**ABSTRACT**

The study of the first samples of aphids collected on Schoepfiaceae (Santalales) is presented. *Aphis prima* sp. n. is described from viviparous females collected in the Argentina provinces of Neuquén, Río Negro and Santa Cruz and in Chilean region of Maule on plants of genera *Quinchamalium* and *Arjona*, which are endemic to South America. The new species is characterized by the presence of marginal tubercles on 5 or 6 abdominal segments, tibiae homogeneously pigmented and triangular cauda in both apterae and alatae, secondary sensoria on antennal segment III in apterae, and once-branched forewing media in alatae. This last is a very rare characteristic in subfamily Aphidinae.

**Keywords:** Aphids, Aphididae, *Aphis*, Schoepfiaceae, once-branched media, new species, Argentina, Chile.

**RESUMEN**

*Aphis prima* sp. n. (Hemiptera, Aphididae), de Argentina y Chile, primera especie de áfido colectada en el Mundo sobre Schoepfiaceae (Santalales).

Se presenta el estudio de las primeras muestras de pulgones recolectadas en Schoepfiaceae (Santalales). *Aphis prima* sp. n. se describe a partir de hembras viviparas colectadas en localidades de las provincias argentinas de Neuquén, Río Negro y Santa Cruz y en la región chilena del Maule sobre plantas de los géneros *Quinchamalium* y *Arjona*, que son endémicos de América del Sur. La nueva especie se caracteriza por la presencia de papilas marginales en 5 o 6 segmentos abdominales, tibias pigmentadas homogéneamente y cauda triangular tanto en apteraes como en aladas, de sensorios secundarios en el segmento antenal III en apteraes y de la vena medial de las alas anteriores ramificada una sola vez en aladas. El último carácter de los mencionados es muy raro en la subfamilia Aphidinae.

**Palabras clave:** Pulgones, áfidos, Aphididae, *Aphis*, Schoepfiaceae, medial ramificada una vez, especie nueva, Argentina, Chile.

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Introduction

Taxonomic studies of aphids are often aimed at studying the diversity related to plant genera or families. This procedure is especially useful to assess the possible novelty of aphid species, especially if they belong to aphid genera with many species, such as *Aphis*, *Uroleucon*, *Dysaphis* or *Macrosiphum* (Aphidinae), *Chaitophorus* (Chaitophorini) or *Cinara* (Lachninae) (see Blackman & Eastop, 2021). The authors of this paper have applied this procedure in their taxonomic studies of aphids in temperate or cold-temperate Argentine and Chilean regions for over 20 years (see Blackman & Eastop, 2021: “Bibliography”), having described several species of *Aphis* and also of *Uroleucon* (Aphidinae) and *Neuquenaphis* (Spicaphidinae).

In this work, results of the study of seven samples of aphids collected on *Quinchamalium chilense* and one from an unidentified species of *Arjona* (Schoeopiaceae), possibly *A. patagonica*, are presented, which show the characteristics of the genus *Aphis* Linnaeus, 1758 (Hemiptera, Aphididae, Aphidina). These plants are herbs with perennial rhizomes.

The Schoeipiaceae family was recognized in APG III, and remains in APG IV (Angiosperm Phylogeny Group, 2009, 2016). It currently includes three genera: *Schoeipia*, *Arjona* and *Quinchamalium* (Hasssler, 2019). *Schoeipia* was classified in Olacaceae until 2009. It currently includes 27 species, 23 of which are South American. *Arjona* and *Quinchamalium* were previously classified in Santalaceae; they include respectively 5 and 20 South American species (Hasssler, 2019), although Vidal-Russell (2019) and López Laphitz et al. (2015) consider that each of these different genera includes a single species.

No aphids have yet been collected from Schoeipiaceae anywhere in the world. Two *Aphis* species are known from Santalaceae: *A. thesii* Holman, 1966 and *A. neotheissii* Paschenko, 1996 (Blackman & Eastop, 2021); these are palaeartic.

The viviparous females collected on *Quinchamalium* and *Arjona* are markedly different from those of *A. thesii* and *A. neotheissii*. They are also different from those of the other *Aphis* species known in South America (see the Taxonomic Discussion section).

These differences have allowed the establishment of *Aphis prima* sp. n.

Material and methods

Standard protocols for collection, rearing, ethanol preservation, slide preparation, and morphometric study have been employed (see Nieto Nafria & Mier Durante, 1998). Microphotographs were taken using a smartphone iPhone 11 through an eyepiece adapted to an Olympus CX41 microscope and were subsequently treated with Corel Photo-Paint 2018 and Microsoft Publisher 2010.

In the collection data: (a) Spanish orthography, diacritics included, was retained in the geopolitical names; (b) geographical coordinates and altitudes were validated using Google Earth Pro, v.7.3.2; and (c) authors’ surnames as collectors of paratypes are abbreviated. The possible novelty of aphid species, especially if the taxa belong to aphid genera with many species, such as *Aphis*, *Uroleucon*, *Dysaphis* or *Macrosiphum* (Aphidinae), *Chaitophorus* (Chaitophorini), or *Cinara* (Lachninae) (see Blackman & Eastop, 2021).

In the description, text and table, the quantities in parentheses show an exceptional limit on the range of variation of the characteristic.

Results and discussion

*Aphis (Aphis) prima* sp. n.

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Figs. 1–3

**Type material.** Holotype, apterous viviparous female (ARG-371-ap.5, on a slide with 3 paratypes), ARGENTINA, Río Negro, Bariloche, San Carlos de Bariloche (41º09’ S, 71º12’ W, 860 m), on *Quinchamalium chilense*, 19-January-2000, Mier Durante, Nieto Nafria and Ortego leg.; Universidad de León collection (León, Spain).

**Paratypes.** 124 apterous viviparous females and 49 alate viviparous females: (1) same data as the holotype, 34 apterae and 23 alatae; (2) same locality, host plant and collectors as the holotype, 14-December-2009, 15 apterae and 10 alatae; (3) same locality and host plant as the holotype, 18-April-2012, O. leg., 6 apterae and 8 alatae; (4) same locality and host plant as the holotype, 11-January-2019, O. leg., 12 apterae; (5) Neuquén, Minas, Lagunas Epulafuqui (36º52’ S, 70º57’ W, 1440 m), on *Q. chilense*, 25-January-2020, M.D., N.N. and O. leg.; (6) Neuquén, Los Lagos, Puerto Huemul (41º01’ S, 71º20’ W, 860 m), on *Q. chilense*, 21-January, 2000; M.D., N.N. and O. leg., 1 alate; (7) Santa Cruz, Lago Argentino, El Chaltén (49º20’ S, 72º53’ W, 750 m), on *Arjona patagonica*, 8-February-2010, Cuesta Segura leg., 14 apterae; and (8) CHILE, Maule, Talca, Paso Peñuelences high slopes (35º59’ S, 70º24’ W, 2520 m) on *Q. chilense*, 31-January, 2000; M.D., N.N. and O. leg., 24 apterae and 6 alatae.

**AFTEROUS VIVIPAROUS FEMALES** (Fig. 1). Based on 125 specimens. 1.125–2.125 mm long. When alive neutral green to light green or yellow-green with a very fine layer of waxy powder, with brown antennae and legs. When mounted, light brown or beige because thorax and abdomen are widely membranous, with head, antennae, rostrum, legs and siphunculi brown, and darker than genital and anal plates, cauda and spiracular and dorsal sclerites. Marginal tubercles present in prothorax and abdominal segments 1–(6)7, all of them round, big, and low pale, the abdominal ones sometimes sitting in small sclerites; if these sclerites are not present, the tubercles can go unnoticed because they are as poorly pigmented as the surrounding cuticle. Setae very long, fine and pointed. Head with very few scattered rectilinear ridges. Frons slightly wavy. Ocelli or ocellar spots present on specimens of 5 samples: one in 6.4% of type specimens, two in 4.0%, and three in 6.4%, up
to maximum per sample of 33.3%, 8.6% and 14.4%. Antennae six-segmented and longer than half body length. Antennal segments I and II smooth. Antennal flagellum imbricated, although the ventral face on segment III is almost smooth. Antennal segment III with 6–14 setae, and usually with secondary sensoria placed on distal three quarters, 1–8(13) on each antenna and 1–15(26) on both antennae. Rostrum long, reaching back beyond hind coxae. Ultimate rostral segment relatively broad and usually with 2 accessory setae, two specimens have 4 setae (1.6% of type specimens), and 18 specimens have 3 setae (14.4%...
of type specimens). Tibiae as dark as femora, usually homogeneously pigmented, but in poorly pigmented specimens progressively darkening towards the apex. Tarsal formula 3.3.2. Dorsum of thorax and abdomen in general membranous and tenuously reticulated or smooth; metathorax with a light brown and reticulated spino-pleural patch; abdominal segment 7 sometimes with small and light brown setiferous sclerites; abdominal segment 8 with a narrow arc-shaped sclerite carrying scattered spinules. Spiracular sclerites usually inconspicuous. Siphunculi usually subcylindrical, sometimes tapering, with transverse linear roughness and very marked flange. Genital plate with 2–8(12) discal and (3)6–12 posterior setae. Abdominal segment 8 with (3)4–6(8) setae. Cauda triangular, with (3)5–8 setae. Metric features in Table 1.

Alatae viviparous females (Figs. 2, 3). Based on 49 specimens. 1.225–1.750 mm. When alive head and thorax (including antennae and legs) brown to dark brown, and abdomen neutral green, light green or yellow green. Pigmentation when mounted similar to apterae but with dark brown thorax. Frons straight. Antennal segment III with 7–18 secondary sensoria placed on the ventral face of almost the entire length of the segment; total for both antennae 18–35. Antennal segment IV with (0)1–4 secondary sensoria on each antenna, total for both antennae 1–7. Antennal segment V sometimes (22% of specimens) with 1–2 secondary sensoria. Ultimate rostral segment with 2–3(4) accessory setae, three or four are present in 16 specimens (32.7% of specimens). The veins of the forewings are costal, radial 1, radial sector, media with marginal sclerites, which are more extensive than those in aptera, peri-siphuncular sclerites, small setiferous sclerites on abdominal segments 7 and infrequently on segment 6, and an arc-shaped band on segment 8, all of them with spinules. Intersegmental sclerites usually conspicuous, although small and less pigmented than the corresponding marginal ones. The qualitative and meristic characteristics like those of the apterae have been omitted. Metric features in Table 1.

Bionomics. Specimens of *Aphis prima* sp. n. live on *Quinchamalium chilense* and *Arjona* sp. (possibly *A. patagonica*), in loose or disturbed soils. It may also live on other species of these plant genera, perhaps with the exception of *A. megapotamica*, because this is the only species of the genus that lives outside the Andean territories.

Aphids usually form compact groups on the basal part of the stem, basal leaves, and highest part of the roots; the specimens in very large colonies invade the highest parts of the plant, especially the nymphs of alate viviparae. They are visited by ants.

The life cycle of *A. prima* sp. n. cannot be specified because no sexuals have been collected. It can be speculated that it is holocyclic due to the climatic characteristics of the collection sites, with cold winters and frequent snowfalls, or on the contrary that it is anoholocyclic because some specimens could subsist on the roots of their host plants during the winter, even under snow, as other aphids do, for example *Acrhythsiphon matilei* Remaudière & Leclant, 2000 (Nieto Nafria & Mier Durante, 2013).

**Distribution.** *Aphis prima* sp. n. is known in the Argentine provinces of Neuquén, Rio Negro and Santa Cruz and in the Chilian region of Maule, but it can be estimated that this aphid is much more widespread in both countries, and even in Bolivia and Peru, because the altitudes of the collection localities are very diverse (750 to 2500 m) and because there are 1500 km between the northernmost and the southernmost collection localities —Paso Pehuenche in Chile and El Chaltén in Argentina, respectively.

**Etymology.** The specific name of the new species, *prima*, is an adjective in nominative feminine singular that means first, because it is the first aphid species collected on species of Schoepfiaceae.

**Taxonomic discussion.** The characteristics of the studied specimens correspond to those of the subgenus *Aphis*, including the usual presence of only 2 accessory setae on the ultimate rostral segment (García Prieto & Nieto Nafria, 2005), although there is a small quantity of specimens with 3 or 4 accessory setae.

The twice-branched media in the forewings is one of the archetypical characteristics of Aphididae, which remains as such in Aphidinae and Aphidini. The media is only once-branched in some genera of this tribe, for example *Schizaphis* Börner, 1931 (Aphidini Rhopalosiphina) and *Casimira* Eastop 1966 (Aphidini Aphidina), and also in three species of *Aphis*, in addition to *Aphis (A.) prima* sp. n.; namely *A. (Toxoptera) aurantii* Boyer de Fonscolomb, 1841 —which is polyphagous and worldwide distributed,— *A. (A.) cottieri* Carver, 2000 —living on species of *Muehlenbeckia* (Polygonaceae) in New Zealand—, and *A. (A.) elena* Lagos-Kutz and Voegtlin, 2017 —living on *Pycnanthemum virginianum* (Lamiaceae) in the northern United States—. Thus, the once-branched media is not unique to either the subtribe or the genus, but it is extremely rare in the genus and it is not present in any of the species of the genus known in South America, with the exception of *A. (T) aurantii*. *Aphis prima* sp. n. can easily be distinguished from *A. cottieri* and *Aphis elena*, because these species lack marginal tubercles on intermediate abdominal segments and have a finger-shaped cauda (Carver, 2000; Lagos-Kutz et al., 2017).
**Table 1.** *Aphis (A.) prima* sp. n., apterous viviparous females. Metric features; in millimeters if body or body parts, in microns if setae. NOTES—

- **A:** 1.125–1.688 on *Quinchamalium* and 1.775–2.125 on *Arjona*; 1.60–0.82 on *Quinchamalium* and 0.53–0.62 on *Arjona*; 0.325–0.513 on *Quinchamalium* and 0.500–0.538 on *Arjona*; 0.9–0.11 on *Quinchamalium* and 0.12–0.13 on *Arjona*; 1.0–1.7 on *Quinchamalium* and 1.7–2.1 on *Arjona*; 20–34 on *Quinchamalium* and 32–59 on *Arjona*; 23–38 on *Quinchamalium* and 40–63 on *Arjona*; 30–55 on *Quinchamalium* and 48–80 on *Arjona*;
- **B:** 0.60–0.82 on *Quinchamalium* and 0.53–0.62 on *Arjona*; 0.325–0.513 on *Quinchamalium* and 0.500–0.538 on *Arjona*; 0.9–0.11 on *Quinchamalium* and 0.12–0.13 on *Arjona*; 1.0–1.7 on *Quinchamalium* and 1.7–2.1 on *Arjona*; 20–34 on *Quinchamalium* and 32–59 on *Arjona*; 23–38 on *Quinchamalium* and 40–63 on *Arjona*; 30–55 on *Quinchamalium* and 48–80 on *Arjona*;

<table>
<thead>
<tr>
<th>Metric Features</th>
<th>Apterous viviparae n = 123</th>
<th>Alate viviparae n = 49</th>
</tr>
</thead>
<tbody>
<tr>
<td>Body</td>
<td>1.125–2.125</td>
<td>1.225–1.750</td>
</tr>
<tr>
<td>Body / Siphunculus</td>
<td>0.80–1.200</td>
<td>0.925–1.275</td>
</tr>
<tr>
<td>Antenna</td>
<td>0.53–0.82</td>
<td>0.69–0.81</td>
</tr>
<tr>
<td>Antennal segment III</td>
<td>0.20–0.35</td>
<td>0.17–0.37</td>
</tr>
<tr>
<td>Antennal segment IV</td>
<td>0.09–0.21</td>
<td></td>
</tr>
<tr>
<td>Antennal segment V</td>
<td>0.10–0.24</td>
<td>0.10–0.21</td>
</tr>
<tr>
<td>Antennal segment VI, base</td>
<td>0.10–0.14</td>
<td>0.07–0.15</td>
</tr>
<tr>
<td>Antennal segment VI, processus terminalis</td>
<td>0.15–0.24</td>
<td>0.18–0.25</td>
</tr>
<tr>
<td>Antennal segment III / Antennal flagellum</td>
<td>0.26–0.38</td>
<td>0.26–0.33</td>
</tr>
<tr>
<td>Antennal segment VI: processus terminalis / base</td>
<td>(1.2)1.4–1.9(2.2)</td>
<td>1.3–2.6</td>
</tr>
<tr>
<td>Antennal segment VI processus terminalis / Antennal segment III</td>
<td>0.6–0.9</td>
<td>0.6–1.1</td>
</tr>
<tr>
<td>Ultimate rostral segment</td>
<td>0.11–0.16</td>
<td>0.11–0.14</td>
</tr>
<tr>
<td>Ultimate rostral segment / its basal width</td>
<td>1.9–3.1</td>
<td>2.3–3.4</td>
</tr>
<tr>
<td>Ultimate rostral segment / Hind tarsi second segment</td>
<td>1.0–1.6</td>
<td>1.0–1.4</td>
</tr>
</tbody>
</table>

- **Hind femur** 0.325–0.538
- **Hind femur / Body** 0.25–0.35
- **Hind tibia** 0.575–0.938
- **Hind tibia / Body** 0.42–0.62
- **Hind tarsal second segment** 0.09–0.13
- **Siphunculus** 0.11–0.21
- **Siphunculus / its basal width** 1.6–4.9
- **Siphunculus / its width at middle length** 2.8–5.4
- **Siphunculus width / Hind tibia width, both at medium length** 0.8–1.4
- **Siphunculus / Cauda** 1.0–2.1
- **Cauda** 0.09–0.13
- **Cauda / its basal width** 0.6–1.3

Longest seta on...

- **antennal segment III** 20–58
- **antennal segment III / Antennal segment III subarticular width** 1.9–2.9
- **head, dorsal** 25–58
- **head, dorsal / Antennal segment III subarticular width** 2.0–4.2
- **hind trochanter, ventral** 25–55
- **hind trochanter, ventral / Trochantero-femoral suture** 0.5–1.3
- **hind femur (dorsal and ventral)** 23–58
- **hind femur / Antennal segment III subarticular width** 1.4–3.5
- **hind tibia, dorsal at middle length** 30–73
- **hind tibia, dorsal / Hind tibial width, both at middle length** 0.8(1.0)–1.8
- **abdominal segments 2–4** 23–63
- **abdominal segments 2–4 / Antennal segment III subarticular width** (1.5)1.8–3.3
- **abdominal segment 8** 25–49
- **abdominal segment 8 / Antennal segment III subarticular width** 2.5–4.9
- **genital plate** 30–80

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**Tabla 1.** *Aphis (A.) prima* sp. n., hembras vivíparas. Caracteristicas métricas; cuerpo y sus partes en milímetros y setas en micras. NOTAS—

- **A:** 1.125–1.688 en *Quinchamalium* y 1.775–2.125 en *Arjona*; 0.60–0.82 en *Quinchamalium* y 0.53–0.62 en *Arjona*; 0.325–0.513 en *Quinchamalium* y 0.500–0.538 en *Arjona*; 0.9–0.11 en *Quinchamalium* y 0.12–0.13 en *Arjona*; 1.0–1.7 en *Quinchamalium* y 1.7–2.1 en *Arjona*; 20–34 en *Quinchamalium* y 32–59 en *Arjona*; 23–38 en *Quinchamalium* y 40–63 en *Arjona*; 30–55 en *Quinchamalium* y 48–80 en *Arjona*;
Fig. 2.— *Aphis (A.) prima* sp. n., alate viviparous female [specimen ARG-371-al.1]. A, habitus (1.375 mm); B, abdominal segments 1 to 5 right marginal zone, tubercles on sclerites; C, antennal segments II (in part), III (0.30 mm), IV (0.14 mm), V (0.15 mm) and VI (0.11 + 0.20 mm).

Fig. 2.— *Aphis (A.) prima* sp. n., hembra vivípara alada [espéímen ARG-371-al.1]. A, hábitus (1.375 mm); B, segmentos abdominales 1 a 5, zona marginal derecha, con papilas sentadas en escleritos; C, artejos antenales II (en parte), III (0.30 mm), IV (0.14 mm), V (0.15 mm) y VI (0.11 + 0.20 mm).
The apterous viviparae collected on Arjona (one sample) differ from those collected on Quinchamalium (remaining samples) in some morphological characters (see Table 1, legend). These differences are interpreted as intraspecific variations, which could be related to the latitude of the collection localities or with the species of host plant or with both.

As noted in the introduction, there are two species of Aphis hosted in species of Santalaceae—the family in which the Quinchamalium and Arjona were previously classified—somewhere in the world, specifically on species of Thesium in palaearctic territories. Aphis thesii has been recorded from France, Hungary, Poland and Slovakia and A. neothesii from east Siberia (Russian Federation). Apterous viviparae of both species are very different of those of the new species, because they lack secondary sensilla on antennal segment III and marginal tubercles on intermediate abdominal segments, and they have a finger-like and dark cauda, conspicuously extensive dorso-abdominal sclerotization, and short setae on antennae, legs and body dorsum, and they are when alive dark brown (Holman, 1966; Pashchenko, 1993; Osiadacz & Halaj, 2010, 2015).

In Argentina and Chile are known: (i) eight species of Aphis whose alata always or occasionally have secondary sensory on antennal segment III [six species included in “group 4” of the keys for apterous viviparae of Aphidina known in South America by Nieto Nafria et al. (2019), plus A. lugentis Williams, 1911 and A. ortegoi Mier Durante, Garcia Gomez & Nieto Nafria, 2021], and (ii) twenty species without secondary sensory but always or sometimes with marginal tubercles on the intermediate abdominal segments [16 species included in group 5 of the above-mentioned keys, plus A. conspicua Nieto Nafria & Mier Durante, 2019, A. fuentesi Nieto Nafria & Ortego, 2019, A. gutierreziae Ortego, Mier Durante & Nieto Nafria, 2021 and A. inegborgiae Nieto Nafria & Brown, 2019]. The viviparae of A. prima sp. n. have both secondary sensory on antennal segment III and marginal tubercles on intermediate abdominal segments, and also a triangular cauda and homogeneously brown tibiae. The viviparae of all of these other species have a finger-shaped cauda; most of them have bicolored tibiae (pale with a dark and contrasted distal portion). Only viviparae of A. lugentis—which also have secondary sensilla on antennal segment III—have homogeneously pigmented tibiae, but these are black or very dark brown.

The presence of secondary sensilla on antennal segment III of apterae, the abundant and big marginal tubercles, the long setae on antennae and legs, and the short cauda are features that A. prima sp. n. shares with Pehuenchaphis agilissima Mier Durante, Nieto Nafria & Ortego, 2003, which lives on the roots of Senecio (Mier Durante et al. 2003). However, apterous viviparae of A. prima can easily be separated from those of the last species, in which the siphunculi are very short (at most a little longer than their basal widths) and are placed on abdominal segment 6 (not on segment 5 as usual in Aphidini), and the antennal setae are much more abundant. The specimens of both species colonize the same part of their respective host plants, are attended by ants and move quickly when disturbed (Mier Durante et al., 2003).

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