

# Lethal Yellowing Susceptibility of Date Palms in Florida

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## ABSTRACT

The true date palm, *Phoenix dactylifera*, as well as *P. canariensis*, *P. reclinata*, *P. rupicola*, and *P. sylvestris* have been reported to be susceptible to lethal yellowing (LY) in Florida. Field estimates, but not experimental data, indicating differences in the degrees of susceptibility of *Phoenix* spp. to LY are available and these are assumed to be imprecise because of inherent biases in field observations and uncertain genetics of date palm species in Florida. In a preliminary field trial of cultivars of the true date palm, 94.1% of the palms eventually developed symptoms of LY. However, because 'Halawy' date palms survived longer than individuals of other cultivars, this cultivar is being tested again. Evidence is presented that when true date palms contract LY, the lateral shoots may survive and grow into mature palms.

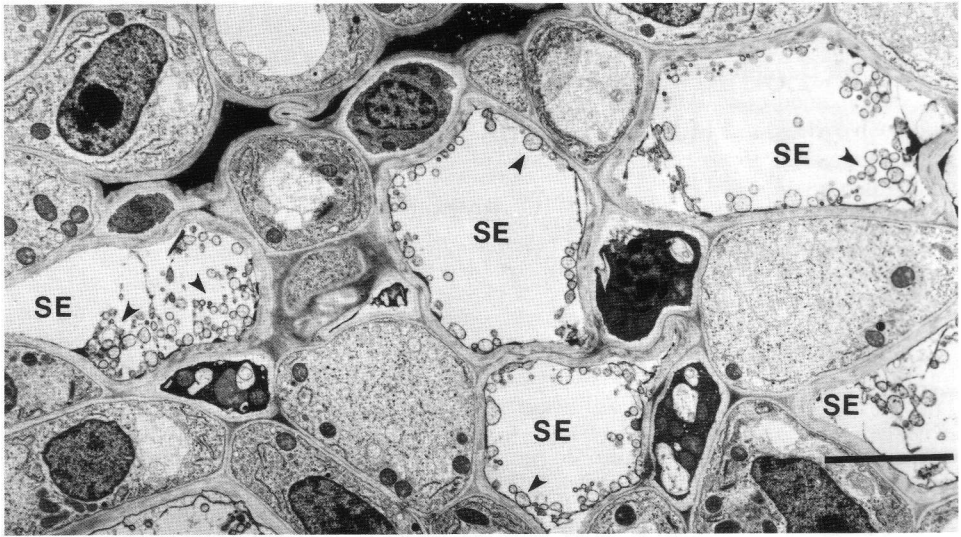
Lethal yellowing (LY) has been known in parts of the West Indies since the 1800s as a highly destructive disease of coconut palms (*Cocos nucifera* L.). When LY invaded the Florida mainland in the early 1970s, another aspect of the disease began to reveal itself—that LY affects many species of palms in addition to coconut. More than 30 species of palms thus far have been shown to be susceptible. That this became apparent first in Florida, rather than in one of the countries of the West Indies, was probably due to the relatively high incidence of exotic palms planted throughout the urban areas of southeast Florida.

The list of LY-susceptible species was critical to the work of regulatory agencies charged with the responsibility of curtailing the spread of LY. There was an obvious

need to restrict or otherwise regulate the movement of species on the list to areas outside of the quarantine area. Of greater interest to palm growers was the degree of susceptibility of different species and varieties. For example, although the coconut palm is a susceptible species, Malayan dwarf varieties are relatively resistant. The risk of losing a Malayan dwarf coconut palm to lethal yellowing is low enough that green, golden and yellow Malayan dwarf varieties can be recommended for planting in an area affected by LY.

The long-range objective of present research on LY is to develop an integrated pest management scheme involving various components, such as environmentally compatible control of the vectors of the disease, therapy of affected trees by more effective antibiotics than those now available, the use of palms with natural resistance to the disease, and possibly genetically engineered resistant palms.

The use of naturally resistant palm species and varieties is presently the most effective means known for preventing loss of palms to LY, and will probably be the most important component of any integrated pest management method available in the foreseeable future. This has generated a need for data on the relative susceptibility of different species and varieties of palms. The acquisition of such data is difficult. Mycoplasma-like organisms (MLO) are apparently the causal agents of LY. There is no known method of artificially inoculating plants with MLOs. Thus, for



1. Electron micrograph of a sieve tube element from a young leaf base of a date palm infected with mycoplasma-like organisms (arrows). Line = 10  $\mu\text{m}$ .

several decades researchers have tested coconut palms for LY resistance by planting them with a known susceptible species as experimental controls in fields where the palms could be expected to become exposed to the disease (Harries 1973). Since the dynamics of the disease are independent of the experimenter, the period of time that must be allotted for a resistance trial of a variety is unpredictable. Generally it has taken years for results to be obtained from such trial gardens, and even then many questions have remained concerning possible differences in results if the same palm varieties had been grown under different conditions than those of the trial garden. This problem has been partially addressed by planting more than one trial garden. The feasibility of testing small containerized palms by exposing them to insect vectors collected in LY-affected areas was demonstrated (Howard et al. 1984). However, this method was overly labor-intensive. In summary, given present technology, testing palms for LY resistance or susceptibility is extremely demanding of resources.

An alternative method has been to base susceptibility ratings on observations in non-experimental plantings that have been affected by LY. For example, the 'Jamaica Tall' coconut palm and Manila palm (*Veitchia merrillii* [Becc.] H. E. Moore) were among the most commonly planted palms in the Miami area prior to the epidemic of the 1970s. Observations by researchers and plant protection personnel indicated that, while many Manila palms were lost to the disease, a higher portion of the 'Jamaica Tall' coconut palms were lost, and thus the latter was considered to be the more susceptible. Observations of LY susceptibilities of different palm species in Fairchild Tropical Garden (FTG) were quite consistent with those made in the broader urban areas of southern Florida. Such field observations were useful for developing qualitative estimates of susceptibilities of different palm species without waiting for a trial garden to grow up and become naturally exposed to LY. The flaw in this method is that landscape plantings and botanical gardens were not designed to serve as disease trial gardens. The spe-

cies to be compared are unlikely to be of comparable age, growing under comparable conditions, etc. Nevertheless, in the absence of experimental data, the method is of some value as an imprecise indicator of comparative risk associated with the planting of different species (Howard et al. 1979).

One of the many kinds of palms grown as ornamentals in southern Florida and known to be susceptible to LY is the date palm, *Phoenix dactylifera* L. Like coconut and oil palms, the date palm is of great economic importance in various parts of the world. Thus, we took special interest in the susceptibility to LY of this species and its close relatives. In addition to the true date palm, species of *Phoenix* which have found a place in the landscape of southern Florida include the Canary Island date palm (*Phoenix canariensis* Hort. ex Chabaud), Senegal date palm (*Phoenix reclinata* Jacq.), miniature date palm (*Phoenix roebelenii* O'Brien), cliff date palm (*Phoenix rupicola* T. Anders.) and silver date palm (*Phoenix sylvestris* Roxb.).

LY is not known to affect miniature date palms. Because this palm is very common in southern Florida, we consider that its resistance to LY has been adequately "tested." Senegal date palm is also fairly common. LY was positively diagnosed in one specimen which had phenotypical characteristics of the Senegal date palm but was thought to be possibly a hybrid. We have no other evidence that this species is susceptible.

The cliff date palm and silver date palm have been shown to be susceptible to lethal yellowing. They are relatively uncommon in Florida outside of private and public palm collections.

The Canary Island date palm is commonly grown throughout the Florida peninsula and elsewhere along the coast of the Gulf of Mexico. In some areas of southern Florida, a high percentage of these died from LY during the epidemic of the 1970s and early 1980s, while in other areas of the same region this species was unaffected

by the disease. Palms of this species were eliminated from areas of southern Texas by an LY epidemic (McCoy et al. 1980a, b). McCoy et al. (1983) rated Canary Island date palm as "moderately susceptible" to LY. This rating was based on combined estimates of three LY researchers who had conducted field observations independently during the period of the epidemic.

The true date palm, which was less common in Florida than the Canary Island date palm, was rated by McCoy et al. (1983) as "highly susceptible." More recently, Broschat and Meerow (1991) rated the true date palm as "slightly susceptible" and the Canary Island date palm as "moderately susceptible." These discrepancies are not surprising, when it is considered that different observers made their assessments on different sites and at different time periods.

The uncertainties of the genetics of *Phoenix* species in Florida further confuse the picture. It is well-known that species of *Phoenix* hybridize readily when grown in the same vicinity (Corner 1966), as is the case in Florida. The palms commonly known as Canary Island date palms in Florida often have characteristics, such as a blue-glaucous leaf color and a sympodial (clustering) habit, which may indicate that they are hybrids with true date palms and possibly additional *Phoenix* species. True date palms are less common in Florida than Canary Island date palms, and traditionally have been grown from seeds. Most are probably hybrids between date palm cultivars, if not hybrids of two *Phoenix* spp. Thus, in Florida, field estimates of LY susceptibility of particular species of *Phoenix*, are probably more accurately described as estimates of susceptibility of species and offtypes (i.e., hybrids) of the species, and are apt to be quite variable among plantings of palms grown from different seed sources.

The true date palm is a sympodial palm. For centuries, true date palms have been propagated vegetatively from offshoots, which are young secondary shoots. This



2. The author's daughter, Andrea, indicates one of the 'Halawy' date palms that survived the LY test conducted 1979-1985 at the Fort Lauderdale Research and Education Center.

has maintained the genetic integrity of many cultivars of date palm in North Africa and the Middle East. Eight cultivars, all originally introduced from the latter

regions, are of commercial importance in California.

A preliminary test of lethal yellowing resistance of five of the most important

cultivars grown in California was attempted at the Fort Lauderdale research and Education Center from 1979 to 1985. Offshoots shipped from California were planted in a field with coconut palms and other susceptible species, many of which were infected with LY. Some offshoots did not survive the first year due to transplant failure. To simplify observations for LY symptoms, the date palms that were successfully established were maintained as single stem palms by pruning their offshoots periodically. The palms were examined frequently and those with LY symptoms were felled and the bud tissue sampled and examined with an electron microscope for the presence of MLOs.

All of the 12 date palms that developed LY symptoms were found to have MLOs present in the phloem, a verification that they were infected with this disease. Palms that remained free of LY symptoms as of May 1985 included the single 'Medjool' date palm that had survived transplanting and one of three 'Deglet Noor', one of six 'Zahidi', and four of six 'Halawy' date palms. Only one palm of the fifth cultivar, 'Thoory', became established from an offshoot, and this was eliminated by LY. These results were reported earlier (Howard et al. 1985).

Following the publication of these results, by the end of the next growing season, *viz.* in November 1985, the remaining 'Deglet Noor' and 'Zahidi' palms had succumbed to LY, while the four remaining 'Halawy' palms were unaffected. The final results, then, were as follows:

Cultivar	Palms Exposed to LY (Survived Transplanting)	Percent Lost to LY
Deglet Noor	3	100
Zahidi	6	100
Thoory	1	100
Medjool	1	0
Halawy	6	33.3

There was a total of 17 date palms exposed to LY in this test, 70.6% of which succumbed to LY. Thus, discounting possible differences between cultivars, the true date palm could be considered as highly susceptible to LY under the conditions of this experiment, an observation in agreement with the estimate of McCoy et al. (1983). Because of the small numbers of palms of each cultivar tested, these results did not show conclusively any differences in susceptibility to lethal yellowing among these cultivars, although a sufficient percentage of 'Halawy' palms survived to warrant further testing.

Because of proposed widening of a road at the perimeter of our research center, in November 1985 we established another experimental area where we planted young coconut palms and transplanted the four surviving 'Halawy' palms and sole surviving 'Medjool' palm. During the next year, the main stems of the four 'Halawy' palms died with LY symptoms. If these results are pooled with those presented above, 94.1% of the 17 date palms contracted LY.

Interestingly, the lateral shoots of three of the four 'Halawy' palms survived. As of September 1992, these are alive and have produced their own offshoots. The survival of the lateral shoots after the death of the main stem of a date palm affected by LY has been noticed on other occasions in southern Florida, and raises interesting questions about the ability of MLO to move through the vascular connection between the main stem and lateral shoots (*cf.* Tomlinson 1990).

Although eventually 100% of the 'Halawy' palms contracted LY, four of them survived longer than palms of any of the other cultivars tested, and only showed LY symptoms after having been transplanted. The possible effect of transplanting on LY susceptibility or symptom expression is not known. To further test the 'Halawy' as a possibly resistant cultivar, we are presently conducting observations on a planting of

11 'Halawy' palms and 12 'Zahidi' planted from offshoots in March 1988. The incidence of LY in the vicinity of the research center has declined during the past two years, and none of these date palms has thus far developed LY symptoms. Although the single 'Medjool' palm has survived until the present, we do not feel that this constitutes convincing evidence that the variety is resistant to lethal yellowing. We are interested in obtaining sufficient material to test this cultivar.

Our cumulative observations indicate thus far that the true date palm, when considered as a species, is highly susceptible to LY, at least under some conditions, while under some conditions the risk of a palm contracting LY might be minimal. The conditions that affect susceptibility await elucidation. Given this uncertainty, date-growing countries should take every precaution to prevent the introduction of this disease. The work also indicates the possibility, now under further investigation, that there are varietal differences in this species to LY susceptibility. Given present technology and resources, only a few of these are likely to be tested in the foreseeable future.

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