

Scale insects introduced into Slovenia in the last fifty years

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Abstract: In the last fifty years, 14 new non-indigenous scale insect species have spread or were introduced into Slovenia: 7 Coccidae (*Ceroplastes japonicus*, *Coccus pseudomagnoliarum*, *Neopulvinaria innumerabilis*, *Pulvinaria floccifera*, *P. hydrangeae*, *Pulvinariella mesembryanthemi*, *Saissetia coffeae*), 3 Diaspididae (*Kuwanaspis pseudoleucaspis*, *Pinnaspis strachani*, *Pseudaulacaspis cockerelli*) and 4 Pseudococcidae (*Planococcus ficus*, *Pseudococcus calceolariae*, *P. viburni* and *Spilococcus mammillariae*). *Neopulvinaria innumerabilis*, *Ceroplastes japonicus* and *Pulvinaria hydrangeae* are widespread and sometimes serious pests on various crops. Further 4 species were only intercepted during the inspection of imported plants (*Aonidiella aurantii*, *Lepidosaphes beckii*, *Dysmicoccus brevipes*, *Ripersiella ficaria*). The first record of *Ripersiella ficaria* on roots of imported bonsai trees of *Ligustrum sinense* is reported.

Key words: Coccoidea, introduction, *Ripersiella ficaria*, scale insects, Slovenia.

Introduction

In Slovenia, the scale insect fauna has been little studied and is still poorly known. Lindinger's faunistic records regarding this area are often not precise enough and have to be applied with care (Lindinger, 1912). This care is necessary particularly for the countries which have emerged from the territory of the former Austro-Hungarian monarchy, due to the immense geopolitical changes of the last 100 years. The most comprehensive overview of the scale insects occurring in the territory of Slovenia was produced by Franc Janežič (1954) who listed 44 species, 9 of which were aliens. Species populating woody and greenhouse plants prevailed. A particularly important contribution was later made by Ferenc Kozár (1983) who recorded 40 species found in the territory of the present Slovenia. Twenty-two of them were new to the Slovenian fauna at the time; two were even new to science [*Rhizococcus evelinae* Kozár, 1983 and *Gregoporia istriensis* Kozár, 1983, now both as *Eriococcus* (ScaleNet, 2007)]. Thus, Slovenia is *terra typica* for these two species. Some subsequently published records dealt only with the introduced species of economic importance (Seljak, 1995; Jančar *et al.*, 1999; Seljak, 2001; Seljak & Žežlina, 2007). A complete list of scale insect species hitherto known to occur in Slovenia has yet to be published. Only species of non-European origin, introduced and/or discovered after 1954 are considered also in this paper, discussing published data as well as data gathered by the author.

Materials and methods

Scale insect samples were collected mainly by chance or were sent to our laboratory by the phytosanitary inspectors or plant owners. In the laboratory, specimens of adult females were removed from infested plants and stored in 70% ethanol until the preparation of slides. Permanent slides were usually prepared according to the Wilkey's mounting procedure (Wilkey, 1977). Permanent slides are deposited in the collection of Agricultural and Forestry Service Nova Gorica, Slovenia.

Distribution data are given by the locality's topographical name and by its 10 × 10 km UTM grid field (in brackets). As the entire territory of Slovenia falls within the grid zone 33T, the zone designation of UTM fields is omitted.

Results

Table 1. List of alien scale insects spread or introduced into Slovenia in the last fifty years with reference to the host plants on which they were found.

Species	Host plants	Year of the first record	References, remarks
Coccidae			
<i>Ceroplastes japonicus</i> Green	<i>Aralia</i> sp., <i>Chaenomeles japonica</i> , <i>Diospyros kaki</i> , <i>Hedera helix</i> , <i>Ilex aquifolium</i> , <i>Laurus nobilis</i> , <i>Morus nigra</i> , <i>Prunus armeniaca</i> , <i>P. avium</i> , <i>Taxus baccata</i>	1990	Jančar <i>et al.</i> , 1999
<i>Coccus pseudomagnoliarum</i> (Kuwana)	<i>Poncirus trifoliata</i> , <i>Zanthoxylum simulans</i>	2003	
<i>Neopulvinaria innumerabilis</i> (Rathvon)	<i>Diospyros kaki</i> , <i>Juglans regia</i> , <i>Vitis vinifera</i>	1985	Seljak, 1995
<i>Pulvinaria floccifera</i> (Westwood)	<i>Camellia japonica</i> , <i>Euonymus japonica</i> , <i>Ilex aquifolium</i> , <i>Jasminum officinale</i> , <i>Laurus nobilis</i> , <i>Pittosporum tobira</i> , <i>Taxus baccata</i>	1981	Kozár, 1983
<i>Pulvinaria hydrangeae</i> Steinweden	<i>Acer palmatum</i> , <i>A. platanoides</i> , <i>A. pseudoplatanus</i> , <i>Cornus mas</i> , <i>C. sanguinea</i> , <i>Hydrangea</i> spp., <i>Prunus avium</i> , <i>P. cerasifera</i> , <i>Taxus baccata</i> , <i>Tilia cordata</i> , <i>T. platyphyllos</i>	1994	Seljak, 2001
<i>Pulvinariella mesembryanthemi</i> (Vallot)	<i>Carpobrotus actinaciforme</i>	2004	
<i>Saissetia coffeae</i> (Walker)	<i>Cycas revoluta</i> , <i>Nephrolepis</i> sp.	2002	
Diaspididae			
<i>Aonidiella aurantii</i> (Maskell)	<i>Citrus</i> sp. (fruits)	2003	intercepted only
<i>Kuwanaspis pseudoleucaspis</i> (Kuwana)	<i>Phyllostachys bambusoides</i>	2007	
<i>Lepidosaphes beckii</i> (Newmann)	<i>Citrus</i> sp. (fruits)	2003	intercepted only
<i>Pinnaaspis strachani</i> (Cooley)	<i>Areca</i> sp., <i>Dracena marginata</i>	2006	
<i>Pseudaulacaspis cockerelli</i> (Cooley)	<i>Areca</i> sp.	1999	
Pseudococcidae			
<i>Dysmicoccus brevipes</i> (Cockerell)	<i>Ananas comosus</i> (fruits)	2000	intercepted only
<i>Planococcus ficus</i> (Signoret)	<i>Vitis vinifera</i> , <i>Ficus elastica</i>	2000	
<i>Pseudococcus viburni</i> (Signoret)	<i>Acer campestre</i> , <i>Cactaceae</i> , <i>Fatsia japonica</i> , <i>Kalanchoe blossfeldiana</i> , <i>Laburnum anagyroides</i> , <i>Nerium oleander</i> , <i>Pelargonium zonale</i> , <i>Viburnum tinus</i>	1981	Kozár, 1983
<i>Ripersiella ficaria</i> (Williams)	<i>Ligustrum sinense</i>	2006	intercepted only
<i>Spilococcus mammillariae</i> (Bouché)	<i>Cactaceae</i>	2002	

Comments on some of the species

Coccidae

Ceroplastes japonicus Green:

Material examined: Šempeter (UL98), 14.06.1989, on *Diospyros kaki*; Nova Gorica (UL99), 28.08.1998, on *Laurus nobilis*; 20.09.2000, on *Hedera helix*; 10.12.2006, on *Diospyros kaki* Solkan (0047), 11.03.1999 on *Prunus armeniaca*; Portorož (UL94), 27.05.2001, on *Laurus nobilis*; Potoče (VL08), 02.09.2002, on *Diospyros kaki*; Izola (UL94), 06.09.2002, on *Laurus nobilis*; Seča (UL93), 16.08.2004, on *Morus nigra*, *Hedera helix*, *Prunus avium*; Renèe (UL98), 20.03.2007, on *Diospyros kaki*.

This soft scale was found in Slovenia for the first time in 1990 (Jančar *et al.*, 1999). Now it is widespread in almost entire south-western submediterranean part of the country and is probably the most common soft scale species. Recently, it has also spread to the adjacent regions in Istria (Croatia) (Masten-Milek *et al.*, 2007). The most numerous populations appear especially on various evergreen woody plants (see table!), but sometimes it is also a serious pest on certain fruit trees such as persimmon and apricot. Treatments with insecticides are sometimes needed.

Coccus pseudomagnoliarum (Kuwana):

Material examined: Šempeter pri Gorici (UL98), 21.05.2003 on *Zanthoxylum simulans*; Kostanjevica na Krasu (UL97), 27.05.2003; Portorož (UL94), 07.05.2004, both on *Poncirus trifoliata*.

This species was found quite recently in the temperate submediterranean part of Slovenia. It was collected on *Poncirus trifoliata*, apart from one occasion when it was found on *Zanthoxylum simulans* Hance [Rutaceae]. According to the database ScaleNet (updated 4 December 2006) *Zanthoxylum simulans* may be a new host plant of this species.

Neopulvinaria innumerabilis (Rathvon):

Material examined: (host: *Vitis vinifera*, if not another is given) Sečovelje (UL93), 24.06.1984; Dragonja (UL93), 17.07.1984; Potoče (VL08), 01.07.1998, on *Diospyros kaki*; Šempas (VL08), 01.07.1998; Duplje (VL18), 28.09.2000; Prvačina (UL98), 12.03.2001; Kozana (UL89), 03.09.2002; Vrhpolje (VL17), 04.07.2003; Dragonja (UL93), 18.06.2004; Lože (VL17), 31.05.2005; Škrbina na Krasu (VL07), 27.06.2005; Sečovelje (UL93), 29.07.2005; Šmarje (VL17), 07.11.2005; Branik (VL07), 31.05.2006; Tomaj (VL16), 12.06.2006; Čehovini (VL17), 12.06.2006; Slap pri Vipavi (VL17), 27.06.2006; Korte (UL93), 06.07.2006; Marezige (VL04), 06.07.2006; Solkan (UL99), 22.07.2006; Kromberk (UL99), 15.09.2006, on *Juglans regia*; This species has been known to occur in the territory of Slovenia since 1984 (Seljak, 1995). Most probably it has spread from the adjacent regions in Italy, where it was first recorded some years earlier (Pellizzari, 1977). Its distribution range in Slovenia remains limited to the temperate southwestern part of the country. Its preferred host is *Vitis vinifera*, only occasionally it can be found also on some other woody plants (*Diospyros kaki*, *Vitis* spp.) In recent times, it has become the most harmful soft scale species of grapevine and periodic treatments with insecticides are required (Seljak & Žežlina, 2007).

***Pulvinaria floccifera* (Westwood):**

Material examined: Ptujška gora (WM53), 12.07.2000, on *Taxus baccata*; Ljubljana (VL69), 22.08.2000, on *Ilex aquifolium*; Nova Gorica (UL99), 08.01.2001, on *Euonymus japonicus*; Panovec (UL98), 28.01.2001, on *Ilex aquifolium*; Portorož (UL94), 27.05.2001, on *Pittosporum tobira* and *Laurus nobilis*; Ljubljana (VM50), 04.09.2002, on *Pittosporum tobira*; Ljubljana (VL69), 22.05.2003, on *Taxus baccata*; Šempeter (UL98), 03.06.2003, on *Camellia japonica*; Šempeter (UL98), 01.04.2004, on *Camellia japonica*; Štore (WM21), 18.05.2007, on *Camellia japonica*; Otočec (WL17), 03.06.2007, on *Taxus baccata*.

Even though this species is widespread across the country and has evidently been present in Slovenia for a long time, it was so far only recorded by Kozár (Kozár, 1983). In general, it is highly polyphagous, but the most numerous populations have so far been found on *Taxus baccata*, *Pittosporum tobira* and on *Ilex aquifolia*.

***Pulvinaria hydrangeae* (Steinweden):**

Material examined: Sabotin (UL99), 11.04.1999; Nova Gorica (UL99), 31.05.1999; Kromberk (UL99), 11.05.2001; Lokev (VL15), 22.09.2001; Potoče (VL08), 16.05.2002; Oševljek (UL98), 27.05.2002; Renče (UL98), 28.05.2002; Ljubljana (VM50), 04.09.2002; Ljubljana - Rožnik (VM60), 04.09.2002; Labinje (VM21), 13.10.2002; Kekec (UL99), 17.05.2003; Tolmin (VM01), 25.05.2003; Idrija (VM00), 19.06.2003; Bertoki (VL04), 21.05.2004; Dekani (VL04), 21.05.2004; Koper (VL04), 21.05.2004; Podsmreka (VL59), 16.06.2004; Ajdovščina (VL17), 01.07.2004; Šempeter (UL98), 12.07.2004; Tolmin (VM01), 19.07.2004; Kanal (UM90), 05.06.2005; Most na Soči (VM01), 06.06.2005; Drobočnik (VM01), 08.06.2006; Šenčur (VM52), 30.11.2006; Kojško (UL99), 04.05.2007; Ljubljana - Rožna Dolina (VL69), 09.05.2007; Dragonja (UL93), 10.05.2007; Spodnja Idrija (VL29), 24.05.2007; Straška Gora - 300 m (WL06), 31.05.2007.

The species was found in Slovenia for the first time in 1998 (Seljak, 2001). Now it is spread throughout the country, although still rather scattered. In some regions it is becoming the most common soft scale on deciduous trees in woods and in parks, especially on *Tilia* spp. and *Acer* spp. Among cultivated plants, *Hydrangea* spp. and *Diospyros kaki* seem to be preferred. Occasionally it becomes a serious pest on *Hydrangea*.

***Pulvinariella mesembryanthemi* (Vallot):**

Material examined: Tolmin (VM01), 27.10.2003 on *Carpobrotus glaucescens*.

Plants of *Carpobrotus glaucescens*, apparently already infested by this soft scale, were presumably brought in from Sicily in 2001. Its occurrence outdoors is probably only transient in Slovenia, due to the unsuitable climatic conditions.

***Saissetia coffeae* (Walker):**

Material examined: Ljubljana (VL69), 04.09.2002 on *Nephrolepis* sp.; Koper (VL04), 07.04.2004 on *Cycas revoluta*.

Until now it has been found only in greenhouses. It may be much more widespread, but little attention has been paid to this species so far. Only seldom does it appear as a minor pest of some ornamental plants.

Diaspididae

***Kuwanaspis pseudoleucaspis* (Kuwana):**

Material examined: Nova Gorica (UL98), 25.02.2007 on *Phyllostachys bambusoides*.

Bamboo was introduced long ago as an ornamental plant growing outdoors only in certain habitats in the submediterranean part of Slovenia. Nevertheless, some rare stands extend for several thousands square metres. Phytofagous fauna associated with these plants is very special and in our climatic conditions usually extremely poor. The above recorded locality for *K. pseudoleucaspis* is the only one known in Slovenia. Small colonies have been found mainly on older plants of *Phyllostachys bambusoides*.

***Pinnaspis strachani* (Cooley):**

Material examined: Šempeter pri Gorici (UL98), 03.10.2006 on *Areca*-palm; Spodnja Branica (VL07), 12.01.2007 on *Dracaena marginata*.

More than fifty years ago, the sister species *Pinnaspis aspidistrae* (Signoret) was recorded on several occasions (Janežič, 1954). Unfortunately, the validity of the identification cannot be verified since no archival material of those records exists.

Pseudococcidae

***Planococcus ficus* (Signoret):**

Material examined: Vrhpolje (VL17), 20.06.2000 and 11.07.2007 on *Vitis vinifera*; Šempeter (UL98), 07.09.2000 on *Ficus elastica*; Nova Gorica (UL99), 28.02.2001 on *Dieffenbachia* sp. In Slovenia, this species has so far only been found indoors, even on grapevine. The fact that it is difficult to distinguish from *P. citri* (Risso) by morphological features might be the main reason why this worldwide distributed species has not been recorded earlier.

***Pseudococcus viburni* (Signoret):**

Material examined: Modrej (VM01), 22.8.2000, on *Pelargonium zonale*; Branik (VL07), 13.1.2003, on Cactaceae; Škrbina na Krasu (VL07), 24.2.2003, on *Kalanchoe blossfeldiana*; Metlika (WL25), 5.5.2003, on *Philodendron* sp.; Nova Gorica (UL99), 31.8.2003, on *Acer campestre*; Portorož (UL94), 15.12.2006, on *Fatsia japonica* and *Viburnum tinus*.

This species was first recorded by Kozár (1983) under the name *Pseudococcus obscurus* Essig. Later, it was intercepted many times during the official inspections of imported ornamental plants. It was most frequently found on pot plants in greenhouses and on house plants. In the temperate submediterranean region it occurs more or less regularly in the open as well. Sometimes it appears as a minor pest on various pot plants.

***Ripersiella ficaria* (Williams, 2004):**

Material examined: Kranj (VM51), 30.11.2006, on *Ligustrum sinense*.

Three specimens of this species were picked from roots of a bonsai tree of *Ligustrum sinensis* during a regular inspection of ornamental plants in the Slovene market suspecting it to be *Ripersiella hibisci* (Kawai & Takagi), which is a quarantine pest. Bonsai on sale originated from China. A detailed laboratory examination led to a different result. *R. ficaria* is a quite recently described mealybug species indigenous to the Oriental zoogeographical region (Williams, 2004; Kozár & Konczné-Benedicty, 2004). Almost nothing is known about its life cycle and the host plant range, or about its phytosanitary significance. *Ligustrum sinensis* appears to be a new host plant for this species. Williams (2004) recorded it only from roots of *Ficus* sp. However, it is most likely much more polyphagous. To my knowledge, there are no other records of the occurrence or interception of this species in Europe.

From the phytosanitary point of view, an exact discrimination between *R. ficaria* and *R. hibisci* (= *Rhizoecus hibisci*) appears to be important. *R. ficaria* differs from the latter in

particular in having six-segmented antennae and in lacking the dorsal multilocular pores. There are very few multilocular pores on the venter as well (usually fewer than ten), arranged on the last two abdominal sternites only. The taxonomic value of vulva shape, which appears to be characteristic of this species, remains unknown.

R. ficaria belongs to the *gracilis* group. The most comprehensive key for species identification of the genus *Ripersiella* was assembled by Kozár & Konczné Benedicty (2004).

***Spilococcus mammillariae* (Bouchè):**

Material examined: Renče (UL98), 16.10.2002; Branik (VL07), 13.1.2003; Vrtojba (UL98), 21.2.2003; Solkan (UL99), 10.4.2006, always on Cactaceae.

It occurs only temporarily as a minor pest on Cactaceae in greenhouses and on house plants.

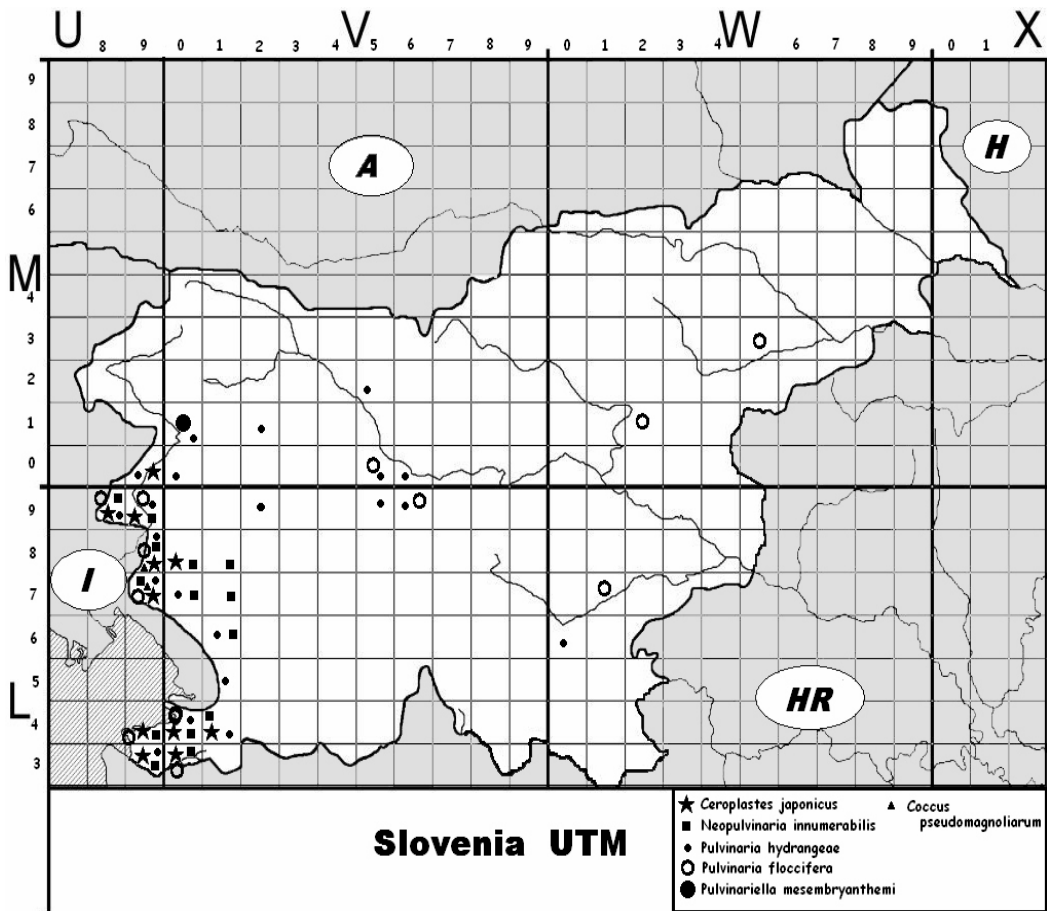


Figure 1. Current geographical distribution of some alien soft scales in Slovenia.

Conclusions

After the first published list of scale insects occurring in Slovenia (Janežič, 1954) which included also the alien species, 17 non-European species have spread or were introduced

into the country or intercepted during the inspection of imported plant material. Some of them had probably been present before but went undiscovered due to the lack of public interest. From the agricultural point of view, especially for the Slovenian viticulture, *Neopulvinaria innumerabilis* is the most important alien scale insect spread to Slovenia during this period. Even though several ubiquitous predators and parasites have been found that partly reduce its populations, they are often not sufficiently efficient. In such cases, insecticides have to be used in early spring or in summer at the time of their mass eclosion. *Pulvinaria hydrangeae*, *P. floccifera* and *Ceroplastes japonicus* are sometimes also serious pests of some ornamental trees and subjects of chemical control. The species of tropic or subtropic origin (e.g. *Saissetia coffeae*, *Pinnaspis strachani*, *Pseudaulacaspis cockerelli*, *Planococcus citri*, *P. ficus*, *Pseudococcus longispinus*, *Spilococcus mammillariae*) can usually only survive indoors, in greenhouses or on house plants. They sometimes appear as minor pests of ornamental plants, but so far there have been very few reports of them causing important damage in Slovenia. *Coccus pseudomagnoliarum*, *Pulvinariella mesembryanthemi*, *Kuwanaspis pseudoleucaspis* and *Ripersiella ficaria* are for the moment purely coccidological curiosities.

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