made plants susceptible to chilling injury when temperatures dropped to 34° to 46°F. An investigation by Marlatt (3) showed *Sansevierias* reached market size fastest when fertilized with 100 lbs./N/A/month. Studies of *Sansevieria* species grown for fiber showed they required high N fertilization (2). Another study by Marlatt showed a rate of 25 lbs. N and 25 lbs. K acre month resulted in the least amount of winter chill (4). This study and the others discussed indicates that *Sansevierias* grown in full sun require more than 30 lbs. N/A/month for best yields.

Literature Cited

1. Conover, C. A. and R. T. Poole. 1972. Fertilization practices for foliage plant stock productions. *Florida Foliage Grower.* 9(3):6-8.

2. Fishler, D. W., and J. B. Pate. 1958. Sansevieria, a potential fiber crop. *Soil and Crop Sci. Soc. Fla. Proc.* 18: 284-287.

3. Marlatt, Robert B. 1973. Nitrogen: Potassium Ratio affects chilling injury of *Sansevieria trifasciata* 'Laurentii'. *HortScience*: In press.

4. ————. 1973. Nitrogen: Potassium nutrition and growth of *Sansevieria trifasciata* 'Laurentii'. *HortScience*: In press.

POSSIBLE LINK BETWEEN DECLINING PALM SPECIES AND LETHAL YELLOWING OF COCONUT PALMS

DARRYL L. THOMAS

IFAS, Agricultural Research Center
Fort Lauderdale

Abstract. **In an area of southern Florida which has lost over 100,000 coconut palms (**Cocos nucifera L.**) to the lethal yellowing (LY) disease since October 1971, several other palm species have declined and died with symptoms similar to LY. Electron microscopic examination has revealed mycoplasmalike bodies in the phloem tissue of the arikury palm,** Arikuryroba schizophylla (Mart.) **Bailey; the palmyra palm,** Borassus flabellifer L.**; the cluster fishtail palm,** Caryota mitis **Lour.; the buri palm,** Corypha elata **Roxb.; the spindle palm,** Mascarena verschaffeltii **(Wendl.) Bailey; the Canary Island date palm,** Phoenix canariensis **Hort.; the Senegal date palm,** Phoenix reclinata **Jacq.; and the windmill palm,** Trachycarpus fortunei **Wendl. The discovery of mycoplasmalike bodies similar to those reported in coconut palms infected with LY indicates that possibly all of the above palm species are new hosts for LY.**

The causal agent of the lethal yellowing (LY) disease of coconut palms (*Cocos nucifera* L.) remained obscure for over 80 years until Plavsic-Banjac et al. (10) reported the presence of mycoplasmalike bodies in tissues of a coconut palm infected with LY and the absence of such bodies in healthy coconut palms. This initial report in 1972 was soon reconfirmed in three additional laboratories (1, 3, 8). Because no other disease agents were observed in the LY material, all four research groups suggested that a mycoplasmalike organism was the probable causal agent of LY. Since mycoplasma, as a group, are highly sensitive to the tetracycline antibiotics but are extremely resistant to penicillin (2), McCoy (5, 7) further implicated a mycoplasmalike organism as the causal agent when he demonstrated remission of LY symptoms with tetracycline antibiotics but not with penicillin.

Shortly after the outbreak of LY in southern Florida, two additional palm species, *Veitchia merrillii* (Becc.) Moore and *Pritchardia pacifica* Seem. and H. Wend., began dying with symptoms similar to coconut palms infected with LY. Parthasarathy (8, 9) observed mycoplasmalike bodies in specimens from both of these diseased palm species but could find no mycoplasmalike bodies in healthy trees. He concluded that the similarity of diagnostic symptoms and the occurrence of mycoplasmalike bodies in diseased coconuts, pritchardias, and veitchias strongly suggested that all three species were affected by the same disease which had a mycoplasmalike organism as its causal agent. McCoy (6) strengthened this hypothesis by demonstrating symptom remission in diseased pritchardias which were injected with tetracycline antibiotics.

In addition to coconut, pritchardia, and veitchia palms, members of several other palm species have

Florida Agricultural Experiment Stations Journal Series No. 5640.

declined and died in Dade County, Florida which has lost an estimated 100,000 or more coconut palms to LY. These affected species were examined for the presence of mycoplasmalike bodies in an effort to determine the possible host range for LY.

Materials and Methods

One to three members of each declining palm species which were examined in this electron microscopic study, were collected from December, 1973 through August, 1974 at locations of Dade County in which LY was well established. In all cases, trees in various stages of decline were felled and entire crowns were returned to the laboratory for further dissection and preparation for observation. Tissue samples, ca. 1 by 1 by 0.5 mm, were excised from young leaf bases within 5 cm of the apical

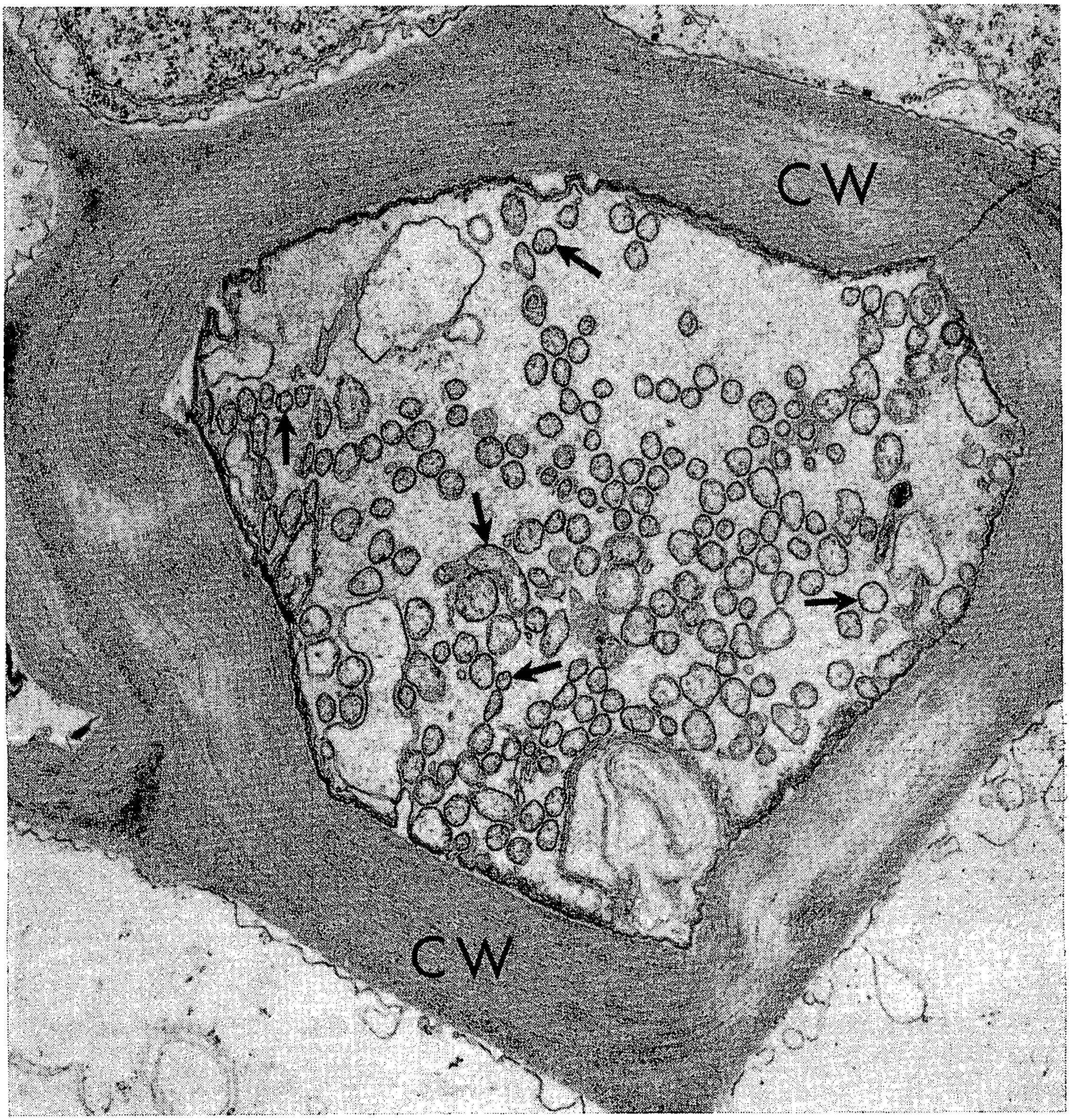

Fig. 1. Transverse section through a sieve element in a young leaf base of Canary Island date palm showing mycoplasmalike bodies (arrows) inside the nacreous cell wall (CW) (ca. X 22,000).

meristem of each tree. Samples were fixed for 18 hr in collidine buffered paraformaldehyde-glytaraldehyde (4), postfixed with collidine buffered 2% osmium tetroxide for 6 hr, and then transferred to 0.5% aqueous uranyl acetate for 18 hr, all at 4 C. The specimens were then dehydrated in a graded ethanol-acetone series before embedding in Spurr plastic (11). Silver sections were cut with the aid of a Sorvall MT-2 ultra-microtome and stained with uranyl acetate and lead citrate before observation with a Philips EM 201 electron microscope.

Results and Discussion

Mycoplasmalike bodies (Fig. 1) similar to those reported in coconut palms infected with LY were found in phloem tissue from declining specimens of 1) the arikury palm, *Arikuryroba schizophylla* (Mart.) Bailey; 2) the palmyra palm, *Borassus flabellifer* L.; 3) the cluster fishtail palm, *Caryota mitis* Lour.; 4) the buri palm, *Corypha elata* Roxb.; 5) the spindle palm, *Mascarena verschaffeltii* (Wendl.) Bailey; 6) the Canary Island date palm, *Phoenix canariensis* Hort.; 7) the Senegal date palm, *Phoenix reclinata* Jacq.; and 8) the windmill palm, *Trachycarpus fortunei* Wendl. Although mycoplasmalike bodies frequently filled individual sieve elements (cross sections often contained more than 100 bodies per cell), the overall concentration of mycoplasmalike bodies in the phloem was seldom high. Some specimens contained mycoplasmalike bodies in ca. 30% of their vascular bundles, but often fewer than 10% of the vascular bundles and only one sieve element per vascular bundle contained mycoplasmalike bodies. Not every sample showed the presence of mycoplasmalike bodies; occasionally three or more samples from an affected palm were examined before mycoplasmalike bodies were found. Two individual trees had to be examined before mycoplasmalike bodies could be found in declining members of *M. verschaffeltii.* Although such concentrations were considered low, specimens taken from comparable leaf bases of coconut palms infected with LY contained the lowest concentrations of any declining palm species examined.

LY infection was suspected in each palm species where mycoplasmalike bodies were observed because a) members of the species died in locations heavily infested with LY but no such death was observed in areas free of LY; b) the disease symptoms of an affected species paralleled the symptoms of a coconut palm infected with LY; and c) the rapid death of the affected palms could not be attributed to another palm disorder. Although the presence of mycoplasmalike bodies in the declining palm species suggests that these species are hosts of the LY pathogen, absolute proof of pathogenicity and proof of the co-identity of the various palm declines must await transmission studies. The report of mycoplasmalike bodies associated with the declining palm species of this study adds support to the hypothesis that these species are possible hosts of LY. Certainly this support will be stronger when larger numbers of declining palms as well as healthy controls are examined.

Literature Cited

1. Beakbane, A. B., C. H. W. Slater, and A. F. Posnette. 1972. Mycoplasmas in the phloem of coconut, *Cocos nucifera* L., with lethal yellowing disease. *J. Hort. Sci.* 47:265.
2. Davis, R. E., and R. F. Whitcomb. 1971. Mycoplasmas, rickettsiae, and chlamydiae; possible relation to yellows diseases and other disorders of plants and insects. *Ann. Rev. Phytopath.* 9:119-154.
3. Heinze, K., H. Petzold, and R. Marwitz. 1972. Beitrag zur Atiologie der Todlichen Vergilbung der Kokospalme (lethal yellowing disease of coconut palm). *Phytopath. Z.* 74:230-237.
4. Karnovsky, M. J. 1965. A formaldehyde-glutaraldehyde fixative of high osmolarity for use in electron microscopy. *J. Cell. Biol.* 27:137A.
5. McCoy, R. E. 1972. Remission of lethal yellowing in coconut palm treated with tetracycline antibiotics. *Plant Dis. Reptr.* 56:1019-1021.
6. ————. 1973a. Antibiotic treatment of lethal yellowing, pp. 157-158 (Abstr.) *In* J. B. Fisher (convener) Report of the lethal yellowing symposium at Fairchild Tropical Garden, Miami. *Principes* 17:151-159.
7. ————. 1973b. Effect of various antibiotics on development of lethal yellowing in coconut palm. *Proc. Fla. State Hort. Soc.* 86:503-506.
8. Parthasarathy, M. V. 1973. Mycoplasmalike organisms in the phloem of palms in Florida affected by lethal yellowing. *Plant Dis. Reptr.* 57:861-862.
9. ————. 1974. Mycoplasmalike organisms associated with lethal yellowing disease of palms. *Phytopathology* 64:667-674.
10. Plasvic-Banjac, B., P. Hunt, and K. Maramorosch. 1972. Mycoplasmalike bodies associated with lethal yellowing disease of coconut palms. *Phytopathology* 62:298-299.
11. Spurr, A. R. 1969. A low viscosity epoxy resin embedding medium for electron microscopy. *J. Ultrastruct. Res.* 26:31-43.