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The genus *Orthezia* Bosc (Hemiptera: Ortheziidae) in Turkey, with 2 new records

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Abstract: This study aimed to identify the ground ensign scale insects in 5 provinces (Ağrı, Bitlis, Hakkari, Iğdır, and Van) in eastern Anatolia, Turkey. In order to achieve this goal, Ortheziidae species were collected from natural and cultivated plants in the 5 provinces listed above between 2005 and 2008. A total of 3 species were found, among them 2 species (*Orthezia maroccana* Kozár & Konczné Benedicty and *Orthezia yashushii* Kuwana) that are new records for the Turkish scale insect fauna.

Key words: Coccoidea, Ortheziidae, scale insects, fauna, Turkey

1. Introduction

The scale insects, Coccoidea (Hemiptera: Sternorrhyncha), are small, sap-sucking true bugs, sister species to Aphidoidea, Aleyrodoidea, and Psylloidea (Gullan and Martin, 2009). According to Koteja (1974) and Gullan and Cook (2007), the superfamily Coccoidea is divided into 2 major informal groups, namely archaeococcoids and neococcoids, based on the structure of the labium and molecular data. While adult female archaeococcoids are characterized by having abdominal spiracles and a labium without apical setae and adult males by having compound eyes, adult female neococcoids, including most of the scale insect families, are characterized by the lack of abdominal spiracles and the presence of apical setae on the labium apex, while the adult males usually have only 4 simple eyes and 1 pair of ocelli (Williams et al., 2011). Archaeococcoids have an XX-XO sex chromosome system like that of Putoidae (Hughes-Schrader, 1944), and neococcoids have a paternal genome elimination system (Normark, 2003; Williams et al., 2011). Currently, there are 49 recognized extant scale insect families (Ben-Dov et al., 2013).

The phylogeny of the scale insects points to 2 clear stages of evolution concerning habitat and feeding behavior (Koteja, 1985). In the first stage, scale insects split off from the homopteran stock during the Carboniferous or Permian, until the appearance of flowering plants in the Jurassic. The early scale insects lived in forest litter on a mixed diet, feeding on the sap from the aerial parts of various plant species and on living or decaying plant tissue. Those species that became adapted to living in the soil developed fossorial-type legs adapted for digging (1 claw, 1 segmented tarsus, functional tibiotarsal articulation); the females lost their wings and became paedomorphic, while the males became dipterous and polymorphic without functional mouthparts and with a different life cycle (with prepupal and pupal stages) (Koteja, 1985). Eventually, the scale insects diverged into numerous groups. The second stage of evolution began with the appearance of flowering plants and has continued up to the present, when scale insects became true plant parasites (Koteja, 1985). Most of the groups started to climb their host plants, and each group acquired and evolved with its own endosymbionts. The transition from the primary habitat and behavior on the ground towards the secondary habitat aboveground occurred over a long period of time and evolved independently in various groups (Koteja, 1985). As a result, the level of specialization in scale insects seen today is extremely variable, and some groups still maintain their primary mode of life (e.g., the Ortheziidae and Rhizoecidae) (Koteja, 1985).

Ortheziidae, or the ensign scale insects, has been considered to be one of the most ancient families of Coccoidea (Koteja, 1996; Vea and Grimaldi, 2012). This family is considered either an 'ancestor' to all scale insects or a 'primitive' isolated branch of the archaeococcoids (Vea and Grimaldi, 2012). Females are distinctive, possessing well-developed legs and antennae, and having much of the body cloaked in bundles of extravagant white wax secretions, giving them a peculiarly flashy appearance

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(Vea and Grimaldi, 2012). There are about 208 described species of Ortheziidae to date, classified within 21 genera (including 4 extinct genera) (Vea and Grimaldi, 2012). A few species of ortheziids are serious pests, such as the greenhouse ensign scale, *Insignorthezia insignis* (Browne). There are 2 main groups of host-plant specialization in the Ortheziidae. The first group is composed of ortheziid species that occur sporadically on leaf litter (presumably feeding on roots and fungal mycelia), with some assumed to feed on mosses and lichens, habitats that are putatively the most primitive in Coccoidea; the second species group is composed of ortheziids that feed on vascular plants, including grasses and herbaceous and woody plants (Koteja, 1996; Kozár, 2004; Vea and Grimaldi, 2012).

According to Kozár (2004), the Ortheziidae family consists of 4 subfamilies, namely Ortheziinae, Newsteadiinae, Ortheziolinae, and Nipponortheziinae. Vea and Grimaldi (2012) gave support to 3 subfamilies (Ortheziinae, Newsteadiinae, and Ortheziolinae), but reported that Nipponortheziinae is not monophyletic. The subfamily Ortheziinae, which includes the genus *Orthezia*, is characterized by having well-separated tibia and tarsus, and 7- or 8-segmented antennae (Kozár, 2004). There are 2 different groups in the subfamily; the first group includes species living on litter and moss and feeding on the roots of different plants (tribe Arctortheziini), and the second group includes species living on different kinds of plants (grasses, herbaceous or woody plants) and mostly species living in dry habitats (tribe Ortheziini).

Turkey has 779,000 km^2 of land in Asia and Europe and is surrounded by 4 seas (Black Sea, Sea of Marmara, Mediterranean Sea, and Aegean Sea), which allows it to have different ecological characteristics, with very different altitudes ranging from sea level to above 5000 m (http://www.cbd.gov.tr/contact/contact.php). These land conditions have resulted in a wide variety of climatic conditions within the country. The first comprehensive study on the scale insect fauna of Turkey was made by Bodenheimer (1952, 1953a, 1953b). Later studies were performed by Ülgentürk and Çanakçıoğlu (2004), Ülgentürk et al. (2003, 2004), Kaydan (2011), Kaydan et al. (2001a, 2001b, 2002, 2004, 2005a, 2005b, 2008, 2013), Kaydan and Gavrilov (2010), and Kaydan and Kozár (2008, 2010a, 2010b, 2011a, 2011b); the newest checklist of the Turkish scale insect fauna, including 267 species in 12 families, was published by Kaydan et al. (2007). Although the scale insect fauna of Turkey has been fairly well studied on cultivated, ornamental, and herbaceous plants and a high number of scale insect species have been recorded, only 1 ortheziid species has been recorded in Turkey, i.e. *Orthezia urticae* (Linnaeus) (Kaydan et al., 2007).

2. Materials and methods

Ortheziid samples were collected from 5 provinces in the eastern part of Turkey (Ağrı, Bitlis, Hakkari, Iğdır, and Van) between 2005 and 2007. Specimens were taken from both wild and cultivated plants twice a week during the spring and summer seasons of the 3-year study. Each sample was put into a plastic bag and taken to the laboratory for examination. Specimens were prepared for light microscopy using the slide-mounting method discussed by Kosztarab and Kozár (1988). Morphological terminology follows that of Kozár (2004).

Both dry and mounted materials were deposited in the Coccoidea Collection of Çukurova University (Adana), Turkey (KPCT).

3. Results

In this study, a total of 27 samples were collected from eastern Anatolia. Among these samples, 3 species were identified, of which 2 species are new records for the Turkish scale insect fauna. As a result of this study, the ensign scale insect species number in Turkey was increased to 3 species.

Genus *Orthezia* Bosc

Adult female external covering made up of definite and usually sharply segregated tufts of waxy secretions. Body oval, often broadly rounded posteriorly and tapering anteriorly (Figures 1a–1c).

Slide-mounted female with 7- or 8-segmented antennae, segments covered with different size, shape, number, and type of setae; flagellate setae present on third, fourth, seventh, and eighth antennal segments. Eye stalks protruding, thumb-like, sometimes with tubercles. Legs well developed, leg setae robust, spine-like or hair-like; trochanter and femur fused but tibia and tarsus not fused; claw digitules generally spine-like, claw with denticle. Labium 1 segmented with numerous setae. Stylet loop short, usually as long as labium. Atrium of thoracic spiracles without pores. Ovisac band with bands or rows of wax plates. Sclerotized cephalic plates absent on head of dorsum. Anal ring with 6 setae, placed in fold of derm on dorsal surface. Pores with 1 to 4 loculi, scattered over surface. Abdominal spiracles 8 pairs on dorsum (Kozár, 2004).

Although most of the species are known from the Nearctic and Palearctic regions, some species are known from South Africa. In total, 24 species have been hitherto known in this genus (Ben-Dov et al., 2013).

Key to *Orthezia* species found in Turkey

1– Fleshy sensory setae present on third, fourth, seventh, and eighth antennal segments ..... *Orthezia maroccana* Kozár & Konczné Benedicty

– Fleshy sensory setae present on seventh and eighth antennal segments 2

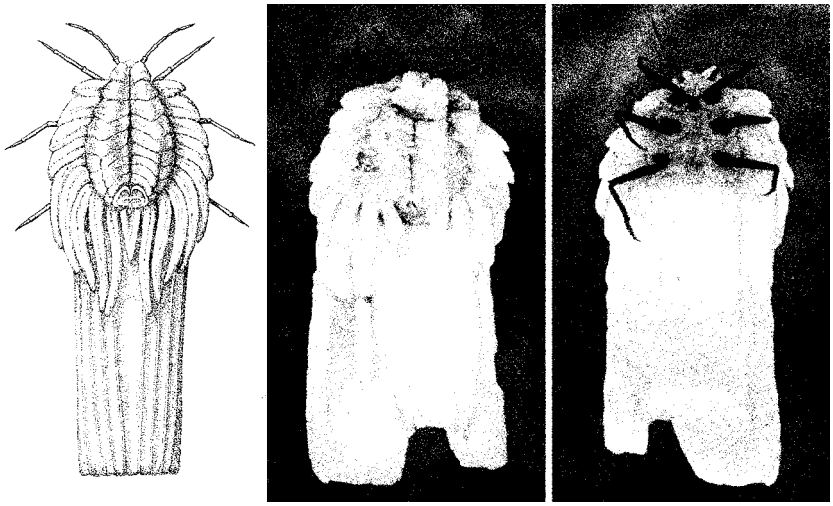

Figure 1. *Orthezia urticae*: **a, b)** dorsum; **c)** venter.

2– Quadrilocular pores absent in ovisac band in mid-venter ..... *Orthezia urticae* (Linnaeus)
– Quadrilocular pores present on one-third of posterior ovisac in mid-venter ..... *Orthezia yashushii* Kuwana

**Orthezia maroccana* Kozár & Konczné Benedicty (Figure 2)

Material examined: Ağrı, Doğubeyazıt-Mount Ağrı, 04.VI.2006, 39°36′520″N, 44°12′498″E, 1635 m, *Astragalus* sp., 4 ♀♀ (KPCT: 2834); Ağrı, Hamur, 10.VII.2007, 39°35′849″N, 42°55′851″E, 1561 m, *Gallium* sp., 3 ♀♀ (KPCT: 4104); Ağrı, Patnos-Gökçeali, 10.VII.2007, 39°06′443″N, 42°54′812″E, 1793 m, *Astragalus* sp., 3 ♀♀ (KPCT: 4103); Bitlis, Hizan, 10.VIII.2005, 38°13′881″N, 42°25′888″E, 1492 m, *Astragalus* sp., 2 ♀♀ (KPCT: 2213); Bitlis, Mount Süphan, 13.VII.2007, 38°53′980″N, 42°54′953″E, 2097 m, *Astragalus* sp., 3 ♀♀ (KPCT: 4166); Hakkari, Beyköy, 14.IX.2005, 37°33′184″N, 43°43′525″E, *Astragalus* sp., 2 ♀♀ (KPCT: 2323); Hakkari, Esendere, 05.VII.2007, 37°41′982″N, 44°34′329″E, 1721 m, *Astragalus* sp., 3 ♀♀ (KPCT: 3966); Hakkari, Esendere, 05.VII.2007, 37°41′982″N, 44°34′329″E, 1721 m, *Eryngium campastre* L., 3 ♀♀ (KPCT: 3967); Hakkari, Esendere, 05.VII.2007, 37°42′423″N, 44°32′047″E, 1783 m, *Eryngium campastre*, 2 ♀♀ (KPCT: 4012); Van, Bahçesaray, 25.VI.2007, 38°11′860″N, 43°13′116″E, 2160 m, *Noneae* sp., 1 ♀ (KPCT: 3786); Van, Başkale-Haşap, 14.VI.2006, 38°08′572″N, 44°03′771″E, 2142 m, *Astragalus* sp., 2 ♀♀ (KPCT: 2906); Van, Çatak, 03.VII.2007, 37°55′952″N, 42°59′973″E, 1535 m, *Astragalus* sp., 2 ♀♀ (KPCT: 3887); Van, Çatak, 19.VII.2005, 38°00′044″N, 43°03′578″E, 1400 m, *Astragalus* sp., 1 ♀ (KPCT: 2042); Van, Erciş road, 22.VI.2007, 38°49′507″N, 43°24′999″E, 1693 m, *Astragalus* sp., 1 ♀♀ (KPCT: 3730); Van, Gürpınar road, 01.VI.2006, 38°03′620″N, 43°29′478″E, 2271 m, *Thymus* sp., 4 ♀♀ (KPCT: 2778).

Adult female 2.74 mm long, 2.5 mm width. Fleshy sensory setae present on seventh and eighth antennal segments. *Venter*. Eyestalk elongate conical. Legs well developed. Stylet loop as long as labium. Wax plates present in marginal areas of head and thorax; with small spine cluster lateral of antennae and normal plate between antennae; with marginal wax band surrounding each thoracic spiracle; with plates in front of coxa; with cluster of spines between hind legs and ovisac band; with 4 bands of spines within ovisac band. Atrium of thoracic spiracles surrounded by wax spines without quadrilocular pores associated with spiracular opening. *Dorsum*. Wax plate bands cover all surface, divided medially. Spines in wax plate capitate, hair-like setae present in marginal wax plate also present in very small numbers on medial bare area. Pores with 4 loculi, present in marginal areas of abdomen, between wax plate bands, some present near anal ring. Abdominal spiracles 8 pairs on each side of abdominal segments (Kozár, 2004).

This species has been recorded only in Morocco, at an altitude of around 1400 m on *Cistus* sp. (Kozár, 2004). *O. maroccana* is a new record for the Turkish scale insect fauna.

Orthezia urticae (Linnaeus) (Figure 3)

Synonymy: *Aphis urticae* Linnaeus, *Orthezia characias* Bosc d'Antic, *Dorthezia characias* Bosc d'Antic, *Coccus characias* Olivier, *Coccus dubius* Fabricius, *Aphis urticata* Stewart, *Dorthezia delavauxii* Thiebaut, *Dorthesia urticae* Burmeister, *Coccus glechomae* Burmeister, *Dorthezia dispar* Kaltenbach, *Orthezia cataphracta* Signoret (incorrect synonymy), *Orthezia maenariensis* Douglas, *Orthezia martelli* Leonardi, *Orthezia japonica* Kuwana, *Orthezia arenariae* Vayssière.

Material examined: Van, Bahçesaray road, 25.VI.2007, 38°06′546″N, 43°08′615″E, 2122 m, *Astragalus* sp., 2 ♀♀

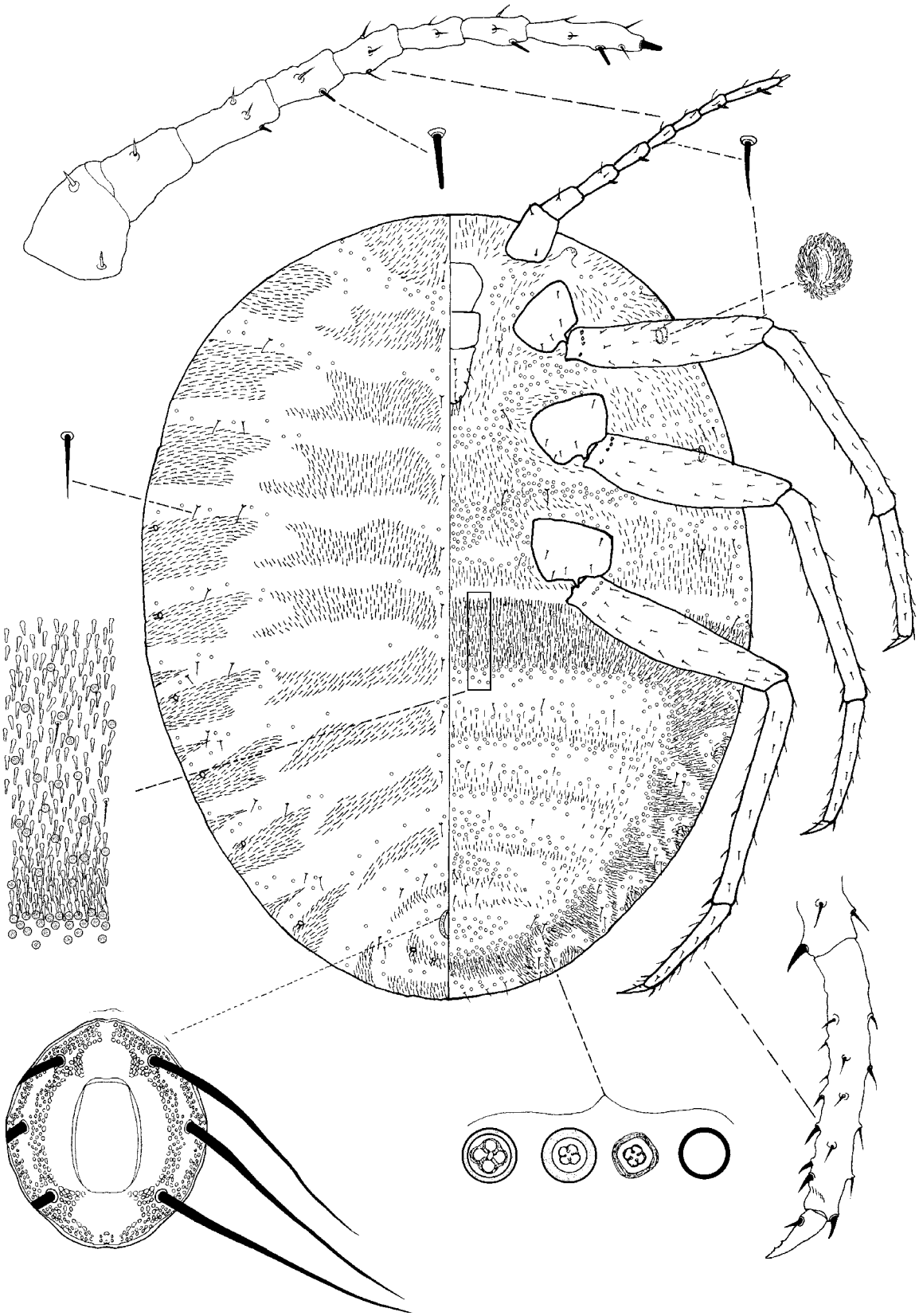

Figure 2. *Orthezia maroccana* Kozár & Konczné Benedicty (after Kozár, 2004, with modifications).

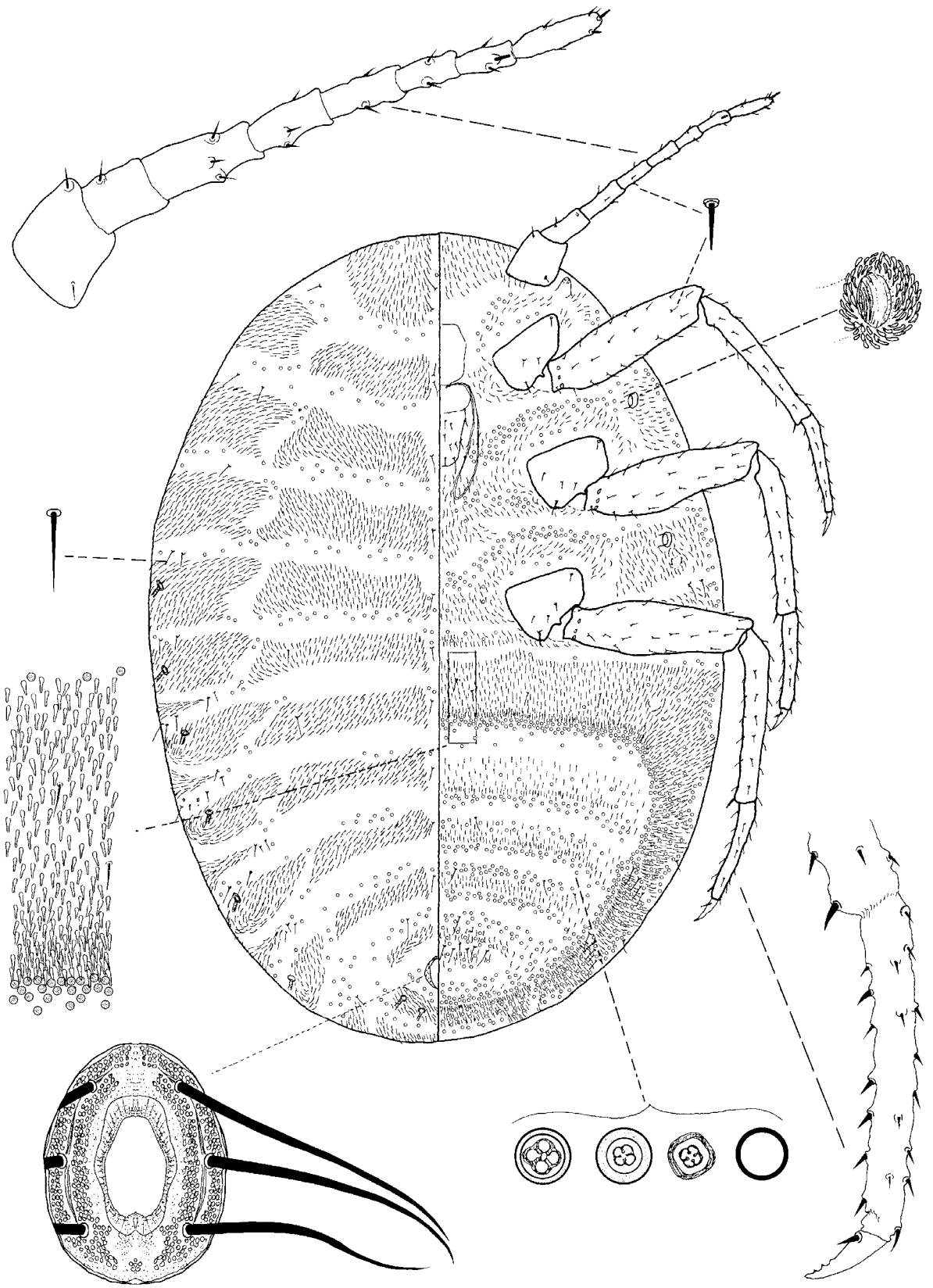

Figure 3. *Orthezia urticae* (Linnaeus) (after Kozár, 2004, with modifications).

(KPCT: 3793); Van, Başkale road, 25.V.2007, 38°08′838″N, 44°02′982″E, 2192 m, *Astragalus* sp., 3 ♀♀ (KPCT: 3399); Van, Bahçesaray, 07.IX.2005, 38°08′879″N, 43°00′742″E, 2307 m, *Dianthus* sp., 1 ♀ (KPCT: 2319); Hakkari-Van road, 08.05.2007, *Thymus* sp., 2 ♀♀ (KPCT: 3215); Hakkari, 30 km to Şemdinli, 06.VII.2007, 37°25′931″N, 44°26′213″E, 1924 m, *Astragalus* sp., 1 ♀ (KPCT: 3068); Van, Bahçesaray-Gayda road, 28.VI.2006, 38°06′609″N, 42°41′553″E, 1961 m, undetermined plant, 1 ♀ (KPCT: 3057); Van, Gürpınar-Yoldüştü, 01.06.2006, 38°10′985″N, 43°32′185″E, 2210 m, undetermined plant, 1 ♀ (KPCT: 2785).

Adult female oval and covered by rows of wax plates, divided in midline. Ovipositing female 5–10 mm long, fully developed ovisac longer than the body and strongly ribbed (Figure 1a) (Kozár, 2004).

Adult female 2.6 mm long, 2.1 mm width. Fleshy sensory setae present on seventh and eighth antennal segments. *Venter.* Eyestalk elongate conical, bearing 1 or 2 distinct lateral tubercles. Legs well developed. Stylet loop as long as labium. Wax plates present in marginal areas of head and thorax; with small spine cluster lateral of antennae and normal plate between antennae; with marginal wax band surrounding each thoracic spiracles; with plates in front of coxa; with cluster of spines between hind legs and ovisac band; with 3 bands of spines within ovisac band. Atrium of thoracic spiracles surrounded by wax spines without quadrilocular pores associated with spiracular opening. Pores with 4 loculi, predominant near anterior edge of spine bands only, as well as in ovisac band (Figure 4a). *Dorsum*. Wax plate bands cover all surfaces, divided medially. Spines in wax plate capitate, hair-like setae present in marginal wax plate, also present in very small numbers on medial bare area. Pores with 4 loculi, predominant only near anterior edge of spine bands, between the spine bands, some present around anal ring. Abdominal spiracles 8 pairs on each side of abdominal segments (Kozár, 2004).

This species has been found on 80 plant species from 30 different families in Algeria, Austria, Bulgaria, Cape Verde, China, Corsica, Croatia, Czech Republic, Denmark, Finland, France, Georgia, Germany, Greece, Hungary, Iran, Iraq, Ireland, Italy, Lithuania, Mongolia, Morocco, Netherlands, Poland, Portugal, Romania, Sicily (Italy), Spain, Sweden, Switzerland, Turkmenistan, United Kingdom, Uzbekistan, and former Yugoslavia (Ben-Dov et al., 2013).

Orthezia urticae has been found in Turkey on various plant species in the Mediterranean, eastern Anatolian, and middle Anatolian regions (Kaydan et al., 2007).

**Orthezia yashushii* Kuwana

Synonym: *Orthezia yasushii* (Morrison, 1952; Kozár 2004), misspelling of the species name (Ben-Dov et al. 2013).

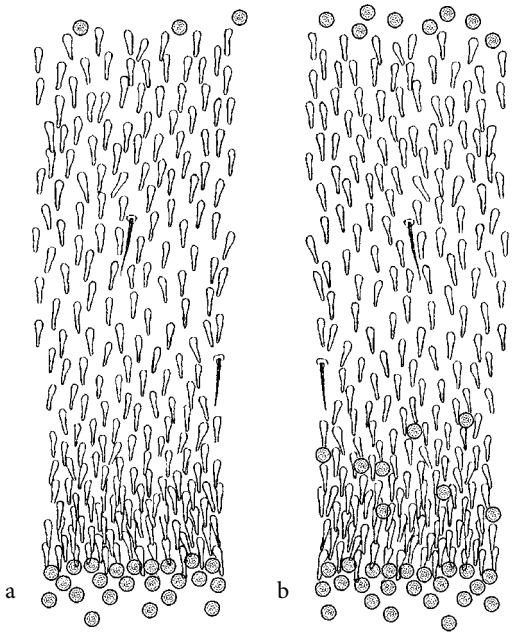

Figure 4. The structure of pores and spines on the middle of ovisac band on venter: **a)** *O. urticae*; **b)** *O. yashusii*.

Material examined: Hakkari, 30 km to Şemdinli, 06.VII.2007, 37°25′931″N, 44°26′213″E, 1924 m, *Astragalus* sp., 1 ♀ (KPCT: 4068); Iğdır, İpsiz, 13.VI.2007, 40°03′942″N, 43°25′244″E, 1807 m, *Thymus* sp., 1 ♀ (KPCT: 3573); Van, Gevaş-Tatvan road, 21.IX.2005, 38°19′981″N, 42°53′023″E, 1720 m, *Thymus* sp., 1 ♀ (KPCT: 2406); Van, Bahçesaray, 04.07.2007, 37°41′673″N, 42°52′296″E, 1538 m, *Thymus* sp., 1 ♀ (KPCT: 3973).

Adult female oval, 2–3 mm long, 1.5–2.0 mm width, ovisac 3.2 mm long. Adult female oval, dark reddish brown on dorsal surface, legs dark brown. Body completely covered with a white waxy secretion in 4 longitudinal bands (Kuwana, 1923). Fleshy sensory setae present on seventh and eighth antennal segments. *Venter*. Well-developed wax plate bands present in marginal areas of head and thorax with groups surrounding each thoracic spiracle, with wax plates in front of coxa with 4 loose bands of spines within ovisac band. Ovisac band well developed, with band of quadrilocular pores on one-third of posterior margin of ovisac band in the mid-venter (Figure 4b), high number of pores scattered among wax spines. *Dorsum*. Wide wax plate bands cover dorsum; divided medially. Quadrilocular pores scattered on dorsum. Anal ring with 6 setae. Abdominal spiracles 8 pairs on each side of abdominal segments (Kozár, 2004).

This species was found on *Anaphalis margaritacea* (L.), *Artemisia capillaris* Thunb., *Artemisia vulgaris* var. *indica* Willd., *Chrysanthemum* sp., *Lespedeza bicolor* Turcz.,

Medicago denticulate Willd., and *Quercus dentata* Thunb. in Taiwan, China, Japan, Russia, Korea, Hungary, and Tunisia (Ben-Dov et al., 2013).

Orthezia yashushii is a new record for the Turkish scale insect fauna.

4. Discussion

With the addition of *O. maroccana* and *O. yashushii*, the number of species in Turkey is increased to 3. The results show that the fauna of Turkey contains some possible unique elements, and further exploration should reveal other undescribed ortheziid taxa both in Turkey and in other countries in the Mediterranean region.

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