing to dark brown or almost black; intersegmental membranes reddish (Fig. 5). Antenna brown. Forewing (Fig. 12) strongly widening towards apical fifth, with light membrane; pterostigma long, with partly subparallel margins; surface spinules evenly spaced, forming regular squares. Veins light brown, after overwintering dark brown to black. Paramere (Fig. 17) lamellar, narrowed in the middle, slightly widening subapically; apex forms a single tooth-like sclerotised process, which is curved anteriad. Distal segment of aedeagus (Fig. 18) with oblique lense-shaped apical dilatation. Female terminalia (Fig. 24) long; dorsal margin of proctiger weakly undulating, apex obliquely truncate; ventral margin of subgenital plate weakly sinuous. Eggs orange, laid in clusters on lower leaf surface.

Cacopsylla picta (Foerster)

Body after last moult remaining green up to the last days of overwintering on conifers, during remigration changing to dark brown or black (Fig. 10); intersegmental membranes greenish in males and reddish in females. Antennal segments conspicuously hooped with black apically (best diagnostic character to separate from *C. mali*). Forewing (Fig. 13) strongly widening towards apical fifth, with light membrane; pterostigma long, with partly subparallel margins; surface spinules evenly spaced, forming regular squares, veins at the beginning concolorous with membrane, during overwintering changing to black. Paramere very characteristic (Fig. 19), broadly lamellar, with anterior blunt lobe and posterior process which forms a tooth-like sclerotised structure, which is curved anteriad. Distal segment of aedeagus (Fig. 20) with oval apical dilatation. Female terminalia (Fig. 25) moderately long, cuneiform; dorsal margin of proctiger concave, apical part forming narrow process, apex subacute; ventral margin of subgenital plate weakly curved. Eggs translucent, light, laid singly on lower leaf surface, hardly visible under leaf trichomes.



Figs 11–26. *Cacopsylla* spp. associated with apple and *Prunus* spp. 11–14. Forewing; 15, 17, 19, 21. paramere, inner face; 16, 18, 20, 22. distal portion of aedeagus; 23–26. female terminalia, in profile. — 11, 15, 16, 23. *C. mali*. — 12, 17, 18, 24. *C. melanoneura*. — 13, 19, 20, 25. *C. picta*. — 14, 21, 22, 26. *C. pruni*.

Cacopsylla pruni (Scopoli)

Body after last moult green for some hours, then quickly becoming red brown (Figs 6, 7), during overwintering changing to dark brown (Figs 8, 9); forewing brown at apex at first, then becoming completely brown, during winter changing to dark brown or sometimes almost black. Forewing (Fig. 14) weakly widening towards apical third, with dark membrane; pterostigma long, with partly subparallel margins; surface spinules densely and irregularly spaced, veins concolorous with membrane. Paramere (Fig. 21) lamellar, evenly tapering to apex which forms a single tooth-like sclerotised process, which is curved anteriad. Distal segment of aedeagus (Fig. 22) with hook-shaped apical dilatation. Female terminalia (Fig. 26) moderately long, cuneiform; dorsal margin of proctiger concave, apical part forming narrow process, apex subacute; ventral margin of subgenital plate weakly curved. Eggs translucent to orange, laid singly or in small clusters mostly on basal part of leaves near leaf veins.

The body size of adults of the four species ranges from 2.5–3.7 mm.

ACKNOWLEDGMENTS

We thank L. Dembický (Brno) for the photographs as well as I. Malenovský (Brno) and G. Seljak (Nova Gorica) for critical comments on previous versions of the manuscript.

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(received November 9, 2001; accepted November 18, 2009)