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Diagnosis of *Spilococcus pacificus* (Borchsenius, 1949) and
an updated list of scale insects (Hemiptera: Coccoomorpha)
on pears (*Pyrus* L.: Rosaceae) in South Korea

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Diagnosis of *Spilococcus pacificus* (Borchsenius, 1949) and an updated list of scale insects (Hemiptera: Coccoomorpha) on pears (*Pyrus* L.: Rosaceae) in South Korea

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Abstract. Pears, *Pyrus pyrifolia* (Burm.f.) Nak. (Rosaceae) are one of the most widely grown fruit trees in South Korea. Approximately 11% of the total pear production in 2022 was exported to countries such as the US and Vietnam. Exported pears must be free of pest species that are considered of quarantine importance by the importing countries. Herein, a list of scale insects (Hemiptera: Coccoomorpha) associated with pear trees is updated. Additionally, *Spilococcus pacificus* (Borchsenius) is added to the list of mealybugs affecting pears in South Korea and is briefly diagnosed based on non-type specimens and illustrated using photographs. Information on its distribution and plant hosts are also provided.

Key words. Export, misidentification, quarantine.

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Introduction

Pears, *Pyrus* L. (Rosales: Rosaceae) are one of the most important fruit crops in temperate regions (Chung et al. 2019). In South Korea, the Asian pear, *Pyrus pyrifolia* (Burm.f.) Nak. cv. Niiitaka is the most widely grown cultivar and makes up approximately 85% of the total area (9,680 hectares) of pears cultivated in the country (KATI 2023). About 11% of the total production of 251,093 tons as of 2022 was exported to countries such as Canada, Hong Kong, Taiwan, USA and Vietnam; of these, the USA accounts for around 48% of the total exports (KATI 2023). Exported pears must be free of pest species such as mealybugs or mites that are not known to occur in the importing countries and are considered to be of quarantine importance.

Scale insects (Hemiptera: Coccoomorpha) are sap-sucking hemipterans that are found on the leaves, twigs, branches, fruits and roots of their host plants (Kondo et al. 2008; Basheer et al. 2016). In South Korea, sixteen species of scale insects have been reported to occur on pear trees (Paik 1978; Kwon and Han 2003; Kwon et al. 2003; Suh 2020). Of them, two mealybugs (Pseudococcidae), *Crisicoccus seruratus* (Kanda) and *Pseudococcus comstocki* (Kuwana) have been found mainly on pear fruits. Recently, Tanaka and Kamitani (2022) reviewed the genus *Crisicoccus* in Japan and synonymized *Crisicoccus matsumotoi* with *C. seruratus*, a species known to occur in South Korea. In the same study, Tanaka and Kamitani (2022) reexamined specimens (two adult females) that were collected on a pear tree in Gunwi, South Korea in 2012, that had been erroneously identified as *C. matsumotoi* (now *C. seruratus*) and determined to be a misidentification of *Spilococcus pacificus* (Borchsenius 1949). In the present study, the remaining mealybug specimens deposited in the Collection of Plant Quarantine Technology Center (CPQTC) that were associated with pear trees in South Korea were re-examined and additional individuals were collected on the same hosts during 2023 and were identified as *S. pacificus*.

For the correct identification, *S. pacificus* is diagnosed based on morphological characteristics of non-type material and illustrated using photographs of insects in life and slide-mounted specimens. Furthermore,

information on the distribution and plant hosts of *S. pacificus* are provided. The list of scale insect species that occur on pear trees in South Korea is updated.

Materials and Methods

Danzig (1980) and Tanaka and Kamitani (2022) provided descriptions of *S. pacificus* that is herein added to a list of scale insects associated with pears in South Korea. The scale insect database, ScaleNet (García Morales et al. 2023) provide a comprehensive summary of information on the nomenclature, host plants and distribution of scale insects of the world. Herein, we provide a brief diagnosis and photographs of the major characters of *S. pacificus*. The slide-mounted specimens studied are deposited in the CPQTC, Animal Plant Quarantine Agency (APQA), South Korea. The characters provided below for diagnoses are based on specimens of adult females collected on its host plants. Terminology for morphological structures follows Williams (2004). Acronyms of collecting regions are as follows: Gyeonggido (GG), Gyeongsangbukdo (GB) and Jeollanamdo (JN). Photographs were taken using an AxioCam MRc5 camera mounted on a ZEISS Axio Imager M2 Microscope and a Leica M165C microscope with a Delta pix camera.

Results

The identity of *S. pacificus* was confirmed by re-examining 64 adult female specimens deposited in the CPQTC that were associated with pear trees and 11 additional adult female specimens collected on the same host in Naju and Anseong, South Korea during this survey of 2023 were also identified as this species. Table 1 presents an updated list of scale insect species associated with pear trees in South Korea based on published literature and specimens collected in the present study.

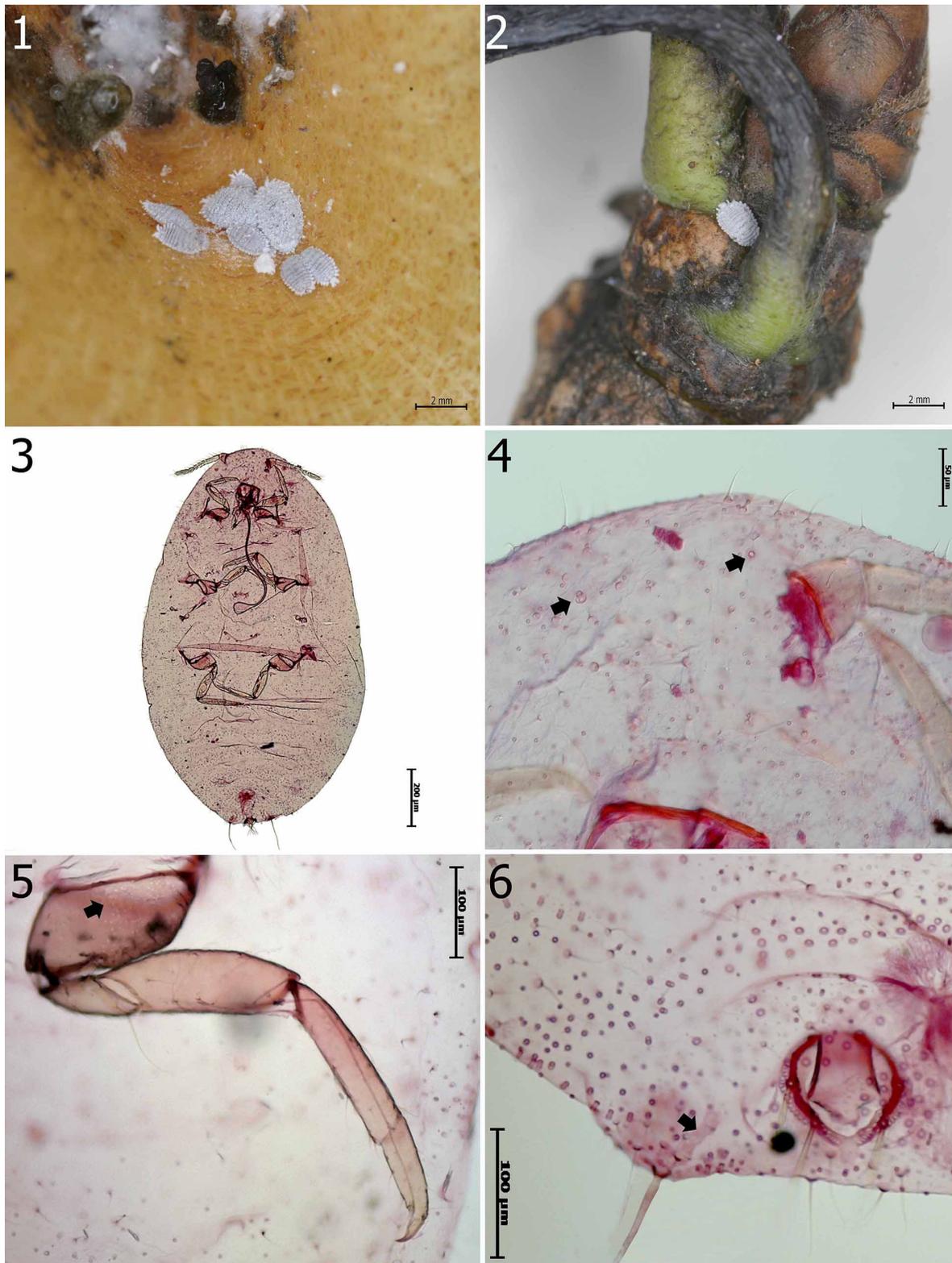
Spilococcus pacificus (Borchsenius, 1949)

(Fig. 1–6)

Borchsenius (1949) described *Pseudococcus pacificus* based on specimens found on apples in Primor'ye Kray, Russia. Borchsenius and Kozarzhevskaya (1966) described *Paracoccus betulae* found on *Betula dahurica* Pallas from Primor'ye Kray, Okeanskoy, Russia. Danzig (1980) synonymized *P. betulae* with *P. pacificus* and transferred it to *Spilococcus pacificus* (Borchsenius). Tang (1992) transferred *P. pacificus* to *Atrococcus pacificus* (Borchsenius) which was subsequently transferred back to *Spilococcus pacificus* (Borchsenius) by Ben-Dov (1994). Paik (1978) misidentified the species as *Crisicoccus seruratus* (Kanda 1933), a species which Tanaka and Kamitani (2022)

Table 1. List of scale insect species associated with pear trees in South Korea. The asterisk (*) indicates an additional recorded species.

Family	Species	Family	Species
Monophlebidae	<i>Drosicha corpulenta</i> (Kuwana)	Coccidae	<i>Nipponpulvinaria horii</i> (Kuwana)
Pseudococcidae	<i>Dysmicoccus wistariae</i> (Green)		<i>Parthenolecanium corni</i> (Bouché)
	<i>Planococcus citri</i> (Risso)		<i>Parthenolecanium glandi</i> (Kuwana)
	<i>Planococcus kraunhiae</i> (Kuwana)		<i>Parthenolecanium persicae</i> (Fabricius)
	<i>Pseudococcus comstocki</i> (Kuwana)	Diaspididae	<i>Comstockaspis perniciosus</i> (Comstock)
	* <i>Spilococcus pacificus</i> (Borchsenius)		<i>Lepidosaphes conchiformis</i> (Gmelin)
Coccidae	<i>Ceroplastes ceriferus</i> (Fabricius)		<i>Lopholeucaspis japonica</i> (Cockerell)
	<i>Ceroplastes japonicus</i> Green		<i>Parlatoria theae</i> Cockerell



Figures 1–6. *Spilococcus pacificus* (Borchsenius) on pear trees. 1–2) Habitus. 3) Adult female. 4) Head (black arrows: oral rim tubular ducts). 5) Hind leg (black arrow: translucent pores). 6) Anal lobe cerarius (black arrow: anal bar).

determined to be a senior synonym of *Crisicoccus matsumotoi* (Shiraiwa 1935). Kwon and Han (2003), Kwon et al. (2003) and Suh (2020) misidentified *S. pacificus* as *Crisicoccus matsumotoi* (Shiraiwa 1935).

Field diagnosis. Body of adult female about 2.5 mm long, soft and wingless, elongated oval, reddish orange in color, covered with white mealy wax; with short wax filaments on each abdominal side of body. During slide-mounting, body contents turn green-black in KOH.

Characteristics of slide-mounted adult female. Body elongate oval, about 2.0 mm long and 1.5 mm wide. Anal lobes well developed; dorsal surface of each lobe with a slightly sclerotized area; ventral surface with well-developed anal lobe bar and long apical seta. Antenna with 8 segments. Legs well developed; hind coxa with translucent pores; claw without a denticle. Circulus usually quadrate. Cerarii numbering 7–8 pairs, all present on abdominal segments; usually each with 2 conical setae. Dorsum with a few oral rim tubular ducts present on submarginal to medial areas of head, thoracic and abdominal segments.

Distribution. China, Russia, South Korea (García Morales et al. 2023).

Hosts. *Betula dahurica* (Betulaceae), *Styphnolobium japonicum* (L.) Schott (Fabaceae), *Broussonetia kazinoki* Siebold, *Morus* sp. (Moraceae), *Fraxinus* sp. (Oleaceae), *Malus mandshurica* (Maxim.) Kom., *M. pumila* Mil., *Prunus* sp., *Pyrus pyrifolia*, *P. ussuriensis* Maxim. (Rosaceae), *Acer palmatum* Thunb. (Sapindaceae) (García Morales et al. 2023).

Material examined. South Korea. GG: Pyeongtaek, 1 female, on *Pyrus pyrifolia*, 2-x-2008 (S.J. Lee); Anseong, 4 females, same host plant, 30-x-2023 (J. Ji). GB: Gumi, 1 female, on *P. pyrifolia*, 8-ix-2009 (Y.H. Lee); same data, except for 29-x-2007; Gunwi, 2 females, *P. ussuriensis*, 13-ix-2012 (S.J. Suh). JN: Naju, 1 female, on *P. pyrifolia*, 21-ix-2006 (S.J. Lee); same data, except for 13-viii-2007; Naju, 26 females, *P. pyrifolia*, 28-viii-2007; Naju, 7 females, same host plant, 28-viii-2007; Naju, 3 females, same host plant, 5-x-2007; Naju, 1 female, same host plant, 23-x-2007; Sinan, 2 females, same host plant, 26-x-2007; Naju, 2 females, *P. pyrifolia*, 30-x-2007; same data, except for 2-xi-2007; same data, except for 3-xi-2007; Naju, 1 female, same host plant, 19-v-2008; Naju, 7 females, same host plant, 23-xi-2023 (N.Y. Lee).

Remarks. This mealybug is fairly common in pear orchards in South Korea. *Spilococcus pacificus*, compared to the other mealybugs found on pears in South Korea, is most similar to *Pseudococcus comstocki*, but can be differentiated from that species by having 7–8 pairs of cerarii and about 90 multilocular disc pores on abdomen, provide here the unique character states of *S. pacificus*. It may also be confused with *Planococcus citri* and *Planococcus kraunhiae* but differs from those species by having oral rim tubular ducts.

Discussion

Through late spring to fall, *S. pacificus* is found on fruits and twigs of pears. Observations made by the authors suggest that this sap-sucking mealybug is not a pest that causes economic damage to its hosts. Oftentimes, mealybugs do not cause serious problems in their countries of origin because endemic parasitoids and predators suppress the population naturally (Shah et al. 2015). In South Korea, fruit bagging has become an integral part of fruits cultivated for domestic and export markets. This cultivation might facilitate the build-up of populations of this species if it is already present on the fruits. High mealybug populations often produce large amounts of honeydew in the case of bagged pears, resulting in the spread of black sooty molds. This species requires much attention since it is not known to occur in several of the countries where the pears are exported and its presence on the stalk and calyx end of pear fruits could lead to their rejection during pre-export inspection, or subsequently at the ports of entry of the importing countries.

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