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# EXCLUSION OF *PLANOCOCCUS LILACINUS* (COCKERELL) FROM THE LIST OF PHILIPPINE BAMBOO PESTS BASED ON FIELD AND LABORATORY STUDIES[1]

**Ireneo L. Lit, Jr.[2] & Merdelyn T. Caasi-Lit[3]**

**ABSTRACT**

The cacao mealybug, *Planococcus lilacinus* (Cockerell), has been recorded on Philippine bamboos since 1922. A 3-year nationwide survey did not yield any cacao mealybug specimen on any bamboo species. Simultaneously, a taxonomic study of bamboo mealybugs revealed nine (9) species but no *P. lilacinus*. Rearing and feeding experiments showed that *P. lilacinus* would rather starve to death than feed on any bamboo species. Hence, bamboos are not among its many hosts and it should be deleted from the list of bamboo pests.

**Key words:** *Planococcus lilacinus* (Cockerell), cacao mealybug, bamboo pests, bamboo mealybugs, taxonomy, survey, feeding experiments

## INTRODUCTION

The lists of pests occurring in a country are considered among the primary references in economic entomology. They are sources of information not only for crop protection students and researchers but also as aids in international trade especially of fresh produce like fruits and flowers. In a number of instances, the existing checklists of pests include erroneously recorded species, which can have wide-ranging implications in plant quarantine, pest management, trade and commerce and biogeography. The negative impacts may include non-acceptance of local produce for export to certain countries, proliferation of misidentifications and errors in the literature. Whereas, it is relatively easy and perhaps exciting to report a new pest record, this is not true when identification of the herbivore or host plant proves to be wrong later. Erroneous reports especially when they involve polyphagous pests are difficult to rectify. A researcher would need to conduct (1) nationwide field surveys, (2) taxonomic studies and (3) rearing/feeding experiments.

A nationwide field survey would confirm or deny the existence of a particular herbivore on a particular host plant in any strategic or representative locality. A taxonomic study of the family or genus to which the herbivore belongs could be a corollary or complementary simultaneous activity that would give clues to possible misidentifications for closely related species. Both field survey and taxonomic study may prove negative as far as the existence of a species on a particular host plant is concerned. In that case, a feeding or rearing experiment will provide the empirical evidence as to whether a particular herbivore will feed on a certain plant species under certain (usually 'forced') conditions. The reason is that, while the first two

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[2] Entomology Section, Museum of Natural History, University of the Philippines Los Baños, College, Laguna, 4031 Philippines; E-mail: junlit@hotmail.com; [3]Entomology Laboratory, Institute of Plant Breeding, College of Agriculture, UPLB; E-mail: mcl@ipb.uplb.edu.ph

sets of studies may be comprehensive and are necessary to explore all possibilities in a wide range of habitat, environmental and geographical conditions, they may result only in an 'absence of evidence'. They will not provide by themselves conclusively an 'evidence of absence' of association of a herbivore ('pest') with a host plant ('crop') like the feeding experiment. Hence, all three steps are necessary as far as establishing the existence or non-existence of a plant-herbivore (or in more economic terms, crop-pest) association is concerned.

An opportunity to illustrate problems associated with erroneous pest records arose during our research project on the insects and mites associated with Philippine bamboos. Here we give you a specific example: the cacao mealybug, *Planococcus lilacinus* (Cockerell), recorded on Philippine bamboos. Gabriel (1997) included *P. lilacinus* in his compendium, which was based largely on his 1977 mimeographed manuscript of the same title. The mimeographed compilation used to be widely consulted by crop protection students and other researchers. A slightly revised version, not quite different from the 1997 publication, was released shortly after his death in 1999 by the National Crop Protection Center, University of the Philippines Los Baños. However, he inherited this record from previous checklists like Capco (1959; see also Baltazar, 1968). In turn, Capco's listing was based on Woodworth's (1922) second host index. Woodworth (1922) acknowledged G.F. Ferris for his assistance on scale insects and most probably it was Ferris who identified specimens as *Ps. lilacinus*. Woodworth acknowledged that his collections, including those identified by Ferris, included submissions from students. Gabriel's listing in the 1977 compilation had been copied or consulted by succeeding authors like Dayan (1990) and PCARRD's (1991) The Philippines Recommends for Bamboo Production. Details of this record are summarized in Table 1.

We doubted this record. Whereas, the cacao mealybug indeed is polyphagous, it has never been collected elsewhere on grasses, much less on bamboos (cf. Williams & Watson, 1988). Also called the coffee mealybug, its reported host plants are mainly dicotyledonous plants, with the exception of stored yam tubers (*Dioscorea* spp.). It is important to know if *P. lilacinus* is a bamboo pest because of its implications in the (a) management of *P. lilacinus* and *Helopeltis* (capsid bugs) on cacao; (b) management of mealybugs on bamboos (nursery, young plants, shoots); (c) site selection for bamboo nurseries; (d) clearing coccidological literature; and (e) studies on ecology and evolution of mealybug-host plant relationships.

In the management of the capsid bug, *Helopeltis* sp., colonies of the cacao mealybug are encouraged and in fact, introduced onto cacao pods to attract black ants (*Dolichoderus* sp.), which are antagonist biological agents of *Helopeltis* sp. Thus, the possible association of *P. lilacinus* with bamboos will have to be considered in looking for sources of colonies for introduction onto cacao pods as well as to control sources of further introduction to prevent overpopulation of mealybugs. This possi-bility will also have impact on the location of bamboo nurseries mainly due to the fact that young bamboo plants are apparently susceptible to mealybugs. Furthermore, there are already a number of 'unusual' items, which are doubtful if not outright wrong or false, that are clumping Philippine coccidological literature (e.g. seven instars for the pink sugarcane mealybug (Uichanco & Villanueva, 1932), etc.). In the same manner, bamboo as host of *P. lilacinus* is an 'outlier'

**Table 1.** Summary of the Philippine record of the cacao mealybug, *Planococcus lilacinus* (Cockerell) on bamboo.

| Reference | Details |
|---|---|
| Woodworth (1922) | p. 323, listed *Pseudococcus lilacinus* (Cockerell) on bamboo, (*Bambusa* spp.) |
| Capco (1959) | p. 38, probably following Woodworth listed *Ps. lilacinus* (Cockerell) on bamboo, (*Bambusa* spp.) |
| Baltazar (1968) | No mention of this record but referred readers to Capco's list for previous records of bamboo pests |
| Gabriel (1977, unpublished manuscript) | Included *Planococcus lilacinus* (Cockerell) under sucking insects attacking bamboo leaves |
| PCARRD (1982) | Included a list of pests possibly based on Gabriel's 1977 manuscript |
| Dayan (1989, unpublished paper presented at a bamboo symposium) | The unpublished version of Dayan (1990), please see details below |
| Dayan (1990) | pp. 67, 71 & 73, reported mealybug on 'kiling' bamboo (*Bambusa vulgaris* Schrad. ex Wendl.) from Binalonan, Pangasinan, identified as *P. lilacinus,* possibly based on host record reflected in Gabriel's 1977 manuscript |
| PCARRD (1991) | Included a list of pests apparently updated based on Dayan's (1990) work |
| Gabriel (1997) | The published edited and updated version of the 1977 mimeographed manuscript |
| Gabriel (2000) | Very slightly revised, but containing essentially the same coccidological information |

This paper aims to present the findings of our survey of mealybugs on bamboos, a summary of the taxonomic study of Philippine bamboo mealybugs and the results of our rearing-feeding experiments involving the cacao mealybug on representative bamboo species.

## MATERIALS AND METHODS

**Survey of mealybugs.** The survey of mealybugs attacking bamboos was conducted as part of a three-year nationwide survey of bamboo pests in our bamboo arthropods project. Mealybugs were collected from as many bamboo species and varieties and as many localities in the various regions of the country as possible. Plant portions bearing a colony or colonies of live specimens were placed in clear plastic bags (21.6 cm x 27.9 cm) and observed further in the laboratory. A portion of the colony was preserved in a vial of 95% ethanol. Live or alcohol-preserved specimens were eventually mounted on glass slides using Canada balsam following the procedures enumerated by Williams & Watson (1988). Identification was made by referring to published taxonomic keys and reference specimens in the first author's collection.

**Taxonomy of Philippine bamboo mealybugs.** The taxonomic study of mealybugs on Philippine bamboos was conducted simultaneously and in conjunction with the survey. Preliminary illustrations and descriptions have been prepared but refinements and finalized versions are still necessary. The results will be published separately. However, we present here a summary list of the species encountered for the purpose of this paper.

**Feeding and rearing experiments.** We conducted rearing and feeding experiments utilizing both free-choice and no-choice tests. Gravid and teneral females were obtained from colonies of cacao mealybugs collected from the field, mainly in Barangay Tranca, Bay, Laguna. Gravid females will less likely feed but will provide eggs that may eventually settle on the target host material. Teneral females, on the other hand, were especially carefully picked up and transferred to the test hosts. This was done by gently teasing the mealybugs first with a soft watercolor brush to allow them to withdraw their stylets. Once they moved away from their original feeding spot, they were picked up with the moist brush. Each individual was placed on a petri dish lined with rough filter paper at the middle of a cage for the free-choice test, and on the target host for the no-choice test. For the free-choice test, clean host specimens were used, namely cacao as control, *Mussaenda* as non-bamboo host check, *Bambusa vulgaris* var. *vulgaris* and *B.v.* cv. *vittata*. During the first trial, conducted with the participation of Mr. C. dC. Bernardo, a student-participant in the 2000 Youth Research Apprenticeship Program, variations of young bamboo plant and bamboo shoots of each species were also included. For the no-choice test, only the cacao pod and young plants and shoots of *Bambusa* spp. were used. A completely randomized design was used for the experiments and trials, involving three replicates each time.

Observations were conducted at 30 min, 1 hr, and 2, 12, 24, 48 and 72 hrs after introduction of the mealybugs, taking note of possible settling, orientation and feeding responses of both teneral females and newly hatched crawlers from eggs of gravid females.

## RESULTS AND DISCUSSION

**Survey of mealybugs.** The survey covered plantations, parks, bambuseta and natural bamboo stands in numerous localities of 27 provinces in 10 regions around the Philippines. Twenty-four taxa of erect bamboos and at least three of climbing bamboos (*Cephalostachyum mindorense* Gamble and at least two others collectively listed as '*Dinochloa* spp.') were also examined for their mealybug fauna. Our findings revealed not a single cacao mealybug specimen on any bamboo species anywhere in the Philippines (Tables 2 & 3). Indeed, previous studies of mealybugs like those of Ezzat & McConnell (1956), Williams & Watson (1988), Cox (1989) and Lit & Calilung (1994) (see also Ben-Dov's catalogue, 1994) did not show any cacao mealybug, *P. lilacinus*, on any bamboo species. In fact, Williams & Watson's host index did not list any monocot (Liliopsida) as host of this species and most reports on *Dioscorea* sp. have proven to be *Planococcus* species other than *P. lilacinus*.

**Taxonomy of Philippine bamboo mealybugs.** The taxonomy of Philippine bamboo mealybugs revealed the existence of nine (9) species but no *P. lilacinus* (Table 4). Among the nine species encountered, *Paracoccus interceptus* Lit, is the only one belonging to what is presently regarded as the tribe Planococcini. Hence, it is also the closest morphologically to *P. lilacinus*. There is great probability that the species referred to in the literature is *P. interceptus*, earlier reported to attack bamboo leaves (Lit, 1997). The species of *Antonina* and *Chaetococcus* were unlikely regarded as mealybugs in the earlier days (e.g. Capco, (1957)1959). The other species are either more rotund, concealed or too small to be mistaken for a cacao mealybug.

If indeed, it was Ferris who identified a mealybug for Woodworth (1922), as *Pseudococcus lilacinus*, then the identity of the species in question may be viewed from the state of mealybug taxonomy during that time. For a long time, the taxonomy of scale insects including mealybugs was clouded by unreliable characters (e.g. number of antennal segments) and species complexes. Ferris' Atlas of the Scale Insects of North America, with the mealybugs in volumes V and VI (Ferris, 1950, 1957), clarified so many things about the group but was obviously not available yet during Woodworth's time. On the other hand, Capco's work must have been completed in 1956 or earlier. Oftentimes, Filipino entomologists cite his work as published in 1957 although the volume of the Philippine Journal of Agriculture where his paper appeared, was apparently intended to be published in 1956, but actually came off the press in 1959. Ferris at the time of Capco's work was still in Stanford but could not have access to the then on-going revision of the mealybugs with a ventral anal lobe bar, allied to *Pseudococcus citri* (Risso). This revision was published as Ezzat and McConnell's work on the Planococcini, in 1956 as a bulletin of the University of Maryland. In that work, *P. lilacinus* was determined from specimens collected on mostly dicotyledonous hosts, excepting stored yam. There also, *Allococcus morrisoni* Ezzat & McConnell was described as occurring on *Lansium domesticum* intercepted at quarantine in the USA. It was only in 1997 that Lit recorded it on Philippine bamboo and transferred it to *Paracoccus* under a new name *P. interceptus* Lit.

**Table 2.** Provinces and localities visited in the 3-year nationwide survey and collection of bamboo mealybugs and other pests.

| Region | Province | Localities |
|---|---|---|
| I – Ilocos Region | Ilocos Norte | Banna, San Nicolas, Sarrat, Dingras, Laoag, Batac, Paoay |
| | Ilocos Sur | Sinait, Vigan |
| | La Union | San Fernando, Rosario |
| | Pangasinan | Bani, Villasis |
| CAR – Cordillera Administrative Region | Ifugao | Banaue, Lagawe |
| | Benguet | La Trinidad, Camp 7, Tuba, Baguio City, Pulag |
| II – Cagayan Valley | Isabela | Gamu, San Mateo, Cabagan |
| | Nueva Vizcaya | Bambang, Bayombong, Sta. Fe (Imugan) |
| III – Central Luzon | Nueva Ecija | Palayan, Muñoz, San Jose |
| | Tarlac | Tarlac, Camiling |
| | Pampanga | Arayat, Magalang |
| | Zambales | Subic |
| IV – Southern Tagalog + NCR – National Capital Region | Batangas | Isla Verde, Lipa, Balayan, Nasugbu, Tanauan |
| | Cavite | Silang, Tagaytay |
| | Laguna | Calamba, Mt. Makiling, UP Los Baños Campus, Biñan, Bay, Sta. Cruz, Cavinti, Luisiana, Pagsanjan, Lumban |
| | Palawan | Aborlan |
| | Quezon | Lucban, Tayabas |
| | Metro Manila | Marikina, Fort Santiago |
| | Occidental Mindoro | Mt. Calavite |
| VIII – Eastern Visayas | Leyte | Tacloban, Ormoc |
| X – Northern Mindanao | Bukidnon | Impalutao, Malaybalay, Sumpong, Musuan |
| CARAGA | Surigao | Butuan |
| XI – Southern Mindanao | Compostela Valley | Nabunturan |
| | Davao del Norte | Tagum, Panabo, Sto.Tomas |
| | Davao del Sur | Davao City: Toril, Calinan |
| | South Cotabato | T'boli, Lake Sebu |
| XII – Central Mindanao | North Cotabato | Kidapawán |

**Table 3.** Bamboo species surveyed for the presence of mealybugs.

| Scientific Name | Common Name |
|---|---|
| *Bambusa atra* Lindley | Long cane bamboo |
| *Bambusa bambos* (L.) Voss | Iron bamboo |
| *Bambusa blumeana* J.A.&J.H. Schultes | Tiník |
| *Bambusa dolichomerithalla* Hayata | Taiwan bamboo |
| *Bambusa maculata* Widjaja | Tiger bamboo |
| *Bambusa merrilliana* (Elmer) Rojo & Roxas | Bayóg |
| *Bambusa multiplex* (Lour.) Raeusch.ex J.A.&J.H.Schultes | Hedge bamboo |
| *Bambusa oldhamii* Munro | Oldham bamboo |
| *Bambusa philippinensis* (Gamble) McClure | Laák |
| *Bambusa tuldoides* Munro | Buddha's belly bamboo |
| *Bambusa vulgaris* Schrad. ex Wendl. | Kilíng |
| *Bambusa vulgaris* cv. *vittata* McClure | Yellow bamboo, dilaw |
| *Cephalostachyum mindorense* Gamble | Bagto, Osiw |
| *Dendrocalamus asper* (Schultes f.) Backer ex Heyne | Giant bamboo |
| *Dendrocalamus latiflorus* Munro | Ma-chiku |
| *Dendrocalamus strictus* (Roxb.) Nees | Male bamboo |
| *Dinochloa* spp. | Climbing bamboos |
| *Gigantochloa atroviolacea* Widjaja | Black bamboo |
| *Gigantochloa atter* (Hassk.) Kurz | Kayalì |
| *Gigantochloa levis* (Blanco) Merr. | Bolò |
| *Phyllostachys bambusoides* Sieb. & Zucc. | Running bamboo |
| *Schizostachyum brachycladum* (Kurz) Kurz | Buhong dilaw |
| *Schizostachyum lima* (Blanco) Merr. | Anos |
| *Schizostachyum lumampao* (Blanco) Merr. | Buhô |
| *Thyrsostachys siamensis* (Kurz) Gamble | Thailand bamboo |
| *Yushania niitakayamensis* (Hayata) Keng f. | Utod, Dwarf bamboo |

**Table 4.** Checklist of Philippine bamboo mealybugs (Pseudococcidae, Coccoidea, Hemiptera).

| Scientific Name | Common Name |
|---|---|
| 1. *Antonina* sp.aff. *thaiensis* Takahashi | Bamboo node mealybug |
| 2. *Antonina zonata* Green | Zonata mealybug |
| 3. *Chaetococcus bambusae* (Maskell) | Bamboo culm mealybug |
| 4. *Kermicus* sp.* | Bamboo internal mealybug* |
| 5. *Palmicultor* sp.aff. *bambusum* Tang | Bamboo shoot mealybug |
| 6. *Paracoccus interceptus* Lit | Bamboo leaf mealybug |
| 7. *Neoclavicoccus* sp. | Buho leaf mealybug |
| 8. *Rhizoecus* sp.* | Bamboo root mealybug* |
| 9. *Trionymus* sp. | Bamboo whorl mealybug |

* N.B.: To be confirmed

Considering the above circumstances, there could have been no way by which Ferris through Woodworth would identify the species in question as different from *P. lilacinus* during the early 1950's. However, subsequent authors (e.g. Dayan, Gabriel) who had access to actual specimens and/or specialist colleagues did have the opportunity to collect and submit those mealybugs for expert identification. With continuing advances in systematics of insects including mealybugs, species and the names attached to them are proposed or sunk. This leaves no excuse for not having the specimens identified and the names checked.

**Rearing and feeding experiments.** In both free-choice and no-choice experiments, both crawlers and teneral females of *P. lilacinus* settled, fed and survived on cacao, but not on any bamboo species. This was true for all observations periods from 30 minutes up to 72 hours after introduction of the mealybugs. Hence, we opted to present these data in a narrative manner rather than as a grossly skewed activity chart. In the free-choice test, they also settled, fed and survived on *Mussaenda.* This positive response for *Mussaenda* diminishes the probability of negative reaction to a new host due mainly to conditioning to the previous host. The closest to settling on a bamboo shoot was for only two individual teneral females that survived for 12 hours but eventually died and dried up. All crawlers on bamboos also dried up, without any signs of feeding. From all the available results and observations, *P. lilacinus* would rather starve to death than feed on any bamboo species.

The definition of a host plant in the case of a mealybug like *P. lilacinus* would be sufficiently limited to a plant species that can support its growth and development. For other insect herbivore groups or species, the definition of a host plant is much broader and may include nectar sources, mating and nesting sites, oviposition hosts, etc. Because mealybugs, except for most adult males, are wingless, the 'choice' of host by the 'crawler' or other subsequent early nymphal instar by chance landing, believed to be aided by wind (anemochore) or transfer aided by ants (myrmecochore), is a lifetime 'destiny'. Thus, encountering a mealybug during a survey or taxonomic study on a host plant and more especially observing an individual respond positively to a host during a feeding experiment would be sufficient to define whether that species of plant is a host. In the case of the cacao mealybug, despite its polyphagous or oligophagous nature, the results of a more or less comprehensive survey, taxonomic study and feeding experiments are negative with regards to its previously reported association with bamboo.

## CONCLUSION AND RECOMMENDATION

The available data and the above results tend to support our hypothesis that bamboos are not among the many host plants of *P. lilacinus*. The published records pointing to the association of the cacao mealybug with bamboos are probably erroneous and the species referred to is probably *P. interceptus*, which we preferred to call the bamboo leaf mealybug. *P. lilacinus,* therefore is hereby deleted from the list of bamboo pests in the Philippines. Lastly, we recommend that reports of 'new' pests or compilation of information should be done only with expert verification.

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