

First record of *Phenacoccus defectus* in Italy, with comments on *Phenacoccus solani* and *Phenacoccus solenopsis*

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Abstract

The alien mealybug *Phenacoccus defectus* Ferris (Rhynchota Pseudococcidae) is recorded in Italy for the first time. The species was first starting from 2009 on potted plants of *Aeonium arboreum*, *Echeveria* sp., *Sedum palmeri*, *Sempervivum tectorum* (Crassulaceae) and *Senecio citrifolius* (Asteraceae). Comments on the morphologically very similar *Phenacoccus solani* Ferris and *Phenacoccus solenopsis* Tinsley are discussed.

Key words: Pseudococcidae, mealybugs, Crassulaceae.

Introduction

The import and trade of succulent plants have led to the introduction to Italy of several alien mealybug species that have spread in greenhouses and private collections, namely *Delottococcus euphorbiae* (Ezzat et McConnell), *Hypogeococcus pungens* Granara de Willink, *Spilococcus mamillariae* (Bouche), *Trochiscococcus speciosus* (De Lotto), *Vryburgia brevicurvis* (McKenzie), and *Vryburgia rimariae* Tranfaglia (Rhynchota Pseudococcidae) (Tranfaglia, 1981; Longo *et al.*, 1989; Williams and Pellizzari, 1997; Pellizzari, 2010). Besides the above recorded species, the North American mealybug *Phenacoccus defectus* Ferris was detected several times, from April 2009 onwards, on ornamental potted Crassulaceae in a private collection in the town of Padova (north-eastern Italy). No chemical control measures were taken by the owner, whose action was just to eliminate highly infested plants. According to the owner, the only additions to the collection were some succulents imported one year before (2008) from Bordighera in the Liguria region (north-western Italy).

Materials and methods

Specimens were mounted according to the procedures of Ben-Dov and Hodgson (1997). Specimen depository: The Scientific Museums of the University of Padova (Italy), Department DAFNAE.

Discussion

P. defectus was first recorded in Europe in Great Britain, in 1997 on succulent plants in private collections and it has since been found indoors at a botanical collection on *Echeveria* plants and on succulent plants outdoors during the summer of 2007 (Malumphy, 1997; Malumphy *et al.*, 2013). In 2006 it was recorded on *Euphorbia* in a greenhouse in South France (Nice) (Germain and Matile Fer-

rero, 2006). In both cases the authors report that the plants were originally imported from Italy (Malumphy *et al.*, 2013; Germain, 2005 *in litteris*).

P. defectus is a North American species, described on specimens collected on *Eriophyllum confertiflorum* (Asteraceae) in California, Santa Clara County (Ferris, 1950). It was recorded later in several localities in California (McKenzie, 1967), in Mexico (Williams and Granara de Willink, 1992) and recently in Japan (Tanaka and Uesato, 2012). It develops on plants of Acanthaceae, Asteraceae, Chenopodiaceae, Crassulaceae, Euphorbiaceae, Fabaceae, Hydrophyllaceae, Lamiaceae, Poaceae and Polygonaceae. With regard to Crassulaceae, it was recorded on *Echeveria longissima*, *Sempervivum tectorum* (McKenzie 1967), *Sedum palmeri* (Williams and Granara da Willink, 1992), *Crassula portulacae*, *Echeveria craigiana*, *E. lurida*, *E. recurvata*, *E. sessiliflora* and *Echeveria* sp. (Malumphy, 1997).

Malumphy (1997) reported the first biological observation on this species: the females are parthenogenetic and ovoviviparous. The mealybugs feed on the growing part of the plant and excrete sticky honeydew; heavily infested plants eventually die.

In Padova *P. defectus* was collected on *Aeonium arboreum*, *Echeveria* sp., *Sedum palmeri*, *Sempervivum tectorum* (Crassulaceae) and *Senecio citrifolius* (Asteraceae). Infested plants are presently kept under glass at the Experimental Farm of the School of Agriculture, University of Padova, in order to study the biology of the mealybug. According to our first observation it is mainly dangerous to *Sempervivum* plants, which can die when highly infested. The mealybugs are well concealed in protected places as under the succulent leaves, near the stem or the crown and low infestations are easily overlooked. The mealybugs crawl actively from pot to pot and can spread rapidly. Sticky honeydew is excreted on infested plants, when population levels are high.

Besides *P. defectus*, two other American *Phenacoccus* species, namely *Phenacoccus solani* Ferris and *Phenacoccus solenopsis* Tinsley, are recent invaders in countries of the Mediterranean basin.

P. solani is spreading in countries of the Mediterranean basin starting from 1999: it was recorded in Sicily (Italy) on *Encephalartos* (Cycadaceae) (Mazzeo *et al.*, 1999), later in Israel (Ben-Dov, 2005), in Turkey (Kaydan *et al.*, 2008), and Spain (Beltrà and Soto, 2011). It is a polyphagous species, common on Solanaceae and many ornamentals.

P. solenopsis, a polyphagous widespread species, was recorded in 2010 in Egypt and Cyprus (Abd-Rabou *et al.*, 2010; EPPO, 2011). It is a highly invasive species, a major pest of cotton in Central Asia and China (Hodgson *et al.*, 2008; Wu and Zhang, 2009) and presently widely distributed in different regions.

The three species *P. defectus*, *P. solani* and *P. solenopsis* are morphologically similar and may be difficult to identify on the basis of microscopic characters only, as pointed out by several studies (McKenzie, 1967; Williams and Granara de Willink, 1992; Culik and Gullan, 2005), even if it is generally assumed that *P. solenopsis* has a higher number of multilocular disc-pores and a larger circulus with respect to the other two species.

Hodgson *et al.* (2008) compared the microscopic morphological differences among *P. solenopsis*, *P. solani* and *P. defectus*, and, based on the morphological variation found in the Asian material, considered that there was some support for the suggestion that these three species might be environmentally-induced variants of a single species.

Even if the mounted specimens of the three above recorded species are similar, the live appearance and the biology of *P. solenopsis* clearly differ from the other two species; the adult females of *P. solenopsis* have usually paired black dorsal markings and short marginal wax filaments (Culik and Gullan, 2005; Malumphy *et al.*, 2013), whereas *P. defectus* and *P. solani* are uniformly whitish on dorsum. Moreover *P. solenopsis* is a biparental species (Hodgson *et al.*, 2008; Vennila *et al.*, 2010) whereas both *P. defectus* and *P. solani* are parthenogenetic species and males are unknown (Lloyd, 1952; Malumphy, 1997; Ben-Dov, 2005; authors' observation, 2012). *P. defectus* and *P. solani* share several host plants in the families Asteraceae, Chenopodiaceae, Crassulaceae, Euphorbiaceae, Fabaceae, Lamiaceae, Poaceae, Polygonaceae). *P. solenopsis*, in spite of its high polyphagy, was never recorded on Crassulaceae, a common host plant family of *P. defectus*.

Concluding remarks

In conclusion, *P. defectus* and *P. solani* are morphologically almost indistinguishable and share many host plants. Molecular identification by DNA sequencing (Malausá *et al.*, 2011; Abd-Rabou *et al.*, 2012) and breeding studies, with transfer between host plants are presently under way to clarify if *P. defectus* and *P. solani* are synonyms of the same taxon as suggested by Malumphy (2009; Malumphy *et al.*, 2013). *P. solenopsis* appears a separate species, identifiable on the basis of both biological and morphological macro- and microscopic characters.

Acknowledgements

The authors are grateful to the three anonymous referees for their comments and suggestions that contributed to improve this paper.

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Received April 5, 2013. Accepted June 4, 2013.