

# New Records of Mealybugs, Scale Insects, and Whiteflies (Hemiptera: Sternorrhyncha) from Mali and Senegal<sup>1</sup>

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J. Agric. Urban Entomol. 28: 1–7 (2012)

**ABSTRACT** This study documents new distribution records of Sternorrhyncha (Hemiptera) in Mali and Senegal. The mealybugs (Pseudococcidae) found were *Ferrisia virgata* Cockerell (striped mealybug), *Phenacoccus manihoti* Matile-Ferrero (cassava mealybug), and *Phenacoccus solenopsis* Tinsley (solenopsis mealybug). Also recorded was a giant mealybug, *Icerya* sp. (Monophlebidae), that was not identified to species. The soft scales (Coccidae) collected were *Ceroplastes rusci* (L.) (fig wax scale), *Coccus hesperidum* L. (brown soft scale), and *Parasaissetia nigra* (Nietner) (nigra scale). The armored scales (Diaspididae) collected were *Aonidiella orientalis* (Newstead) (oriental scale), *Lepidosaphes tapleyi* Williams (guava long scale), and *Parlatoria crypta* McKenzie (mango white scale). The whiteflies (Aleyrodidae) found were *Aleurolobus marlatti* (Quaintance) (Marlatt whitefly), *Aleurotrachelus atratus* Hempel (palm-infesting whitefly), and *Trialeurodes ricini* (Misra) (castor bean whitefly).

**KEY WORDS** West Africa, Aleyrodidae, Coccidae, Diaspididae, Monophlebidae, Pseudococcidae

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Phloem-feeding insects (Hemiptera: Sternorrhyncha) are important crop pests in West Africa. They can damage important crops significantly by direct feeding and indirectly by deposition of honeydew that gives rise to sooty mold growth, blocking light and air from the leaves and reducing photosynthetic productivity (Williams & Granara de Willink 1992). Some phloem-feeding insects appear to be actively extending their geographical ranges and will likely continue to disperse in West Africa due to movement of infested plant material between countries. This has happened with the spread of introduced pests such as spiraling whitefly, *Aleurodicus dispersus* Russell (Aleyrodidae), cassava mealybug, *Phenacoccus manihoti* Matile-Ferrero (Pseudococcidae), and other Sternorrhyncha (Neuenschwander 2003, Muniappan et al. 2008, 2009).

During visits to Senegal and Mali, West Africa in 2011, and Senegal in 2012, surveys for arthropods and plant diseases of crop, ornamental, and weed plants

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<sup>1</sup>Accepted for publication 25 January 2012.

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were conducted. Here we present the identifications of phloem-feeding insects that were collected during those surveys. New country records are listed and discussed. Scale insect species (Coccoidea) not reported previously from Mali or Senegal by Ben-Dov et al. (2001) and whiteflies (Aleyrodoidea: Aleyrodidae) not recorded from these countries by Evans (2008) were regarded as new introductions.

### Materials and Methods

The areas surveyed included Dakar; Saint-Louis and Dagana in north Senegal; and Bayakh, D'Jender, Fass Boye, Keur Lemou, Mboro village, Notto, Potou village, and Thiès in central Senegal (the Niaye). In Mali, areas surveyed included Baguineda, Niono, and Ségou. Insect samples were collected 17–24 March 2011 and 14 January 2012 from heavily infested plants. Sampling ranged from inspecting ornamental plants in and around urban settings to surveys of agricultural production areas, including subsistence farmers' fields of African eggplant, cabbage, cassava, onion, pepper, and tomato. Because all of the farms had only small plantings (0.5–1.0 ha), most or all of the plants in each field, as well as surrounding vegetation (weeds and perennial plants), were visually inspected for the presence of arthropods and diseases. Plant fragments containing insects were placed in Eppendorf tubes containing 80% ethanol with labels bearing full collection data (location, host plant, collector, and date). Immediately after a tube was sealed, it was placed in freshly boiled water for 20 minutes to denature enzymes and ensure optimal preservation. Insect materials were prepared as archival-quality slide mounts for identification purposes. This involved maceration of the insect body contents in 10% KOH, staining the cuticle with acid Fuchsin, and mounting the specimens in Canada balsam using the methods described in Watson & Chandler (2000) and Watson & Kubiriba (2005). Black whitefly pupae were bleached and mounted in Canada balsam using the method of Watson & Chandler (2000).

Identifications were made by GWW using a Zeiss compound microscope with phase contrast illumination and 25–800× magnification. Whitefly pupae were identified using Bink-Moenen (1983), Martin (1987), and reference to specimens in the California State Collection of Arthropods (CSCA) (California Department of Food and Agriculture, Sacramento, CA) (<http://www.cdfa.ca.gov/plant/ppd/csc.html>). Identifications of Coccoidea adult females were made using Williams & Watson (1988, 1990), Williams & Granara de Willink (1992), Watson (2002), Unruh & Gullan (2006), and reference to specimens in CSCA. Slide-mounted specimens from every sample were deposited in CSCA, and duplicate slides were deposited in the collection at the International Institute of Tropical Agriculture (IITA), Cotonou, Benin (<http://www.iita.org/iita-benin>).

### Results

The species identified are listed below by country; all the samples were collected by R. Muniappan. The number of slide-mounted specimens sent to each depository is given in parentheses. The specimens were all adult females unless noted otherwise.

**Mali (collected from Ségou unless specified otherwise).** One Aleyrodidae species, *Aleurolobus marlatti* (Quaintance), was collected [Bamako,

Sotuba, on *Ziziphus* sp. (Rhamnaceae), 21.iii.2011 (15 pupae CSCA, 12 pupae IITA)]. The Coccidae collected were *Ceroplastes rusci* (L.) [Segoukoro Bada, on *Psidium guajava* L. (Myrtaceae) (1 CSCA)], *Coccus hesperidum* L. [on *Ixora* sp. (Rubiaceae) (2 CSCA, 2 IITA)], and *Parasaissetia nigra* (Nietner) [on *Plumeria* sp. (Apocynaceae) (3 CSCA, 3 IITA)]. The Diaspididae collected were *Aonidiella orientalis* (Newstead) [Bamako, on *Cycas revoluta* Thunb. (Cycadaceae), *Ravenala madagascariensis* Sonn. (Strelitziaceae), *Cocos nucifera* L. (Arecaceae), and *Plumeria* sp., all collected on 22.iii.2011; and on *Mangifera indica* L. (Anacardiaceae), 21.iii.2011 (17 CSCA, 17 IITA)], *Lepidosaphes tapleyi* Williams [Bamako, on *Mangifera indica*, 21.iii.2011 (1 CSCA)], and *Parlatoria crypta* McKenzie [on *Azadirachta indica*, 22.iii.2011 (2 CDFA, 4 IITA)]. One Monophlebidae species, *Icerya* sp., was collected [Segoukoro Bada, on *Psidium guajava*, 22.iii.2011 (1 immature female CSCA)]. The Pseudococcidae species collected were *Ferrisia virgata* (Cockerell) [on *Acalypha* sp. (Euphorbiaceae), 24.iii.2011, and Segoukoro Bada, on *Psidium guajava*, 22.iii.2011 (4 adult females, 2 adult males, and 3 immatures CSCA; 4 adult females and 2 adult males IITA)], *Phenacoccus manihoti* Matile-Ferrero [on *Manihot esculenta* Crantz (Euphorbiaceae), 24.iii.2011 (7 CSCA, 2 IITA)], and *Phenacoccus solenopsis* Tinsley [on *Plumeria* sp., 24.iii.2011 (1 CSCA, 1 IITA)].

**Senegal.** One Aleyrodidae species, *Aleurotrachelus atratus* Hempel, was collected [St. Louis, on ornamental plant leaves, 17.iii.2011, and on *Cocos nucifera* L. leaves, 18.iii.2011 (1 pupa CSCA, 1 pupa IITA)]. A new country record of Diaspididae, *Aonidiella orientalis*, was collected [Dakar, on *Cycas* sp. leaves, 24.i.2012 (3 CSCA, 3 IITA)]. The Pseudococcidae species collected were *Ferrisia virgata* [St. Louis, on ornamental plant leaves, 17.iii.2011 (3 female adults and 1 male adult CSCA, 2 female adults and 1 male adult IITA)] and *Phenacoccus solenopsis* [Thiès, on *Hibiscus* sp., 15.iii.2011 (4 CSCA, 4 IITA)].

## Discussion

The newly recorded species discussed below apparently have been introduced accidentally in recent years; four are of New World origin.

**Aleyrodidae.** *Aleurolobus marlatti* (Marlatt whitefly) is a polyphagous species of neotropical origin. It has been recorded previously in Asia (Iran, Israel, Jordan, Saudi Arabia, China, Japan, Philippines, Taiwan, India, Malaysia, and Indonesia) and Africa (Egypt, Sudan, Congo, Ivory Coast, Cameroon, and Chad) (Evans 2008). This is the first record from Mali, possibly because insects are seldom surveyed there.

*Aleurotrachelus atratus* (palm-infesting whitefly) is another polyphagous whitefly of neotropical origin. Borowiec et al. (2010) recorded it on 56 palm species and mentioned that coconut was its main host plant. This species has been reported previously from the Neotropical Region (Florida, Bahamas, Brazil, Colombia, Ecuador, Guatemala, Guadeloupe, Mexico, Puerto Rico, St. Lucia, Trinidad & Tobago, Venezuela, and the Virgin Islands), the Pacific Region (Hawaii and Samoa), parts of the African Zoogeographical Region (Uganda, Mozambique, Cape Verde Islands), and the southwestern Indian Ocean (Comoros, Réunion, and the Seychelles Islands) (Borowiec et al. 2010). This is the first record of *A. atratus* from West Africa, where it was found on the leaves of an ornamental plant and a coconut palm at Saint-Louis, Senegal.

*Trialeurodes ricini* (castor bean whitefly) was described from India, but it has spread to other parts of southern Asia, the Middle East, and Africa. This species is fairly polyphagous and has been recorded from members of 13 plant families (Evans 2008); *Ricinus communis* L. (castor bean) is a favored host. *Trialeurodes ricini* has been recorded from Cameroon, Central African Republic, Chad, Cote d'Ivoire, Madagascar, Nigeria, Sierra Leone, Sudan, Uganda, Zaire, and Zimbabwe in the African Zoogeographical Region. This is the first record of *T. ricini* from Mali.

**Coccidae.** *Ceroplastes rusci* (fig wax scale) is polyphagous, with a preference for woody hosts and palms; its area of origin is not known. This species has been reported from Europe (Albania, Balearic Islands, Corsica, France, Greece [Crete and the Dodecanese islands], Italy, Madeira Islands, Malta, Netherlands, Portugal, Sardinia, Sicily, Spain, and the former Yugoslavia), Asia (Afghanistan, Cyprus, Iran, Iraq, Israel, Indonesia, Jordan, Lebanon, Saudi Arabia, Syria, Turkey, and Vietnam), Australia, some Pacific Islands, the Neotropical Region (Antigua & Barbuda, Argentina, Brazil, Florida, Galapagos Islands, Guadeloupe, Guyana, Haiti, Puerto Rico, Uruguay, and the U.S. Virgin Islands), and parts of the African Zoogeographical Region (Algeria, Canary Islands, Egypt, Ethiopia, Ghana, Libya, Madeira, Morocco, Príncipe Island, Senegal, Sudan, Tunisia, Zimbabwe, and Zambia) (CABI 1993, Ben-Dov 2010a). A single specimen was collected in Mali for the first time on a guava tree at Segoukoro Bada, near Ségou. This insect is a polyphagous pest, known to transmit two grape vine virus diseases in Tunisia: *Grapevine leafroll associated virus-3* (GLRaV-3) and *Grapevine leafroll associated virus-5* (GLRaV-5) (Mahfoudhi et al. 2009). Known natural enemies of *C. rusci* (Ben-Dov 2010a) possibly could be used for classical biological control of this pest.

*Coccus hesperidum* (brown soft scale) is a cosmopolitan, polyphagous species of unknown origin. In West Africa, it has been reported previously from Cameroon, Nigeria, Senegal, Sierra Leone, and the Democratic Republic of Congo (Ben-Dov 2010b). This is the first report of *C. hesperidum* from Mali, where it was collected on *Ixora* sp. (Rubiaceae). There are numerous natural enemies of *C. hesperidum* listed by Ben-Dov (2010b) that might be used for classical biological control of this pest species.

*Parasaissetia nigra* (nigra scale) is a tropicopolitan, polyphagous species, possibly of African origin. In West Africa it has been recorded previously from Burkina Faso, Cameroon, Chad, Ivory Coast, Ghana, Guinea, Nigeria, São Tomé & Príncipe, Senegal, and Sierra Leone (Ben-Dov 2010c). This is the first record of nigra scale from Mali. Numerous natural enemies of *P. nigra* are known (Ben-Dov 2010c) that possibly could be used for classical biological control of this pest.

**Diaspididae.** *Aonidiella orientalis* (oriental scale) is a highly polyphagous tropicopolitan armored scale, probably originating from northern India (Boa 1995). It has been present in West Africa since the early 1970s (Boa 1995), and has been reported from Benin, Chad, Congo, Cameroon, Niger, and Nigeria (Ben-Dov 2010d, Boa 1995). *Aonidiella orientalis* was first recorded from Mali by Keita (1987). In 2011, it was common in Mali and was sampled on cycad, coconut, traveler's palm, plumeria, and mango. The infestation on one *Cycas revoluta* plant was so heavy that the plant seemed likely to die in the following few months. *A. orientalis* was collected from Senegal for the first time in January 2012. There was no evidence of any hymenopteran parasitoids in any of the samples. Many natural enemies of this scale were listed by Ben-Dov (2010d).

*Lepidosaphes tapleyi* Williams (guava long scale) was described from Africa (Tanzania), and has been recorded also from Benin, Sudan, and Egypt. It also occurs in the Australasian and Oriental Biogeographical Regions (Miller et al. 2011a). The single specimen collected is the first record from Mali. Miller et al. (2011a) list records of *L. tapleyi* from 18 plant families, including economically important genera like *Citrus*, *Mangifera*, *Psidium*, and *Punica*.

*Parlatoria crypta* (mango white scale) may be of Middle Eastern origin. It has been recorded from the Indian subcontinent, the Middle East, and parts of Africa (Comoro Islands, Sudan, Niger, and possibly Nigeria). This species feeds on hosts in 23 plant families (Boa 1995, Miller et al. 2011b). Boa (1995) regarded *P. crypta* (and its junior synonym *P. morrisoni* McKenzie) of only minor importance on neem, *Azadirachta indica* A. Juss, in West Africa. This is the first record of mango white scale from Mali.

**Monophlebidae.** According to the distribution data in Ben-Dov (2011), there have been very few records of *Icerya* species from West Africa and none from Mali. An immature, parasitized specimen of *Icerya* sp. was collected on guava near Ségou, Mali. The absence of black setae indicated that it was not *I. purchasi* Maskell, which has been recorded from Senegal previously. However, identification to species level was not possible. The presence of the endoparasitoid, *Cryptochaetum* sp. (Diptera: Cryptochaetidae), suggested that one or more *Icerya* species have been present in the region for some time and may be under natural control there.

**Pseudococcidae.** *Ferrisia virgata* (striped mealybug) is a cosmopolitan, polyphagous species, probably of neotropical origin. In West Africa, it has been recorded from Benin, Congo, Ivory Coast, Ghana, Guinea, and Guinea-Bissau (Ben-Dov 2010e). This is the first report of *F. virgata* from Mali and Senegal. Numerous natural enemies of *F. virgata* listed by Ben-Dov (2010e) might be appropriate for use in a biological control program.

*Phenacoccus manihoti* (cassava mealybug), an invasive pest of South American origin, devastated cassava production in equatorial Africa following its accidental introduction in the 1980s (Neuenschwander 2003, Williams & Granara de Willink 1992). It has been reported from most West African countries, but this is the first published report from Mali. The recent introduction of this major pest to Asia (Cambodia, Laos, Indonesia, and Thailand) was reported by Winotai et al. (2010) and Muniappan et al. (2009). Although cassava mealybug is generally under effective biological control in most of equatorial Africa by the endoparasitoid *Epidinocarsis lopezi* (De Santis) (Hymenoptera: Encyrtidae) (Neuenschwander 2003), the samples examined from Mali and Senegal contained few parasitoids.

*Phenacoccus solenopsis* (solenopsis mealybug) is of North American origin; it is a highly polyphagous, invasive pest of cotton (*Gossypium hirsutum* L., Malvaceae) and vegetables. In West Africa, it was reported from Benin, Cameroon, and Nigeria by Hodgson et al. (2008), but these are the first reports of *P. solenopsis* from Mali and Senegal. Hodgson et al. (2008) and Muniappan et al. (2009) reported its introduction to South and South-East Asia. Its potential range globally was discussed by Wang et al. 2010. Classical biological control of solenopsis mealybug may be possible using the endoparasitoid, *Aenasius bambawalei* Hayat (Hymenoptera: Encyrtidae), described from India by Hayat (2009).

Lack of insect identification studies by major taxonomic institutions from the 1990s onwards, and the lack of taxonomic expertise on Sternorrhyncha in most

West African countries, has resulted in little survey work being done in this region over the last fifteen years. Any in-country studies that have been done, have not been published in the international literature. Accidental introductions on imported plant materials have continued to occur during this period, and some of the introduced species in the region may not have been detected yet. The introduced species may impact commercial and subsistence crops seriously; however, there is potential for classical biological control of many of these pests.

### Acknowledgments

This project supported by IPM CRSP was made possible by the United States Agency for International Development (USAID) Cooperative Agreement No. EPP-A-00-04-00016-00. We would like to thank the two anonymous reviewers who helped to make several improvements in this manuscript.

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