ASEAN PLANT QUARANTINE CENTRE AND TRAINING INSTITUTE

CADANG-CADANG DISEASE

Names of the disease

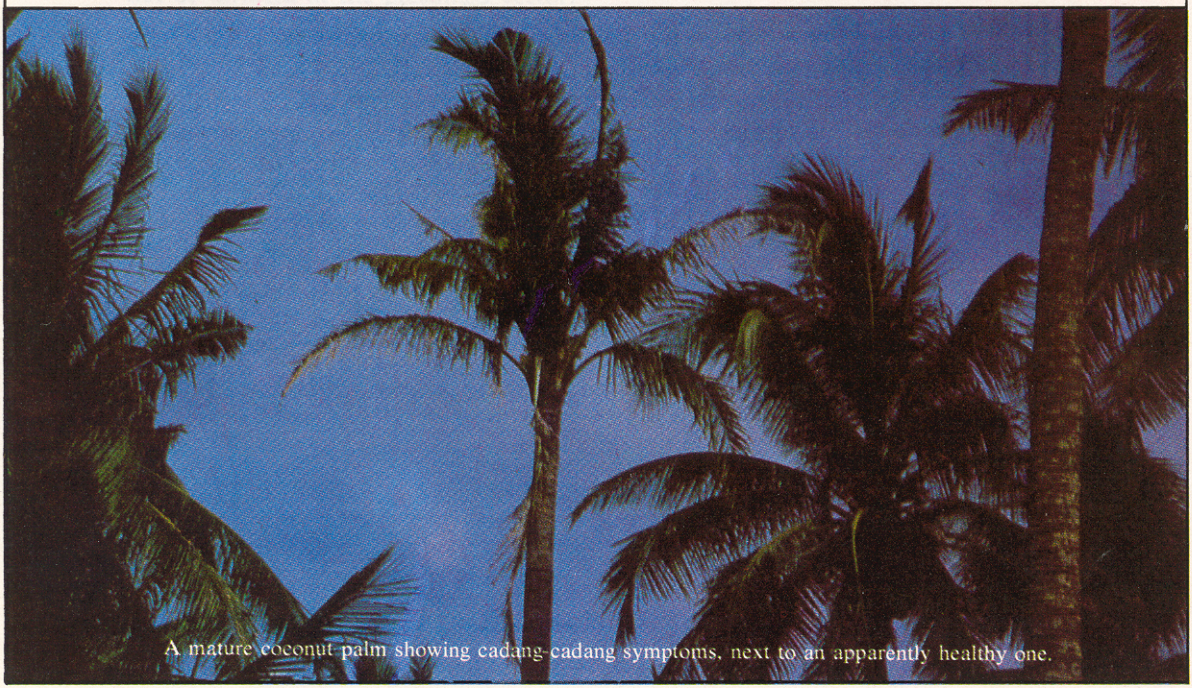
Cadang-cadang disease of coconut palms (Philippines)
Tinangaja disease of coconut palms (Guam)
"Yellow mottle decline" was described as closely resembling cadang-cadang; however the resemblance is questionable (2)

Principal host

Coconut *(Cocos nucifera)*

Other hosts

African oil palm *(Elaeis guineensis)**
Buri palm *(Corypha elata)*



A mature coconut palm showing cadang-cadang symptoms, next to an apparently healthy one.

*Besides infestation of coconut palms, the disease is a major threat to oil palm because natural infections of oil palm are known from the Philippines.

Geographical distribution

Cadang-cadang is confined to the Western Pacific region. In the Philippines the known distribution of cadang-cadang is a zone approximately 600 km long and 270 km wide with the island of San Miguel, where it was first reported in 1931, as the centre of distribution. Among the Marianas Islands, tinangaja (caused by the same pathogen as cadang-cadang) was recorded in Guam as early as 1917. It has since destroyed the coconut industry on Guam, and symptoms of the disease have been observed on Rota and Tinian, two islands near Guam (2). Due to the interchange among the Marianas group, the disease may occur in other islands of the South Pacific as well.

Vector

Not known

Biology

Cadang-cadang is caused by viroids. Low molecular weight, circular, single-stranded RNA, unrelated to the nucleic acids of healthy coconut palms, were found to be specifically associated with cadang-cadang infected palms (5,6). The RNA (ccRNA) can be detected in diseased palms by fractionating nucleic acids on polyacrylamide gels (3) and a positive diagnosis can, therefore, be based upon its presence or absence.

Further, the synthesis and use of a radioactive complementary DNA-probe for this ccRNA (3,6) has shown that tinangaja was identical with cadang-cadang disease.

ccRNA occurs as two species, a small circle (CC-1) and a dimer of CC-1 (CC-2), both of which open into a circular structure when denatured (5). CC-1 and CC-2 have many physio-chemical properties in common with the viroids. Viroids are naked, circular, single-stranded, low molecular weight RNAs, infectious, and pathogenic to plants.

Spread

Detailed surveys (7) within, and at the margins of the regions of disease distribution, indicated that although the disease advanced at an average of less than 500 m per year, jumps of several hundred meters did occur. Water barriers did not influence spread of the disease, indicating that air-borne transmission occured. Diseased palms apparently acted as sources of inoculum for spread, and there was positive correlation with age

of palms, and negative correlation with altitude. No insect vector was identified, and the possibilities of pollen, seed or mite transmission are under investigation (9).

Means of entry

Unknown

Identification - symptoms

In the Philippines infected palms first show characteristic non-necrotic yellow leaf spots, which appear on fronds below the thrid or fourth frond down from the unopened spear leaf. This is followed by characteristic nut rounding and scarification, then cessation of nut and inflorescence production; death occurs 8-16 years after disease on set (8).

Like cadang-cadang, tinangaja in Guam primarily affects trees 25-30 or more years old. The leaflets of tinangaja-affected coconuts show chlorotic spots very similar to those observed on cadang-cadang-affected trees, although this is not considered a diagnostic symptom. In the early stage, cadang-cadang induced the production of smaller-than-normal, rounded nuts scarified around the equator (1); while no such symptom has been reported for tinangaja. Instead the formation of crinkled, mummified nuts with no kernel inside has been observed. Palms die soon after nut production ceases, whereas in cadang-cadang, sterility is induced much earlier and the late stage (no nuts) can last for years (2).

Therefore, diagnosis of cadang-cadang based on symptoms of the disease in the Philippines and outside may be unrealiable. However, the discovery that tinangaja-affected palms from Guam contain an essentially identical RNA is convincing evidence that tinangaja and cadang-cadang diseases are caused by the same pathogen.

Economic importance

Cadang-cadang is perhaps the most serious disease of coconut and has probably killed more palms than all other coconut diseases combined (1). Total palm losses of about 30 million, and annual yield losses of about 20,000 tonnes of copra have been attributed to cadang-cadang in the Philippines (3,9). The disease is seriously threatening a large

A cocounut plantation with high incidence of cadang-cadang; some palms are already dead.

area in the Philippines, while in Guam, the disease has totally destroyed the coconut industry (2).

Potential within ASEAN

As the distribution of cadang-cadang is still confined to a few islands in the Philippines and Marianas Groups, and in view of the present rate of spread, it appears that the threat of an epidemic of cadang-cadang in coconut palm outside the present disease zone is small. Nevertheless, long distance jumps of cadang-cadang apparently have occurred, and until the mode of transmission is fully known, there is strong argument for prohibition of material likely to introduce the disease. This line of action would seem even more meaningful when one considers that the epidemiology of the disease in oil palm may differ from that in coconut; as natural infections of cadang-cadang into African oil palm and buri palm have been observed (4). Cadang-cadang, therefore, presents a threat of unknown magnitude to oil palm plantations in the ASEAN, especially to Malaysia where vast oil palm estates are a major revenue earner.

The development of more specific quarantine and eradication procedures, however, must await the result of further research on the mode of natural transmission of cadang-cadang.

Control

Failure so far to identify the mode of spread of cadang-cadang means that control cannot be directed at the presumed vector.

Rogueing is now being reconsidered as a means of control. An early study attributed to J.L. Naron (9) suggested that eradication of diseased palms significantly reduced the rate of appearance of new cases of cadang-cadang.

It is important to prohibit importation of seednuts and other plant materials of coconut origin from the disease endemic areas. In the Philippines, quarantine legislation regulates the movement of plant materials to areas free of the disease.