

Notes on Armored Scale Species from Greenhouse in Korea (Hemiptera: Diaspididae)

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온실의 깍지벌레과(노린재목)에 대한 발생조사

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ABSTRACT : Seventy two species of armored scale have been recorded from the Korean peninsula since late 1920s. Nine of these species were obtained from greenhouses. Of these 9 armored scale species, 7 species are considered to have failed to colonize fields or greenhouses and 2 species, which were collected from pineapple plants, Tillandsia plants and cactus trees in greenhouses, were never taken from the exterior environment.

KEY WORDS : armored scales, Diaspididae, Hemiptera, greenhouses, Korea

초 록 : 우리나라에 1920년대 후반부터 현재까지 72종의 깍지벌레과가 보고되었으며, 이중 9종은 온실에서 보고된 종이다. 온실에서 보고된 9종중 7종은 야외에서 서식하는 자생식물 또는 온실에서 재배되는 식물에서 발생이 확인되지 않았다. 나머지 2종은 온실에서 재배되고 있는 파인애플, 틸란드시아 및 선인장에서 채집 확인되었으나, 야외에서 서식하는 자생식물에서 발생되지 않았다.

검색어 : armored scales, 깍지벌레과, 노린재목, 온실, 한국

Records on armored scales in Korea began in 1928 with the first report of the white peach scale, *Pseudaulacaspis pentagona* (Targioni-Tozzetti), by Machia and Aoyama (Paik, 1978). A number of diaspidid species were then reported by Japanese entomologists such as Saito, Nakayama, and Kanda during the early 1930s and 1940s (Paik, 1978). During the 1960s and early 1980s,

Borchsenius and Danzig added some diaspidids from North Korea (Paik, 2000). In 1972, Paik reported additional information for four diaspidid species as occurring in greenhouses in Korea. In addition, Paik (1978) published the illustrated diaspidid fauna of Korea. No other major study on Diaspididae of Korea has been conducted. At present, seventy two species of armored scale insects are

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known to occur on the Korean peninsula, including literature records (Paik, 1978; Paik, 2000; Kwon et al., 2003; Kwon et al., 2005; Suh and Hodges, 2007).

Of the seventy two species, the following nine species are known only to occur in greenhouses in Korea (Paik, 1972; Paik, 1978; Paik, 2000): *Aspidiotus nerii* Bouché, *Chrysomphalus aonidum* (Linnaeus), *Diaspis boisduvalii* Signoret, *Diaspis bromeliae* (Kerner), *Diaspis echinocacti* (Bouché), *Hemiberlesia lataniae* (Signoret), *Parlatoria proteus* (Curtis), *Pinnaspis buxi* (Bouché), and *Pinnaspis strachani* (Cooley). The oleander scale (*Aspidiotus nerii* Bouché) may have been added to the list of Korean armored scales because this species was taken in quarantine on Korean produce at U.S. ports of entry, but earlier records could not be traced (Paik, 2000).

Most of the armored scales are of economic significance because they occur on a variety of host plants including

ornamental plants. Two of the most important species are the Florida red scale (*Chrysomphalus aonidum* (Linnaeus)) and boisduval scale (*Diaspis boisduvalii* Signoret) because they are considered serious pests of citrus and orchids (Miller and Davidson, 2005).

The purpose of this survey was to confirm if the nine greenhouse diaspidid species reported in previous papers currently occur in the field or in greenhouses in the Republic of Korea.

Materials and Methods

From 2005 to 2008 we surveyed plants growing in the wild and in greenhouses, as well as areas around the greenhouses (Table 1). Field and greenhouse observations and collections of specimens based on host-plant

Table 1. Survey records of armored scales conducted from 2005 to 2008 in Korea

Date	Month	Locality
2005	Jul.	JN: Damyang-gun (field). JJ: Jeju-si (field and greenhouse), Seogwipo-si (field and greenhouse)
	Sep.	GN: Gimhae-si (field and greenhouse)
	Oct.	JJ: Jeju-si (field and greenhouse), Seogwipo-si (field and greenhouse)
	Nov.	GG: Goyang-si (greenhouse), Yongin-si (greenhouse)
2006	Mar.	GN: Gimhae-si (greenhouse). JB: Gimje-si (greenhouse), Jeonju-si (field and greenhouse)
	Apr.	GG: Suwon-si (field). GB: Daegu-si (field), Geumosan (field). GN: Pyochungsa (field). JJ: Jeju-si (field and greenhouse), Seogwipo-si (field and greenhouse)
	May	GG: Youngjusa (field), Gwanggyosan (field). GB: Palgongsan (field). JJ: Jeju-si (field and greenhouse), Seogwipo-si (field and greenhouse)
	Jun.	GB: Gatbawi (field)
	Jul.	GG: Eobisan (field)
	Aug.	GG: Hongneung-arboretum (field), Gwangneung-arboretum (field).
	Sep.	CN: Chollipo-arboretum (field), Anmyeon-do (field), Ganwol-do (field). GN: Geumjeongsan (field)
Oct.	CN: Cheongyang-gun (field), Goun-arboretum (field)	
2007	Apr.	JJ: Jeju-si (field and greenhouse), Seogwipo-si (field and greenhouse)
	May	JN: Mokpo-si (field), Wando-arboretum (field)
	Jun.	GG: Namhansanseong (field). GN: Busan-si (field and greenhouse)
	Jul.	JN: Sanpo-myoen (field and greenhouse), Gwangju-si (field)
	Aug.	JN: Geumcheon-myeon (field)
Dec.	GN: Busan-si (field)	
2008	Mar.	GN: Jinju-arboretum (field and greenhouse)
	Apr.	GN: Jinju-arboretum (field). JN: Bogil-do (field)
	May	GG: Suwon-si (field). GN: Busan-si (field), Jinju-arboretum (field). JN: Muan-gun (greenhouse). JJ: Jeju-si (field and greenhouse), Seogwipo-si (field and greenhouse)
	Jun.	JN: Mokpo-si (field), Wando-arboretum (field and greenhouse)
	Jul.	JJ: Jeju-si (field and greenhouse), Seogwipo-si (field and greenhouse)
	Aug.	GN: Busan-si (field)
	Sep.	GG: Bulamsan (field), Goyang-si (greenhouse), Hongneung-arboretum (field). GN: Busan-si (field)
	Oct.	GB: Gyeongju-si (field)
	Nov.	GN: Oedo (field)

Abbreviations: GG, Gyeonggi-do; CN, Chungcheongnam-do; GB, Gyeongsangbuk-do; GN, Gyeongsangnam-do; JB, Jeollabuk-do; JN, Jeollanam-do; JJ, Jeju-do.

data for the nine greenhouse diaspidid species were conducted and all freshly collected specimens were slide-mounted in Canada balsam. They were compared to slide-mounted museum specimens for identifications (Florida Department of Agriculture, Division of Plant Industry, USA). Illustrative photographs were taken using a Leica MZ12 stereomicroscope with a camera connected to the iSolution-DT.

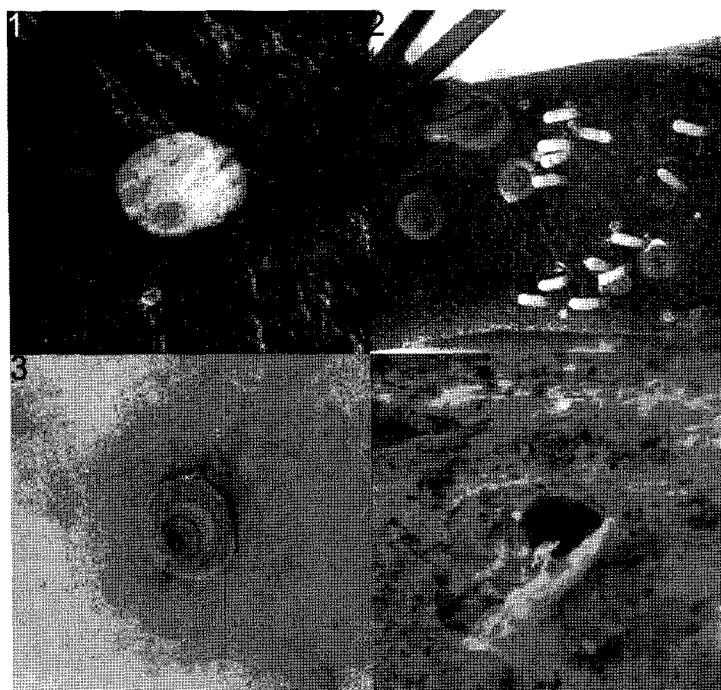
Results and Discussion

Plant materials that may contain exotic pest species continue to be imported into Korea from other countries.

Under these circumstances, greenhouse scale species have potential opportunities to establish in the Korean environment. In this respect, to fairly regulate the armored scales intercepted on imported plant material requires the correct knowledge of species of armored scales known to occur in Korea. However, we were not able to examine specimens collected before our study, except for *Diaspis boisduvalii* Signoret (on *Dendrobium*) and *Diaspis bromeliae* (Kerner) (on *Ananas*) taken from greenhouses (Table 2). During this survey, the pineapple scale, *Diaspis bromeliae* (Kerner) was also taken on *Ananas* (once) and *Tillandsia* (once) growing inside greenhouses from Jeju-do. In addition, the cactus scale, *Diaspis echinocacti* (Bouché) was on an unidentified cactus (once) growing

Table 2. Collection records of armored scales known as greenhouse species in Korea

Species	Date	Host	Locality
<i>Diaspis boisduvalii</i> Signoret	IV-16-2003	<i>Dendrobium</i>	JJ: Seogwipo-si (greenhouse)
<i>Diaspis bromeliae</i> (Kerner)	III-23-1972	<i>Ananas</i>	JJ: Seogwipo-si (greenhouse)
	IV-6-1972	ditto	GG: Suwon-si (greenhouse)
	V-14-1977	ditto	GG: Seoul (greenhouse)
	III-11-1988	ditto	GG: Yongin-si (greenhouse)
	IV-2-1998	ditto	GG: Suwon-si (greenhouse)



Figs. 1~4. 1. *Aspidiotus nerii* Bouché, New Zealand, intercepted at Busan Int. Seaport, on *Cucurbita*, VI-9-2006; 2. *Diaspis echinocacti* (Bouché), China, intercepted at Incheon Int. Seaport, on unidentified cactus, I-23-2007; 3. *Hemiberlesia lataniae* (Signoret), USA, intercepted at Busan Int. Seaport, on *Pyrus*, X-7-2008 (photo C.S. Ryu, Yeongnam R/O, 2008). 4. *Pinnaspis strachani* (Cooley), Costa Rica, intercepted at Incheon Int. Airport, on *Dracaena*, I-14-2009.

Table 3. List and collection details of armored scales known as greenhouse species in Korea

Species	Earliest Korea Record	Host	Collected during the survey	
			Field (Host)	Greenhouse (Host)
<i>Aspidiotus nerii</i> Bouché	Nakahara, 1982	Unknown plant	No	No
<i>Chrysomphalus aonidum</i> (Linnaeus)	Kanda, 1942a	<i>Citrus, Musa</i>	No	No
<i>Diaspis boisduvalii</i> Signoret	Nakayama, 1933	<i>Oncidium, Laelia</i>	No	No
<i>Diaspis bromeliae</i> (Kerner)	Paik, 1978	<i>Ananas</i>	No	Yes (<i>Ananas & Tillandsia</i>)
<i>Diaspis echinocacti</i> (Bouché)	Nakayama, 1933	<i>Epiphyllum</i>	No	Yes (Unidentified cactus)
<i>Hemiberlesia lataniae</i> (Signoret)	Nakayama, 1933	<i>Rhapis</i>	No	No
<i>Parlatoria proteus</i> (Curtis)	Kanda, 1942a	<i>Pyrus</i>	No	No
<i>Pinnaspis buxi</i> (Bouché)	Nakayama, 1933	<i>Chrysanthemum</i>	No	No
<i>Pinnaspis strachani</i> (Cooley)	Kanda, 1942	<i>Asplenium</i>	No	No

in the greenhouses of Jeju-do (Table 3).

The nine scale species known to occur only in greenhouses were usually found on potted seedlings brought into Korea; four species are illustrated in figures 1 to 4. They are considered to have failed to establish in the exterior environment because we have not collected them in the field during the last 4 years (Table 3). This work provides correct information on the current status of nine greenhouse diaspidid species.

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