Scale Insects (Hemiptera: Coccoidea) of ornamental plants from São Carlos, São Paulo, Brazil

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Abstract. A list of 35 scale insects collected from 72 ornamental plant species in São Carlos, São Paulo, Brazil is provided. Regarding host specificity, 30 scale insects were polyphagous, 4 oligophagous, and 1 monophagous. A total of 102 coccoid/plant associations are recorded, 29 of which are new host records for the species; 60 are new host records for the species in Brazil. *Pulvinaria urbicola* Cockerell, 1893 (Coccidae), *Phenacoccus similis* Granara de Willink, 1983 (Pseudococcidae), and *Orthezia molinarii* (Morrison, 1952) (Ortheziidae) are recorded for the first time in Brazil. In addition, we describe the injury caused by scale insects on ornamental plants.

Key words. Scale insect diversity, Scale/plant associations, Floricultural pests.

Introduction

Floriculture, which consists of the cultivation of ornamental plants used for cut flowers, flowering and non-flowering potted plants, and the production of seeds, bulbs, and large trees, is an important part of Brazilian agriculture, with annual gross sales of approximately one billion Brazilian reals (currently about half a billion U. S. dollars). The state of São Paulo holds a 70% share of this market, and specialists in floriculture estimate an annual growth of 20% in the next few years (Arruda et al., 1996).

Scale insects (Superfamily Coccoidea) stand out as important pests among insects that feed on ornamental plants (Arruda et al., 1996). They cause damage to plants directly by sucking their sap, and indirectly by injecting toxic salivary secretions, transmitting pathogens, attracting ants, and encouraging the development of sooty-mold (Lara, 1992; Zucchi et al., 1993). Besides their impact on the commercial value of ornamental plants, these insects also affect urban landscapes. Infested containerized plants become disseminators of harmful insects when they are transported to regions or countries far from their place of origin or production.

Despite the increase of ornamental plant production in Brazil, very few studies have been undertaken on the insects associated with plants in gardens. Recent publications include Bergmann & Alexandre (1995) and Imenes and Alexandre (1996); they discuss the occurrence of pests, diseases, and forms of control in roses (*Rosa* sp.) and chrysanthemums (*Chrysanthemum* sp.), respectively. Favero (1996) describes some pests of flowers, ornamental foliage, and orchids and gives methods of control, and Imenes and Bergmann (2000) characterize the principal pests of ornamental plants including some scale insect-plant interactions and provide information on control strategies.

TABLE 1. Scale insects and their ornamental host plants collected in São Carlos – SP from August 1997 to April 1999.

Scale insects collected	Host plant species/Common names in Portuguese shown in quotes	Plant family	Plant Origin	Plant Form
MONOPHAGOUS				
Diaspididae				
Kuwanaspis bambusicola (Cockerell, 1899)(vrw)	*Bambusa gracilis* Hort. "bambu-de-jardim"	Poaceae	exotic	shrub
OLIGOPHAGOUS				
Diaspididae				
Acutaspis oliverai (Lepage & Gianotti, 1942)(vrw)	****Hedera canariensis*** Willd. "hera-da-algéria"	Araliaceae	exotic	vine
Eriococcidae				
Eriococcus campinensis Hempel, 1937 (drm)	****Mimosa caesalpiniaefolia*** Benth. "sansão-do-campo"	Fabaceae	native	tree
Ortheziidae				
Orthezia molinarii Morrison, 1952 (drm)	****Bougainvillea spectabilis*** Willd. "primavera"	Nyctaginaceae	native	shrub
	****Cordilyne terminalis*** Kunth. "dracena-vermelha"	Liliaceae	exotic	shrub
Pseudococcidae				
Phenacoccus similis Granara de Willink, 1983 (drm)	****Saintpaulia ionantha*** Wendl. "violeta-africana"	Gesneriaceae	exotic	herb
POLYPHAGOUS				
Coccidae				
Ceroplastes cirripediformis Comstock, 1881 (mlw)	***Duranta repens*** var. *aurea* L. Hort. "pingo-de-ouro"	Verbenaceae	native	shrub
Ceroplastes floridensis Comstock, 1881 (mlw)	*Hedera canariensis* "hera-da-algéria"	Araliaceae	exotic	vine
	Schefflera actinophylla Harms "cheflera"	Araliaceae	exotic	shrub
	Schefflera arboricola (Hay.)Merr. "cheflera-pequena"	Araliaceae	exotic	shrub

The objective of this study was to survey scale insect-plant interactions in ornamental plants in the city of São Carlos, state of São Paulo (SP), Brazil. In addition, we classified the species of scale insects according to their host specificity and characterized host-plant injury caused by scale insects.

Materials and Methods

The buds, branches, and leaves of ornamental plants infested by scale insects were collected in public and private gardens in the city of São Carlos, SP, Brazil and taken to the laboratory of the Department of Ecology and Evolutionary Biology of the Federal University of São Carlos (UFSCar).

Collections were made from August 1997 to April 1999. In the laboratory, scale insects were collected from host plants with brushes and were stored in vials filled with 70% alcohol. They were mounted on microscope slides according to the technique described by Granara de Willink (1990). Scale insects were identified with a compound light microscope using keys Granara de Willink (1999) and Hodgson (1994) for Coccidae; Ferris (1937, 1938, 1941, 1942) and Lepage and Gianotti (1942) for Diaspididae; Morrison (1925, 1952) for Ortheziidae; and Williams and Granara de Willink (1992) for Pseudococcidae. Most of the scale insects were sent to specialists for confirmation of final identifications. Categorization of scale insect host-plant specificity was based in large part on classic defini-

TABLE 1. Continued.

Scale insects collected	Host plant species/Common names In Portuguese shown in quotes	Plant family	Plant origin	Plant form
Coccus hesperidum Linnaeus, 1758 (drm, mlw)	****Davallia fejeensis* Hook. "renda-portuguesa"	Davalliaceae	exotic	herb
	**Platycerium bifurcatum* (Cav.) Chr. "chifre-de-veado"	Polypodiaceae	exotic	herb
	**Schefflera actinophylla* "cheflera"	Araliaceae	exotic	shrub
Coccus viridis (Green, 1889) (drm, mlw)	**Murraya exotica* Jack "falsa-murta"	Rutaceae	exotic	tree
	Gardenia jasminoides Ellis "jasmim-do-cabo"	Rubiaceae	exotic	shrub
	**Polyscias fruticosa* N.E.Br. "árvore-da-felicidade-fêmea"	Araliaceae	exotic	shrub
	**Ixora coccinea* L. var. *compacta* Hort. "ixora-compacta"	Rubiaceae	exotic	shrub
Coccus sp. (alp)	*Ixora chinensis* Lam. "ixora-chinesa"	Rubiaceae	exotic	shrub
Parasaissetia nigra (Nietner, 1861) (drm, mlw)	**Schinus molle* L. "aroeira-salsa"	Anacardiaceae	native	tree
	**Euphorbia fulgens* Karw ex Kl. "chiquita-bacana"	Euphorbiaceae	exotic	shrub
Parasaissetia sp. (drm)	*Camellia japonica* L. "camélia"	Theaceae	exotic	shrub
Protopulvinaria pyriformis (Cockerell, 1894) (drm)	*Schefflera arboricola* "cheflera-pequena"	Araliaceae	exotic	shrub
	Bauhinia variegata Linn. "pata-de-vaca"	Fabaceae	native	tree
Pulvinaria urbicola Cockerell, 1893 (drm)	****Schinus molle* "aroeira-salsa"	Anacardiaceae	native	tree

tions, in which "polyphagous" is used for species that live on a variety of non-related plants, i.e., plants from different families and, "oligophagous" is defined as species that live on a reduced number of non-related host plants. We defined "monophagous" as species that feed on one or more plants of the same family. Scale insect specimens are deposited in the Insect Collection of the Department of Ecology and Evolutionary Biology (Colecoc/DEBE) at UFSCar and in the Smithsonian's National Coccoidea Collection, Beltsville, Maryland, USA. Ornamental plants were identified according to Lorenzi (1992) and Lorenzi and Souza (1995) or sent to specialists. Determination of new host records are based on a search of the literature or ScaleNet (Ben-Dov et al. 2001). Determinations of scale insects were made by Douglass R. Miller (drm), Michael L. Williams (mlw), Vera R. dos Santos Wolff (vrw), and Ana Lúcia B. G. Peronti (alp) and are so indicated in the accompanying table. New records for Brazil are indicated with an asterisk (*); new host records for a species of scale are indicated with a double asterisk (**).

Results and Discussion

A total of 184 samples of scale insects were collected from 72 ornamental species (8 trees, 39 shrubs, 23 herbaceous plants, and 2 vines) distributed among 37 botanical families. Approximately

TABLE 1. Continued.

Scale insects collected	Host plant species/Common names In Portuguese shown in quotes	Plant family	Plant origin	Plant Form
Saissetia coffeae (Walker, 1852) (drm, mlw)	**Ervatamia coronaria* Stapf. "jasmim-café"	Apocynaceae	exotic	shrub
	**Pseuderanthemum atropurpureum* Radlk. "pseudoerântemo´	Acanthaceae	exotic	shrub
	** *Nephrolepis* sp. "samambaia"	Davalliaceae	_____	herb
	**Asparagus africanus* "aspargo"	Liliaceae	exotic	herb
Diaspididae				
Abgrallaspis cyanophylli (Signoret, 1869) (vrw)	**Philodendron* sp. "filodendro"	Araceae	native	shrub
Acutaspis perseae (Comstock, 1881) (vrw)	***Dietes iridioides* Sweet "moréia"	Iridaceae	exotic	herb
Chrysomphalus aonidum (Linnaeus, 1758) (vrw)	*Chrysalidocarpus lutecens* Wendl. "areca-bambu"	Palmae	exotic	palm tree
	**Dracaena marginata* Lam. "dracena-de-madagascar"	Liliaceae	exotic	shrub
	"orquídea"	Orchidaceae	_____	herb
Chrysomphalus dictyospermi (Morgan, 1889) (vrw)	*Rosa* sp. "roseira"	Rosaceae	exotic	shrub
Diaspis boisduvalii Signoret, 1869 (drm, vrw)	**Oncidium varicosum* Lindl. "chuva-de-ouro"	Orchidaceae	native	herb
	Cattleya walkueriana var. *princeps* Barb. Rodr. "orquídea"	Orchidaceae	native	herb
Fiorinia fioriniae (Targioni-Tozzetti, 1867) (drm, vrw)	**Camellia japonica* "camélia"	Theaceae	exotic	shrub
	Podocarpus lambertii Klotz. "podocarpo"	Podocarpaceae	native	shrub
Hemiberlesia rapax (Comstock, 1881) (vrw)	**Chrysalidocarpus lutecens* "areca-bambu"	Palmae	exotic	palm tree

74% of host plants were exotics, and all were perennials. One hundred and two coccoid-plant associations were recorded; 26 of them were new for the scale species and 60 were new for Brazil. Thirty-five species of scale insects were identified, including 18 diaspidids (armored scales), 8 coccids (soft scales), 6 pseudococcids (mealybugs), 2 ortheziids (ensign scales), and 1 eriococcid (felt scale). The *Icerya* sp. (Margarodidae) found on *Pittosporum tobira* (Thunb.) Ait. (Pittosporaceae) is probably *Icerya purchasi* Maskell (Table 1).

Pulvinaria urbicola Cockerell, 1893 (Coccidae), *Phenacoccus similis* Granara de Willink, 1983 (Pseudococcidae), and *Orthezia molinarii* (Morrison, 1952) (Ortheziidae) were recorded for the first time in Brazil.

Based on host-plant information provided in Morrison (1952), Vernalha (1953), Silva et al. (1968), Ben-Dov (1993, 1994), Ben-Dov et al. 2001, and Williams and Granara de Willink (1992), 30 of the scale-insect species are polyphagous, 4 are oligophagous, and 1 is monophagous (Table 1).

Among the polyphagous species, the most commonly encountered were *Coccus viridis* and *Saissetia coffeae* (Coccidae); *Ischnaspis longirostris*, *Pinnaspis strachani* and *Parlatoria proteus* (Diaspid-

TABLE 1. Continued.

Scale insects collected	Host plant species/Common names In Portuguese shown in quotes	Plant family	Plant origin	Plant Form
Howardia biclavis (Comstock, 1833) (vrw)	***Ervatamia coronaria* "jasmim-café"	Apocynaceae	exotic	shrub
Ischnaspis longirostris (Signoret, 1882) (drm, vrw)	*Chrysalidocarpus lutecens* "areca-bambu"	Palmae	exotic	palm tree
	***Ctenanthe oppenheimiana* Schum. "maranta-variegata"	Marantaceae	native	herb
	***Dietes iridioides* "moréia"	Iridaceae	exotic	herb
	Ficus benjamina L. "ficus"	Moraceae	exotic	tree
	**Heliconia rostrata* Ruiz et. Pav. "helicônia"	Musaceae	exotic	shrub
	Ixora coccinea L. "ixora-coral"	Rubiaceae	exotic	shrub
	Phoenix roebelinii O' Brien. "tamareira-de-jardim"	Palmae	exotic	palm tree
Parlatoria proteus (Curtis, 1843) (vrw)	**Monstera* sp. "monstera"	Araceae	____	herb
	**Schefflera arboricola* "cheflera-pequena"	Araliaceae	exotic	shrub
	***Spathiphyllum wallissii* Regel "lírio-da-paz"	Araceae	exotic	herb
	**Yucca elephantipes* Hort. ex Regel "iuca-elefante"	Liliaceae	exotic	shrub
	"orquídea"	Orchidaceae	____	herb
Pinnaspis aspidistrae (Signoret, 1869) (drm, vrw)	**Platycerium bifurcatum* (Cav.) Chr. "chifre-de-veado"	Polypodiaceae	exotic	herb

idae); *Phenacoccus madeirensis* and *Pseudococcus longispinus* (Pseudococcidae); and *Orthezia insignis* (Ortheziidae). These eight species occurred on 42% of the scale-infested hosts.

Eriococcus campinensis (Eriococcidae), described by Hempel (1937), and *Acutaspis oliverai* (Diaspididae), described by Lepage and Giannotti (1942), are recorded from Brazil only, and *Orthezia molinarii* (Ortheziidae) and *Phenacoccus similis* (Pseudococcidae), previously were recorded by Morrison (1952) and Williams and Granara de Willink (1992), respectively, only in Argentina. It is possible that additional records will place these species in the polyphagous category.

Kuwanaspis bambusicola (Diaspididae), collected from *Bambusa gracilis*, is a monophagous species. According to Ben-Dov (1990), this species has been reported from species in only two genera of bamboo, *Bambusa* and *Dendrocalamus*.

Most samples of scale insects were collected from plants growing in pots or narrow flower beds in the shade (indoors) or semi-shade (under nursery netting, trees, or open porches). Infestations of the armored scale *Ischnaspis longirostris* on *Ficus benjamina* and of the mealybug *Pseudococcus longispinus* on *Cordilyne terminalis* were found only on potted plants, with the former interaction occurring both in shade and in bright sunlight and the latter only indoors. In larger flowerbeds where these pests were found, they appeared in small numbers.

Dense scale-insect populations were observed on the majority of host plants. Most infested plants showed symptoms such as dried or shriveled leaves; in a small number of cases flowers or fruit were aborted and leaves were deformed. Chlorosis of leaf tissue was detected mainly on hosts infested by species of Diaspididae.

TABLE 1. Continued.

Scale insects collected	Host plant species/Common names In Portuguese shown in quotes	Plant family	Plant Origin	Plant form
Pinnaspis strachani (Cooley, 1899) (vrw)	**Asparagus densiflorus* (Kunth.) Jess. var. *sprengeri* Hort. "aspargo-pendente"	Liliaceae	exotic	herb
	**Bauhinia variegata* Linn. "pata-de-vaca"	Fabaceae	native	tree
	Hibiscus rosa-sinensis L. "hibisco"	Malvaceae	exotic	shrub
	**Murraya exotica* "falsa-murta"	Rutaceae	exotic	tree
	***Nephrolepis exalta* Schot var. *forida-ruffle* "samambaia-crespa"	Davalliaceae	native	herb
Pinnaspis sp. (vrw)	*Asplenium nidus* L. "asplênio"	Aspleniaceae	exotic	herb
Pseudaonidia trilobitiformis (Green, 1896) (drm, vrw)	**Nerium oleander* L. "espirradeira"	Apocynaceae	exotic	shrub
	**Ficus pumila* L. "unha-de-gato"	Moraceae	exotic	tree
Pseudaulacaspis pentagona (Targioni –Tozzetti, 1886) (vrw)	sp. 2 "orquídea"	Orchidaceae	____	herb
	**Ligustrum sinense* Lour. "ligustro-chinês"	Oleaceae	exotic	shrub
Pseudischnaspis bowreyi (Cockerell, 1893) (vrw)	***Chrysalidocarpus lutecens* "areca-bambu"	Palmae	exotic	palm tree
Selenaspidus articulatus (Morgan, 1889) (vrw)	***Ervatamia coronaria* "jasmim-café"	Apocynaceae	exotic	shrub
	**Murraya exotica* "falsa-murta"	Rutaceae	exotic	tree
Margarodidae:				
Icerya sp. (drm)	*Pittosporum tobira* (Thunb.) Ait. "pitosporo-japonês'	Pittosporaceae	exotic	shrub

Sooty-mold frequently was found on plants infested by species of Ortheziidae, Pseudococcidae, and Coccidae. A large amount of sooty mold was found on *Nectandra megapotamica* infested by *Nipaecoccus nipae* (Pseudococcidae) and on *Schefflera arboricola* and *S. actinophylla* infested by *Orthezia* sp. (Ortheziidae).

Withered and dead plants of *Cordilyne terminalis* were observed infested by *P. longispinus* (Pseudococcidae) as were plants of *Asparagus densiflorus* and *Murraya exotica* infested by *Pinnaspis strachani* (Diaspididae), and *Saintpaulia ionantha* infested by *Phenacoccus similis* (Pseudococcidae). These plants were apparently negatively impacted because of direct and indirect damage caused by these insects.

In most cases, it was not possible to determine the extent of the ultimate destruction caused by these insects because most infested hosts were treated in some way to protect them from extensive damage.

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TABLE 1. Continued.

Scale insects collected	Host plant species/Common names in Portuguese shown in quotes	Plant family	Plant Origin	Plant form
Ortheziidae				
Orthezia insignis Browne, 1887 (drm, alp)	*Ardisia crenata* Sims. "ardísia"	Myrsinaceae	exotic	shrub
	* *Iresine herbstii* Hook. "iresine"	Amaranthaceae	native	shrub
	**Duranta repens* L. var. *aurea* Hort. "pingo-de-ouro"	Verbenaceae	native	shrub
	***Pseuderanthemum atropurpureum* "pseudoerântemo'	Acanthaceae	exotic	shrub
	***Pachystachys lutea* Nees. "camarão-amarelo"	Acanthaceae	exotic	shrub
	Solenostemon scutellarioides (L.) Lodd. "cóleus"	Labiatae	exotic	herb
Orthezia sp (drm, alp).	*Brunfelsia uniflora* D. Don. "manacá-de-cheiro"	Solanaceae	native	shrub
	Codiaeum variegatum Blume. "cróton"	Euphorbiaceae	exotic	shrub
	Dichorisandra thyrsiflora Mik. "marianinha"	Comeliaceae	native	shrub
	Duranta repens L. "violeteira"	Verbenaceae	native	shrub
	Euphorbia milii des Moulins var. *milii* "coroa-de-cristo"	Euphorbiaceae	exotic	shrub
	Euphorbia milii des Moulins var. *breonii* Hort. "coroa-de-cristo"	Euphorbiaceae	exotic	shrub
	Hibiscus syriacus L. "hibisco-colunar"	Malvaceae	exotic	shrub
	Lantana camara L. "camarazinho"	Verbenaceae	native	shrub
	Schefflera actinophylla "cheflera"	Araliaceae	exotic	shrub
	Schefflera arboricola "cheflera-pequena"	Araliaceae	exotic	shrub
	Syngonium podopylum Schott. "singônio"	Araceae	exotic	herb

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TABLE 1. Continued.

Scale insects collected	Host plant species/Common names in Portuguese shown in quotes	Plant family	Plant Origin	Plant form
Pseudococcidae				
Ferrisia virgata (Cockerell, 1893) (drm)	*Codiaeum variegatum* "cróton"	Euphorbiaceae	exotic	shrub
	***Rhipsalis baccifera* (Mill.)Stearn "cacto-macarrão"	Cactaceae	exotic	herb
Nipaecoccus nipae (Maskell, 1893) (drm)	***Nectandra megapotamica* Spreng. "canelinha"	Lauraceae	native	tree
Phenacoccus madeiriensis Green, 1923 (drm)	**Pachystachys lutea* "camarão-amarelo"	Acanthaceae	exotic	shrub
	**Salvia splendens* Ker-Gawl. "sangue-de-adão"	Labiatae	native	herb
	Hibiscus rosa-sinensis "hibisco"	Malvaceae	exotic	herb
	Acalypha wilkesiana M. Arg. "acalifa"	Euphorbiaceae	exotic	shrub
	Lantana camara "camarazinho"	Verbenaceae	native	shrub
Planococcus sp. (drm)	*Oncidium varicosum* Lindl. "chuva-de-ouro"	Orchidaceae	native	herb
Planococcus citri (Risso, 1813) (drm)	***Kalanchoe blossfeldiana* v. Poelln. "calancoê"	Crassulaceae	exotic	shrub
Pseudococcus longispinus (Targioni-Tozzetti, 1867) (drm)	**Cycas circinalis* Roxb. "cicas"	Cycadaceae	exotic	shrub
	***Cordilyne terminalis* "dracena-vermelha"	Liliaceae	exotic	shrub
	***Dracaena surculosa* Lindl. "dracena-bambu"	Liliaceae	exotic	shrub
	***Syngonium podophyllum* "singônio"	Araceae	exotic	herb
	***Rosa* sp. "roseira"	Rosaceae	exotic	shrub
Pseudococcus sp. (drm, alp)	*Davallia fejeensis* "renda-portuguesa"	Davalliaceae	exotic	herb
	Dieffenbachia amoena Hort. ex Gent. "comigo-ninguém-pode"	Araceae	exotic	herb

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