Coconut Varieties and Lethal Yellowing: A Regional Perspective for the Americas

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The local tall coconut palms on the Atlantic and Caribbean coasts of America are highly susceptible to lethal yellowing disease (LY) whereas those on the Pacific coast have a degree of resistance that reduces the risk of an epidemic of this disease. Resistant varieties and hybrids are available, and research and development are accessible on the Internet.

The year 1999 was the 500th anniversary of the introduction of coconut to the Western hemisphere (Harries 1977). They were carried back to Portugal by Vasco da Gama in 1499 from India or East Africa and en route some were left at the Cape Verde Islands. Within 50 years, by 1549, records show that coconuts from Cape Verde were taken to Brazil and to Puerto Rico. They would have reached the Atlantic and Caribbean coasts of other Latin American countries, as well as the Atlantic coast of Africa, quite quickly because, at that time coconuts were carried on all sailing ships as a source of water and they were planted wherever sailing ships called for just that purpose. The coconuts on the Pacific coast of Central and South America arrived at about the same time in the mid-16th century and for the same reason but came from Manila in the Philippines. They were different from the Caribbean Atlantic coastal coconuts and the two populations have remained distinct, with a few exceptions, to this day (Harries 1971). There was no trade in copra or coconut oil at that time but the most important point to understand is that there could have been no epidemic diseases or serious pests present to prevent successful establishment because within 500 years coconuts were everywhere in America.

Over the last one hundred years the role of coconut changed. Steamships, making quicker journeys and carrying tanks of fresh water for the boilers, no longer needed to carry coconuts for drinking. Instead, cargoes of copra (the dried endosperm) were carried because coconut oil became the most important source of vegetable oil for margarine, soaps and explosives (nitro-glycerine). This was particularly so at the time of the first World War, when plantations were established, and after the Second World War when a world-wide edible oil shortage encouraged expansion of coconut planting in Mexico and Brazil (and stimulated the soybean industry in the USA).

Global and regional threat

With the economic importance of the coconut came the first reports of serious diseases (coinciding with a scientific interest in agricultural diseases generally). From the descriptions it is hard to be sure if fungal, bacterial or physiological causes were being recorded. For instance, bud rot, which is common wherever coconuts (or other palm species) grow was widely reported (in English, French, German and Spanish speaking countries), whilst red ring, also a serious problem, seems to be of South American origin. The most important problem, lethal yellowing, which became notorious because it was epidemic, is now known to be caused by a phytoplasma (formerly called an MLO or mycoplasma-like organism) and transmitted by a planthopper vector. It seems likely that LY was introduced to the region when vectors were unintentionally carried on other plants (possibly on grass) from south-east Asia at a time when both colonial authorities and amateur horticulturists were keen to move plants and before there were strict quarantine regulations.

Although lethal yellowing disease is thought to have been recognised about one hundred years ago it came into prominence only about forty years ago in Jamaica, thirty years ago in Florida, twenty years ago in Mexico and five years ago in Honduras. Its potential for spread is unlimited, but the rate cannot be easily predicted. An infected palm, of any variety, will die within four to six months of the first symptom. In an area of susceptible Atlantic coast tall cultivar, almost all palms may die within four years. A few will escape and may subsequently die if another epidemic cycle starts. If a block of Malayan Dwarf are present in an epidemic area, the disease eliminates a few, but most survive. When LY became epidemic in Jamaica the Coconut Industry Board began a replanting programme with the highly resistant Malayan Dwarf variety. The CIB also made major germplasm collections to look for other sources of LY resistance and these resulted in the production of the Maypan hybrid in 1974.

The method for large scale hybrid coconut seed production was introduced to other countries and specifically to Costa Rica in 1977. Observations made during the visit to Costa Rica crystallised ideas on coconut evolution and the identification of wild-type, domestic-type and introgressed-types of coconut varieties. This had particular application to LY disease resistance in three ways: the origin of LY resistant varieties in south-east Asia; the prediction that LY type diseases would be found in southeast Asia; and the assessment that LY presented a threat to about 62% of the world's coconut palms (Harries 1978).

During that period of intense LY research an International Council on Lethal Yellowing was established and held four meetings. ICLY subsequently ceased to function but has recently been revived, on the internet, as the Centre for Information on Coconut Lethal Yellowing (CICLY) <http:// www.cicy.mx/dir_acad/cicly/main.html> and an associated e-mail discussion group <http://groups.yahoo.com/group/CICLY> on the internet. CICLY is an attempt to provide a clearing house for information on LY-type diseases and is a new approach that benefits from research done on LY in Mexico, on similar diseases in East and West Africa and on recent findings in southeast Asia.

One recent outcome of research is the possibility of ranking varieties on a 1 to 5 scale of resistance-susceptibility:

Malayan Dwarf (MD)	=	1
MD × PT	=	2
Panama Tall (PT) and also MD × AT	=	3
PT × AT	=	4
Atlantic Tall (AT)	=	5

Varieties behave differently with respect to LY disease. The Malayan Dwarf (MD) is highly resistant and, as a result, the disease is not epidemic or is no longer epidemic where this variety has been widely planted. The Pacific coast tall (PT) has shown intermediate resistance when planted in epidemic areas, and the dwarf × tall hybrids (MD × PT and MD × AT) are intermediate between the respective parents in trials. Thus there are five apparent degrees of resistance or susceptibility: MD > MD × PT > PT > MD × AT > AT. In Jamaica the difference between 1 and 5 (MD and Jamaica Tall (JT)) is very clear. In Tanzania, the differences are not so clear cut, perhaps because the strain of the phytoplasma is different, and different East African Tall (EAT) accessions are located at 2, 3 and 4 on the scale (Harries 1995).

Another outcome, based on accumulated information, is a reduction in the global threat by a few percentage points (from 62 to 58 based on calculated areas of cultivated coconuts) or even more, if the disease fails to become epidemic in areas, like the Pacific coast, where resistant varieties predominate. This reassessment of the threat of LY applies mainly within the Latin American region. Lethal yellowing is currently epidemic on the Caribbean coast from Mexico to Honduras where the Atlantic coast tall (AT) is highly susceptible. The disease has not yet spread to the Pacific coast and, although phytoplasma have been associated with a yellowing decline condition, this is non-epidemic. Lethal yellowing may not become epidemic on the Pacific coast because resistant coconut varieties (or other immune palm species) can slow or prevent its spread.

Conclusions

Where large areas of resistant material occur the disease ceases to be epidemic. It has been suggested that the disease and the resistant varieties co-evolved in south-east Asia, where non-epidemic yellows diseases have recently been associated with phytoplasma. Further research is required to ascertain the closeness of the relationship and the relative pathogenicity of phytoplasmas associated with coconut palms in the various regions. However, in the present state of knowledge, it is hoped and believed that LY will not become epidemic on the Pacific coast of the Americas. Similarly, the best way to slow or stop the spread along the Atlantic coast is to replant with resistant varieties and hybrids before the disease arrives.

Areas such as Jamaica and Florida, have lower risk because of the replanting with resistant material. In areas of new LY outbreaks, in Mexico, Belize and Honduras, the same option should also work. Those areas where the disease has not yet arrived (such as Brazil or Costa Rica) or become epidemic (such as Dominican Republic) can benefit if the same precautions are taken. It has to be borne in mind that LY is not the only threat in the Americas. There may be other phytoplasma-related yellows and there are phytomonas and red ring. Nevertheless, the potentially large markets for value-added coconut products on the American continents, gives producers in the region an advantage over older, traditional areas of production in south-east Asia.

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