BioOne COMPLETE

Invasion of the Main Cocoa-Producing Region of South America by Maconellicoccus hirsutus (Hemiptera: Pseudococcidae)

Authors: Fornazier, Mauricio José, Martins, David dos Santos, Souza, Carlos Alberto Spaggiari, Culik, Mark Paul, Chipolesch, João Marcos Augusto, et al.

Source: Florida Entomologist, 100(1) : 168-171

Published By: Florida Entomological Society

URL: https://doi.org/10.1653/024.100.0124

BioOne Complete (complete.BioOne.org) is a full-text database of 200 subscribed and open-access titles in the biological, ecological, and environmental sciences published by nonprofit societies, associations, museums, institutions, and presses.

Your use of this PDF, the BioOne Complete website, and all posted and associated content indicates your acceptance of BioOne's Terms of Use, available at www.bioone.org/terms-of-use.

Usage of BioOne Complete content is strictly limited to personal, educational, and non - commercial use. Commercial inquiries or rights and permissions requests should be directed to the individual publisher as copyright holder.

BioOne sees sustainable scholarly publishing as an inherently collaborative enterprise connecting authors, nonprofit publishers, academic institutions, research libraries, and research funders in the common goal of maximizing access to critical research.

Downloaded From: https://bioone.org/journals/Florida-Entomologist on 28 Mar 2024
Terms of Use: https://bioone.org/terms-of-use

Invasion of the main cocoa-producing region of South America by *Maconellicoccus hirsutus* (Hemiptera: Pseudococcidae)

Mauricio José Fornazier[1,2,], David dos Santos Martins[1], Carlos Alberto Spaggiari Souza[3], Mark Paul Culik[1], João Marcos Augusto Chipolesch[1], Débora Lorenção Fornazier[1], Paulo Sérgio Fiuza Ferreira[2], and José Cola Zanuncio[2]*

Maconellicoccus hirsutus (Green) (Hemiptera: Pseudococcidae), the pink hibiscus mealybug, is an invasive mealybug that has been recorded from numerous plant species (over 350 species in 75 families), and is a potential pest of many agricultural crops as well as a threat to native plants in biologically diverse areas such as the Neotropics (Kairo et al. 2000; García Morales et al. 2016). Economically important crops throughout the world, such as cotton and grape, are hosts of *M. hirsutus*, but it apparently prefers plants of the family Malvaceae (Meyerdirk et al. 2001; Goolsby et al. 2002; Vitullo et al. 2009). Although it is now found in all biogeographic regions except the Antarctic, *M. hirsutus* invaded the Caribbean relatively recently and subsequently North America and Caribbean South America, including Colombia, French Guiana, Guyana, Suriname, and Venezuela (Kairo et al. 2000; Culik et al. 2013a). First detected in northern Brazil in 2010, *M. hirsutus* has spread to northeastern, southeastern, and central western regions, where it has been found on host plants in the families Anacardiaceae, Annonaceae, Fabaceae, Malpighiaceae, Malvaceae, Myrtaceae, Oxalidaceae, Rutaceae, and Solanaceae (Broglio et al. 2015; Peronti et al. 2016). Although *M. hirsutus* has previously been recorded from cocoa (*Theobroma cacao* L.; Malvaceae), there is no published study documenting its damage to this economically and socially important crop (Kairo et al. 2000). Therefore, the objective of this research was to document the recent range expansion of *M. hirsutus* into the main cocoa production region of South America, located in the states of Bahia and Espírito Santo, Brazil (IBGE 2015; FAO 2016) and to evaluate and describe the signs of *M. hirsutus* infestation and damage to cocoa.

Cocoa plantations (n = 460) were sampled from Feb 2013 to Feb 2014 in 87 municipalities of the 3 main cocoa production regions of Bahia: Recôncavo Baiano (n = 6), southern region (n = 40), and extreme south (n = 11); and in northern (n = 15) and southern (n = 15) Espírito Santo, Brazil, to determine the distribution of *M. hirsutus* in these areas. Samples of cocoa stems, shoots, leaves, flowers, and fruits with mealybugs were collected from infested cocoa plants. Mealybugs and natural enemies in the samples were preserved in 70% alcohol and sent to collaborating taxonomists for confirmation of identifications of the insects collected.

Maconellicoccus hirsutus was identified in 27 infested cocoa samples from 24 locations in 13 municipalities of Espírito Santo (2 samples also contained *Planococcus minor* Maskell; Hemiptera: Pseudococcidae). *Maconellicoccus hirsutus* was also found on cocoa in 2 municipalities of the extreme south, and 6 of the Recôncavo Baiano regions of Bahia. No *M. hirsutus* was found in the southern cocoa producing region of Bahia during this research (Fig. 1). Thus, at the start of this study in Feb 2013, 9 mo after the initial detection of *M. hirsutus* in southeastern Brazil (Culik et al. 2013b), this mealybug was observed for the first time on cocoa in South America, on plants of cocoa in northern Espírito Santo in the municipality of Linhares (19.481644°S, 39.926136°W), and at the conclusion of this research, 1 yr after its initial detection on cocoa in this region, *M. hirsutus* had become widespread in cocoa plantations in Espírito Santo and Bahia.

Adult females covered with white, powdery wax, nymphs, and reddish ovisacs with large numbers of eggs were observed in all parts of the canopy of *T. cacao* plants sampled in this research, including shoots, leaves, and fruits (Figs. 2–8). Large numbers of ovisacs, nymphs, and adults (Fig. 2) were noted on shoots, particularly on new growth, and on cocoa fruits at different stages of development. The mealybugs damaged cocoa shoots, with development of sooty mold on young (6 mo to 2 yr old) (Figs. 3 and 4) and 4- to 5-yr-old plants, as well as cocoa flowers (Figs. 5 and 6) and fruits (Figs. 7 and 8). *Maconellicoccus hirsutus* infestation was associated with cocoa leaf curling and deformation, and infested growing points of cocoa plants were stunted and swollen with severe crumpling of leaves. Heavy infestations were associated with de-

[1]Department of Entomology, Instituto Capixaba de Pesquisa, Assistência Técnica e Extensão Rural - Incaper, P.O. Box 147, 29375-000, Venda Nova do Imigrante-ES, Brasil; E-mail: mauriciofornazier@gmail.com (M. J. F.), davidmartins@incaper.es.gov.br (D. S. M.), markculik3@yahoo.com (M. P. C.), joaomarcosac@hotmail.com (J. M. A.C.), deborafornazier@gmail.com (D. L. F.)

[2]Department of Entomology, Federal University of Viçosa (UFV) - Av. Peter Henry Rolfs s/n, Campus Universitário, CEP 36570-900, Viçosa, MG, Brazil; E-mail: pfiuza@ufv.br (P. S. F. F.), zanuncio@ufv.br (J. C. Z.)

[3]Cocoa Research Station "Filogônio Peixoto" - CEPLAC, BR 101 N, km 150, CEP 29900-000, Linhares, Espírito Santo, Brazil; E-mail: spaggiari@ceplac.gov.br (C. A. S. S.)

*Corresponding author; E-mail: mauriciofornazier@gmail.com (M. J. F.)

Downloaded From: https://bioone.org/journals/Florida-Entomologist on 28 Mar 2024
Terms of Use: https://bioone.org/terms-of-use

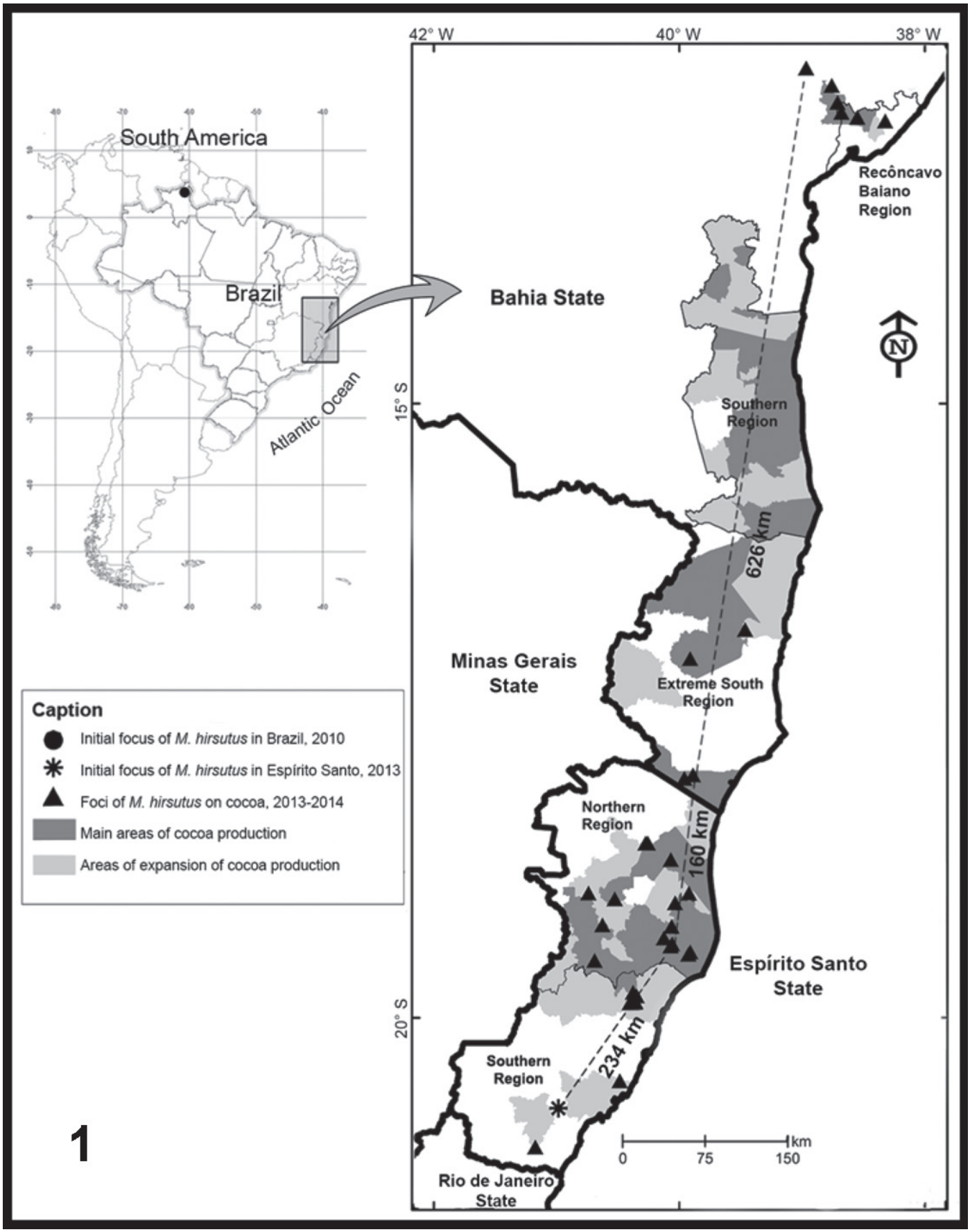
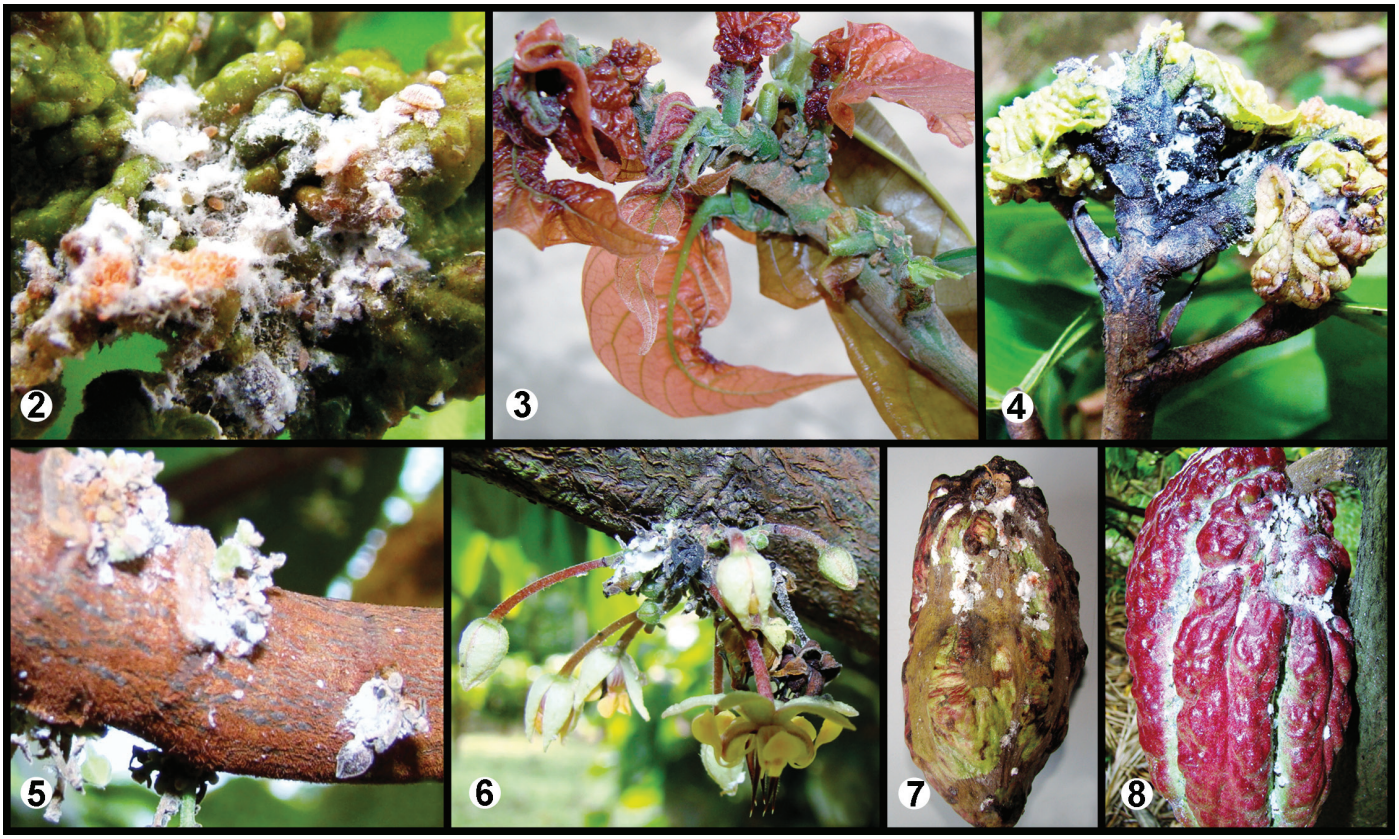


Fig. 1. Range of *Maconellicoccus hirsutus* in cocoa orchards in the states of Bahia and Espírito Santo, Brazil, Feb 2013 to Feb 2014.

Downloaded From: https://bioone.org/journals/Florida-Entomologist on 28 Mar 2024
Terms of Use: https://bioone.org/terms-of-use



Figs. 2–8. Infestation of *Maconellicoccus hirsutus* on cocoa plants. **2**. Adults, nymphs, and eggs; **3.** damage to cocoa shoots; **4.** developing sooty mold; **5**, **6.** Infested cocoa flowers; **7.** *M. hirsutus* infesting young cocoa fruit; **8.** *M. hirsutus* infesting mature cocoa fruit.

formation of shoots and atrophy of terminal buds, and reduction in new flushes of growth. Infested shoot tips had a bushy form leading to an appearance similar to "bunchy top," as described by Kairo et al. (2000) on *M. hirsutus* infested hibiscus. Flowers infested with *M. hirsutus* usually appeared wilted or dead. Fruits infested with *M. hirsutus* in early stages of development were deformed. Death of infested cocoa plants was not observed, but development of young plants appeared to be inhibited in comparison with nearby uninfested plants.

The predatory lady beetle *Cryptolaemus montrouzieri* Mulsant (Coleoptera: Coccinellidae) was found with occasional occurrence in *M. hirsutus* infested samples collected in this research, but no parasitoids were observed in the samples. Parasitoids of *M. hirsutus*, such as *Anagyrus kamali* Mourisi and *Gyranusoidea indica* Shafee, Alam & Agarwal (Hymenoptera: Encyrtidae) have successfully been used in other areas for classical biological control of *M. hirsutus*, but are not recorded in this region (Michaud 2003; Noyes 2016).

Results of this study confirm that *M. hirsutus* is now established and widespread on cocoa in Bahia and Espírito Santo, Brazil, the main cocoa producing region of South America. This pest now threatens cocoa and other crops in one of the major cocoa producing areas of the world, and the occurrence of *M. hirsutus* on cocoa reported in this study is an indication of its expanding range in Brazil and South America, where it also threatens native Neotropical biodiversity. These results indicate that further research should be conducted to evaluate the potential introduction of biological control agents for control of *M. hirsutus* in this region.

We thank A. L. B. G. Peronti for mealybugs identification, and L. M. Almeida for coccinellid identification. The Conselho Nacional de Desenvolvimento Científico e Tecnológico (CNPq), and Fundação de Amparo à Pesquisa e Inovação do Espírito Santo (FAPES) provided financial support.

Summary

Maconellicoccus hirsutus (Green) (Hemiptera: Pseudococcidae) was first detected in Brazil in 2010, and this study documents the recent range expansion into the major cocoa producing regions of Espírito Santo and Bahia, Brazil. We describe the signs of *M. hirsutus* infestation and damage to cocoa plants. Infestation of cocoa by adult females with nymphs and egg masses was observed, particularly on new flushes of growth and on fruits, and is a major threat to one of the largest cocoa producing areas of the world. The predator *Cryptolaemus montrouzieri* Mulsant (Coleoptera: Coccinellidae) was associated with *M. hirsutus*, but no parasitoids were observed. *Maconellicoccus hirsutus* is now established and widespread on cocoa in southeastern Brazil and spreading to producing regions of Bahia.

Key Words: geographic distribution; invasive species; range expansion; *Theobroma cacao*

Sumário

Maconellicoccus hirsutus (Green) (Hemiptera: Pseudococcidae) foi detectada pela primeira vez no Brasil em 2010, é praga invasora e potencial de muitas espécies de plantas e que se estabeleceu nas regiões tropicais e subtropicais. Este estudo documenta a recente expansão de *M. hirsutus* na maior região produtora de cacau do Brasil, é seu primeiro relato em cacau na América do Sul e documenta os sintomas de sua ocorrência em plantas infestadas de cacau. Foram observadas infestações de adultos com ninfas e massa de ovos, principalmente em novos pontos de crescimento e frutos, ela agora ameaça uma das principais áreas produtoras de cacau do mundo. O predador *Cryptola-*

Downloaded From: https://bioone.org/journals/Florida-Entomologist on 28 Mar 2024
Terms of Use: https://bioone.org/terms-of-use

emus montrouzieri Mulsant (Coleoptera: Coccinellidae) foi associado a *M. hirsutus*, no entanto nenhum parasitoide emergiu das cochonilhas. *Maconellicoccus hirsutus* está estabelecida no Sudeste do Brasil e se dissemina nas regiões produtoras de cacau da Bahia.

Palavras Chave: encarquilhamento de brotações; espécie invasiva; planta hospedeira; *Theobroma cacao*

References Cited

Broglio SMF, Cordero EP, Santos JM, Micheletti LB. 2015. Registro da cochonilha-rosada-do-hibisco infestando frutíferas em Maceió, Alagoas, Brasil. Revista Caatinga 28: 242–248.

Culik MP, Fornazier MJ, Martins DS, Peronti ALBG, Zanuncio JC. 2013a. The invasive mealybug *Maconellicoccus hirsutus*: lessons for its current range expansion in South America and invasive pest management in general. Journal of Pest Science 86: 387–398.

Culik MP, Martins DS, Zanuncio Junior JS, Fornazier MJ, Ventura JA, Peronti ALBG, Zanuncio JC. 2013b. The invasive hibiscus mealybug *Maconellicoccus hirsutus* (Hemiptera: Pseudococcidae) and its recent range expansion in Brazil. Florida Entomologist 96: 638–640.

FAO. 2016. FAOSTAT. Food and Agriculture Organization of the United Nations, Rome, Italy, http://faostat.fao.org/site/339/default.aspx (last accessed 17 Jul 2016).

García Morales M, Denno BD, Miller DR, Miller GL, Ben-Dov Y, Hardy NB. 2016. ScaleNet: A literature-based model of scale insect biology and systematics. Database. doi: 10.1093/database/bav118, http://scalenet.info (last accessed 21 Jul 2016).

Goolsby JA, Kirk AA, Meyerdirk DE. 2002. Seasonal phenology and natural enemies of *Maconellicoccus hirsutus* (Hemiptera: Pseudococcidae) in Australia. Florida Entomologist 85: 494–498.

IBGE. 2015. Indicadores da produção agrícola fevereiro de 2014, http://ftp.ibge.gov.br/Producao_Agricola/Fasciculo_Indicadores_IBGE/estProdAgr_201402.pdf (last accessed 23 Sep 2015).

Kairo MTK, Pollard GV, Peterkin DD, Lopez VF. 2000. Biological control of the hibiscus mealybug, *Maconellicoccus hirsutus* Green (Hemiptera: Pseudococcidae) in the Caribbean. Integrated Pest Management Reviews 5: 241–254.

Meyerdirk DE, Warkentin R, Attavian B, Gersabeck E, Francis A, Adams J, Francis G. 2001. Biological control of pink hibiscus mealybug project manual. United States Department of Agriculture, Washington, District of Columbia, https://www.aphis.usda.gov/import_export/plants/manuals/domestic/downloads/phm.pdf (last accessed 21 Jul 2016).

Michaud JP. 2003. Three targets of classical biological control in the Caribbean: success, contribution, and failure, pp. 335–342 *In* Van Dreische RG [ed.], Proceedings of the First International Symposium on Biological Control of Arthropods. FHTET-03-05. United States Department of Agriculture, Forest Service, Washington, District of Columbia.

Noyes JS. 2016. Universal Chalcidoidea Database, http://www.nhm.ac.uk/chalcidoids (last accessed 21 Jul 2016).

Peronti ALBG, Martinelli NM, Alexandrino JG, Marsaro-Júnior A, Penteado-Dias AM, Almeida LM. 2016. Natural enemies associated with *Maconellicoccus hirsutus* (Hemiptera: Pseudococcidae) in the state of São Paulo, Brazil. Florida Entomologist 99: 21–25.

Vitullo J, Zhang A, Mannion C, Bergh JC. 2009. Expression of feeding symptoms from pink hibiscus mealybug (Hemiptera: Pseudococcidae) by commercially important cultivars of hibiscus. Florida Entomologist 92: 248–254.

Downloaded From: https://bioone.org/journals/Florida-Entomologist on 28 Mar 2024
Terms of Use: https://bioone.org/terms-of-use