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Scientific Paper - *Artículo Científico*

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Abstract

In the present paper the author carries out a list with the *Hemiptera* species, belonging to *Coccidae*, *Diaspididae*, *Pseudococcidae* or *Rhizoecidae* identified on woody ornamental crops of Galicia, as part of his independent consultancy service, carried out from 1999 to 2019. A total number of 12 new different species were identified, 5 *Coccidae*, 5 *Diaspididae*, 1 *Pseudococcidae* and 1 *Rhizoecidae*. Considering only crop pests, 7 from 11 were new references for woody ornamental crops in Galicia and 4 of them were new references for Spain.

Key words: ornamental armoured scales, ornamental soft scales, ornamental mealybugs, Galicia, woody ornamental crops.

Resumen

En el presente trabajo el autor relaciona la totalidad de especies de hemípteros de las familias *Coccidae*, *Diaspididae*, *Pseudococcidae* y *Rhizoecidae* identificadas en cultivos de especies leñosas ornamentales de Galicia, basándose en la información obtenida de su trabajo como consultor entomológico independiente, desde 1999 a 2019. Se identificaron un total de 12 especies diferentes, 5 de la familia *Coccidae*, 5 de *Diaspididae*, 1 perteneciente a *Pseudococcidae* y 1 a *Rhizoecidae*. En condiciones de cultivo, 7 de las 11 especies relacionadas son nuevas citas, para Galicia y 4 de las mismas para España.

Palabras clave: Cócidos ornamentales, diaspídidos ornamentales, pseudocócidos ornamentales, Galicia, cultivos de leñosas ornamentales.

1. Introducción

Except for the valuable references of *Camellia japonica* –*Hemiberlesia rapax*, *Pulvinaria floccifera*, *Coccus hesperidum*, *Planococcus citri* and *Cerosplastis sinensis* (Salinero & Vela, 2004) –there is a great lack of information about armored scales, soft scales or mealybugs species in Galicia– Northwest Spain–.

The situation in the rest of Spain is not much better: Villaba makes a list of the most important scales identified by her in the gardens of Central Spain: *Quadraspidotus perniciosus*, *Aspidiotus hederæ*, *Pseudococcus adonimum*, *Aucalaspis rosæ*, *Aonidia lauri*, *Leucaspis pini*, *Unaspis euonymi*, *Phoenococcus mullati*, *Curulaspis juniper* and *Diaspis viscid* (Villava, 1996). Muñoz & Ruperez study the main causes

of the cypress missing in Spain, specifying the following scales as part of these causes: *Pericerya purchase*, *Eriococcus juniper*, *Carulaspis carueli*, *carulaspis juniper*, *Lineaspis striata*, *Diaspis vici* and *Chionaspis striata* (Muñoz & Ruperez, 1980).

Soria studies the *coccoidea* species from ornamental yews (*Taxus baccata*) in Spain, specifying the following species: *Parthenolecanium pomericum*, *Pulvinaria floccifera*, *Lineaspis striata*, *Curulaspis juniper* and *Chrysomphalus dictyospermi* (Soria *et al.*, 1996). This author also studies the main *Curulaspis* species identified at parks and gardens of Central Spain, which were the following: *Curulaspis juniper* and *Curulaspis caureli* (Soria *et al.*, 1993). This author also describes the presence of the armoured scales *Odonaspis greeni* and *Bambusaspis bambusae*. The first one identified on *Bambusa ventricosa* in Madrid and *Bambusaspis bambusae* on *Bambusa sp.* in the Canary islands (Soria *et al.*, 1998).

Pons studies the main key pests of the main urban green areas of Lleida (Cataluña, Northeast Spain) pointing out the following coccidae species: *Palaeococcus fuscipenis* and *Pseudaucalaspis pentagona* (Pons *et al.*, 2006).

The identification of the main key species of woody ornamental crops is specially useful for the design of sustainable plant protection programs due to the problem of resistance to insecticides referenced on different armored scales –*Aonidiella aurantii* to carbamate insecticides in California– (Grafton-Cardwell, 1995), soft scales –*Phenacoccus solenopsis* to deltamethrin in Pakistan (Saddiq *et al.*, 2015), *Pseudococcus affinis* to chlorpyrifos in New Zealand (Charles *et al.*, 1993) – and mealybugs.

2. Material & methods

The study was carried out only in woody ornamental production centres of Galicia, intermittently from 1999 to 2019. The samples were obtained from 9 nurseries belonging to the following Galician provinces: 6 in Pontevedra and 3 in A Coruña. The entomological monitoring of the pests was carried out every 15 or 30 days, sampling periodically in order to identify the hemiptera species by means of classical entomological determination methods.

The infested plant material samples were analyzed in the entomological laboratory of the firm CONSULTORIAS NOROESTE S.C. The

mounting methods were based on the studies of Williams and Granara de Willink (1992).

The species determinations, carried out by the author, were performed based on the following taxonomical keys: Williams and Watson (1990) and Pellizari & Germain (2010) for Coccidae species; Miller & Davidson (2005) for Diaspididae species; Williams and Granara de Willink (1992) and Kaydan & Gullan (2012) for Pseudococcidae species and Ramos-Portilla (2015) for Rhizoecidae species.

3. Results

LIST OF IDENTIFIED ESPECIES

FAMILY COCCIDAE

1. *Coccus hesperidum* Linnaeus, 1758

Hosts: *Nerium oleander*, *Laurus nobilis*

Type of crop: soil.

Province: Pontevedra

2. *Protopulvinaria pyriformis* (Cockerell)

Hosts: *Gardenia japonica*, *Laurus nobilis*

Type of crop: container.

Province: Pontevedra

3. *Pulvinaria floccifera* (Westwood)

Host: *Ilex aquifolium*, *Camellia japonica*.

Type of crop: container.

Province: Pontevedra

4. *Eriococcus leptospermi*, Maskell, 1891

Host: *Leptospermum scoparium*

Type of crop: container.

Province: A Coruña

5. *Ceroplastes sinensis* (Del Guercio, 1900)

Host: *Ilex aquifolium*

Type of crop: soil and container

Province: Pontevedra

FAMILY DIASPIDIDAE6. *Aspidiotus nerii* (Bouche, 1833)

Hosts: *Cyca revolute*, *Laurus nobilis*

Type of crop: container.

Province: Pontevedra

7. *Nuculaspis regnieri* (Balachowski, 1928)

Hosts: *Cedrus atlantica*

Type of crop: container.

Province: Pontevedra

8. *Saissetia oleae* (Olivier, 1791)

Host: *Cyca revoluta*

Type of crop: container

Province: Pontevedra

9. *Unaspis euonymi* (Comstock)

Host: *Euonymus japonicus*

Type of crop: soil.

Province: Pontevedra

10. *Hemiberlesia rapax* (Comstock) 1881

Host: *Camellia japonica*

Type of crop: container.

Province: Pontevedra

FAMILY PSEUDOCOCCIDAE11. *Balanococcus diminutus*, Leonardi, 1918

Hosts: *Phormium tenax*, *Viburnum tinus*, *Nandina domestica*.

Type of crop: container.

Province: Pontevedra

Type of crop: container.

Province: A Coruña, Pontevedra

FAMILY RHIZOECIDAE12. *Rhizoecus falcifer* Kunckel d'Herculais

Hosts: *Phyllostachys aurea*, *Phyllostachys nigra*, *Leucothoe fontanesiana*, *Buxus sempervirens*, *Camellia japonica*.

Type of crop: container.

Province: A Coruña, Pontevedra

4. Discussion

Scale insects are one of the arthropod groups most commonly dispersed between countries as a consequence of the international trade being one of the most successful groups invading new geographical areas (O' Connor *et al.*, 2013). This was also confirmed in this study: all of the species identified by the author in Galicia were non-native, probably introduced by the planting vegetal material imported from other countries or geographical regions.

It is important to mention that 7 out of the total number of species were first references of their presence in Galicia –*Protopulvinaria pyryformis*, *Eriococcus leptospermi*, *Aspidiotus nerii*, *Nuculaspis regnieri*, *Saissetia oleae*, *Unaspis euonymi*, and *Balanococcus diminutus*– and two of them –*Eriococcus leptospermi* and *Balanococcus diminutus*– were first references on any crop in Spain (De Liñán, 1998; García Mari *et al.*, 1994; Villalva, 1996; Pellizari & Germain, 2010). If we consider only ornamental crops there were four new references for our country with this study: *Protopulvinaria pyryformis*, *Eriococcus leptospermi*, *Hemiberlesia rapax* and *Balanococcus diminutus* (De Liñán, 1998; García Mari *et al.*, 1994; Villalva, 1996; Pellizari & Germain, 2010).

The hosts where the different species were identified are also important to mention, since there were 7 new registers that were not previously referenced worldwide, these are the following: *Protopulvinaria pyryformis* on *Gardenia japonica*, *Saissetia oleae* on *Cyca revoluta*, *Rhizoecus falcifer* on *Phyllostachys aurea*, *Phyllostachys nigra* and *Leucothoe fontanesiana* as well as *Balanococcus diminutus* on *Viburnum tinus* and *Nandina domestica* (Malumphy & Badmin, 2012; Granara de Willink & Claps, 2003; Pellizari & Germain, 2010; Alford, 1995).

All of the identified species were clearly phytophagous in the conditions of Galicia, considered as important pests for all their respective crops. This is not in concordance with the results described by certain authors that point out that certain species are not injurious to ornamental crops in their climatic conditions: *Aspidiotus nerri* and *Hemiberlesia rapax* on several ornamental

species in Argentina (Granara the Willink & claps, 2003).

None of the twelve identified species is still considered quarantine in Europe. *Unaspis euonymi* is considered quarantine pest in Southern

Africa (A1 list), *Saissetia oleae* in East Africa, Southern Africa and Azerbaijan (A1 list) and *Ceroplastes sinensis* for Eastern and Southern Africa (A1 list) (EPPO, 2019).

TABLE 1. HEMIPTERA SPECIES OF THE FAMILIES COCCIDAE, DIASPIDIDAE, PSEUDOCOCCIDAE AND RHIZOECIDAE IDENTIFIED ON WOODY ORNAMENTAL CROPS IN GALICIA FROM 1999 TO 2019 AND ITS REFERENCES WORLDWIDE

Identified species	Cited in Galicia on ornamental crops	Cited in Spain on ornamental crops	Present in Spain as a polyphagous pest**	Native range
1. <i>Coccus hesperidium</i> Linnaeus, 1758	Salinero & Vela, 2004	De Liñán, 1998	Pellizari & Germain, 2010	Tropical/subtropical
2. <i>Protopulvinaria pyriformis</i> (Cockerell)	No	No	Pellizari & Germain, 2010	Asia –Tropical
3. <i>Pulvinaria floccifera</i> (Westwood)	Salinero & Vela, 2004; Andrés, 2017.	De Liñán, 1998	Pellizari & Germain, 2010	Asia – Temperate
4. <i>Eriococcus leptospermi</i> , Maskell, 1891.	No	No	No	Australasia/Australia
5. <i>Ceroplastes sinensis</i> (Del Guercio, 1900)	Salinero & Vela, 2004;	Salinero & Vela, 2004;	De Liñán, 1998	Central America
6. <i>Aspidiotus nerii</i> (Bouche, 1833)	No	De Liñán, 1998; García Marí <i>et al.</i> , 1994	Pellizari & Germain, 2010	Afrotropical
7. <i>Nuculaspis regnieri</i> (Balachowski, 1928)	No	De Liñán, 1998 *	De Liñán, 1998 *	Northern Africa
8. <i>Saissetia oleae</i> (Olivier, 1791)	No	García Marí <i>et al.</i> , 1994	Pellizari & Germain, 2010	Afrotropical
9. <i>Unaspis euonymi</i> (Comstock)	No	De Liñán, 1998; Villalva 1996	Pellizari & Germain, 2010	Asia temperate/ Eastern Asia
10. <i>Hemiberlesia rapax</i> (Comstock) 1881	Salinero & Vela, 2004; Andrés, 2017	No	Pellizari & Germain, 2010	Cryptogenic
11. <i>Rhizoecus falcifer</i> Kunckel d'Heroulais	Andrés, 2017	Gómez Menor, 1937; Andrés, 2017	Martín Mateo, 1985	Cryptogenic
12. <i>Balanococcus diminutus</i> , Leonardi, 1918	No	No	No	Australasia/Australia

* Referenced on *Cedrus atlantica* either as forest crop or ornamental crop.

** The reference does not specify if it is an ornamental pest or an arthropod infesting other type of crops.

TABLE 2. HOSTS AND STATUS OF THE HEMIPTERA SPECIES BELONGING TO THE FAMILIES COCCIDAE, DIASPIDIDAE, PSEUDOCOCCIDAE AND RHIZOECIDAE IDENTIFIED ON WOODY ORNAMENTAL CROPS IN GALICIA FROM 1999 TO 2019 AND ITS REFERENCES WORLDWIDE

Identified species	Species status	Ornamental hosts identified in this study in Galicia	Referenced on such ornamental crops worldwide
1. <i>Coccus hesperidum</i> Linnaeus, 1758	Non- native introductions naturalised outdoors	<i>Nerium oleander</i>	Malumphy & Badmin, 2012; Granara de Willink & Claps, 2003
		<i>Laurus nobilis</i>	Malumphy & Badmin, 2012
2. <i>Protopulvinaria pyriformis</i> (Cockerell)	Non- native introductions naturalised outdoors	<i>Gardenia japonica</i>	No
		<i>Laurus nobilis</i>	Granara de Willink & Claps, 2003
3. <i>Pulvinaria floccifera</i> (Westwood)	Non- native introductions naturalised outdoors	<i>Ilex aquifolium</i>	Pellizari & Germain, 2010
		<i>Camellia japonica</i>	Salinero & Vela, 2004
4. <i>Eriococcus leptospermi</i> , Maskell, 1891	Non- native introductions established on indoor plantings.	<i>Leptospermum scoparium</i>	Hoy, 2012
5. <i>Ceroplastes sinensis</i> (Del Guercio, 1900)	Non- native introductions naturalised outdoors	<i>Ilex aquifolium</i>	De Liñán, 1998
6. <i>Aspidiotus nerii</i> (Bouche, 1833)	Non- native introductions naturalised outdoors	<i>Cyca revoluta</i> ,	Granara de Willink & Claps, 2003
		<i>Laurus nobilis</i>	Granara de Willink & Claps, 2003
7. <i>Nuculaspis regnieri</i> (alachowski, 1928)	Non- native introductions naturalised outdoors	<i>Cedrus atlantica</i>	De Liñan, 1998
8. <i>Saissetia oleae</i> (Olivier, 1791)	Non- native introductions established on indoor plantings.	<i>Cyca revolute</i>	No
9. <i>Unaspis euonymi</i> (Comstock)	Non- native introductions naturalised outdoors	<i>Euonymus japonica</i>	Alford, 1995
10. <i>Hemiberlesia rapax</i> (Comstock) 1881	Cryptogenic	<i>Camellia japonica</i>	Salinero & Vela, 2004
11. <i>Rhizoecus falcifer</i> Kunckel d'Herclais	Non- native introductions established on indoor plantings	<i>Phyllostachys aurea</i>	No
		<i>Phyllostachys nigra</i>	No
		<i>Leucothoe fontanesiana</i>	No
		<i>Buxus sempervirens</i>	Ramos-Portilla, 2015
		<i>Camellia japonica</i>	Andrés, 2017
12. <i>Balanococcus diminutus</i> , Leonardi, 1918	Non- native introductions naturalised outdoors	<i>Phormium tenax</i>	O' Connor <i>et al.</i> 2013; Pellizari & Germain, 201
		<i>Viburnum tinus</i>	No
		<i>Nandina domestica</i>	No

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