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Jungyoun Ji

Animal, Plant and Fisheries Quarantine and Inspection Agency, Incheon, KOREA

Soo-Jung Suh

Animal, Plant and Fisheries Quarantine and Inspection Agency, Busan, KOREA, suhsj97@gmail.com

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Jungyoun Ji

Animal, Plant and Fisheries Quarantine and Inspection Agency
2850, Unseo-dong, Jung-gu
Incheon, KOREA

Soo-Jung Suh

Animal, Plant and Fisheries Quarantine and Inspection Agency
10-4, Jungang-dong 6-ga, Jung-gu
Busan, KOREA

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Jungyoun Ji and Soo-Jung Suh

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A list of scale insects (Hemiptera: Coccoidea) intercepted in quarantine on imported succulent plants in Korea 2006-2010

Jungyoun Ji

Animal, Plant and Fisheries Quarantine and Inspection Agency,
2850, Unseo-dong, Jung-gu, Incheon, KOREA

Soo-Jung Suh

Animal, Plant and Fisheries Quarantine and Inspection Agency,
10-4, Jungang-dong 6-ga, Jung-gu, Busan, KOREA
suhsj97@gmail.com

Abstract. A list of scale insects (Hemiptera: Coccoidea) intercepted on imported succulent plants at the plant quarantine of Korea from 2006 to 2010 is provided. A total of 15 species belonging to four families are listed. Of the 15 species that were intercepted, some species are potential pests that could gain entry and establish in Korea through the importation of plant material. Current information on intercepted scale insects is required to alert inspectors at quarantine sites to look carefully at succulent plants to prevent the introduction of an exotic species.

Key words. List, scale insects, quarantine, intercepted, succulents

Introduction

Many succulents come from the dry areas of tropical and subtropical climates. Due to the desert climate, they often have a swollen or fleshy appearance and peculiar shaped flowers. Their exotic shapes have made them popular to collect and cultivate. Succulent plants, such as those in the families Cactaceae, Agavaceae, Aizoaceae and Crassulaceae, have been introduced from the New World and have become established in the wild in the Old World, including Korea. In addition some succulents that have been moved by man for many years are now cosmopolitan in distribution. With the introduction of succulents through commerce and hobbyist exchange, several scale insects species have been spread from one country to another.

According to a database of Total Situation Management System (TSMS 2011), various types of succulent plants from China, Japan, Indonesia, Italy, Netherlands, Australia, New Zealand, USA, Mexico and Brazil have been introduced into Korea. Recently, the quantity of succulents imported into Korea and cultivated in greenhouses has increased dramatically (Table 1). These plants may harbor potential pest species which could accidentally be introduced in new environments. Some species such as the cyanophyllum scale, *Abgrallaspis cyanophylli* (Signoret) and prickly pear scale, *Diaspis echinocacti* (Bouché) collected on imported succulents at the quarantine sites are recorded as important pests on prickly pears and cacti (Miller and Davidson 2005; Mazzeo et al. 2008). In Korea, the prickly pear scale occurs on cacti in greenhouses and is considered to be an invasive species.

We provide information on 15 species of scale insects intercepted at Korean ports of entry from imported succulent plants from 2006 to 2010: *Planchonia stentae* (Brain) (Asterolecaniidae), *Abgrallaspis cyanophylli* (Signoret), *Diaspis echinocacti* (Bouché) (Diaspididae), *Acanthococcus coccineus* Cockerell (Eriococcidae), *Dysmicoccus neobrevipes* Beardsley, *Ferrisia virgata* (Cockerell), *Paracoccus solani* Ezzat and McConnell, *Phenacoccus solani* Ferris, *Planococcus citri* (Risso), *Pseudococcus viburni* (Signoret), *Spilococcus mamillariae* (Bouché), *Vryburgia amaryllidis* (Bouché), *Vryburgia distincta* (De Lotto), *Vryburgia trionymoides* De Lotto, and *Vryburgia* sp. (Pseudococcidae) (Figure 1). Current information on intercepted scale insects, their plant hosts and origin is necessary to alert inspectors to the possible presence of invasive species and the importance of careful examination of imported succulent plants.

Materials and methods

Specimens of scale insects intercepted at quarantine sites from imported succulent plants from 2006 to 2010 were mounted on slides for species identification. Some species were identified and confirmed by

Table 1. Quarantine record on importing succulents from 2006 to 2010 (pcs = pieces; inspected case = number of quarantine inspections of imported succulents).

Year		2006	2007	2008	2009	2010
Imported quantity	Tons	-	-	0.78	0.74	2.95
	1000pcs	0.07	107.25	336.80	209.34	304.57
Inspected case		9	1374	2070	1230	445

scale insect experts: Drs. Ian Stocks (Florida Department of Agriculture, Division of Plant Industry, USA), Greg Evans (USDA/Animal and Plant Health Inspection, USA) and Gaetana Mazzeo (University of Catania, Italy). Nymphal stages of scale insect species were collected and reared on their hosts, however some did not develop to the adult stage and could not be identified to species, and therefore are not included in the results of this survey. Illustrative photographs were taken using a Leica M165C microscope and Delta pix camera. All specimens from this study are deposited in the Collection of Yeongnam Regional Office, Animal, Plant and Fisheries Quarantine and Inspection Agency (QIA) in Busan, Korea.

Results and discussion

The list of species collected at the quarantine sites is shown in Table 2. The most frequently intercepted pests are species of the family Pseudococcidae [*Planococcus citri* (Risso) (16 times), *Vryburgia trionymoides* De Lotto (24 times) and *Phenacoccus solani* Ferris (33 times)]. Some of the mealybugs, such as *Dysmicoccus neobrevipes* Beardsley, *Ferrisia virgata* (Cockerell), *Phenacoccus solani* Ferris, *Planococcus citri* (Risso) and *Pseudococcus viburni* (Signoret), are cosmopolitan and polyphagous pests that often seriously damage host plants (Mazzeo et al. 2008). *Dysmicoccus neobrevipes* Beardsley, *F. virgata* (Cockerell) and *P. viburni* (Signoret) are categorized as quarantine pests in Korea. *Paracoccus solani* Ezzat and McConnell has been recorded from the following zoogeographic regions: Australasian (Australia), Nearctic (Mexico, USA) and Neotropical (Costa Rica, Galapagos Islands, Peru) (ScaleNet 2011). In addition to these records, we found this species on *Echeveria* plants imported from Brazil during this survey. While examining species related *Vryburgia*, considerable effort was spent sorting out the identity of *Vryburgia* species that occur on succulents. Ten species are assigned to *Vryburgia* at present. Most of these species are from Africa, and often feed on succulents, but some species feed on a broad range of plants. Of these, 3 species (*V. amaryllidis* (Bouché), *V. brevicurvis* (McKenzie) and *V. rimariae* Tranfaglia) are considered as important pests in greenhouses and plant nurseries (Williams 2004); in this survey, *V. amaryllidis* (Bouché), *V. trionymoides* De Lotto and *Vryburgia* undetermined sp. were found on imported succulents. Recently, a quarantine sample of *V. trionymoides* De Lotto was collected on succulents in Florida, USA (I. Stocks, personal communication).

With regard to Diaspididae, *Abgrallaspis cyanophylli* (Signoret), a pest of prickly pears and *Diaspis echinocacti* (Bouché), a pest of cacti, were found on succulent plants from China and USA, respectively. *Planchonia stentae* (Brain) belongs to the family Asterolecaniidae. It was originally described from South Africa, but recently has established in the New World from imported exotic plants (Stumpf and Lambdin 2006). This species was intercepted at a Korean port of entry on *Echeveria* plants imported from Mexico, it had not previously been recorded Mexico (ScaleNet 2011).

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Table 2. A list of scale insects intercepted on succulent plants at ports of entry of Korea.

Family	Species	Host Plants (Place of origin)
Asterolecaniidae	<i>Planchonia stentae</i> (Brain)	<i>Echeveria</i> (Mexico)
Diaspididae	<i>Abgrallaspis cyanophylli</i> (Signoret)	<i>Crassula</i> (USA)
	<i>Diaspis echinocacti</i> (Bouché)	<i>Gymnocalycium</i> (China) undetermined cactus (China)
Eriococcidae	<i>Acanthococcus coccineus</i> Cockerell	<i>Echeveria</i> (Japan)
Pseudococcidae	<i>Dysmicoccus neobrevipes</i> Beardsley	<i>Yucca</i> (China)
	<i>Ferrisia virgata</i> (Cockerell)	<i>Echeveria</i> (Japan)
	<i>Paracoccus solani</i> Ezzat&McConnell	<i>Echeveria</i> (Brazil, Mexico)
	<i>Phenacoccus solani</i> Ferris	<i>Aeonium</i> (Italy) <i>Crassula</i> (Japan) <i>Echeveria</i> (Brazil, China, Japan, Netherlands) <i>Graptoveria</i> (Japan) <i>Pachyphytum</i> (Netherlands)
	<i>Planococcus citri</i> (Risso)	<i>Echeveria</i> (Japan, USA)
	<i>Pseudococcus viburni</i> (Signoret)	<i>Echeveria</i> (USA) undetermined succulent (Netherlands)
	<i>Spilococcus mamillariae</i> (Bouche)	undetermined succulent (Indonesia)
	<i>Vryburgia amaryllidis</i> (Bouché)	<i>Echeveria</i> (USA)
	<i>Vryburgia distincta</i> (De Lotto)	<i>Crassula</i> (Netherlands)
	<i>Vryburgia trionymoides</i> (De Lotto)	<i>Aeonium</i> (Australia) <i>Crassula</i> (Australia) <i>Echeveria</i> (Australia, Japan, Netherlands, New Zealand, USA) <i>Sedum</i> (Japan)
	<i>Vryburgia</i> undetermined sp.	<i>Graptoveria</i> (Japan) <i>Echeveria</i> (Australia, Japan)

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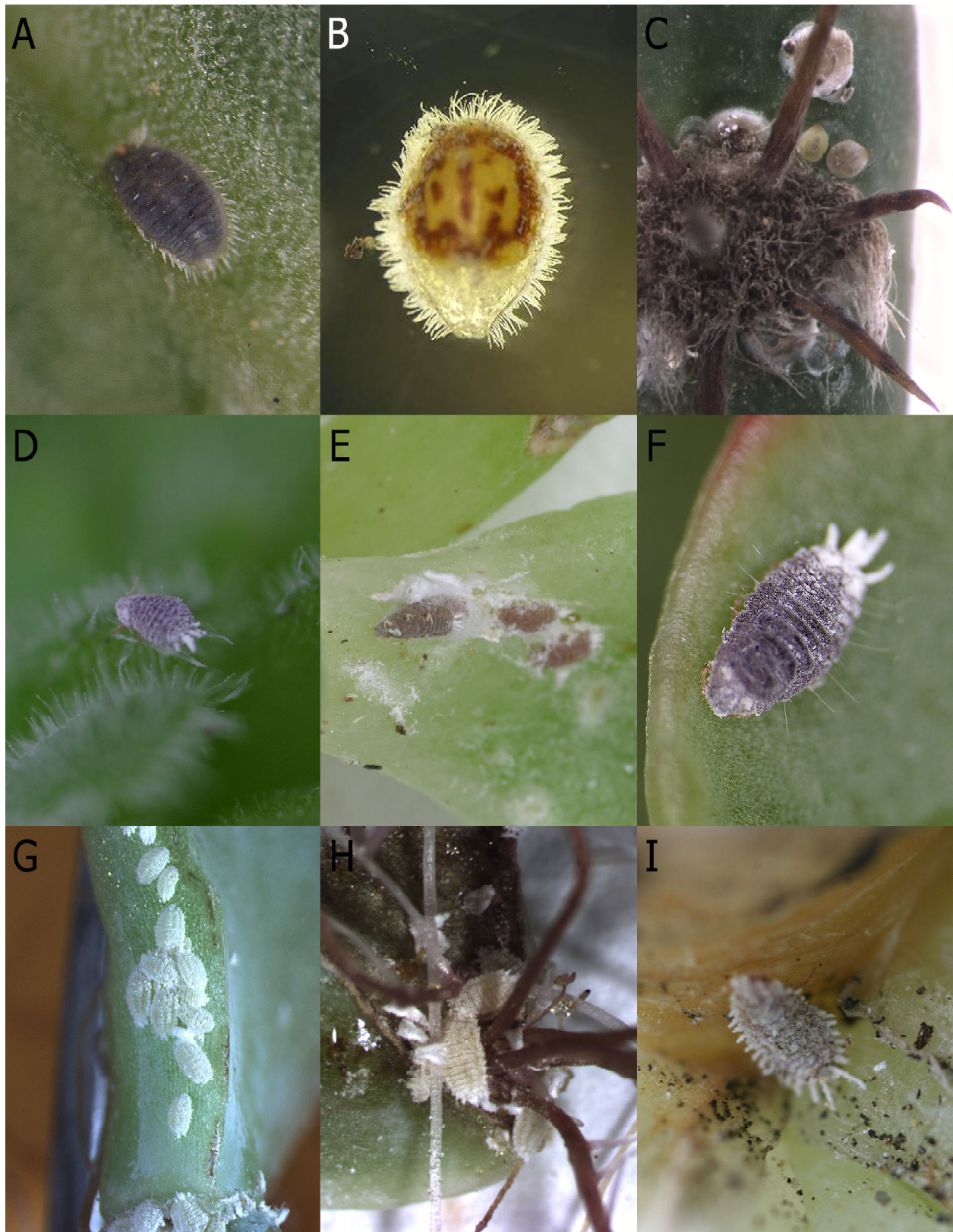


Figure 1. A. *Acanthococcus coccineus* Cockerell, female; B. *Planchonia stentae* (Brain), female; C. *Diaspis echinocacti* (Bouché), scale cover and female; D~F. *Vryburgia trionymoides* (De Lotto), female; G~H. *Phenacoccus solani* Ferris, female; I. *Pseudococcus viburni* (Signoret), female.

