

**THE MEALY PLUM APHID AND ITS CONGENERS: A SYNONYMIC
REVISION OF THE *PRUNUS*-INFESTING APHID GENUS *HYALOPTERUS*
(HEMIPTERA: APHIDIDAE)**

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Abstract.—The three species of *Hyalopterus* Koch cause economic damage to various stone fruit trees of the genus *Prunus* L., *H. pruni* (Geoffroy), *H. amygdali* (Blanchard), and *H. persikonus* Miller et al. Although the third species was established recently, it has been suggested that one of the twelve older synonyms of the first two may be applicable to the third. We undertook a synonymic revision of the nominal species of *Hyalopterus* to clarify the taxonomy and nomenclature of the genus. The three valid species of *Hyalopterus* are affirmed to be *H. pruni* (the mealy plum aphid), *H. amygdali*, and *H. arundiniformis* Ghulamullah, stat. nov. We determined that *H. mimulus* Börner and *H. persikonus* are junior synonyms of *H. arundiniformis*, syn. nov., and that *Brachysiphum kobachidzei* Rusanova is not a synonym of *H. amygdali* but a valid species of *Aphis*, stat. nov., comb. nov. *Aphis amygdalipersicae* Mosley is likely a senior synonym of *Brachycaudus helichrysi* (Kaltenbach), syn. nov.; to maintain current usage, we establish the former as a *nomen oblitum* with respect to the latter. Finally, several other nominal species were un-evaluable and are therefore listed as *nomina dubia*.

Key Words: almond, apricot, nomenclature, peach, plum

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Species of the aphid genus *Hyalopterus* (Koch 1854) are important pests of stone fruits of the genus *Prunus* L., including especially almond, apricot, peach, and plum (including prunes), with respective

market values in the United States in 2014 of 6.4 billion, and 53, 629.1, and 332.2 million dollars (Agricultural Marketing Resource Center 2017). *Hyalopterus* species are known to alternate between

Prunus and *Phragmites* Adans. (Blackman and Eastop 2000). The genus name *Hyalopterus* was once used to refer to a number of aphid species with short cornicles in the subfamily Aphidinae, including several currently placed elsewhere, e.g., *Aphis hyperici* Monell, *Coloradoa abrotani* (Koch), *Hayhurstia atriplicis* (Linnaeus), *Hyadaphis albus* (Monzen), *Longicaudus trirhodus* (Walker), and *Semiaphis sphondylii* (Koch) (Favret 2017). Due to their economically-important status, *Hyalopterus* species have attracted a lot of attention and various authors have established nominal species based on relatively minor differences. Valid *Hyalopterus* species have thus accumulated many synonyms. As of the last published aphid catalog, there were 12 names associated with two valid species, *H. amygdali* (Blanchard 1840), and *H. pruni* (Geoffroy 1762) (Remaudière and Remaudière 1997). However, a number of authors have provided morphological and molecular evidence of a third species of *Hyalopterus* (Spampinato et al. 1988; Mosco et al. 1997; Lozier et al. 2007, 2008; Poullos et al. 2007), this third species having been given the name *H. persikonus* Miller et al. in Lozier et al. 2008. Although the evidence for the validity of three species of *Hyalopterus* is strong, previous studies did not evaluate the possible validity of the many synonyms and it does not appear that the type material of these nominal species was examined. Blackman and Eastop (2011) suggested that an older name may have priority over *H. persikonus*. To establish the validity of the three species in question and assign them their correct names, we undertook a taxonomic and nomenclatural study of the nominal species of *Hyalopterus*.

MATERIALS AND METHODS

We evaluated the status and validity of the fifteen nominal species of *Hyalopterus* listed by Remaudière and Remaudière (1997) and Lozier et al. (2008). Study consisted primarily in reviewing the historical literature, especially original descriptions, and the examination of the primary types of nominal species, when available. Particular attention was paid to the possible synonyms of *H. persikonus*; type specimens were identified using the keys to the species of *Hyalopterus* published by Lozier et al. (2008) and Rakauskas et al. (2013). Literature and type material are listed with each nominal species, below.

RESULTS

Aphis amygdali Blanchard 1840: 206

Primary type information.—Host, *Prunus persica* (L.) Batsch; Locality, near Paris, France; Specimen(s), presumed lost or non-existent.

Comments.—Despite its specific epithet, this species was first described from peach with no explicit indication of how it differed from the only other nominal species described at that time, *H. pruni*. Boisduval (1867) associated *A. amygdali* with almond (*Prunus dulcis* (Mill.) D.A. Webb (= *P. amygdalus* Batsch)). Börner (1952) treated *H. pruni* and *H. amygdali* side by side, listing many synonyms of each, and no study has ever suggested these two should themselves be considered synonyms. We thus treat *H. amygdali* as one of the three valid species of *Hyalopterus*. Our modern concept of the species has evolved and become refined over time, more by taxonomic tradition than by specific reference to Blanchard's (1840) description. Several recent descriptions and diagnoses are available (Nieto

Nafria et al. 2005, Lozier et al. 2008, Rakauskas et al. 2013).

Conclusion.—Valid as *Hyalopterus amygdali* (Blanchard).

Aphis amygdalipersicae Mosley
1841: 684

Primary type information.—Host, *Prunus persica* (L.) Batsch; Locality, Britain; Specimen(s), presumed lost or non-existent.

Comments.—Mosley (1841) described this species briefly: “body light green; eyes deep crimson; antennae long; legs and tubercles, which are very short, of an amber color.” He did not mention the presence of wax, a significant oversight, and the cornicle color (tubercles) does not match that of *Hyalopterus*. We therefore suspect his species may not be *Hyalopterus* at all, but more likely a synonym of the polyphagous species *Brachycaudus helichrysi* (Kaltenbach 1843). The Mosley species has nomenclatural priority over that of Kaltenbach. The less-than-certain synonymy and the long-standing use of the name *B. helichrysi* argue against establishing a straight-forward synonymy. We therefore here consider *A. amygdalipersicae* a *nomen dubium* and furthermore establish it, per ICZN Article 23.9 (International Commission on Zoological Nomenclature (ICZN) 1999), as a *nomen oblitum* with respect to *B. helichrysi*. *Aphis amygdalipersicae* has not been used as a valid name after 1899, whereas *B. helichrysi* has been used as valid at least 25 times by at least 10 authors in the last 50 years, over a span of more than 10 years (Smith and Cermeli 1979; Raychaudhuri et al. 1980, 1981; Remaudière 1983; Harrington 1985; Sorin 1992; Verma and Das 1992; Blackman and Eastop 1994, 2000, 2006; Aldryhim and Khalil

1996; Remaudière and Remaudière 1997; Ortego 1998; Halbert et al. 2000; Remaudière and Talhouk 2001; Noordam 2004; Sorin and Arakawa 2005; Pérez Hidalgo et al. 2009; Favret et al. 2010; Adachi 2012; Buga and Stekolshchikov 2012; Piffaretti et al. 2012; 2013; Zamora Mejías et al. 2012; Miller et al. 2016).

Conclusion.—*Nomen dubium*. Senior synonym of *Brachycaudus helichrysi* (Kaltenbach 1843), **syn. nov.** *Nomen oblitum* with respect to *B. helichrysi*; *B. helichrysi* a *nomen protectum* with respect to *A. amygdalipersicae*.

Aphis arundinis Fabricius 1775: 734

Primary type information.—Host, *Calamagrostis epigeois* (L.) Roth; Locality, Europe; Specimen(s), non-existent.

Comments.—The original morphological description of this nominal species is too brief to clearly place it in any specific taxon. However, Fabricius (1775) named “*Arundinis epigeois*” as the host, today’s *Calamagrostis epigeois* (L.) Roth. This plant species is not a host of *Hyalopterus*, hence the placement of *A. arundinis* as a synonym of *Diuraphis calamagrostis* (Ossiannilsson 1959) by Eastop and Hille Ris Lambers (1976). Kaltenbach (1843), Koch (1854), Buckton (1879), Del Guercio (1900), and Patch (1914) essentially stated that *A. arundinis* is closely related to but distinct from *H. pruni*, and Theobald (1927) went one step further treating *H. arundinis* and *H. pruni* as synonyms. However, the Fabricius (1775) description places it outside the scope of *Hyalopterus*. Given the confused history of the name, we do not attempt to place *A. arundinis* definitively, nor do we attempt to rectify its nomenclatural priority over *D. calamagrostis*.

Conclusion.—Not *Hyalopterus*, *nomen dubium*.

Aphis gracilis Walker 1852: 1040

Primary type information.—Host, *Salix* L.; Locality, Britain; Specimen, dry alata, at the Natural History Museum, London (Doncaster 1961).

Comments.—The lone alate specimen of this nominal species was collected on willow, a spurious host association. Doncaster (1961) listed it as a synonym of *H. pruni*, although given that it is an alate, that its host association is unestablished, and that the dry specimen prevents adequate microscopic examination, we are unable to place it in any of the known species of *Hyalopterus*.

Conclusion.—*Nomen dubium*.

Aphis persicariae Hartig 1841: 370

Primary type information.—Host, *Prunus armeniaca* L., *P. domestica* L., and *P. persica* (L.) Batsch; Locality, Germany; Specimen(s), presumed lost or non-existent.

Comments.—Hartig's (1841) description is probably of a *Hyalopterus*, but it does not permit us to distinguish which of the three species he was describing. In fact, he lists apricot, peach, and plum as hosts, suggesting that he was probably dealing with more than one species. Given the lack of primary type specimens, we are unable to evaluate the validity of this name.

Conclusion.—*Nomen dubium*.

Aphis phragmitidicola Oestlund
1886: 44

Primary type information.—Host, *Phragmites* Adans.; Locality, near Minneapolis, Minnesota, USA; Specimens, 10 on a single slide, at the University of Minnesota (Cook 1982).

Comments.—Both *H. pruni* and *H. amygdali* are known from North America (Footitt et al. 2006), whereas the third species is not (Lozier et al. 2008).

With clearing and remounting, the type specimens of Oestlund's (1886) nominal species may be assignable to one of the species in North America, but in either case *A. phragmitidicola* would be a junior synonym.

Conclusion.—*Nomen dubium*.

Aphis pruni Geoffroy 1762: 497

Primary type information.—Host, *Prunus domestica* L.; Locality, France; Specimen(s), presumed lost or non-existent.

Comments.—Although Geoffroy's (1762) work is rejected for the purposes of nomenclature (Hemming 1954), an exception was made for the validation of *Hyalopterus pruni* (Geoffroy) (Hemming 1956). Geoffroy references Réaumur (1737) in his description, who in turn cites the species as infesting the plum, *Prunus domestica*. Types are unavailable for this species but it is the most well-established of the *Hyalopterus* names and surely the mealy plum aphid is the most studied. A fair amount of literature cites Fabricius (1775) as the author of *H. pruni* (Favret 2017), but as Fabricius explicitly cites Geoffroy (1762), the Fabricius attribution is simply an error propagated in the literature. We consider *H. pruni* one of the three valid species of *Hyalopterus*, but it should be noted that there is no way to definitively validate the modern concept of the species with that of Geoffroy (1762) or Réaumur (1737), who very likely were referencing two or all three species in their publications. Our modern taxon concept of *H. pruni* has developed over time and by taxonomic tradition. Several recent descriptions and diagnoses are available (Nieto Nafria et al. 2005, Lozier et al. 2008, Rakauskas et al. 2013).

Conclusion.—Valid as *Hyalopterus pruni* (Geoffroy).

Aphis prunicerasi Stewart 1802: 110

Primary type information.—Host, *Prunus avium* L.; Locality, Europe; Specimen(s), non-existent.

Comments.—The name is presented without description.

Conclusion.—*Nomen nudum*.

Aphis spinarum Hartig 1841: 370

Primary type information.—Host, *Prunus spinosa* L.; Locality, Germany; Specimen(s), presumed lost or non-existent.

Comments.—*Prunus spinosa*, blackthorn, is a species distributed over most of Europe. *Hyalopterus pruni* is the only species of the genus recorded from this host (Lozier et al. 2008, Holman 2009).

Conclusion.—Junior synonym of *H. pruni* (Geoffroy).

Brachysiphum kobachidzei Rusanova 1941: 228

Primary type information.—Host, *Typha angustifolia* L.; Locality, Azerbaidjan; Specimens, 3 apterae, one ovipara, one nymph, at the Zoological Institute, Russian Academy of Sciences, St. Petersburg.

Comments.—The type specimens, with seventh abdominal marginal tubercles below the level of the spiracles, are those of an *Aphis*. In having much shorter cornicles, however, they do not match those of the other *Typha*-feeding *Aphis*, *A. typhae* Mamontova.

Conclusion.—Made valid and transferred to *Aphis*, *A. kobachidzei* (Rusanova) **stat. nov.**, **comb. nov.**

Hyalopterus abietinus Matsumura 1917: 358, 391

Primary type information.—Host, *Abies* Mill.; Locality, Sapporo, Hokkaido, Japan; Specimen(s), lost or non-existent, confirmed absent from the Hokkaido

University insect collection where Matsumura's types are deposited.

Comments.—The lack of specimens and the spurious host plant prevents us from properly evaluating this nominal species.

Conclusion.—*Nomen dubium*.

Hyalopterus arundiniformis Ghulamullah 1942: 226

Primary type information.—Host, *Prunus armeniaca* L.; Locality, Kabul, Afghanistan; Specimen, alata, at the Indian Agricultural Research Institute, Pusa Campus, New Delhi.

Comments.—The holotype (alata) and a paratype (aptera) were examined. The original description lists *Prunus armeniaca*, *P. domestica*, and *P. persica* as hosts, but the holotype itself is labeled with “apricot” (*P. armeniaca*). We identified the aptera using the dichotomous keys published by Lozier et al. (2008) and Rakauskas et al. (2013). One couplet in the Rakauskas et al. (2013) key requires the measurement of the width of the ultimate rostral segment, a character unfortunately obscured in the aptera. Rostral morphology is generally conserved across aphid morphs, so for that measurement only, we used the width of the ultimate rostral segment of the alata. In both keys, the specimen keyed out as *H. persikonus*. We thus consider it a synonym of this latter species and not of *H. amygdali*, as previously recorded (Remaudière and Remaudière 1997).

Conclusion.—Valid as *Hyalopterus arundiniformis* Ghulamullah, **stat. nov.**

Hyalopterus mimulus Börner 1950: 6

Primary type information.—Host, *Prunus persica* (L.) Batsch; Locality, Germany; Specimens, apterae and alatae, at Bio-Test Labor, Groß Lüsewitz, Sanitz.

Comments.—All six apterae syntypes were examined and identified using the Lozier et al. (2008) and Rakauskas et al. (2013) keys. In all cases the specimens keyed out as *H. persikonus* and not as *H. amygdali*.

Conclusion.—Transferred from being junior synonym of *H. amygdali* (Blanchard) to be junior synonym of *H. arundiniformis* Ghulamullah, **syn. nov.**

Hyalopterus persikonus Miller, Lozier, and Footitt in Lozier et al. 2008: 11

Primary type information.—Host, *Prunus persica* (L.) Batsch; Locality, Kala Nera, Thessaly, Greece; Specimens, aptera, at US National Aphid Collection, Beltsville, Maryland.

Comments.—The evidence is strong that this nominal species represents, along with *H. amygdali* and *H. pruni*, the third species of *Hyalopterus* (Spampinato et al. 1988; Mosco et al. 1997; Lozier et al. 2007, 2008; Poullos et al. 2007). However, *H. arundiniformis* Ghulamullah 1942 and *H. mimulus* Börner 1950 also fit the description of this third species and both have nomenclatural priority. Despite the new nomenclatural synonymy, Miller's et al. description of the species (in Lozier et al. 2008) is the most complete and authoritative.

Conclusion.—Junior synonym of *H. arundiniformis* Ghulamullah, new synonymy.

DISCUSSION

Insects of agricultural and medical importance attract a lot of research attention and, as a consequence, tend to have a higher-than-average taxonomic and nomenclatural complexity. Aphids are no exception, especially polyphagous species such as *Aphis gossypii* Glover or *Myzus persicae* (Sulzer), with 41 and 38 subjective synonyms, respectively (Favret

2017). With the addition here of *Aphis amygdalipersicae*, *Brachycaudus helichrysi* has now accumulated 48 such synonyms. As our methods for species diagnosis and delimitation improve, the multiple synonyms of important species, many with poor original descriptions and missing type specimens, complicate the evaluation and description of possible future new species. A lot of effort went into adequately establishing the existence of a third species of *Hyalopterus* (Spampinato et al. 1988; Mosco et al. 1997; Lozier et al. 2007, 2008; Poullos et al. 2007) and subsequently resurrecting, here, one out of twelve possible names. If the conclusions of Piffaretti et al. (2012, 2013) are correct and a sibling species of *B. helichrysi* is formally recognized, the work of establishing which of the 48 possible names it should bear, if any, will be challenging.

We have surveyed and revised the nominal species of the mealy plum aphid species complex. We conclude that there are three species of *Hyalopterus*, each causing varying degrees of economic damage to stone fruit trees of the genus *Prunus*. These are (1) the mealy plum aphid itself, *H. pruni*, primarily colonizing plum trees; (2) *H. amygdali*, primarily colonizing almond and apricot trees; (3) *H. arundiniformis*, primarily colonizing apricot and peach trees. It should be noted that, although they do exhibit preferences, all three of these species can be found on each other's hosts. Care should be taken to monitor regions of *Prunus* domestication where the introduction of one or another *Hyalopterus* species could have important economic repercussions (Lozier et al. 2008).

Synonymy of *Hyalopterus* Koch 1854

Nomina dubia

H. abietinus Matsumura 1917

H. gracilis (Walker 1852)

- H. persicariae* (Hartig 1841)
H. phragmitidicola (Oestlund 1886)
Nomina valida
H. amygdali (Blanchard 1840)
H. arundiniformis Ghulamullah 1942,
stat. nov.
 =*H. mimulus* Börner 1950, **syn. nov.**
 =*H. persikonus* Miller et al. in Lozier
 et al. 2008, **syn. nov.**
H. pruni (Geoffroy 1762)
 =*H. spinarum* (Hartig 1841)

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