

THE AUCHENORRHYNCHA (HOMOPTERA) ASSOCIATED WITH PALMS

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ABSTRACT

The leafhopper, planthopper, treehopper and cicada species (Homoptera: Auchenorrhyncha) associated with palms are reviewed. Five fulgoroid families; Delphacidae, Tropiduchidae, Issidae, Lophopidae, and Flatidae are represented by species that breed on palms. Several species of Cicadellidae and one species of Membracidae are also known to breed on palms. Many Cixiidae and Derbidae whose nymphs are found underground or in rotten wood, feed on palms as adults. Direct damage to date palms is caused by the feeding of the tropiduchid Ommatissus binotatus lybicus de Bergevin and the lophopid Zophiuma lobulata Ghauri on coconuts as well as indirect damage by the growth of mould on the honeydew produced by O. b. lybicus. Auchenorrhyncha are currently under investigation as vectors of a number of palm disorders, among them lethal yellowing. A summary of diseases that affect coconut is given. Vector species have been found among those species that are not known to complete their development on palms but which feed frequently from palm foliage, the most notable being the cixiid Myndus crudus Van Duzee, the vector of palm lethal yellowing in southern USA and the Caribbean.

INTRODUCTION

Palms are among the most impressive plants and some of the most important tree crops in the tropical and sub-tropical world. Among the cultivated palm species coconut (Cocos nucifera L.), oil-palm (Elaeis guineensis Jacq.) and dates (Phoenix dactylifera L.) are of great importance in the economy of many countries and products from palms are used worldwide. Palms are attacked by a considerable array of insects and Lepesme (1947) reviewed and listed all those recorded, pests and non-pests, from palms. The more important pests attacking coconut have been reviewed by Lever (1969) and in less detail by Ohler (1984).

In general Hemiptera have not been considered important pests of palms. Exceptions are Heteroptera such as Pseudotheraptus wayi Brown (Coreidae) in Africa and Amblypelta spp. (Coreidae) in the Pacific Islands, both attacking coconuts (see Lever 1969) and among the Auchenorrhyncha only Ommatissus binotatus var lybicus Bergevin (Tropiduchidae, see below) has been noted as a pest of date palms. Lever (1969) does not include any Auchenorrhyncha species as pests of coconut. Increasingly, however, Hemiptera are implicated in the transmission to palms of plant disease pathogens such as lethal yellowing. Among the Heteroptera two species of pentatomid bug are known to transmit a flagellate disease to oil-palm and coconut in S. America (Dolling 1984) and in India a tingid, Stephanitis typicus Distant is the vector of a coconut root wilt (Joseph et al. 1972).

In the Auchenorrhyncha, Cixiidae, Delphacidae and Cicadellidae species are now known to transmit disease pathogens to coconut, and surveys are being conducted that may implicate further species. Much of the information in this paper has come from the results of earlier surveys (e.g., Zelazny & Pacumbaba 1982), especially where the biology of suspect vector species has been investigated.

This study is an attempt to bring together literature and records of palm-associated Auchenorrhyncha and has arisen from a number of independent taxonomic enquiries made to CIE. In the literature search the starting point has been the excellent compilation of Lepesme (1947) who listed many species of Auchenorrhyncha recorded from palms. Many of these records were from early lists (e.g., Gater 1926, Hargreaves 1937) of species found associated with tropical crops, including coconut

TABLE 1: Summary of records of Auchenorrhyncha associated with palms. Emphasis has been placed on those species breeding on palms and on those indicated as disease vectors. Full details and references appear in the text. ** indicates species breeding on palms. + = known vector species. l = adult host records only.

Family/ species	Country/region	host plant(s)
Flatidae		
<u>Ormenaria rufifascia</u> **	southern USA, Jamaica	<u>Sabal palmetto</u> , <u>Latanaria lontaroides</u>
<u>Psenoflata brevis</u> **	Jamaica	coconut
Delphacidae		
<u>Nesodryas antiope</u> **	Seychelles, Mascarenes, Africa: Tanzania	coconut
<u>Sogatodes cubanus</u> +	W. Africa	coconut
<u>Sogatella kolophon</u> +	W. Africa	coconut
Tropiduchidae		
<u>Athestia chariclo</u> **	Mexico	<u>Chamaedorea</u> sp.
<u>Kallitaxila apicalis</u> **	Philippines	coconut
<u>Tambinia verticalis</u> **	Africa: Tanzania	coconut
<u>Ommatissus binotatus</u> **	Spain	<u>Chamaerops humilis</u>
<u>O. b. lybicus</u> **	Middle East	date palm
<u>O. tumidulus</u> **	Sudan	<u>Phoenix</u> sp.
Issidae		
<u>Asarcopus palmarum</u> **	Middle East, USA (intr.)	date palm
<u>Colpoptera ?elevans</u> **	Jamaica	coconut
Lophopidae		
<u>Zophiuma lobulata</u> **	Papua New Guinea	coconut
<u>Painella simmondsi</u> **	Solomon Islands	coconut
<u>Virgilia luzonensis</u> **	Philippines	coconut
Achilidae		
<u>Synedoche helenae</u>	USA (California)	<u>Washingtonia filifera</u>
Cixiidae ¹		
<u>Myndus crudus</u> +	southern USA, Caribbean	coconut and other palms
<u>Myndus taffini</u> +	New Hebrides	coconut
Derbidae ¹		
Many species recorded	Africa, Asia, S. USA	adults on various palms
Ricanidae		
<u>Ricania speculum</u>	Malaysia	oil-palm
<u>Pochazia fasciata</u>	Africa	oil-palm/coconut
Membracidae		
<u>Idioderma virescens</u> **	USA, Dominican Reb.	<u>Seronoa repens</u> , <u>Phoenix roebelinii</u>
Cicadidae		
<u>Diceroprocta apache</u>	USA: California	date palm
<u>Proarna hilaris</u>	Jamaica	coconut
Cicadellidae ⁺		
<u>Recilia mica</u>	W. Africa	oil-palm/coconut
<u>Anocofana makilingensis</u> **	Philippines	coconut
<u>Sochinsogonia longa</u> **	Philippines	coconut
<u>Bakera nigroscuta</u> **	Philippines	coconut

and oil-palm. Where possible the original references have been checked rather than relying on citation in Lepesme (1947).

The following account is divided into two sections. The first is an annotated list of those Auchenorrhyncha species recorded on palms. Second, a list of the diseases of coconut is given with which Auchenorrhyncha have been associated or tested as vectors.

AUCHENORRHYNCHA SPECIES ON PALMS

Differentiation has been made between species breeding on palms and those found casually on palms feeding as adults but whose nymphal stages are found elsewhere. Table 1 is a summary of the information given below.

** indicates species breeding on palms

FULGOROIDEA

The major pest species, both as plant disease vectors and for the effects of direct feeding, occur within the fulgoroid (planthopper) families. Nine families are represented on palms, although the total number of species is relatively small. Further collecting will certainly increase the records of palm associated species.

FLATIDAE

Six species are recorded on palms. Lepesme (1947) and Howard *et al.* (1981) listed; Phromnia limbata F. (Africa), Phromnia pallida Olivier (Africa) Salurnis marginellus Guérin-Meneville (Malaysia) and Planodascalia sp. on Sabal umbraculifera in the Dominican Republic (Howard *et al.* 1981). The first two were given by Mayne and Ghesquire (1934) as rare on oil-palm and coconut. More information is given for the following species breeding on palms.

Ormenaria rufifascia (Walker)**

Host in USA: Sabal palmetto (cabbage palm)

Distribution: southern USA, Cuba

Although this species has been reported as commonly occurring on palms the actual injury to palms is slight on the eight palm species involved (Mead 1965). Adults were collected on 12 species of palms and non-palms in Florida (Wilson & Tsai 1984). Over a 2-year period 14 species of palm and non-palm were examined for nymphs which are gregarious and sedentary near basal portions of pinnae on the underside and are attended by the ant Campanotus floridanus Buckley. Only Sabal palmetto (cabbage palm) and Latania lontaroides (Red Latania palm) were found to support nymphal development. Cabbage palm is a native N. American plant and a common host for O. rufifascia. L. lontaroides is an introduced ornamental palm and a less important host. Wilson & Tsai (1984) found that O. rufifascia is univoltine. The host of O. rufifascia in Cuba has not been confirmed.

Psenoflata brevis Van Duzee**

Host: coconut

Distribution: Jamaica

Nymphs were found on coconut in Jamaica (Eden-Green 1973). Schuiling *et al.* (1976) recorded the nymphs on Coccoloba uvifera (sea grape) (Polygonaceae).

DELPHACIDAE

Most Delphacidae feed on a wide range of Gramineae, but some, particularly those from from the Hawaiian Islands, are known to feed on a wide range of plants,

including some palms. Many of these species were formerly placed in the Tribe Alohini Muir but this tribe is not known considered valid but part of the larger Delphacini (Asche 1985). Among these the following have been recorded from palm species but it is not certain if they breed on palms. Nesodryas swezeyi Zimmerman was recorded (and described) by Zimmerman (1948) from Pritchardia palm in Hawaii. Nesosydne gigantea (Muir) was recorded by Giffard (1922) on a Pritchardia palm in Hawaii from only a single male whereas for some other delphacid species he records a long series on their host plants. Ambarvalia pyrops (Distant) was recorded by Fennah (1964) from the Seychelles, where adults had been collected from Stevensonia.

Grass-feeding delphacids appear to be comparatively rarely encountered on palms. Tsai & Mead (1982) list 12 species found in samples collected by rotary-net from among sabal palm and coconut groves in Florida. In West Africa two species, Sogatella kolophon (Kirkaldy) and Sogatodes cubanus (Crawford) (listed as Sogatella by Julia & Mariau 1982) have been found to be vectors of dry bud rot of coconuts and more rarely of oil-palm (Julia & Mariau 1982).

Nesodryas antiope Fennah**

Host: coconut

Distribution: Seychelles, Mauritius, Tanzania

In the Seychelles, Vesey-Fitzgerald (1941) recorded a "Stenocranus" sp. (Delphacidae) as occurring as both nymphs and adults on coconut. He reported that the species was responsible for slight yellowing of the leaves and much honey-dew production on the foliage. N. antiope was described by Fennah (1964) from coconut in Mauritius. The sub-species, seychellensis, was described at the same time by Fennah from specimens Vesey-Fitzgerald had sent to the Imperial Institute of Entomology (predecessor of CIE) for identification. N. antiope has recently been found commonly on coconut in Tanzania (samples submitted for identification by M. Schuiling, National Coconut Development Programme) where it was found in several localities but no particular damage to coconuts was reported. It is not clear if it has been introduced to mainland Africa. C.J. Lomer (pers. comm.) has told me that N. antiope has recently caused what appeared to be local 'hopperburn' on coconuts in some islands of the Seychelles.

TROPIDUCHIDAE

Five genera of Tropicuchidae are recorded from palms in both Old and New World. In particular, the genus Ommatissus has four species that have known palm hosts, including the important date pest O. binotatus var. lybicus. Linnavuori (1973) described Numicia orphana (type and some paratypes) from Phoenix spp. in Sudan but no further information was given. Other Numicia species appear to be associated with Gramineae. Tambinia capitata Distant is recorded as feeding on African oil-palm in the Selangor district of Malaya by Gater (1926) and the record is also given in Dammermann (1929). It is not clear how many specimens were originally found. Three specimens collected from oil-palm are present in the BMNH collection and do appear to be conspecific with the holotype from India. No mention of the species is made by Wood (1968) in his review of Malaysian oil-palm pests. It is probable that the species only occurs casually on oil-palm.

Athestia chariclo (Fennah)**

Host: Chamaedorea spp.

Distribution: Mexico

This species was described by Fennah (1974) (as Birugo chariclo) from specimens (nymphs and adults) intercepted by US Quarantine on Chamaedorea palm fronds from Mexico. Later Fennah (1982) transferred it to Athestia. No further information is available and the species has not yet been found under natural conditions.

Kallitaxila apicalis (Melichar)**

Host: coconut

Distribution: Philippines

Recorded breeding on coconut in Luzon Island, (Zelazny & Pacumbaba 1982).

Tambinia verticalis Distant**

Host: coconut (in Tanzania)

Distribution: India, Tanzania (introduced)

This species has recently been found breeding on coconuts in Zanzibar and also mainland Tanzania (Wilson 1986). The genus was not previously known from Africa; many of the species, including T. verticalis, are of S. Indian origin. It is presumed that T. verticalis has been introduced to Zanzibar. In S. India the recorded host plants include Canthium sp. (Rubiaceae) but no mention has been made of coconut (see Wilson 1986).

Ommatissus spp.

This genus is currently under revision by Asche & Wilson. The important date pest known in the literature as O. binotatus var. lybicus is considered to be a separate species from O. binotatus Fieber which is found only on Chamaerops palm. To avoid anticipation of that work the new status is not formally established here. A third, undescribed, species has been found from Chamaerops palms in Morocco.

Ommatissus binotatus Fieber**

Host: Chamaerops humilis L.

Distribution: S. Spain, Sicily

Found only in S. Spain and Sicily on its host plant Chamaerops humilis. Other records given in Alfieri (1934) and others (e.g. Lepesme 1947) for its occurrence in N. Africa and southern Russia appear to be erroneous. Records of binotatus in Taiwan and Korea (Kwon & Lee 1979) are referable to other Ommatissus species.

Ommatissus binotatus var lybicus de Bergevin** "Dubas bug"

Host: date palm

Distribution: Middle East

An important pest of date palms in the Middle East. The name "dubas-bug" comes from the Arabic (dibis) for honeydew. In Oman O. b. lybicus has been considered the most serious pest of date production and can cause the death of the trees (Hunter-Jones & Tunstall 1972).

The species was first noted as a pest of dates in Iraq (Ramchandra Rao 1922) but was not named at that time. It was considered to be a cixiid but the drawings given are clearly referable to this species as noted by Dowson (1936). Bergevin (1930) described the species as a new variety, lybicus, of binotatus, but did not consider the genitalia differences significant. The locality he gives "de l'oasis de Siwa (Desert Lybique)" has been quoted as Libya by Metcalf (1954), and Hussain (1963) but is in fact in Egypt. Alfieri (1933, 1934) reported that the species was severely damaging dates in Egypt in 1927. Dowson (1936) reported it as a serious pest in southern Iraq (Basrah area) in 1935.

The biology of the species has been described by various authors (Alfieri 1933, Hussain 1963, Klein & Venezian 1985). Eggs are laid in the upper or lower surface of the midrib of leaf pinnae, as well as in the fruit stalk. Hussain (1963) also found them in the upper and lower leaf surfaces. Nymphs feed from the midrib, leaf surface, fruit stalk and from the fruits. Severe infestation causes

considerable debilitation as a result of feeding, as well as by the honeydew deposit on the leaves and fruit encouraging the growth of mould. This severely reduces the quality of the fruit. Two generations occur (Alfieri 1933 reported only one in Egypt) with the second generation laying eggs that overwinter and hatch the following spring.

O. b. lybicus is known from Egypt (de Bergevin 1930, Alfieri 1933), Iraq (Hussain 1963, 1974), Iran (Hussain 1963), Sudan (El-Haidari 1982), and Israel (Klein & Venezian 1985). The record in Lepesme (1947) for "Trinidad" is a misinterpretation of the article by Dowson (1936).

Ommatissus tumidulus Linnavuori**

Host: Phoenix spp.
Distribution: Sudan

Linnavuori (1973), in describing this species, mentions many specimens having been collected from Phoenix spp. It is possible that the record of O. b. lybicus from Sudan (El-Haidari 1982) might concern this species.

Ommatissus sp.**

Host: Chamaerops humilis
Distribution: Morocco

A new species to be described by Asche & Wilson (in prep). Records of O. binotatus from Morocco probably concern this new species.

LOPHOPIDAE

Two species are recorded as breeding on coconut, with Zophiuma lobulata Ghauri associated with "Finschhaffen disorder" (see below). Painella simmondsi Muir has also been reported as the causative agent of a yellowing disorder of coconuts in the Solomon Islands (Stapley 1976, 1978 and pers. comm. in Smith 1980) where it appears to cause symptoms similar to those of Z. lobulata. It is not clear whether the species breeds on coconut.

Zophiuma lobulata Ghauri**

Host: coconut
Distribution: Papua New Guinea

This species was originally described from specimens collected in Morobe Province, New Guinea where "plague infestations on coconut" had been observed, with over 1000 insects per frond found on several occasions (Ghauri 1966). The feeding activities of Z. lobulata are associated with "Finschhaffen disorder" (see below) as reviewed by Smith (1980). The species was observed to breed on coconut and the biology was described (Smith 1980).

Virgilia luzonensis Muir**

Host: coconut
Distribution: Philippines

Recorded as breeding on coconut in Luzon, Philippines (Zelazny & Pacumbaba 1982).

ISSIDAE

Two species of issid have been identified as breeding on palms. The first, Asarcopus palmarum is a Middle Eastern species, breeding on date palms, that has been introduced into the the USA.

Asarcopus palmarum Horvath**

Host: date palm

Distribution: Middle East, USA (introd. to California)

Willocks (1922) records the species as the "date palm sucker" from Egypt and notes that Horvath had informed him that it was a new species and genus. It was described by Horvath (1921 and re-published 1924). Willocks states that colonies were found in the heart of the crown of the palms but that there was little obvious damage caused. Recently the species has been found in Israel (Klein pers. comm. who also sent specimens to the BMNH).

In the USA A. palmarum was first noticed in 1922 and since then has been reported as seriously damaging date palms on several occasions (Stickney et al. 1950). Known as "date bug" in the USA (Stickney et al. 1950) nymphs and adults are found between unexpanded parts of terminal leaves, and within the spathes on the white tissue of the current season's fruit stalks. In the USA, the host plants are the date palm, a related sp. Phoenix roebelini and hybrid palms produced by crossing the date palm and Phoenix canariensis.

Asarcopus sp. ? palmarum has recently been collected from palms (Caryota urens (L.)) in India (Lois O'Brien pers. comm.).

Colpoptera ? elevans Walker**

Host: coconut

Distribution: Jamaica

Nymphs found on coconut (Eden-Green 1973) and on Coccoloba uvifera (seagrape) (Schuiling et al. 1976).

ACHILIDAE

The nymphs of achilids are found under bark, in leaf litter or in rotten wood. They are believed to feed on fungi. Only one species has been noted specifically on palms.

Synedoche helena (Van Duzee)

Host: Washingtonia filifera

Distribution: USA; California

Found in localities where the fan palm is native in California. O'Brien (1971) considers that the adults feed from green leaves during the night, perhaps sheltering in dead leaves in the day. The nymphs may live amongst the leaf litter caught in bases of old leaves. The original description (Van Duzee 1918) states that S. helena appears confined to fan palm.

CIXIIDAE

The nymphs of cixiids, where known, are subterranean, feeding on the roots of plants. Adults occur on a wide range of plants. Several species have been noted or described from palms and some are now implicated as the vectors of palm lethal yellowing. Many species may be found only casually, some such as Euryphlepsia annandalei cocos and Oliarus cocosivora were evidently found abundantly on coconuts at the time of their original collection but do not appear to have been noted since their descriptions. Euryphlepsia annandalei cocos Muir was described (Muir 1924) from coconut in Guadalcanal, Solomon Islands and reported that it had been found "in countless numbers". Interestingly E. cocos has not been found during recent surveys of coconuts (R. Macfarlane pers. comm.). Oliarus cocosivora Muir was described by Muir (1929). Corbett (1932) reported that it had been found in large numbers on seedling coconut palms in 1926 and had been described from specimens collected at that time. It does not appear to have been noted from coconut since.

Myndus crudus Van Duzee

Distribution: southern USA, Caribbean

This species has become increasingly implicated as the vector of palm lethal yellowing in the Caribbean and S. USA (see review by Howard in this volume). Field evidence and transmission experiments (e.g. Howard et al. 1983) have provided strong evidence that Myndus crudus is a vector of lethal yellowing. It is the only species consistently associated with coconut and other palms (Tsai 1980). Nymphs develop on the roots of grasses, the adults feeding on a range of monocotyledons including palms. Control might be achieved by the management of grass species used as nymphal hosts as well as by the planting of resistant palms.

Myndus taffini Bonfils

Distribution: Vanuatu

Myndus taffini is now recognised as the vector of foliar decay of coconuts, a disease of unknown etiology, in Vanuatu (Julia 1982, Julia et al. 1985), where the disease is endemic. Nymphs feed on the roots of Hibiscus tileaceus.

Other Myndus species.

In the Reef Islands (Solomon Islands) north of Vanuatu a closely related yet undescribed species (Wilson, in prep.) has been found on Areca palm and on coconuts. However, there is no indication that the species is acting as a disease vector (R. Macfarlane pers. comm.). Myndus maculosus Muir was collected in numbers from coconuts in the Philippines (Zelazny & Pacumbaba 1982). Myndus mavors Fennah has also been collected in low numbers from coconut in the Solomon Islands (Wilson, in prep.).

DERBIDAE

Many different species are often abundant and commonly encountered on palms as well as on other crops such as bananas and sugarcane and many have been described from palms (e.g. Muir 1915). Lepesme (1947) listed 48 species collected from palms worldwide. More recently Zelazny & Pacumbaba (1982) listed 15 species from southern Luzon Island in the Philippines. It is felt inappropriate to list here every species that has been recorded from palms. The nymphal stages of derbids are thought to feed on fungi. Adults evidently feed and also aggregate to mate on many plants whose leaves (or parts of leaves) may be held out horizontally. Ball (1928) described Mula resonans which had been found resting on the horizontal leaves of cabbage palmetto palm and he suggested that they might use the large leaf of the palm as a "sounding board" for sound production. It is possible that abundance and diversity of derbids on palms may be directly related to the quantity and availability of suitable nymphal habitats, e.g. rotten wood, nearby. At present there is little evidence of any damage to palms by derbids but species in Tanzania are being evaluated as possible vectors of lethal yellowing.

The common Asian species Proutista moesta (Westwood) has been specifically noted from coconuts on a number of occasions (e.g. Wood 1968, Corbett 1932).

At least 35 species have been described from coconut and oil-palms in Africa. Many of these had been collected in survey work by Hargreaves (1937). Recent survey work, in the search for the vector of lethal yellowing disease of coconuts in Tanzania, has revealed 10 new species (Wilson 1987).

In southern USA and the Caribbean species of the genus Cedusa are commonly found. Cedusa inflata is commonly found in Florida on coconuts and other palms (Howard & Mead 1980, Howard et al. 1981). Neocenchrea sp. was collected from three species of palms in diverse localities in the Dominican Republic (Howard et al. 1981). Omolicna spp. are common on palms in the Caribbean region (Howard et al. 1981, Johnson & Eden-Green 1978).

RICANIIDAE

Wood (1968) records Ricania speculum Walker adults as commonly found on oil-palm in Malaysia and as ovipositing in petioles. However, nymphal habits are unknown. Mayne & Ghesquire (1934) listed Pochazia fasciata (Fab.) as commonly found on palm and coconut in the former Belgian Congo (Zaire).

MEMBRACOIDEA

MEMBRACIDAE

Only one species has apparently been recorded breeding on palms.

Idioderma virescens Van Duzee**

Hosts: Seronoa repens(Bartram), Phoenix roebelinii (O'Brien)
Distribution: southern USA, Dominican Republic, Cuba, Bahamas

This species had been occasionally collected in surveys connected with the search for the vector of palm lethal yellowing (e.g. Howard & Mead 1980). The interest in the species for transmission studies prompted a revision of the genus and work on the biology of I. virescens (Kopp & Tsai 1983). Two species are known in the genus, I. virescens in southern USA, Dominican Republic (Howard et al. 1981), Cuba (Metcalf & Bruner 1925), Bimini, the Bahamas (Metcalf 1954b) and I. picta Osborn from Cuba. In Florida the main host plant of I. virescens was found to be the native Seronoa repens (saw palmetto) with the introduced ornamental Phoenix roebelinii also used. Nymphs feed on the rachis of the inflorescence. Host plants are not known for I. picta.

CICADOIDEA

CICADIDAE

The eggs of cicadas are laid into woody tissue of trees and shrubs and the first instar larvae, upon hatching, drop to the ground and burrow into the soil where they feed on the roots of plants. Three species of cicada are recorded as ovipositing on palms. Corbett (1932) records oviposition sites of Dundubia rufivena Walker on a variety of plants, including coconut in Malaya. The following two species have been considered as minor pests.

Diceroprocta apache (Davis)

Distribution: USA

Considered to be a minor pest of date palms (Stickney et al. 1950, Elmer 1963). The damage is caused by oviposition. Egg punctures accumulate in older foliage (both on midribs and leaf pinnae) from year to year where injury to leaves may become significant. Egg punctures on fruit threads may obstruct the flow of sap and the development of the fruit. The cicada nymphs are found in the soil but were not found to damage the roots of date palms (Stickney et al. 1950).

Proarna hilaris Germar

Distribution: Jamaica

Adults were frequently found feeding from coconut palm and oviposition into rachis tissue caused damage (Eden-Green & Schuiling 1978). Nymphs were found feeding from coconut roots. The species was tested as a vector of lethal yellowing but no transmission was demonstrated (Eden-Green & Schuiling 1978).

CICADELLOIDEA

CICADELLIDAE

Compared with the Fulgoroid families rather few cicadellids (leafhoppers) are presently known from palms. Zelazny & Pacumbaba (1982) record a number of

species as being found on coconuts in the Philippines and of these three were found to breed on coconut : Anacofana makilingensis (Baker) (Cicadellinae) (listed by them as Tettigoniella makilingensis). Young (1986) transferred the species to a new genus Anacofana. Sochinsogonia longa (Walker) (Cicadellinae) (listed as Bothrogonia longa by Zelazny & Pacumbaba 1982), transferred to Sochinsogonia by Young (1986). Bakera nigroscuta Mahmood (Typhlocybae)

In West Africa the grass-feeding species Recilia mica Kramer has been found to transmit blast disease to oil-palm (Desmier de Chenon 1979) and coconut (Julia 1979).

In the search for the vector of lethal yellowing disease of coconuts in Florida a number of species have been noted (e.g. Howard & Mead 1980) but none found breeding. Similar survey work has noted species on Canary Island date palm in S. Texas (Meyerdirk & Hart 1982) and on coconut in Jamaica (Esfaki 1982).

Since so many of the records appear to be casual it has not been thought necessary to list here all the species recorded on palms.

DISEASES OF COCONUT

Auchenorrhyncha have been implicated or suspected as the vectors of a number of diseases affecting coconuts. Some of the disease syndromes described here e.g. lethal yellowing, also affect other palms. Table 2 gives a summary of these diseases of coconut, their causes (where known), vectors and distribution.

Cadang-cadang: Philippines

Cadang-cadang occurs on the Philippine islands of Luzon, Samar and neighbouring islands where it is destructive to coconut palms over 10 years old (Zelazny & Pacumbaba 1982). The disease is thought to be caused by a viroid and viroid-like RNA has been transmitted mechanically (Randles *et al.* 1977). Many insects have been tested unsuccessfully as vectors of this disease, including leafhoppers and planthoppers. These attempts have been reviewed by Bigornia (1977). Zelazny and Pacumbaba (1982) surveyed the insects associated with both diseased and healthy palms with the aim of drawing up a list of species which should be given priority for future insect transmission trials. Sixty-three insect species were caught by means of sticky traps or by direct aspirating from leaves. Homoptera (leafhoppers, planthoppers, aphids and coccids) with 52 species formed the highest proportion (the remainder being Orthoptera, Coleoptera and Heteroptera). Fourteen species of Homoptera were found breeding on coconut and where appropriate, details of these species have been given above. The results of the survey indicated that no single species could be considered as a suspect for transmitting cadang-cadang.

Finschhaffen disorder: Papua New Guinea

The symptoms of this disorder include gradual yellow bronzing from the tip of leaflets towards the petiole. As the condition advances the leaflet tips become necrotic and the necrosis spreads to those areas affected by bronzing. The lower fronds may die prematurely. This disorder was first noticed in 1960 near Finschhaffen, Morobe province in Papua New Guinea. Smith (1980) summarises the information available on the disorder and its link with the feeding of the lophopid planthopper Z. lobulata Ghauri. It was noted that a large build up of the insects preceded damage symptoms and any improvement in previously affected palms appeared to be related to a general decrease in Z. lobulata populations. Transfer experiments reported by Smith show that Z. lobulata is intimately involved in the Finschhaffen coconut disorder. Feeding by large numbers caused symptoms very similar to those observed on young palms. In the original description of Z. lobulata, Ghauri (1966) records that up to 1000 insects per frond had been found. Smith also reported that the remission of symptoms indicated that it was unlikely that a viroid or mycoplasma-like organism was involved. The symptoms could be taken for a form of hopperburn.

A similar disorder of coconuts in the Solomon Islands, associated with the presence of another lophopid, Painella simmondsi Muir, was reported by Stapley (1976, 1978).

TABLE 2: Summary of diseases of coconut with which Auchenorrhyncha have been implicated or suspected of transmission. Details and references are given in the text.

Country/Region	Disease	Cause	Vector(s)
Philippines	"cadang-cadang"	viroid	?? (Auchen. tested)
New Hebrides	"Lethal decay"	MLO ? virus ?	<u>Myndus taffini</u> (Cixiidae)
Papua New Guinea	"Finschhaffen Disorder"	Hopperburn ?	<u>Zophiuma lobulata</u> (Lophopidae)
Solomon Islands	local hopperburn		<u>Painella simmondsi</u> (Lophopidae)
Southern USA, Caribbean	Lethal Yellowing	MLO	<u>Myndus crudus</u> (Cixiidae)
Africa: Tanzania	lethal decline	MLO	?? Auchen. being tested
Africa: W. Africa	dry bud rot	??	<u>Sogatella kolophon</u> , <u>Sogatodes cubanus</u> (Delphacidae.)
Africa: W. Africa	"Blast"	??	<u>Recilia mica</u> (Cicadellidae)

Palm lethal Yellowing

This syndrome, was named lethal yellowing by Nutman & Roberts (1955) for the disease of coconut palms in Jamaica. Howard (1983) reviewed the literature on the disease both in the S. USA and Caribbean as well as on the similar, if not identical, diseases in Africa. Here mention will be made only of the lethal yellowing conditions that have been implicated with transmission by Auchenorrhyncha.

Lethal Yellowing : southern USA, Caribbean

The literature is extensive and only selected papers are mentioned here. The magnitude of the problem may be gauged from the information that since 1971 when first reported from mainland Florida, lethal yellowing has killed 80-90% of the estimated 1 million of the susceptible Jamaic Tall variety coconuts (Howard pers. comm.) As Tsai (1980) states "the aesthetic value and environmental impact of the coconut palms in South Florida are far greater than the simple monetary value". Lethal yellowing has been the subject of a considerable research effort over a long period in order to find the vector. Experimental work in Jamaica has been reviewed by Johnson & Eden-Green (1978) while the search for a vector in Florida prior to 1980 was reviewed by Tsai (1980).

Most insect surveys have concentrated on Homoptera on the assumption that the vector came from this group. Palms have been surveyed in Jamaica (Esfaki 1982), Florida (Howard & Mead 1980, Tsai & Mead 1982) and Texas (Meyerdirk & Hart 1982). No firm conclusions resulted from these surveys but incidental evidence for the role of the cixiid M. crudus has accumulated over several years. Howard & Mead (1980) found M. crudus on all but the rarest lethal yellowing-susceptible palm species. Successful transmission experiments with M. crudus were reported in 1983

(Howard et al.). This is far from the end of the research project as methods of control have still to be investigated, as well as among other aspects of the problem. The role of Myndus crudus in lethal yellowing is fully reviewed in a paper by Howard (1987, this volume).

Lethal Disease: Tanzania

A lethal yellowing syndrome has apparently been known in coconut palms in Tanzania for at least 30 years (Nienhaus et al. 1982). In a survey carried out in Tanzania (Steiner 1978) many palms showed symptoms of lethal yellowing but no pathogens including MLO could be identified, but MLO association was demonstrated by Nienhaus et al. (1982). A full description of the disease syndrome was given by Schuiling et al. (1981). The vector has yet to be identified and tests are currently being carried out with a range of Auchenorrhyncha (Schuiling pers. comm.). Those insects that have been submitted to the CIE for identification have provided some interesting records (Wilson 1986, 1987).

Lethal yellowing: Vanuatu

The wilt disease now known as "Foliar decay of coconuts by M. taffini" (FDMT) has been known since 1965 on Santo Island, Vanuatu (Julia 1982). The disease only affects introduced coconuts and has never appeared on native varieties. The vector of the disease has been found to be a cixiid (Julia 1982) and the species was named M. taffini Bonfils (1982). Recent results (Julia et al. 1985) have shown by indirect evidence that the causal agent is unlikely to be an MLO and a virus remains the most probable cause.

Dry bud rot: West Africa

Dry bud rot affects young coconuts and only rarely oil-palm, and was first identified in 1972 (Renard et al. 1975). Julia (1979) showed that the vector was a delphacid, subsequently identified as Sogatella kolophon (Kirkaldy) and Sogatodes cubanus (Crawford) (Julia & Mariau 1982). Both species breed on grasses and Julia & Mariau (1982) state that the incidence of the disease at any site is due partly to the variable development of the host grasses. Elimination of grasses is a form of preventative control in coconut seed-beds and nurseries. The causative agent of the disease is not known.

Blast disease: West Africa

Blast disease, which is confined to Africa, is a disease of young coconuts and of oil-palm (Julia 1979). The cicadellid Recilia mica Kramer was shown to be the vector of blast disease to oil-palm (Desmier de Chenon 1979) and of blast to coconuts (Julia 1979).

DISCUSSION

Representatives of nine Fulgoroid families have been found on palms and members of the Flatidae, Delphacidae, Lophopidae, Issidae and in particular the Tropicuchidae are known to breed on palms. It is, perhaps, too early to draw any particular conclusions from the incidence of planthoppers with palms but other Auchenorrhyncha appear, in comparison, almost depauperate on palms and must surely be under-recorded.

From those records given here it may be seen that various Auchenorrhyncha species are suspected, implicated or have been shown to be vectors of several diseases of palms in several areas of the world. Interestingly these vectors have come, not from species that breed on palms, but from those that feed more or less regularly on palms and actually breed elsewhere. The implication for survey work has already been grasped since such investigation in the search for a vector is usually wide ranging. However, not all the pests of palms have come from species only casually associated with palms since some species that breed on palms may also cause damage. What might be considered "hopperburn" has been caused by the feeding of Z. lobulata and N. antiope on coconuts. The tropiduchid O. b. lybicus is a major date pest because of its feeding and because of the honeydew it produces.

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