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Phenacoccus solenopsis Tinsley (Sternorrhyncha: Coccoidea: Pseudococcidae), an invasive mealybug damaging cotton in Pakistan and India, with a discussion on seasonal morphological variation

CHRIS HODGSON[1], GHULAM ABBAS[2], MUHAMMAD JALAL ARIF[3], SHAFQAT SAEED[4] & HAIDER KARAR[5.]

[1]*Department of Biodiversity and Systematic Biology, National Museum of Wales, Cardiff, CF10 3NP, Wales, UK. E-mail: hodgsoncj@cardiff.ac.uk*
[2]*Pest Warning and Quality Control of Pesticides, Punjab, 21 Davis Road, Lahore, Pakistan. E-mail: abbas700@gmail.com*
[3]*Department of Agricultural Entomology, University of Agriculture, B.Z. University, Multan, Pakistan. E-mail: jalalarif807@yahoo.com*
[4]*Department of Agricultural Entomology, University of Agriculture, Faisalabad, Pakistan. E-mail bumblebeepak@gmail.com*
[5]*Entomological Research Sub-station, Multan, Pakistan. E-mail: karar853@yahoo.com*

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Abstract

Since at least 2005, a possibly introduced mealybug of the genus *Phenacoccus* has been causing serious damage to cotton (*Gossypium hirsutum*) over much of the Sindh and Punjab districts of Pakistan and in north-western India. Some short papers have been published locally giving details on the structure and biology of this species and suggesting the name *Phenacoccus gossypiphilous* Abbas, Arif & Saeed (2005) but without designating type specimens or depositories. This name is here considered a *nomen nudum.* A detailed morphological study has been unable to separate this species from many specimens of *Phenacoccus* from the Neotropics that are believed to be *Phenacoccus solenopsis* Tinsley. The material from the Indian subcontinent shows considerable morphological variation in the frequency of multilocular disc pores and oral collar tubular ducts on the ventral submargin of the abdomen; this appeared to be related to conditions under which this species was reared, with those cultured in a screen-house during the non-cotton-growing season being indistinguishable from *P. solenopsis* from the Neotropics . This paper re-describes the adult female of *P. solenopsis* Tinsley based on the type specimens from New Mexico, and designates a lectotype. The type material was compared with specimens considered to be *P. solenopsis* from elsewhere in the New World, and from West Africa and several areas in Asia, particularly Pakistan and India. Based of our present understanding of the morphology of adult female *P. solenopsis*, it is concluded that the species is rather variable, that this variability may be environmentally induced, and that the species currently causing widespread damage to cotton on the Indian subcontinent is referable to *P. solenopsis*. Adult male *P. solenopsis* from North America, Pakistan and India were also studied and again no significant differences were found. Descriptions are provided of the adult male and all the immature stages of *P. solenopsis*, based on material from India and Pakistan. Keys are provided to (a) separate *P. solenopsis* from similar species of *Phenacoccus* currently known from Asia and (b) to identify all instars. The morphological differences between *P. solenopsis*, *P. solani* Ferris and *P. defectus* Ferris are reviewed and, based on the morphological variation found in the Asian material, it is considered that there is some support for the suggestion that these three species might be environmentally induced variants of a single species. A few details are given of the biology of *P. solenopsis* on cotton in Pakistan.

Key words: *Phenacoccus gossypii*, *P. madeirensis*, *P. parvus*, *P. similis*, Malvaceae, Thailand, Taiwan, Benin, Nigeria, Camaroon, New Caledonia, North America

Introduction

In 2005, a possibly introduced species of *Phenacoccus* (Sternorrhyncha: Coccoidea: Pseudococcidae) was found causing serious damage to cotton in Punjab and Sindh Provinces, Pakistan (Abbas *et al*., 2005). It was thought to be undescribed. The infestation was recorded from 11 out of the 18 cotton-growing areas (Anon., 2005) covering 45,000 sq.km. This outbreak occurred on both BT cotton and non-BT cotton and the growers response has been to use large amounts of pesticides (US$ 121.4 million worth in the Punjab in two months in 2007 (Dutt, 2007a)). As Pakistan is the third largest exporter of cotton in the world, this outbreak is of major economic importance. Because of its economic impact, a series of popular and semi-scientific papers were published, naming the insect as *Phenacoccus gossypiphilous* Abbas & Arif and giving various details regarding its biology and structure. However, none of these papers described the species in detail and no holotype specimen or depositories of type material were designated, and so this name is considered a *nomen nudum.* Since then, morphological studies have shown that this species is rather variable in several characters and that cultures kept in a screen-house during the non-cotton-growing season in both Pakistan and India appear to be indistinguishable from *P. solenopsis* Tinsley from the Nearctic and Neotropics. This paper discusses this variation and its significance.

Materials and methods

The specimens were slide mounted using the method given in Hodgson & Henderson (2000) except that initially the insects were cleared for three days at room temperature in potassium hydroxide (10% KOH). The