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SCIENTIFIC NOTES

# Armored scales as new pests in grapevine and mango crops in northeast Brazil

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**Abstract**
Armored scales are highly invasive insects, and their presence often necessitates quarantine measures, increasing the risk of product rejection. In Brazil, the São Francisco Valley in the Northeast region is the country's most important tropical fruit production zone. New diaspidid scales were observed, inflicting damage on table grapes and mango crops, particularly affecting the fruit quality and marketability. Armored scales infested the internodes, petioles, leaves, and trunks of grapevines. In areas with severe infestations, these pests caused plant death. The major problem with mangoes was the aesthetic damage to fruits discarded for exportation. Thus, in this study, we aimed to identify the Diaspididae species causing damage to grape and mango crops in Northeast Brazil. In grapevines, the specimens collected were identified as *Melanaspis arnaldoi* (Costa Lima) infesting trunks and *Aonidiella orientalis* (Newstead) occurring in internodes, petioles, leaves, and grape berries. The following species sampled in mango were identified: *Chrysomphalus aonidum* (L.), *Mycetaspis personata* (Comstock), *Aonidiella comperei* McKenzie, and *Hemiberlesia lataniae* (Signoret). The first three species were collected in leaves and fruits, while *H. lataniae* only in leaves. All six species are registered for the first time in the São Francisco Valley fruit-producing region. For the scale insect sampled in mango crops, *A. comperei* was the only one with no citations associated with *Mangifera indica* L. and no other Anacardiaceae species. Our results will aid the producers in monitoring the armored scales and guide control management strategies.

**Keywords** Diaspididae · *Mangifera indica* · *Vitis* · Fruit pests · *Melanaspis arnoldoi* · *Mycetaspis personata*

Scale insects (Hemiptera: Coccoidea) are worldwide pests of crops and ornamental plants (Kondo and Watson 2022). The armored scales (Hemiptera: Diaspididae) is the largest family in Coccoidea, with over 2,600 species and 419 genera of economic importance (García Morales et al. 2016). Besides the high number of diaspidid pests, this family is also among the most invasive insects in the world (Miller et al. 2005). Thus, some markets require quarantine, with risks regarding product rejection (Amouroux et al. 2017).

In Brazil, the São Francisco Valley (SFV) in Northeast Brazil is the country's most important tropical fruit production zone, responsible for 99% and 93% of the table grape and mango exportation, respectively (EMBRAPA 2024a, b). Mango farmers in the SFV, Brazil, communicated to Embrapa Semi-arid (Brazilian Agriculture Research Corporation) between 2021 and 2022 about damages to the leaves and fruits caused by armored scale insects. Diaspididae species were also observed infesting grapevine trunks, internodes, petioles, leaves, and grape berries in the region in 2023 and 2024. The major problem with mangoes was the aesthetic damage to fruits discarded for exportation. In grapevines, some areas with armored scales infesting the trunks led to plant death, and diaspidids in grape berries resulted in losses in the postharvest. Thus, in this study, we aimed to identify the Diaspididae species causing damage to mango and table grape crops in SFV Brazil.

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In table grape crops, the armored scale insects were sampled from six sites in Petrolina (PE) (Table 1; Fig. 1). Pruning shear was used to remove grapevine trunk parts (~8×4 cm) with diaspidids, over 15 to 20 samples per site. Over 20 to 30 branches were collected from each table grape farm to sample armored scales in leaves, internodes, and petioles, and 40 to 50 grape berries. In the five mango areas, leaves (20 to 30) and fruits (10 to 15) with diaspidids were sampled (Table 1; Fig. 1). The scale insects were slide-mounted following the techniques adapted by Wolff et al. (2014) and were identified according to the morphological characteristics of the adult female (Costa Lima 1924; Lepage and Giannotti 1943; Claps and Wolff 2003; Miller and Davidson 2005; Wolff et al. 2014). Voucher specimens of the diaspidids were deposited in the entomological collection from the "Ramiro Gomes Costa" museum (MRGC, RS).

In grapevines, all the specimens collected in trunks were identified as *Melanaspis arnaldoi* (Costa Lima). *Vitis vinifera* L. was cited as a host plant for *M. arnaldoi* 100 years ago in Brazil (Costa Lima 1924). In a more recent study, this insect scale was reported in South Brazil; however, no economic damages were mentioned (Wolff et al. 2014). The present study observed plants with trunks almost covered with *M. arnaldoi* in three sites, leading to plant deaths. The insects occurred over and underneath the trunk bark (Fig. 2). Thus, many producers adopted manual bark removal before spraying insecticides directed to the trunk. This new practice increased the labor cost associated with pest management.

**Table 1** Plant structures, sample dates, sites, and coordinates from the table grape and mango areas sampled for Diaspididae in the São Francisco Valley, Brazil

| Plant structure | Sample dates | Site | Coordinates |
|---|---|---|---|
| **Grapevine** | | | |
| Trunk | Jun - Aug 2023; May - Jun 2024 | Petrolina | 9°17'23.5"S 40°28'47.7"W, 9°18'39.8"S 40°28'39.0"W, 9°19'35.4"S 40°24'03.4"W, 9°05'19.6"S 40°18'45.5"W, 9°21'00.1"S 40°38'57.2"W and 9°21'35.7"S 40°37'33.1"W |
| Internodes, petioles, leaves, and berries | Jan - Apr 2024 | Petrolina | 9°17'23.5"S 40°28'47.7"W and 9°20'00.4"S 40°22'19.9"W |
| **Mango** | | | |
| Leaves and fruits | Oct - Nov 2021; Aug 2022 | Belém de São Francisco | 8°41'28.9"S 39°10'37.4"W and 8°40'19.5"S 39°09'57.5"W |
| Leaves and fruits | Aug 2023; Mar 2024 | Petrolina | 9°18'37.8"S 40°34'15.6"W and 9°08'06.0"S 40°18'21.2"W |
| Leaves and fruits | Nov 2021; Jan 2023 | Curaçá | 9°02'55.1"S 39°55'18.5"W |

Our results extend the species distribution, with its first occurrence in the Northeast Brazilian region. Until now, *M. arnaldoi* has been reported only in Brazil, in two states in the South and Southeast regions.

The armored scales sampled from the grapevine's internode, petioles, leaves, and berries were identified as *Aonidiella orientalis* (Newstead) (Fig. 3). The oriental yellow scale was observed in grape bunches, and in one area caused losses in the postharvest berries selection. *Aonidiella orientalis* is a polyphagous species, with records in host plants from 77 families and 188 genera distributed in 72 countries (García Morales et al. 2016). It is an introduced species in Brazil associated with four non-cultivated plants (Peronti et al. 2024). In grapevine, it was observed in the bark of small branches in the Philippines (Cockerell and Robinson 1915). The oriental yellow scale has already been reported as a pest in several crops, such as citrus (Rosen 1990), papaya (Elder et al. 1998), and mango (Ben-Dov and Wysoki 1990).

The species identified in mango crops included *Chrysomphalus aonidum* (L.), *Mycetaspis personata* (Comstock), *Aonidiella comperei* McKenzie, and *Hemiberlesia lataniae* (Signoret). The first three species were collected in leaves and fruits, while *H. lataniae* only in leaves. The armored scales *C. aonidum*, *M. personata*, and *A. comperei* have records in northeast Brazil, while this is the first citation for *H. lataniae* in the region (García Morales et al. 2016; Peronti et al. 2024). However, this is the first record for the four species in the SFV fruit-producing region.

*Mycetaspis personata* was recorded in Belém de São Francisco (PE) sites and one site in Petrolina (PE) in mango leaves and fruits. The diaspidid feeding caused fruit depigmentation around the scale, resulting in aesthetic damage (Fig. 4). In one site in Petrolina, infestation from *M. personata* led to fruit discarding. In Egypt, this species was already cited as a mango pest (Salama 1970). The species' diminutive size, adult female scale ranging from 0.5 to 1.0 mm (Watson 2002), and black color make it difficult for its field identification. In the SFV, the producers confused it in some areas as feeding necrosis of sap-sucking insects.

For the armored scales insect identified in mangoes, *A. comperei* was the only one with no citations associated with this crop and no other Anacardiaceae species. This insect has registered as host plant species from 12 botanical families and 12 genera (García Morales et al. 2016). The species was identified by samples from the Curaçá (BA) site in mango leaves and fruits (Fig. 5). Besides this new information associated with mangoes, it also caused economic losses due to discarding fruits due to aesthetic damage. Since then, *A. comperei* has been highlighted only as a major papaya pest (Martins et al. 2015).

*Chrysomphalus aonidum* incidence was from the Belém de São Francisco sites in mango leaves and fruits (Fig. 5).

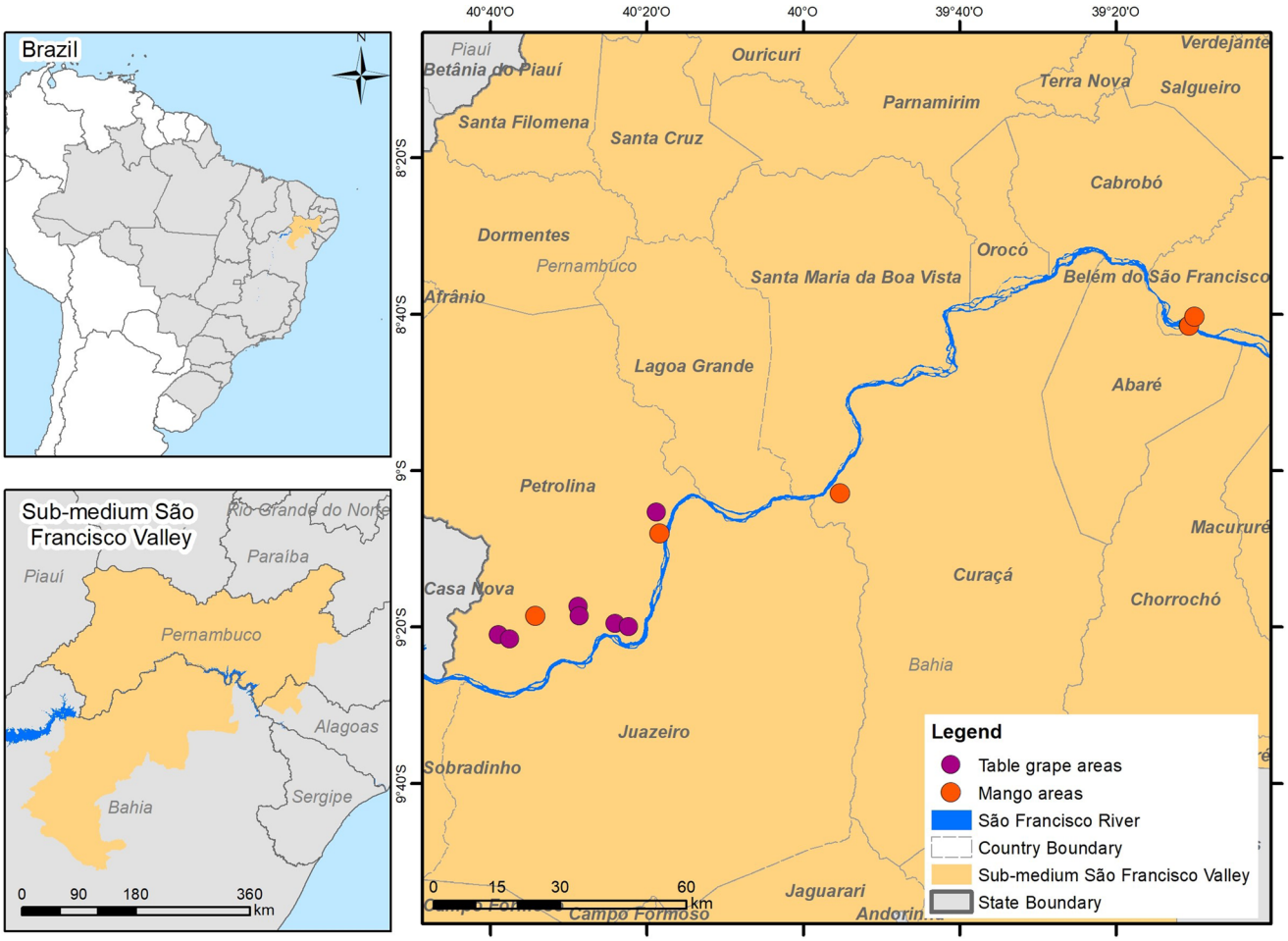


**Fig. 1** Diaspididae sampling sites in table grape and mango production areas in the Sub-medium São Francisco Valley, Brazil


**Fig. 2** Armored scale insect *Melanaspis arnaldoi* infesting grapevine trunk (left) and a magnified view showing infestation beneath the bark (right)

**Fig. 3** *Aonidiella orientalis* (Newstead) in grapevine internodes, petioles, and leaves (left) and in grape berries (right) in Northeast Brazil


**Fig. 4** *Mycetaspis personata* infesting mango fruit in Northeast Brazil (left) and a magnified view showing fruit depigmentation around the scales (right)

However, no fruit discarding was reported associated with this species. This diaspidid is a worldwide distributed and polyphagous species associated with plants from 80 families and 199 genera (García Morales et al. 2016). It is dispersed in all Brazilian regions and recorded in mango plants (Silva et al. 1968). This species is known as the Florida red scale and is a citrus pest (Rosen and Debach 1979).

*Hemiberlesia latania* was observed only in mango leaves in one site in Petrolina, which did not cause economic losses. This insect scale is a cosmopolitan and polyphagous species associated with 371 host plant genera in 153 countries (García Morales et al. 2016). In Malaysia, it was cited as a pest for the mango crop (Chua and Wood 1990) and also is cited for causing economic damage in other crops, such as kiwi (Blank et al. 1999) and avocado (Gerson and Zor 1973).

Recently, new records of one Diaspididae and two Coccidae species were done, causing damage to mango crops in the SFV (da Costa-Lima et al. 2022). The increasing incidence of new-scale insects in mango in SFV can be related to recent, higher-density mango plantings in the region. This crop management enhances the shaded areas, where the insect diversity is generally higher (De Cauwer et al. 2006).

All species recorded in mango crops and *A. orientalis* in grapevine were sampled in leaves, showing the importance of monitoring these diaspidids in the vegetative stage to reduce the chances of population growth and future migration to fruits. The same behavior was observed for other diaspidids in citrus (Rodrigo et al. 2004). Sustainable control strategies are important to be evaluated against these armored scales; it has been shown that the rigorous importer


**Fig. 5** *Aonidiella comperei* in fruit (left) and *Chrysomphalus aonidum* in *Mangifera indica* leaf (right)

residue limits reduce trade in fruits and vegetables by 8.8% (Hejazi et al. 2022). Mating disruption, parasitoids (Vacas et al. 2012), entomopathogenic bacteria (Tozlu et al. 2020), and reduced-risk insecticides, such as vegetable and mineral oils (Xiao et al. 2016) have studies showing efficiency for other diaspidids that can be evaluated for the identified species in the present study.

Correct pest identification is the first step in an integrated pest management program, and this practice becomes increasingly important for invasive pests in fruit international commerce. Our results will aid table grape and mango producers in monitoring armored scales and guiding control management strategies.

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**Data availability** Not applicable.

## Declarations

**Conflict of interest** The authors have no conflicts of interest to declare that are relevant to the content of this article.

**Financial interests** The authors declare they have no financial interests.

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