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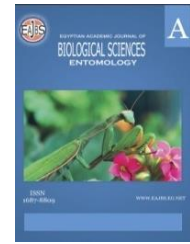
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***Pauesia silana* Tremblay, 1969 A Parasitoid of *Cinara maghrebica*-Aphid in Aleppo Pine Forests in Algeria Case Khenchela Province**

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ABSTRACT

Aphids are categorized as serious pests, causing different damages to plant species; they have a great number of known natural enemies as predators and parasitoids. Among parasitoids, all members of the Aphidiinae subfamily were considered the most important. *Pauesia* species are restricted to Lachninae aphid hosts. In Algeria, there is a lack of formations of *Pauesia* species richness. This study conducted in the forest habitat of Khenchela province dominated by Aleppo pine aims to explore *Pauesia* diversity in this region. A total of 208 mummified *Cinara maghrebica* (Mimeur) aphid were collected on *Pinus halepensis* trees. Among them, 106 *Pauesia silana* have emerged in association with males of a second species (*Pauesia* sp) and two hyperparasitoid species *Asaphes suspensis*(Nees) and *Asaphes* sp. *Pauesia silana* Tremblay is reported for the first time in Khenchela province. This natural enemy was found only parasitizing the aphid *Cinara maghrebica* (Mimeur) feeding on Aleppo pine (*Pinus halepensis*). *Pauesia silana* is redescribed and illustrated.

INTRODUCTION

According to Medvedev (1995), there are about 55 described species of the genus *Pauesia* Quilis around the world (Sanchis *et al.*, 2001). This genus belongs to Aphidiine and comprises 420–505 species worldwide (Rakhshani *et al.*, 2019; Žikić *et al.*, 2017). Their adult size ranges from about one to several millimeters. They are solitary endoparasitic, lay eggs into the host body paralyzing it temporarily with secretions of ovipositor glands; parasitize both larvae and adult aphids. *Pauesia* species are restricted to Lachninae aphid hosts; mainly species of *Cinara* Curtis are associated with conifers (Smith 1944; Takada, 1968; Stary, 1970; Michelena Saval & Gonzalez Funes, 1988; Pike & Stary, 1996; Brajkovic *et al.*, 1999; Stary *et al.*, 2005; Boivin *et al.*, 2012).

The genus *Pauesia* differs from its relatives by wing-venation, Carinae on propodeum form a large, wide pentagonal areola which is sometimes poorly visible in the longitudinal portion, the stigma is less than three times as long as broad and hosts complex general distribution (Watanabe & Takada, 1965; Stary & Schlinger, 1967; Stary, 1976).

This genus has distribution in the Holarctic, Oriental and Ethiopian regions (Stary & Schlinger, 1967; Žikić *et al.*, 2017). In Algeria, the first records on the genus *Pauesia* have been presented by Aroun & Abdel Hussain, 2006.

The aims of this article are to inform the occurrence of *Pauesia silana* Tremblay in Khenchela province (East Algeria), to provide a redescription of adults of this species, and also to supply information about its associations with aphids and plants.

MATERIALS AND METHODS

Samplings were located in a forest dominated by Aleppo pine (1,224 m., 7°7'25, 11"N; 35°25'24, 28"E) in Khenchela province. The annual average rainfall is 472.8 mm. and the monthly average minimum temperature is 6.5 °C and the average maximum is 26.45 °C. Aphidiine parasitoids were obtained by collecting the host aphid from their host plant *P. halepensis* in January 2014 and 2018. Aphididae samples were preserved in 90% ethanol for later identification. Mummified aphids of the same species and tree samples were placed in groups in small plastic boxes. On the lid of each box, there was a circular opening covered with muslin for ventilation under controlled conditions with a temperature range of 24–28 °C and RH of 60 ± 5% for 2–3 weeks until the emergence of the adult parasitoids. The emerged parasitoids were preserved in 75% ethanol, with representative specimens mounted and identified using the keys of Smith (1944), Watanabe & Takada (1965), and Stary (1976). Also, representative specimens identified as *P. silana* from Khenchela were examined and confirmed by European aphidiine specialist Prof. P. Stary (Institute of Entomology, Acad. Sci. Czech Republic, Ceske Budejovice, Czech Republic). External morphology was illustrated using a stereo microscope and a microscope with a digital camera (Motic® Images Plus 2.0ML China).

RESULTS

A total of 208 mummified *Cinara maghrebica* (Mimeur) were collected. Among them, 106 *Pauesia silana* have emerged with biparental population bias toward females (37 males and 69 females). The emergence rate obtained from this aphid was 50.96%. This is the first record of *P. silana* from Khenchela province parasitizing the aphid *C. maghrebica*. Like other Aphidiinae, *P. silana* is a primary solitary koinobiont endoparasitoid of other aphids (*C. acutirostris* Hille Ris Lambers, *C. palaestinensis* Hille Ris Lambers, and *C. pini* (L.) (Pike & Stary, 1996; Mifsud & Stary, 2009). Adults are free-living and feed on honeydew, nectar, pollen and other plant secretions (Stary, 1970).

Pauesia silana Adult Description:

The morphological terminology used here is generally set out in taxonomic glossaries and follows in particular that of Stary (1976).

Female (n=69): Colour: Brown to yellowish. Face, clypeus, mouth parts, palpi, scape yellowish, pronotum, and mesoscutum brown. Abdomen entirely yellowish, wings hyaline, stigma and veins brown; stigma somewhat yellowish basally. The fore and middle legs are yellowish browns with dark brown coxae basally. Hind legs: dark brown to brown (Fig. 1A). The body is 2.0–4.5 mm long, and the antennae are 2.0–2.5 mm long.

Head: transverse dorsally, smooth and shining, so that the tentorial-ocular line is almost less than the intertentorial line, the face is a little less than two times as long as it is broad.

Antennae: Flagellomeres are entirely black except F1 and F2 which are sometimes yellowish or brownish, with 16 to 19 flagellomeres becoming weakly stouter towards the apex; the first flagellomere is as long as broad and equal to the second in length.

Mesoscutum: smooth and shining, without notaulices (Fig. 2B).

Fore wing: with sclerosed stigma, broad, triangular, as long as the metacarpus and as wide as the length of r1 (Fig. 2A).

Propodeum: smooth and shining, with large wide pentagonal areola (longitudinal carinae absent) (Fig. 2C).

Abdomen: Lanceolate. First tergite twice (or almost) as wide at the apex as at spiracles, with deep lateral impressions behind spiracular tubercles, strongly dilated to the apex hind portion of tergite 1 flat smooth.

Genitalia: Ovipositor sheath stout, almost quadrate, slightly curved upwards (Figs 2 D).

Male (n = 37): Antenna 19 antennomeres. Coloration is similar to that of the female, except for the abdomen, which is entirely brown (Fig. 1B).

Note: Mummified *Cinara* specimens are brown. Pupation occurs inside the skin of parasitized aphids (Stary &Schlinger 1967) with two kinds of emergence holes.

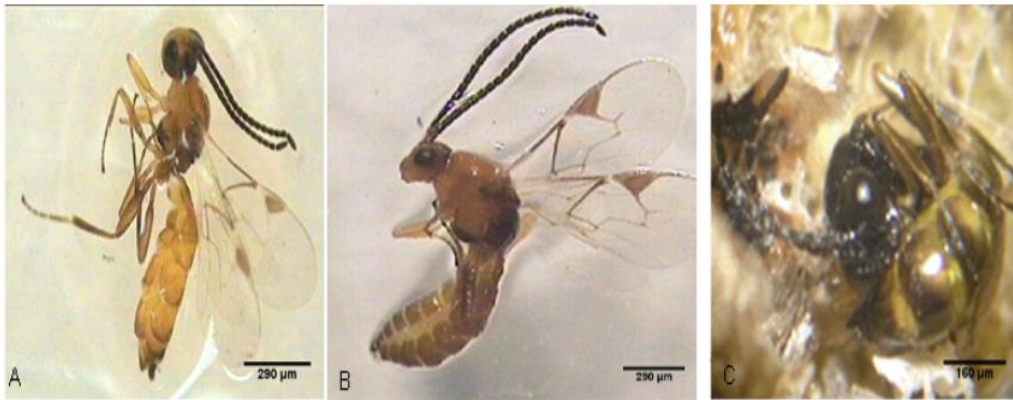


Fig. 1. Adult of *Pauesiasilana*. A. Female. B. Male. C. Position of *P. silana* inside the mummy.

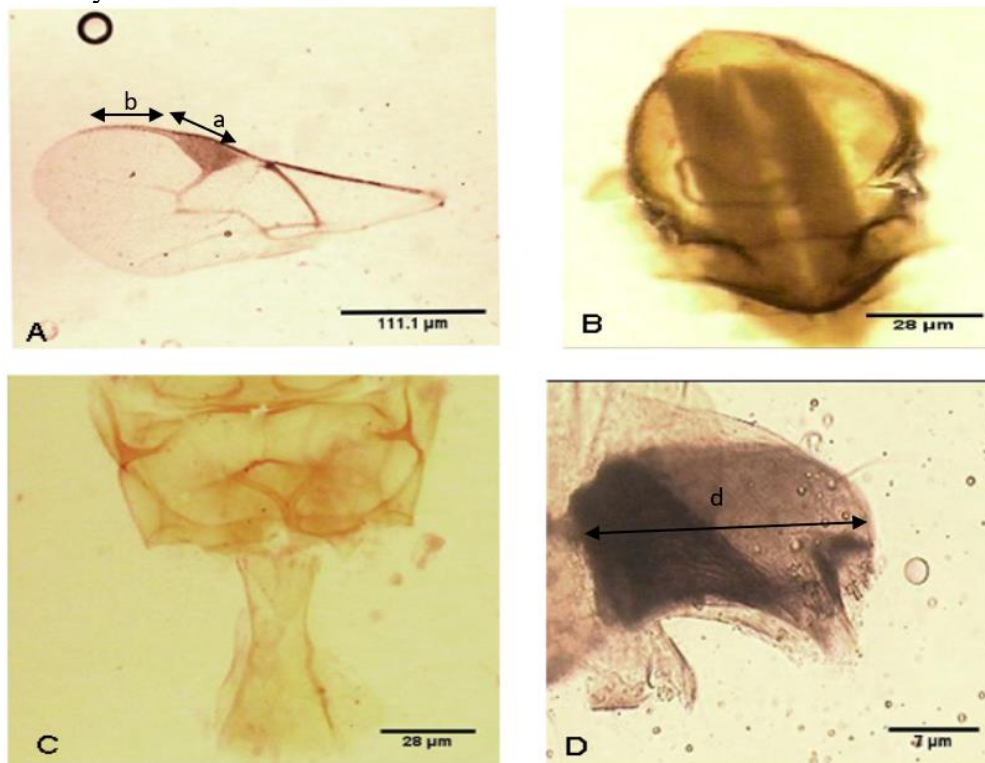


Fig. 2. External morphology of *P. silana* female. A. Forewing (a. stigma length, b. metacarpus); B. Mesoscutum; C. Propodeum and dorsal view of tergite 1; D. Ovipositor sheath (d. length of valvae).

DISCUSSION

Pauesia silana attacked the aphid *C. maghrebica* that lives in dense colonies on young twigs of *P.halepensis* and it is attended by ants. Aleppo pine is a dominant species in the region that grows spontaneously and is also the first choice for reforestation in the region.

Khenchela province is the largest producer of wood in Algeria. Economically, the pine trees constitute one of the most important resources for the bulk of timber, pencil wood, paper pulp, resin, oil, tar, turpentine, fuel, and medicine, and they are even used for tanning (Dar & Dar, 2006; Hussain *et al.*, 2006). Among the important pest insects in pine are aphids (Hemiptera: Aphididae), such as *Cinara* that generally feed on leafy and woody parts of Pinaceae and Cupressaceae (*Abies*, *Cedrus*, *Larix*, *Picea* and *Pinus* spp. (trunks, branches, or roots) and might cause permanent damage to the host plant including wrapping and drying (Blackman & Eastop, 2019). Thus, an aphid attack on such an important group of plants is a matter of concern for silviculture (Chakrabarti, 2020).

The aphid *C. maghrebica* is known in the Mediterranean Region and Middle East (Mifsud *et al.*, 2009). It is recorded in Italy, France, Spain, Morocco and Malta, and has also been recorded in Argentina and Turkey (Pike & Stary, 1996).

In Algeria *P. silana* has been found in three different habitats: the forest of Khenchela, the sub-urban habitat of Algiers and the urban Batna region, where it is reported to parasitize *C. maghrebica* feeding on *P. halepensis* (Aggoun, 2015; Allali, 2016; Mestek, 2019); it has also been reared from the aphid *C. pini* on *P. nigra* and *P. halepensis* (Benhamacha *et al.*, 2017). *Pauesia silana* seems to be well distributed in coastal and mainland areas of the Mediterranean Region. It is recorded on aphids of the genus *Cinara* that are reared on *P. nigra*, *P. halepensis*, and *P. pinea* (Mifsud & Stary, 2009).

Aphid parasitoids are considered highly efficient biological control agents (Boivin *et al.*, 2012). The genus *Pauesia* has shown promise as introduced biological agents in several such cases. *Pauesia cedrobii* Stary & Leclant, a parasitoid native to the mountains of North Africa (Stary & Leclant, 1977), was introduced into France to control the cedar aphid *Cedrobium laportei* Remaudière (Pike & Stary, 1996). In this study, two hyperparasitoid species were detected on *Pauesia silana* *Asaphes suspensis* (Nees) and *Asaphes* sp.

In Algeria, the fauna of Aphidiine wasps of forest trees has been little studied; only a few papers have been published. These new results on parasitoid-aphid-plant association contribute to local biodiversity studies mainly on faunal compositions and forestry ecosystem relationships.

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