Bulletin OEPP/EPPO Bulletin (2020) **0** (0), 1–4 ISSN 0250-8052. DOI: 10.1111/epp.12674

First record of cotton mealybug, *Phenacoccus solenopsis* Tinsley 1898 (Hemiptera: Pseudococcidae), from Saudi Arabia

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The cotton mealybug, *Phenacoccus solenopsis* Tinsley 1898 (Hemiptera: Pseudococcidae), is recorded from Saudi Arabia for the first time. This species was collected from heavily infested *Hibiscus rosa-sinensis* L. (Malvaceae) from the city of At-Taif in the south-western part of the Arabian Peninsula. In addition, the mealybug *Ferrisia virgata* (Cockerell, 1893), previously recorded in Saudi Arabia, was found on *Plumeria rubra* L. (Apocynaceae) and on *Dodonaea viscosa* Jacq. (Sapindaceae). Slide mounts were prepared and voucher specimens were preserved at the University of Jordan Insects Museum. Further surveys should be initiated to investigate the distribution and hosts of *P. solenopsis* in Saudi Arabia.

Introduction

The cotton mealybug, *Phenacoccus solenopsis* Tinsley, was described form North America in 1898 (Tinsley 1898). Hodgson *et al.* (2008) redescribed the adult female, designated a lectotype for the species, described the adult male and all the immature stages, and provided a key to separate *P. solenopsis* from similar species of south Asian *Phenacoccus* and a key to identify the immature stages of males and females.

Phenacoccus solenopsis is a highly polyphagous species with more than 200 host species. Recently, it has spread to new areas in Asia and Africa, and many studies have been published regarding its distribution, pest status, hosts, natural enemies and control. After its introduction in 2012 to Ethiopia via mango seedlings, Gebregergis (2018) conducted surveys for the mealybug and assessed its incidence and severity during the 2016 sesame production season. Ibrahim *et al.* (2015) recorded *P. solenopsis* for the first time in Egypt on tomato plants. Beshr *et al.* (2016) surveyed this pest for 2 years in Alexandria and Behaira governorates in Egypt and recorded 22 host species in 12 families, including vegetable crops, ornamental plants, and wild shrubs and weeds of arable lands. El-Zahi *et al.* (2016) evaluated eight insecticides and a mineral oil to control *P. solenopsis* on cotton under field conditions. Kaydan *et al.* (2013) reported *P. solenopsis* for the first time from ornamental plants in the Adana Mediterranean region. *P. solenopsis* was recorded on cotton crop in Punjab, India during 2006 (Dhawan & Saini, 2009). Abbas *et al.*, 2010 recorded 55 host plant species for *P. solenopsis* and gave observations on the overwintering of the mealybug in Pakistan. Ashraf *et al* (2016) evaluated the mineral oil Diver on *P. solenopsis* and its parasitoid *Aenasius bambawalei* (Hymenoptera: Encyrtidae), and showed that the mealybug was more sensitive to the oil than the parasitoid. Çalişkan *et al.* (2016) recorded three parasitoids on *P. solenopsis* in Turkey, one of them, *Prochiloneurus uyguni* Hayat, was new to science. *P. solenopsis* was recorded on the ornamental plant *Lantana camara* (Verbeneceae) and other host plants for the first time in Iraq (Abdul-Rassoul *et al.*, 2015). Spodek *et al.* (2018) stated that *P. solenopsis* was reported for the first time in the Jordan Valley in 2008 on basil and bell pepper. Mohammed *et al* (2019) studied the biology of this mealybug on tomato and eggplant after an outbreak on many crops in different areas of Sudan. Beccari, (1971) listed 31 scale insect species from Saudi Arabia, providing data about their hosts and distribution. A total of 15 species in 12 genera of the Pseudococcidae occur in Saudi Arabia without listing any species of *Phenacoccus* Fullaway (Morales *et al.*, 2016).

Wang *et al.* (2010) analysed the annual population growth data of *P. solenopsis* in the United States and worldwide using the CLIMEX model and found that the tropical regions were very suitable for the pest. Wei *et al.* (2017) proposed a current and future potential global distribution map for this pest under several variables of climate change based on MaxEnt software. Fand & Suroshe (2015) stated that this species has high potential to spread to new areas and can adapt to diverse ecological situations in the tropics and subtropics where the temperatures are expected to increase due to climate change.

The main objective of this paper is to record *P. solenopsis* Tinsley 1898 for the first time from Saudi Arabia in order to alert those working in plant health and entomologists in this country and urge them to conduct investigations on its status in the country.

Materials and method

Samples of mealybug-infested ornamental plants *Hibiscus rosa-sinensis* L. (Malvaceae), *Plumeria rubra* L. (Apocynaceae), and *Dodonaea viscosa* Jacq. (Sapindaceae) were collected on the 9 October 2019 from a garden in At-Taif

city (21° 16′ 34″ N, 40° 24′ 47″ E) in Saudi Arabia. All plants of *Hibiscus rosa-sinensis* L. were heavily infested with adult females with egg-filled ovisacs and large numbers of newly hatched first instar nymphs (Fig. 1). The infestation on *Plumeria rubra* L. was moderate (Fig. 2) and all the plants in the area were also infested. However, few mealybugs were observed on *Dodonaea viscosa* Jacq. (Fig. 3). The collected samples were placed in airtight plastic bags and transferred to the University of Jordan Insect Museum (UJIM) for preparation and identification. Mealybugs were then removed with a fine brush and soaked in 10% KOH for 2 days, cleared from body contents, dyed with acid fuchsin, fixed with absolute ethanol and cleared in clove oil. The specimens were slide mounted and identified by the first author following the interactive key of Miller *et al.* (2014) and the key by Hodgson *et al.* (2008). Voucher specimens of the collected samples were preserved in UJIM.

Results and discussion

All specimens collected from *Hibiscus rosa-sinensis* L. (Malvaceae) were found to belong to *P. solenopsis* (Fig. 1). This is the first record for the genus *Phenacoccus* and the species in Saudi Arabia. Alive adult females matched the description of Hodgson *et al.* (2008), "pale yellow to almost orange, with a pair of dark dorsal markings on head, about six pairs of transverse markings across pro- and mesothorax, possibly absent on the metathorax, and with pairs of dark transverse markings on each abdominal segment; also with a submarginal line of dash marks on thorax and abdomen. Venter with circulus dark". In addition, mounted adult females matched the description of Hodgson *et al.* (2008), "with multilocular disc pores medially on abdominal segments VI–IX (rarely also 1 or 2 on V), scattered across full depth of segment VII between anterior to posterior margins; also usually present submarginally on some abdominal segments (about equally frequent on segments II–VI when present); antenna usually 9 segmented".

Fig. 1 *Phenacoccus solenopsis*, on *Hibiscus rosa-sinensis* L. At-Taif city, Saudi Arabia.

Fig. 2 *Ferrisia virgata* (Cockerell) on the underside of *Plumeria rubra* L. (Apocynaceae) leaf. At-Taif city, Saudi Arabia.

Fig. 3 *Ferrisia virgata* (Cockerell, 1893) on *Dodonaea viscosa* Jacq. (Sapindaceae) leaf. At-Taif city (21° 16′ 34″ N, 40° 24′ 47″ E), Saudi Arabia.

The introduction of *P. solenopsis* into Saudi Arabia does not seem to be recent because this species was intercepted 198 times at US ports of entry between 1995 and 2012, with specimens originating from Europe, Africa and Asia, including Saudi Arabia and the United Arab Emirates from the Arabian Peninsula (Miller *et al.*, 2014). All populations of *P. solenopsis* are known to reproduce sexually except for one population in India (Hao-jie *et al.*, 2019). No males were found among the specimens from Saudi Arabia, which may suggest its introduction from India. Wei *et al.* (2017) presented the global potential distribution map of *P. solenopsis* based on current and future climate variables under different scenarios up to 2070. He graded all areas into four groups: (1) unsuitable habitat area; (2) low habitat suitability area; (3) moderate habitat suitability area; (4) high habitat suitability area. Most of Saudi Arabia was in the unsuitable habitat area except for the south-western part in which At-Taif city is located and in which the species was found.

Specimens collected from *Plumeria rubra* L. (Apocynaceae) (Fig. 2) and *Dodonaea viscosa* Jacq. (Sapindaceae) (Fig. 3) were found to belong to the guava mealybug (also called the striped mealybug), *Ferrisia virgata* (Cockerell, 1893). This species was previously recorded by Beccari (1971) in Saudi Arabia. It is the most widespread species in the genus and has an unknown area of origin. It was a pest at the time of its description from Jamaica, suggesting its introduction from other areas (Kaydan & Gullan, 2012). *F. virgata* is a polyphagous species attacking 207 genera in 78 families (Morales *et al.*, 2016), including *P. rubra* L. However, *D. viscosa* Jacq. (Sapindaceae) appears to be a new host for the species.

Conclusion

The highly polyphagous *P. solenopsis* is expected to be present on different hosts and areas in the south-western parts of Saudi Arabia. Further studies are needed regarding its pest status, distribution and the presence of its native natural enemies in the country.

Acknowledgments

The samples were taken during an official FAO mission concerning fall army worm *Spodoptera frugiperda*. The second author noted heavy infestations of mealybugs on ornamentals around the workshop venue. Samples were taken and given to the first author for identification and the Saudi Arabian IPPC contact point was informed of this finding.

Premier signalement de la cochenille du coton, *Phenacoccus solenopsis* Tinsley 1898 (Hemiptera : Pseudococcidae), en Arabie Saoudite

La cochenille du coton, *Phenacoccus solenopsis* Tinsley 1898 (Hemiptera : Pseudococcidae), est signalée pour la première fois en Arabie Saoudite. Cette espèce a été prélevée sur un *Hibiscus rosa-sinensis* L. (Malvaceae) fortement infesté dans la ville de Taïf, dans la région sud-ouest de la péninsule arabique. Par ailleurs, la cochenille *Ferrisia virgata* (Cockerell, 1893), déjà signalée auparavant en Arabie Saoudite, a été détectée sur *Plumeria rubra* L. (Apocynaceae) et *Dodonaea viscosa* Jacq. (Sapindaceae). Les insectes ont été montés entre lame et lamelle, et des spécimens de référence ont été conservés à la Galerie d'Entomologie de l'Université de Jordanie. D'autres prospections devraient être entreprises afin de déterminer la distribution géographique et les hôtes de *P. solenopsis* en Arabie Saoudite.

Первые сведения о хлопковом мучнистом червеце *Phenacoccus solenopsis* Tinsley 1898 (Hemiptera: Pseudococcidae) из Саудовской Аравии

В Саудовской Аравии был впервые зарегистрирован хлопковый мучнистый червец *Phenacoccus solenopsis* (Hemiptera: Pseudococcidae). Этот вид был собран на сильно заражённых растениях *Hibiscus rosa-sinensis* L. (Malvaceae) в городе Ат-Тайф в юго-западной части Аравийского полуострова. Кроме того, мучнистый червец *Ferrisia virgata* (Cockerell, 1893), ранее зарегистрированный в Саудовской Аравии, был найден на растениях *Plumeria rubra* (Apocynaceae) и *Dodonaea viscosa* (Sapindaceae). Были подготовлены микропрепараты, а ваучерные особи были сохранены в Музее насекомых Иорданского университета. Необходимо предпринять дальнейшие обследования с целью изучения распределения и хозяев *P. solenopsis* в Саудовской Аравии.

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