

Scale Insects on Ornamental Plants in Tunisia

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Abstract: A survey was conducted from 2008 to 2022 in eight Tunisian coastal governorates to identify the scale insects of ornamental plants, as well as their host plants and to document their geographical distribution. Eighteen species from four families were identified: *Aonidia lauri* Bouché, *Aonidiella aurantii* Maskell, *Aulacaspis rosae* Bouché, *Chrysomphalus aonidum* L., *Leucaspis pusilla* Löw, *Parlatoria ziziphii* Lucas (Diaspididae), *Ceroplastes floridensis* Comstock, *Ceroplastes rusci* L., *Saissetia olea* Olivier, *Coccus hesperidum* L. (Coccidae), *Maconellicoccus hirsutus* Green, *Phenacoccus peruvianus* Granara de Willink, *Phenacoccus madeirensis* Green, *Planococcus vovae* Nasonov, *Planococcus citri* Risso, *Ferrisia virgata* Cockerell and *Pseudococcus longispinus* Targioni-Tozzetti (Pseudococcidae) and *Icerya purchasi* Maskell (Margarodidae). In this study, the authors reported, for the first time, *L. pusilla* on *Pinus halepensis* (Pinaceae), *Coccus hesperidum* on *Musa sp.* and the secondary host *Dracenea marginata* (Asparagaceae) of *C. aonidum* for the first time in Tunisia. Faunistic studies are important for documenting new distributional data and notifying researchers of potential exotic pests.

Keywords: Scale insects, Ornamental plants, Invasive species, Geographical distribution, Tunisia.

Introduction

Scale insects are successful invaders of new territories, frequently introduced and acclimatized in all terrestrial zoogeographical regions. Several scales are established in Europe, representing hence one of the major insect groups alien to Europe (Pellizzari and

Germain, 2010). Most of them (Diaspididae and Pseudococcidae) originate from tropical regions and essentially from Asia. The scale insect family Diaspididae (Hemiptera: Coccoidea), includes a number of important pests of wild and greenhouse plants (Alford, 2002). Based on literature, several scale insect species can be found on various host plants grown in Tunisia. Garcia Morales *et al.*, (2016) have reported sixteen scale insect species to occur in Tunisia. In addition, other species have also been recorded in Tunisia (Mansour *et al.* 2017). Studies on Scale Insects fauna were conducted in Tunisia and the Mediterranean Basin (Mansour *et al.*, 2012) on crops with high economic value including olive groves (Mansour *et al.*, 2011), vineyards and *Citrus* plantations (Mansour *et al.*, 2009 and 2010). Moreover, Mdellel *et al.*, (2019) conducted a survey to identify mealybugs on ornamental plants and the host plants. Faunistic studies are important for documenting new distributional data and notifying researchers of potential exotic pests (Jendoubi, 2018). This work explores the fauna of scale insects on ornamental plant hosts, and their distribution across Tunisia.

Material and methods

Study sites

The study was conducted over the period from 2008 to 2022 in eight Tunisian coastal governorates. A total of twenty-six sites were surveyed irregularly (Figure 1). The study sites (Table 1) were chosen on the basis of the presence of many species of ornamental plants and various climate zones.

Infested leaves, inflorescences, and fruits with scale insects were collected, kept in alcohol 70°, and were sent to ANSES (French Agency for Food, Environmental,

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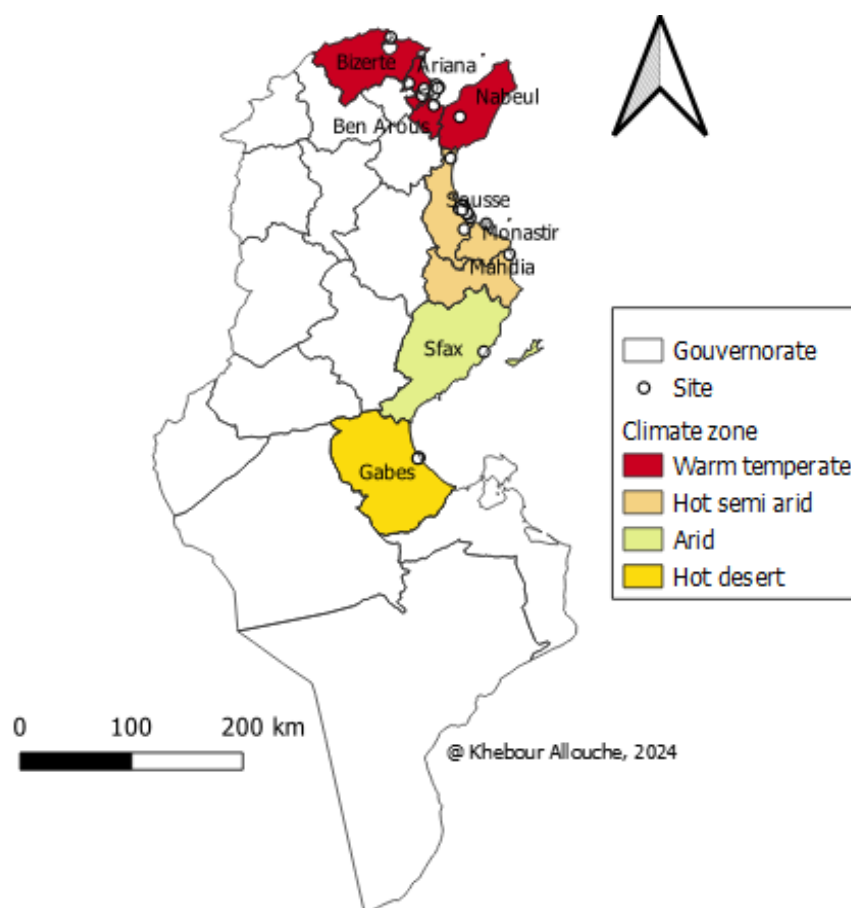


Figure 1. Climate zones in Tunisia and the collecting sites.

* Climate: According to Koppen Geiger (2016) classification (Rubel et al. (2017).

Table 1. The study's sites and period of the survey

Governorate	Bizerte	Ariana	Tunis	Ben Arous	Nabeul	Sousse	Monastir	Sfax	Gabes
Survey period	2016	2016-2017	2015-2017	2016	2015	2008 - 2022	2016	2016	2015-2016

and Occupational Health & Safety/France) for identification and confirmation. Identification and confirmation were done by Germain JF until 2019; after that Ouvrad D. and Balmés V. helped in the confirmation process.

After the mounting, the identification of mealy bugs was done by the first authors and was confirmed by Anses (Cox (1989), Kaydan and Gullan (2012), and Danzig and Gavrilov-Zimin (2015)). Samples of Coccidae were stored in 75% ethanol and slide mounted according to the methodology described by Kosztrab and Kozar (1988). The Coccidae were identified mainly using the characteristics given by Gill (1988). Voucher specimens were deposited in ANSES/France.

Results

The following is a list of scale insects collected from ornamental plants in different areas in Tunisia during a survey which lasted from 2008 to 2022 (Table 1). Members of four families were found on ornamental plants: Diaspididae (Table 2), Coccidae (Table 3), Pseudococcidae (Table 4) and Margarodidae (Table 5) with eighteen species of scale insects found on eighteen plant families in four climate zones.

Six species of Diaspididae were collected from different sites. *Aonidia lauri* and *Leucaspis pusilla* were observed in a hot semi-arid area. *L. pusilla* is recorded for first time in Tunisia in a hot semi-arid area on the needles of *Pinus halipensis*.

Aulacaspis rosae has been recorded on *Cycas* plant in different areas in Tunisia (Table 2) with heavy infestations near the crown of the host which can weaken or kill the plant. The species *Chrysomphalus aonidum* was observed on *Dracenea marginata* as a secondary host for the first time in a hot semi-arid zone. On this secondary host, an infestation appears as dark purple to reddish-brown or black spots with paler margins on both surfaces of the shaded leaves of the host plant.

As for the Pseudococcidae family, seven species were identified. Most of them are newly introduced in Tunisia (Mdellel et al., 2019). *Ferrisia virgata*, *Planococcus*

vovae, and *Phenacoccus madeirensis* were reported mainly from *Lantana camara*, *Cupressus macrocarpa* and *Cestrum nocturnum* and *Lantana camara* were found in hot semi-arid areas across Tunisia (Table 3) respectively. However, *Maconellicoccus hirsutus* colonies were recorded on leaves, shoots, the trunk and collar of the plant and induced desiccation of *Hibiscus rosasinensis* L. (Malvaceae) in warm temperatures, and hot semi-arid and desert areas. Concerning *Phenacoccus peruvianus*, it was observed on different ornamental plants in areas with warm temperatures and a hot semi-arid climate (Table 3).

Table 2. Diaspididae species, host plants, and collection areas in Tunisia.

Species	Host plant	Area	Climate
<i>Aonidia lauri</i> Bouché (1833)	<i>Laurus nobilis</i> (Lauraceae)	Akouda	Hot semi-arid
<i>Aonidiella aurantii</i> Maskell (1879)	<i>Citrus aurantium</i> (Rutaceae)	Nabeul city, Akouda, Ariana city	Warm temperate, Hot semi-arid
<i>Aulacaspis rosae</i> Bouché (1833)	<i>Cycas revoluta</i> (Cycadaceae)	Ariana city, Tunis city, Chott Mariem	Warm temperate, Hot semi-arid
<i>Chrysomphalus aonidum</i> L. (1758)	<i>Citrus aurantium</i> (Rutaceae)	Ariana city	Warm temperate
	<i>Dracaena marginata</i> (Asparagaceae)	Akouda, Tantana	Hot semi-arid
<i>Leucaspis pusilla</i> Löw (1833)	<i>Pinus halepensis</i> (Pinaceae)	Tantana, Chott Mariem	Hot semi-arid
<i>Parlatoria ziziphii</i> Lucas (1853)	<i>Citrus aurantium</i> (Rutaceae)	All governorates prospected	Warm temperate, Hot semi-arid, Arid, Desert

Table 3. Species of the Pseudococcidae family, host plants and collection areas in Tunisia.

Species	Host plant	Area	Climate
<i>Ferrisia virgata</i> Cockerell (1893)	<i>Lantana camara</i> (Verbenaceae)	Khezama	Hot semi-arid
<i>Planococcus citri</i> Risso (1813)	<i>Tradescantia fluminensis</i> (Commelinaceae)	Sidi Thabet	Warm temperate
<i>Planococcus</i> <i>vovae</i> Nasonov (1908)	<i>Thecoma smithi</i> (Bignoniaceae)	Chott Mariem	Hot semi-arid
	<i>Cupressus macrocarpa</i> (Cupressaceae)	Hammem Sousse	Hot semi-arid
	<i>Myoporum sp</i> (Scrophulariaceae)	Sousse City, Hammem Sousse, Akouda, Kalaa Kebira Monastir City, Tunis City	Hot semi-arid Warm temperate
<i>Phenacoccus peruvianus</i> Granara de Willink (2007)	<i>Citharexylum</i> <i>quadrangularis</i> (Verbenaceae)	Akouda	Hot semi-arid
	<i>Bougainvillea glabra</i> (Nyctaginaceae)	Sousse City, Akouda, Hammem Sousse, Msaken, Port Kantaoui, Ariana City, El Aouina, Tunis City, El-Marsa, Monastir city	Hot semi-arid, Warm temperate
	<i>Brugmansia arborea</i> , <i>Solandra maxima</i> (Solanaceae)	Akouda	Hot semi-arid
<i>Phenacoccus madeirensis</i> Green (1923)	<i>Cestrum parquii</i> (Solanaceae)	Akouda	Hot semi-arid
	<i>Lantana camara</i> (Verbenaceae)	Hammem Sousse	Hot semi-arid
<i>Pseudococcus</i> <i>longispinus</i> Targioni- Tozzeti (1867)	<i>Jasminum grandiflorum</i> (Oleaceae)	Port Kantaoui	Hot semi-arid
<i>Maconellicoccus hirsutus</i> Green (1908)	<i>Hibiscus rosasinensis</i> (Malvaceae)	Tunis City, El-Marsa, Goulette, Sidi- Bou Saïd, Carthage, Port Kantaoui, Akouda, Chott Mariem, Hammem Sousse, Msaken, Ariana City, El- Aouina, Bizerte City, Monastir City, Boumhel, Sfax city, Gabes city, Merth	Warm temperate, Hot semi-arid,, Arid, Desert
	<i>Hibiscus mutabilis</i> (Malvaceae)	Chott Mariem	Hot semi-arid

All species of the Coccidae family were recorded in areas with a hot semi-arid climate. *Ceroplastes floridensis* was detected during this survey on three plants (Table 4) in areas with a hot semi-arid climate. *Coccus hesperidum* was observed for the first time

on banana trees. This plant is a new host of *C. hesperidum* in Tunisia. *Saissetia oleae* is recorded on *Alcea rosea* for the first time in Tunisia. As for the Margarodidae family, *I. purchasi* was collected on five plant families (Table 5) in warm temperate areas.

Table 4. Species of the Coccidae family, host plants, and the collection areas in Tunisia.

Species	Host plant	Area	Climate
<i>Coccus hesperidum</i> L. (1758)	<i>Sheflera arboricola</i> (Araliaceae)	Chott Mariem	Hot semi-arid
	<i>Musa</i> sp. (Musaceae)	Akouda	
<i>Ceroplastes floridensis</i> Comstock (1881)	<i>Pittosporum tobira</i> (Pittosporaceae)	Sousse city	Hot semi-arid
	<i>Laurus nobilis</i> (Lauraceae)	Akouda	Hot semi-arid
	<i>Hedera helix</i> (Araliaceae)		
<i>Ceroplastes rusci</i> L. (1758)	<i>Ficus nitida</i> , <i>Ficus benjamina</i> (Moraceae)	Sousse city, Akouda, Chott Mariem	Hot semi-arid
<i>Saissetia olea</i> Olivier (1791)	<i>Alcea rosea</i> (Malvaceae)	Port Kantaoui	Hot semi-arid

Table 5. Species of Margarodidae family, host plants and the collection areas in Tunisia.

Species	Host plant	Area	Climate
<i>Icerya purchasi</i> Maskell (1879)	<i>Laurus nobilis</i> (Lauraceae)	Akouda	Hot semi-arid
	<i>Ocimum basilicum</i> (Lamiaceae)		
	<i>Citrus aurantium</i> (Rutaceae)	Akouda, Chott Mariem Beni Khaled	Hot semi-arid, Warm temperate
	<i>Ficus nitida</i> (Moraceae)	Akouda, Chott Mariem	Hot semi-arid
	<i>Hedera helix</i> (Araliaceae)	Akouda, Chott Mariem	

Discussion

The survey, which was carried out in twenty-three sites distributed across eight Tunisian coastal governorates, allowed the discovery of eighteen species belonging to four families on eighteen plant families in four climate zones. These include *A. lauri*, *A. aurantii*, *A. rosae*, *C. aonidum*, *L. pusilla*, *P. ziziphii*, *C. floridensis*, *C. rusci*, *S. olea*, *C. hesperidum*, *M. hirsutus*, *P. peruvianus*,

P. madeirensis, *P. vovae*, *P. citri*, *F. virgata*, and *P. longispinus* and *I. purchasi*. In this study *A. lauri* was observed infesting the leaves and bark of laurel during 2008 in a hot semi-arid area. The laurel scale is widely distributed in the Mediterranean basin, almost exclusively on *Laurus nobilis* and other species of *Laurus*. *A. aurantia*. The red scale was observed on bitter-orange trees in urban areas and represents a real menace for citrus groves and fruit cultivations

(Jendoubi, 2018). *C. aonidum* was reported as a potential problem for ornamental plants in Hungary (Reiderné and Kozár, 1994). In this study, the authors report, for the first time, the presence of *L. pusilla*. This species was studied in a pine forest in Tuscany (Italy) and was found to cause damage to some of the pine forests in which the trees had already been weakened by abiotic and biotic factors (Raspi and Antonelli, 1987). *L. pusilla* was listed in Turkey (Ülgentürk *et al.*, 2012) and Egypt (Badr, 2014). The climate as an extrinsic integrative factor plays a crucial role in determining the abundance and distribution of insect pest population. This can explain the presence of *P. ziziphii* in four climate zones. It is a major pest of citrus in all Tunisian citrus regions (Jendoubi, 2018). *F. virgata* and *P. madeirensis* were newly introduced in Tunisia (Mdellel *et al.*, 2019). The genus *Ferrisia* is apparently of a New World origin, and it is by far the most widespread species in the genus (Kaydan and Gullan, 2012). The Madeira mealybug is a pest of ornamental plants both outdoors and in greenhouses (Pellizzari & Germain, 2010). *P. longispinus* was a less prevalent species recorded on *Jasminum grandiflorum* during July in one site in the Sousse governorate. The citrus mealybug, *P. citri*, is a common polyphagous species known from all zoogeographical regions and *P. vovae* is widespread throughout the Mediterranean region as well as the Palaearctic region (Mdellel *et al.*, 2019). The fig wax scale was observed frequently on *Ficus microcarpa* and *Ficus benjamina* especially in a nursery of ornamental plants with a hot semi-arid climate. It is interesting to mention that *S. oleae* is an economic pest on both olive and citrus trees in Tunisia, and it is considered the key scale insect species (Jarraya, 2003). In this study, it was noted that the trade of ornamental trees appears to be the main pathway of the transfer of scale insects. In Tunisia, despite the economic implications of scale insects, very few studies have so far been carried out to provide a checklist of the species injuring many strategic crops

(Mansour *et al.*, 2017). This basic study demonstrates the role of ornamental plants to be an alternative host of several scale insects.

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