Mycoplasmalike Bodies Associated with Lethal Yellowing Disease of Coconut Palms

Biljana Plavšić-Banjac, Peter Hunt, and Karl Maramorosch

Senior Fulbright-Hays Scholar, Boyce Thompson Institute for Plant Research, Yonkers, New York; Professor, Department of Botany, University of the West Indies, Mona, Kingston, Jamaica; and Program Director, Insect Physiology and Virology, Boyce Thompson Institute for Plant Research, Yonkers, New York 10701, respectively. Present address of senior author: Department of Botany, University of Sarajevo, Sarajevo, Yugoslavia.

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ABSTRACT

Mycoplasmalike bodies were detected in phloem elements from inflorescences of lethal yellowing-diseased coconut palms. This finding suggests a mycoplasma etiology for lethal yellowing, and is the first report of mycoplasmalike bodies in diseased coconut palms.

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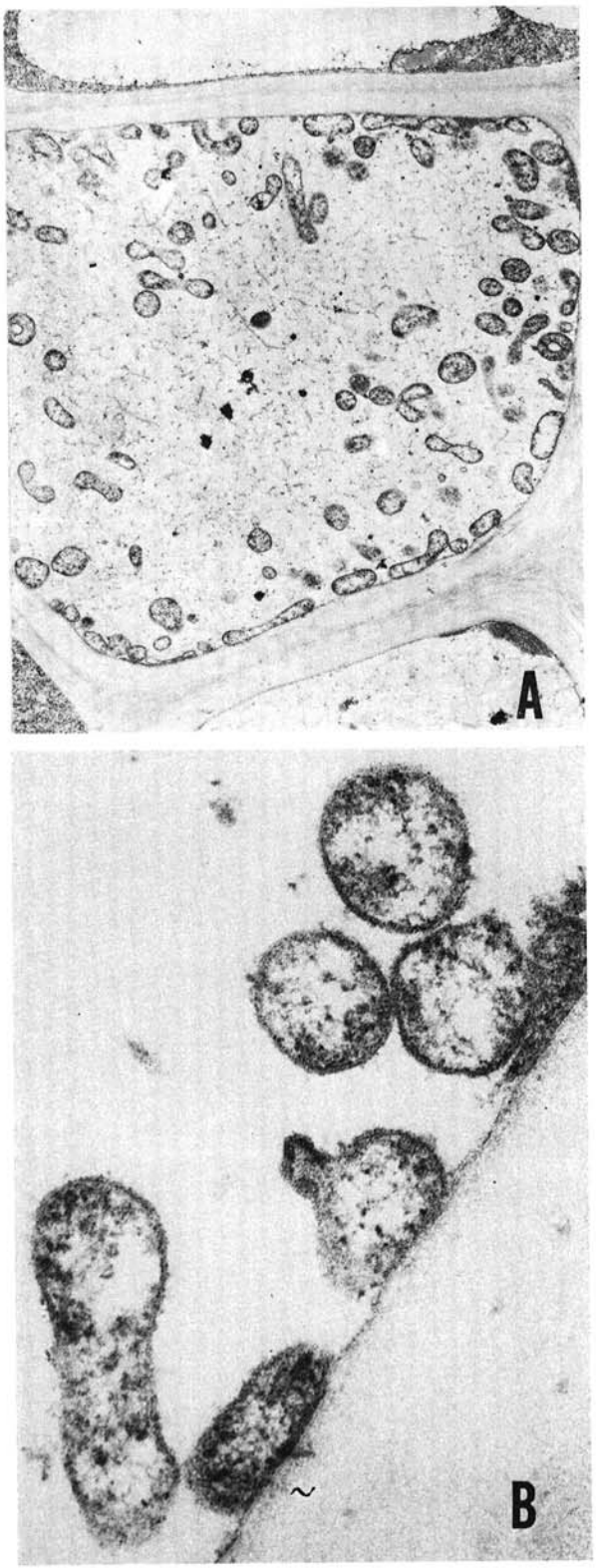
Lethal yellowing of coconut palms, observed in the Caribbean Islands after 1891 (3), accounted for the rapid death of 100,000 productive palms/annum in Jamaica alone in recent years. It devastated coconut plantations in Haiti, Cuba, Togo, Ghana, and Nigeria (8). An outbreak of the disease in 1955 in Key West, Fla., destroyed many palms there during the next 12 years before disappearing spontaneously. The cause of lethal yellowing has been variously attributed since 1905 to bacteria, salt damage, strontium or other toxic materials, nutritional deficiency, nematode injury, or a virus (1, 4, 8). This latter hypothesis was strengthened by reports of mechanical transmission of a filterable agent (12, 13). However, mechanical transmission has not been confirmed in Jamaica despite repeated attempts using the same and other techniques (4, 5). The present note reports the results of electron-microscopic examination of the earliest stage of the disease.

An 8-year-old coconut (*Cocos nucifera* L.) palm of the Jamaica Tall variety was felled at Darlingford near Manchioneal on the northeast coast of Jamaica near sea level. The tree, showing the earliest symptoms of lethal yellowing disease, still retained a proportion of its nuts and was without symptoms on the mature foliage. The young spear leaf appeared normal, but the next spear leaf, which was only partly expanded, had slight necrosis at the tips of a few pinnae. The inflorescence from which a sample was removed had just split along one side and, when opened, was about 50% necrotic at the distal end. Samples were taken at the plantation within 0.5 hr of felling.

The rachilla material taken from just below the necrotic tip was prepared for electron-microscopic examination as described elsewhere (6). Bodies resembling mycoplasmas were found in sieve tube elements of the rachillae of the inflorescence taken from the tree showing early symptoms of disease. Ovoid, elongated, and filamentous forms were observed (Fig. 1-A). These pleomorphic bodies were bounded by a triple-layered structure comprising two electron-dense layers with a transparent layer between. This limiting unit membrane was ca. 10 nm thick. The internal structure of the bodies was indistinguishable from that described for other mycoplasmalike bodies associated with yellows-type diseases (10, 11). The central fibrillar material in the bodies was surrounded by a granular peripheral zone containing ribosomelike particles (Fig. 1-B). Some of the elongated bodies measured up to 2 μ in length. Filamentous forms were sometimes present as beaded chains. Mycoplasmalike bodies were also detected in sieve tube members from coconut palm leaves at later stages of the disease. They were less abundant in leaves than in the rachillae and, therefore, more difficult to locate. Mycoplasmalike bodies were not found in healthy coconut palms, nor were virus particles or microorganisms observed in the phloem, xylem, or parenchyma of diseased tissue.

The bodies associated with coconut lethal yellowing in the earliest symptoms of disease, but not associated with normal healthy plants, are similar in appearance to bodies found in other diseases of the yellows type (2, 11). The microorganisms have been provisionally described as mycoplasmalike bodies (MLB) (9), whose taxonomic status as well as the causal relationship to plant diseases is still enigmatic. Although temporary remission of several yellows-type diseases has been achieved by tetracycline chemotherapy, only in two instances was this linked with the disappearance of the microorganisms (7, 14). The finding of MLB in the phloem elements taken from the inflorescence of an infected palm, together with the absence of fungi, bacteria, or viruslike particles, suggests, but does not prove, that they may be the causative agents of lethal yellowing disease. In instances of animal and human diseases, the hypothesis of possible mycoplasma etiology, based solely on an association with mycoplasma, requires extreme caution, because mycoplasmas form part of the normal microbial flora of warmblooded animals. This is not so with plants, in which mycoplasma or mycoplasmalike bodies have never been observed in normal ones. Nevertheless, additional tests will be needed to establish whether the hypothesis of a mycoplasma etiology is correct. Supporting evidence will be hampered by the lack of proper cultivation methods for the presumptive plant mycoplasma agents, by the inability to graft coconut palms and so transmit the agent, by the lack of knowledge concerning the vector of the disease agent, and by the impracticality of chemotherapeutically treating a plant as large as a coconut palm to induce remission



of symptoms (7, 14). Unequivocal proof of the hypothesis that lethal yellowing is caused by a mycoplasmalike agent will, therefore, require a concentrated attack on several fronts.

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Fig. 1. A) Mycoplasmalike bodies (MLB) in the phloem elements from an inflorescence removed from a lethal yellowing diseased coconut palm. The ultrathin section is from rachilla material taken just below a necrotic tip (X 6,000). **B)** Note ribosomelike particles and central fibrillar material of MLB (X 80,000).