First Record of Pseudococcus jackbeardsleyi (Hemiptera: Pseudococcidae) from Africa, Côte d'Ivoire

Authors: N'Guessan, Pierre Walet, Watson, Gillian W., Brown, Judith K., and N'guessan, François K.

Source: Florida Entomologist, 97(4) : 1690-1693

Published By: Florida Entomological Society

URL: https://doi.org/10.1653/024.097.0443

FIRST RECORD OF *PSEUDOCOCCUS JACKBEARDSLEYI* (HEMIPTERA: PSEUDOCOCCIDAE) FROM AFRICA, CÔTE D'IVOIRE

PIERRE WALET N'GUESSAN[1*], GILLIAN W. WATSON[2], JUDITH K. BROWN[3] AND FRANÇOIS K. N'GUESSAN[4]
[1,4]Programme cacao, Centre National de Recherche Agronomique, BP 808 Divo, Côte d'Ivoire

[2]Plant Pest Diagnostic Center, California Department of Food & Agriculture, Sacramento, California, USA

[3]School of Plant Sciences, The University of Arizona, Tucson, Arizona, USA

*Corresponding author; E-mail: walet_pierre@yahoo.fr

ABSTRACT

Cocoa swollen shoot virus disease is an important virus disease of cocoa occurring mainly in West Africa. Mealybugs are known to be vectors of the pathogen, *Cacao swollen shoot virus*. Since recent outbreaks in Côte d'Ivoire, studies have been undertaken on different aspects of the disease. During 2013, surveys were conducted to identify mealybug species infesting aerial parts of cocoa (*Theobroma cacao* L.; Malvales: Malvaceae) trees at various sites and the samples were authoritatively identified using morphological characters. A species new to Africa, *Pseudococcus jackbeardsleyi* Gimpel & Miller (Hemiptera: Pseudococcidae), was found at 2 localities in Côte d'Ivoire, i.e., Buyo (Soubré county) and Gbalékro (Agboville county). Hosts of this polyphagous mealybug belong to 47 plant families and include banana, eggplant, *Hibiscus* spp., potato, sweet pepper and tomato. Virus transmission by *P. jackbeardsleyi* has not been recorded, but it belongs to the same genus as *P. maritimus* (Ehrhorn), which transmits *Little cherry virus 2* to sweet cherry, and *P. longispinus* (Targioni Tozzetti), which transmits *Grapevine A trichovirus* (GAV) to grapevine and *Cacao swollen shoot virus* (CSSV) to cocoa. The introduction and establishment of *P. jackbeardsleyi* in Africa may have a considerable impact on both commercial and subsistence agriculture.

Key Words: *Cacao swollen shoot virus,* invasive species, *Theobroma cacao*

RESUMEN

La enfermedad viral de retoños hinchados de cocoa (cocoa swollen shoot virus disease en inglés) es una enfermedad viral importante del cacao que ocurre principalmente en el África occidental. Las cochinillas son conocidas por ser vectores del patógeno, *Cacao swollen shoot virus*. A partir de los brotes recientes en Côte d'Ivoire (Costa de Marfil) se han realizado estudios sobre diferentes aspectos de la enfermedad. Durante 2013, se realizó un sondeo para identificar las especies de cochinillas que infestan las partes aéreas de los árboles de cacao (*Theobroma cacao* L; Malvales: Malvaceae) en diferentes sitios y los especimenes recolectadas fueron identificados meticulosamente usando caracteres morfológicos. Se encontró una especie nueva para África, *Pseudococcus jackbeardsleyi* Gimpel & Miller (Hemiptera: Pseudococcidae), en 2 localidades de Côte d'Ivoire (Costa de Marfil), en Buyo (condado Soubré) y Gbalékro (condado Agboville). Los hospederos de esta cochinilla polífaga pertenecen a 47 familias de plantas e incluyen el plátano, berenjena, *Hibiscus* spp., papa, chile dulce y tomate. La transmisión del virus por *P. jackbeardsleyi* no ha sido registrado, pero pertenece al mismo género que *P. maritimus* (Ehrhorn), que transmite el *Little cherry virus 2* a cereza dulce, y *P. longispinus* (Targioni Tozzetti), que transmite el *Grapevine A trichovirus* (GAV)) y el *Cacao swollen shoot virus* (VRHC) a cacao. La introducción y el establecimiento de *P. jackbeardsleyi* en África pueden tener un impacto considerable tanto en la agricultura comercial y como de subsistencia.

Palabras Clave: *Cacao swollen shoot virus*, especies invasoras, *Theobroma cacao*

Several mealybug (Hemiptera: Pseudococcidae) species have been reported as insect vectors of the plant-infecting *Cacao swollen shoot virus* (genus *Badnavirus*, family *Caulimoviridae*), which causes swollen shoot disease of cocoa plants (*Theobroma cacao* L.). At least 14 mealybug species have been recorded to be capable of CSSV transmission in a semi-persistent manner (Roivainen 1980; Posnette 1950). Since the re-emergence of this disease in Côte d'Ivoire during

2003 (Kébé et al. 2007), efforts to study the still poorly understood aspects of the disease have increased, including investigations to identify mealybug vector species. To this end, surveys are under way to identify the mealybug species colonizing cocoa plants in Côte d'Ivoire. The first survey, conducted in 2009, revealed the presence of 11 species of scale insects (Hemiptera: Coccoidea): Stictococcidae (2 species), Coccidae (1 species) and Pseudococcidae (8 species) (N'Guessan 2013). During 2013, cocoa orchard surveys were conducted to confirm the presence of the species identified previously in 2009, and to collect and identify additional species that could be found. During these surveys, *Pseudococcus jackbeardsleyi* Gimpel & Miller was identified for the first time from Côte d'Ivoire, a new continental record for Africa.

Materials and Methods

During the 2013 surveys of cocoa orchards in Côte d'Ivoire, different parts of the trees were searched for mealybugs, especially the trunks, stems, chupons (basal shoots), leaves, flowers and pods. The mealybugs collected were stored in 75% ethanol in 2 mL tubes. Each sample was given a unique number to associate it with the relevant collection data. Specimens were sent to the second author, who identified the mealybugs based on morphology.

Specimens were prepared as archival-quality microscope slide mounts in Canada balsam, using the method described by Watson & Chandler (2000) and refined by Sirisena et al. (2012). Slide-mounted specimens were examined by a Zeiss compound microscope with phase contrast illumination and magnifications of x25–x800, and were identified using keys in the literature (Cox 1989; Gimpel & Miller 1996; Williams 1958). Specimens were photographed using a Nikon Digital Sight DS-5M camera, NIS-Elements F 3.0 software, and a Nikon Eclipse 80i compound microscope. Automontage of photograph series was done using Combine ZP software, and Adobe Photoshop was used to adjust exposure levels in the photographs for Fig. 1.

Results

Four adult females were identified as *Pseudococcus jackbeardsleyi* Gimpel & Miller. They were collected from 2 localities: (1) Buyo, a new county in South-West Côte d'Ivoire; this specimen was collected on 6 Mar 2013 from commercial cocoa trees that were known to be infected by cocoa swollen shoot virus disease; and (2) 3 adult females from Gbalékro, in Agboville county in South Côte d'Ivoire, which were collected on 18 May 2013 on a cocoa farm presumed to be swollen shoot free; however, cocoa swollen shoot virus disease occurs on some other farms in the same county.

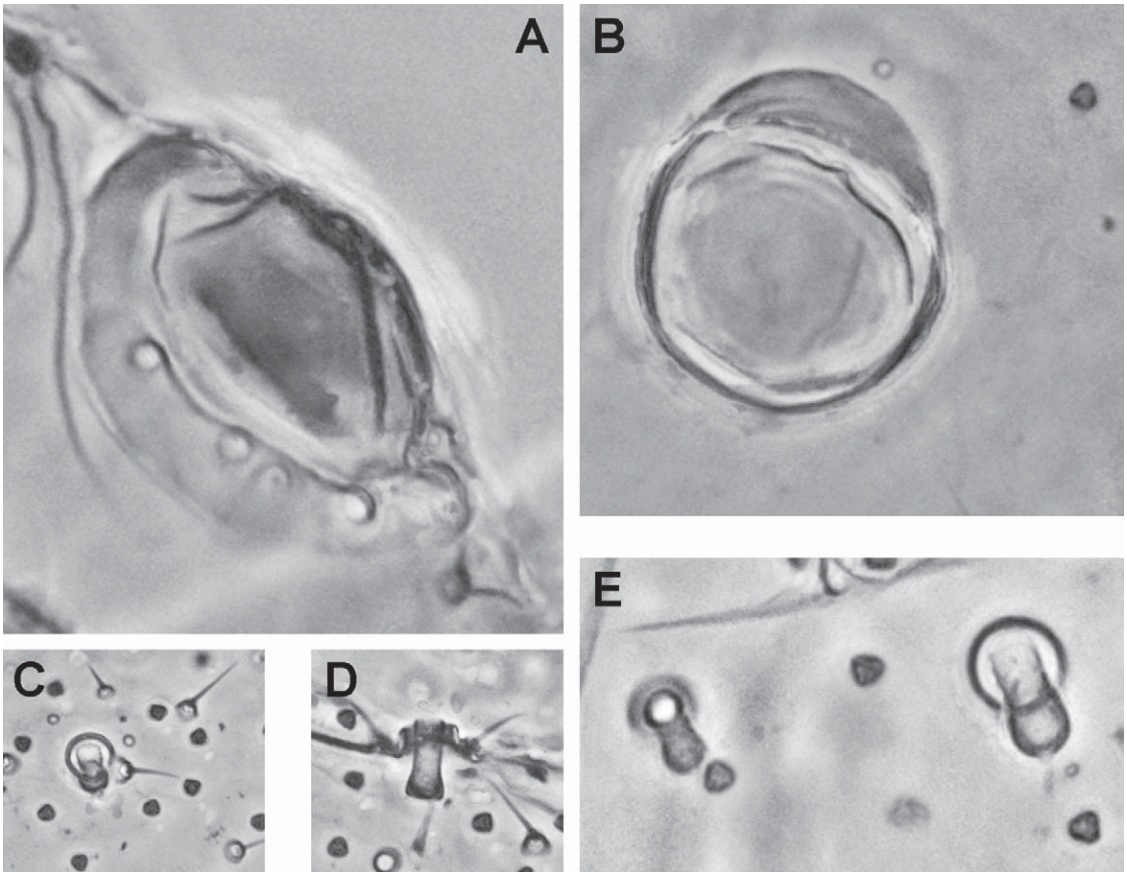
Diagnosis of *Pseudococcus jackbeardsleyi*

Cerarii numbering 17 pairs, each containing several accessory setae and 2 conical setae (except in a few cerarii at the anterior end, each with 3 or 4). Antenna with 8 segments. Eye surrounded by a sclerotized rim containing 6 or more discoidal pores (Fig. 1A). On the dorsum: oral rim ducts all of one size, fairly numerous, each closely associated with 1 or 2 setae (Fig. 1C and 1D); most cerarii each associated with an oral rim duct. Oral rim ducts also present on submedian areas of thorax, on the midline of abdomen and behind each posterior ostiole. Dorsal setae flagellate and short. On the venter: legs well developed, each claw without a denticle. Hind legs each with translucent pores on femur and tibia, but absent from coxa. Circulus present between abdominal segments III and IV, with an intersegmental crease. Multilocular disc pores present across anterior and posterior margins of abdominal segments V–VIII, often a few on posterior margin of IV, 0–2 on segment III. Taxonomic illustrations of *P. jackbeardsleyi* are available in the literature (Gimpel & Miller 1996; Williams 2004).

Live specimens of *P. jackbeardsleyi* resemble *P. longispinus* (Targioni Tozzetti) in having an elongate-oval body covered with white mealy wax; 17 pairs of slender, rigid lateral wax filaments, those at the posterior end being longer, the longest usually significantly longer than the body; and legs pale yellowish brown. In microscope slide mounts *P. jackbeardsleyi* is easy to identify because it is the only *Pseudococcus* species in Africa possessing sclerotized rims around the eyes containing simple pores (Fig. 1A) in comparison with the eye of *P. longispinus* (Fig. 1B), an example of the sort of eye possessed by other species of *Pseudococcus* occurring in Africa; and having oral rim ducts each closely associated with 1 or 2 setae (Figs. 1C and 1D) in comparison with the oral rim ducts of *P. longispinus* (Fig. 1E). Specimens on which this identification was based have been deposited at the Plant Pest Diagnostic Center, California Department of Food & Agriculture, Sacramento, California, USA and in the insect collection at the International Institute of Tropical Agriculture in Benin.

Discussion

Pseudococcus jackbeardsleyi is of Neotropical origin. When first described, it was recorded from the Neotropical region, Canada, the USA (Florida, Texas and Hawaii), and Kiribati in the South Pacific region (Gimpel & Miller 1996). It has also been recorded (under the misidentification as *P.*



Figs. 1A to 1E. Automontage photographs of slide-mounted adult female mealybugs for comparison. Details of simple pores by the eye: A. *Pseudococcus jackbeardsleyi*, B. *P. longispinus.* Details of dorsal oral rim ducts: C. Surface view of duct orifice with associated setae in *P. jackbeardsleyi*, D. Side view of duct with associated setae in *P. jackbeardsleyi*. E. Surface view of two different duct sizes, without associated setae, in *P. longispinus.*

elisae Borchsenius) from Papua New Guinea and Tuvalu (Williams & Watson 1988); and as *P. jackbeardsleyi* from parts of southern Asia (Williams 2004) and the Seychelles (Germain et al. 2008). This record from Côte d'Ivoire is the first time the species has been found in Africa.

The Jack Beardsley mealybug is polyphagous, feeding on hosts in 47 plant families. Its hosts include crop plants belonging to economically important genera like *Ananas, Annona, Cajanus*, *Capsicum, Carica, Citrus, Cocos, Coffea, Cucumis, Cucurbita, Ficus, Gossypium, Hibiscus, Ipomoea, Litchi, Macadamia, Mangifera*, *Manihot, Mentha, Morus, Musa, Nephelium, Ocimum, Persea, Phaseolus, Piper, Psidium, Punica, Salvia, Solanum, Tamarindus, Theobroma, Vitis* and *Zea* (Ben-Dov 2014). It has been most commonly collected on banana, *Hibiscus*, potato, sweet pepper and tomato (Gimpel & Miller 1996).

Several of the hosts of *P. jackbeardsleyi* are species that are grown in association with cocoa, such as *Persea americana* Mill. (Lauraceae), *Citrus sinensis* (L.) Osbeck (Rutaceae) and *Mangifera indica* L. (Anacardiaceae); these are present on 48–60% of cocoa farms in Côte d'Ivoire (Assiri et al. 2010). Movement of these host plants could result in the spread of *P. jackbeardsleyi.* The mealybug may be present elsewhere in the country in addition to Buyo and Agboville.

Virus transmission by *P. jackbeardsleyi* has not been recorded, but some other species in the genus *Pseudococcus* are known to be plant virus vectors, e.g. *P. maritimus* (Ehrhorn) has been demonstrated to transmit *Little cherry virus 2* to sweet cherry (Mekuria et al. 2013), and *P. longispinus* is a known vector of *Grapevine A trichovirus* (GAV) in grapevine (La Notte et al. 1997) and *Cacao swollen shoot virus* (CSSV) in cocoa. *P. longispinus* has been reported also to transmit "Agou 1", the dominant CSSV strain in Togo (Dufour 1991), and the "Kpévé" strain in Ghana (Posnette 1950). However, it is reportedly not a

vector of the "New Juaben" strain, a very aggressive form of CSSV found in Ghana (Dufour 1991; Posnette 1950).

The ability to transmit different CSSV strains appears to vary among the mealybug species that are known CSSV vectors. The capacity of *P. jackbeardsleyi* to transmit CSSV is not known, but the specimen from Buyo was collected on a farm infected by CSSV, and so the potential importance of this species as a CSSV vector needs to be investigated.

In view of its polyphagy, the introduction and establishment of *P. jackbeardsleyi* in Côte d'Ivoire could have negative effects on both commercial and subsistence agriculture there, and in other parts of West Africa, should it spread elsewhere in the region or become more widespread on the continent.

Acknowledgments

We wish to thank Conseil du Café-Cacao (CCC) and Fonds Interprofessionnel pour la Recherche et le Conseil Agricoles (FIRCA) for financing this work through the *Programme de lutte contre la maladie du swollen shoot du cacaoyer en Côte d'Ivoire*; the World Cocoa Foundation (WCF), with partial funding from the Borlaug Fellowship Program (undertaken in the J. K. Brown laboratory, University of Arizona). We are grateful to Marcel N'Doua for his help in collecting mealybugs, and Romain Aka and Koffié Kouakou for their assistance with fieldwork. Ms Susan McCarthy (Branch Chief, CDFA-PPDC) kindly permitted the morphological identification to be conducted at that facility.

References Cited

Assiri, A. A., Koko, L. K., Lekadu, T., Konan, A., Kébé, B. I., and N'Guessan, K. F. 2010. Cacaoculture et diversification: les arbres à usages multiples dans les cacaoyères en Côte d'Ivoire, pp. 503-512 *In* Cocoa Producer's Alliance [ed.], Actes de la 16ème Conf. Intl. sur la Recherche Cacaoyère, Bali (Indonesia), 16–21-XI-2009. Academy Press Plc Lagos, Nigeria. 1637 pp.

Ben-Dov, Y. 2014. ScaleNet, *Pseudococcus jackbeardsleyi*. http://www.sel.barc.usda.gov/catalogs/pseudoco/PseudococcusjackbeardsleyI.htm.

Cox, J. M. 1989. The mealybug genus *Planococcus* (Homoptera: Pseudococcidae). Bull. British Mus. (Nat. Hist.) Entomol. 58(1): 1-78.

Dufour, B. 1991. Place et importance des différentes espèces d'insectes dans l'écologie du CSSV (*Cacao swollen shoot virus*) au Togo. Café Cacao Thé 35(3): 197-203.

Germain, J-F., Attie, M., Barbet, A., Franck, A., and Quilici, S. 2008. New scale insects recorded for the Comoros and Seychelles Islands, pp. 129-135 *In* M. Branco, J. C. Franco and C. J. Hodgson [eds.], Proc. XI Intl. Symp. Scale Insect Studies, Oeiras, Portugal, 24-27-IX-2007. ISA Press, Lisbon, Portugal. 322 pp.

Gimpel, W. F., and Miller, D. R. 1996. Systematic analysis of the mealybugs in the *Pseudococcus maritimus* complex (Homoptera: Pseudococcidae). Contrib. Entomol. Intl. Assoc. Publ. 2: 1-163.

Kébé, I. B., Koffie, K., N'guessan, K. F., Assiri, A. A., Adiko, A., Ake, S., and Anno, P. A. 2007. Le swollen shoot en Côte d'Ivoire: situation actuelle et perspectives, pp. 907-922 *In* Cocoa Producer's Alliance [ed.], Actes de la 15ème Conf. Intl. sur la Recherche Cacaoyère, San José, Costa Rica, 9-10-X-2006, Vol. 2. Academy Press Plc Lagos, Nigeria. 1950 pp.

La Notte, P., Buzkan, N., Choueiri, E., Minafra, A., and Martelli, G. P. 1997. Acquisition and transmission of grapevine virus A by the mealybug *Pseudococcus longispinus*. J. Plant Pathol. 79(1): 79-85.

Mekuria, T. A., Smith, T. J., Beers, E., Watson, G. W., and Eastwell, K. C. 2013. First report of transmission of Little Cherry Virus *2* to sweet cherry by *Pseudococcus maritimus* (Ehrhorn) (Hemiptera: Pseudococcidae). Disease Note. Plant Dis. 97(6): 851.

N'Guessan, W. P. 2013. Identification of vectors of *Cocoa swollen shoot virus* and control methods: A perspective from Côte d'Ivoire. *In* Conseil du Café-Cacao [ed.], Intl. Wkshp. on the Cocoa Swollen Shoot Disease. 26-28-XI-2013, Grand-Bassam, Côte d'Ivoire. http://www.conseilcafecacao.ci/docs/swollen_shoot/N'GUESSAN_W_PRESENTATION.pdf.

Posnette, A. F. 1950. Virus diseases of cacao in West Africa. VII. Virus transmission by different vector species. Ann. Appl. Biol. 37: 378-384.

Roivainen, O. 1980. Mealybugs, 15-38 *In* K. F. Harris and K. Maramorosch [eds.], Vectors of Plant Pathogens. Academic Press, New York, USA. 467 pp.

Sirisena, U. G. A. I., Watson, G. W., Hemachandra, K. S., and Wijayagunasekara, H. N. P. 2012. Preparation of Hemiptera: Sternorrhyncha for identification. Trop. Agric. Res. J. 24(2): 139-149.

Watson, G. W., and Chandler, L. R. 2000. Identification of mealybugs important in the Caribbean Region. Second edition (revised). CABI Bioscience, Egham, Surrey, U.K. 40 pp.

Williams, D. J. 1958. The mealybugs (Pseudococcidae - Homoptera) described by Hall, W. J., Laing, F. and Strickland, A. H. from the Ethiopian Region. Bull. British Mus. (Nat. Hist.) Entomol. 7: 1-37.

Williams, D. J. 2004. Mealybugs of Southern Asia. The Natural History Museum, London, U.K. Southdene SDN. BHD., Kuala Lumpur, Malaysia. 896 pp.

Williams, D. J., and Watson, G. W. 1988. The Scale Insects of the Tropical South Pacific Region. Pt. 2: The Mealybugs (Pseudococcidae). CAB International, Wallingford, U.K. 260 pp.