

## Lethal Yellowing (LY) of Palm<sup>1</sup>

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### Summary

- Lethal yellowing (LY) is a systemic disease caused by a phytoplasma transmitted by a planthopper.
- LY occurs only in the southern one-third of Florida because the planthopper is not cold hardy.
- LY symptoms are highly variable among *Cocos nucifera* (coconut) cultivars and among other palm genera.
- Palms with greater than 25% leaf discoloration due to LY should be removed.
- Management of LY includes trunk injections of oxytetracycline HCl (OTC) every four months, and planting of palm species that are not hosts of LY.
- Palm species native to Florida and the Caribbean Basin appear to be non-hosts of LY.
- *Cocos nucifera* (coconut), *Adonidia merrilli* (Christmas palm), *Phoenix dactylifera* (date palm) and *Pritchardia* spp. are highly susceptible

and are not recommended for widespread landscape use in areas where LY is known to occur.

### Introduction

Lethal yellowing (LY) is a palm disease prevalent in Florida landscapes in the southern one-third of the state. It is also observed in field nurseries. This disease has significantly reduced the number of tall-type *Cocos nucifera* (coconut) in Florida and the Caribbean Basin, and localized outbreaks continue to occur.

### Pathogen and Hosts

LY is caused by a phytoplasma, a cell wall-less bacterium. It is spread by the planthopper *Myndus crudus*, a common planthopper in southern Florida. The phytoplasma is a systemic pathogen that is found only in the phloem tissue (vascular tissue transporting carbohydrates) of palms. It is not known to survive outside either its plant or insect hosts. The planthopper is a piercing and sucking insect, meaning it feeds on the contents of the plant host vascular system, including the phloem. The insect moves the

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phytoplasma from palm to palm as it moves during its feeding cycles.

The geographic range of LY in Florida is limited to the subtropical southern one-third of the state because the planthopper is not cold hardy. At least 36 palm species have been documented with LY (Table 1), but *Cocos nucifera* (coconut) is most often associated with this disease, followed by *Adonidia merrilli* (Christmas palm), *Phoenix dactylifera* (date palm) and *Pritchardia* species.

## Symptoms

As with any disease, diagnosis is based on a series of symptoms. Furthermore, no single symptom is diagnostic of LY. Rather, it is the appearance and chronological progression of symptoms that accurately identifies the disease. The difficulty with LY diagnosis is that symptoms vary according to the palm species, and in the case of coconuts, the particular cultivar involved.

The first obvious symptom on mature palms (those able to produce fruit) is a premature drop of most or all fruits. For coconuts, the calyx (stem) end of the fruit will usually have a brown to black, water-soaked appearance (Figure 1). Next, inflorescence (flower) necrosis (death) develops. Normally light yellow to creamy white in color, emerging flower spikelets are instead partially or totally blackened. Male flowers abscise from flower spikelets and no fruit is set.

Boron deficiency in coconut will also cause premature nut drop. However, nuts dropped due to boron deficiency will not have the discolored, water-soaked appearance at the calyx (stem) end of the nut (Figure 1).

For tall-type coconut cultivars, the next symptom is a yellowing of the foliage, beginning with the lowest (oldest) leaves and progressing upward through the crown (Figure 2). In some cases, this symptom is seen as a solitary, yellowed leaf (“flag leaf”) in the middle of the leaf canopy (Figure 3). Typically, yellowed leaves remain turgid, but eventually turn brown, desiccate and hang down forming a skirt around the trunk for several weeks before falling (Figure 3). As leaf yellowing



**Figure 1.** Fruits that prematurely dropped from *Cocos nucifera* due to Lethal Yellowing. Note dark, water-soaked calyx (stem) end. Credits: N.A. Harrison

advances, the spear (youngest) leaf collapses and hangs down in the crown. Death of the apical meristem (bud) occurs when one-half to two-thirds of the crown has yellowed. Eventually, the entire crown of the palm withers and topples, leaving a bare trunk standing (Figure 4). Infected palms usually die within 3 to 5 months after the first appearance of symptoms.

Foliar discoloration varies markedly among coconut cultivars and other palm genera. For most tall-type coconut cultivars, leaves turn a golden yellow before dying, while on dwarf cultivars, leaves generally turn a reddish to grayish-brown (Figures 5 and 6). Leaflets on the green form of the 'Malayan Dwarf' cultivar may be folded around the midvein. Affected leaves appear noticeably flaccid rather than turgid, giving an overall wilted appearance to the palm canopy (Figure 5), but this is not a consistent symptom.

Foliar yellowing develops on such species as *Caryota mitis* (clustering fishtail palm) (Figure 7), *C. rumphiana* (Figure 8), *Chelyocarpus chuco*, *Corypha elata*, *Dictyospermum album* (hurricane or princess palm), *Hyophorbe verschaffeltii* (spindle palm) (Figure 9), *Livistona chinensis* (Chinese fan palm) (Figure 10), *Pritchardia* spp., and *Trachycarpus fortunei* (windmill palm).

For other palm species, such as *Adonidia merrilli* (Christmas palm), *Borassus flabellifer* (palmyra



**Figure 2.** Foliar yellowing symptoms of *Cocos nucifera* due to Lethal Yellowing. Credits: N.A. Harrison



**Figure 3.** 'Jamaica Tall' *Cocos nucifera* on left is exhibiting Lethal Yellowing symptoms of solitary, yellowed leaf ("flag leaf") in middle of canopy plus dead leaves hanging down around trunk. Credits: T.K. Broschat

palm) (Figure 11), *Dypsis decaryi* (Triangle palm) (Figure 12), *Phoenix* spp. (Canary Island date palm, date palm) (Figures 13, 14 & 15), and *Veitchia arecina* (Montgomery palm), successively younger



**Figure 4.** Death of *Cocos nucifera* apical meristem (bud) from Lethal Yellowing causes crown to wither and topple from trunk. Credits: N.A. Harrison



**Figure 5.** Green form of 'Malayan Dwarf' *Cocos nucifera* with Lethal Yellowing exhibiting discoloration of leaves (grayish-brown rather than yellow) and overall wilted appearance. Credits: N.A. Harrison

leaves turn varying shades of reddish-brown to dark brown or gray rather than a distinctive yellow.



**Figure 6.** 'Maypan' *Cocos nucifera* with Lethal Yellowing exhibiting discoloration of leaves (grayish-brown rather than yellow). Credits: N.A. Harrison



**Figure 8.** Foliar yellowing symptoms of Lethal Yellowing on *Caryota rumphiana*. Credits: N.A. Harrison



**Figure 7.** Foliar yellowing symptoms of Lethal Yellowing on *Caryota mitis*. Credits: N.A. Harrison



**Figure 9.** Foliar yellowing symptoms of Lethal Yellowing on *Hyophorbe verschaffeltii*. Credits: N.A. Harrison

Differences may occur in the stage at which spear leaf necrosis appears. For *Phoenix dactylifera* and *Borassus flabellifer*, death of the spear often precedes foliar discoloration. For *Adonidia* and *Veitchia*, the spear is usually unaffected until after all

other leaves have died. Also for *Adonidia merrillii* the oldest leaves kink along the petiole and hang down parallel to the trunk (Figure 16).



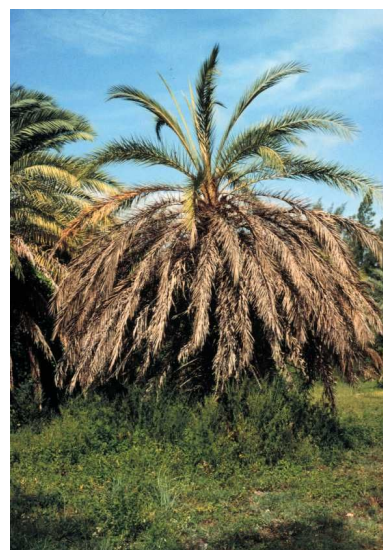
**Figure 10.** Foliar yellowing symptoms of Lethal Yellowing on *Livistona chinensis*. Credits: N.A. Harrison



**Figure 12.** Foliar browning symptoms of Lethal Yellowing on *Dypsis decaryi*. Credits: N.A. Harrison



**Figure 11.** Foliar browning symptoms of Lethal Yellowing on *Borassus flabellifer*. Credits: N.A. Harrison



**Figure 13.** Foliar browning symptoms of Lethal Yellowing on *Phoenix dactylifera*. Credits: N.A. Harrison

## Diagnosis

The plant symptoms described above are relied upon to make the initial diagnosis. Since the phytoplasma is not culturable, a molecular diagnostic test is used to confirm the presence of the pathogen. If pathogen confirmation is necessary, contact your local county Extension office or the Florida Extension Plant Disease Clinic for information on sample submission and cost of laboratory diagnosis.

## Disease Management

Chemical control of LY is achieved by application of the antibiotic oxytetracycline HCl (OTC) administered to palms by liquid injection into the trunk. There is currently only one source of this product (Tree Saver®), and it is for distribution and use only in Florida. As a therapeutic measure, systemic treatment on a 4-month treatment schedule should begin as early in symptom expression as possible. Symptomatic palms with >25% discolored leaves should be removed, since they are unlikely to respond to OTC treatment. The antibiotic can also be used preventively to protect palms when LY is known



**Figure 14.** Foliar browning symptoms of Lethal Yellowing on *Phoenix sylvestris*. Credits: N.A. Harrison



**Figure 15.** Foliar browning symptoms of Lethal Yellowing on *Phoenix reclinata*. Credits: N.A. Harrison

to occur in the area. The amount recommended depends on the size of the treated palm. Always follow directions for use on the label.

The one question often asked regarding OTC injections concerns the length of time one must continue to inject. Unfortunately, there is no definitive answer. The antibiotic does not necessarily kill the phytoplasma but simply reduces or suppresses the phytoplasma population in the palm to a level that is no longer harmful, allowing resumption of normal growth of the palm. If injections are stopped, it is possible the phytoplasma will begin to increase once again and symptoms will reappear on the palm.



**Figure 16.** Leaf kink along petiole due to Lethal Yellowing on *Adonidia merrillii*. Credits: T.K. Broschat

Alternatively, if the disease is still active in the area, the unprotected palm could be re-infected with the phytoplasma.

Disease management via control of planthopper populations is insufficient to justify repeated insecticide applications in landscapes. Planthoppers are flying insects, and they also can be blown around by wind.

Use of host palm resistance represents the most practical long-term solution for LY control. For palm species other than coconuts, there is insufficient information to adequately evaluate their susceptibility. The few exceptions include *Adonidia merrillii* (Christmas palm), *Phoenix dactylifera* (date palm) and *Pritchardia* spp., which have sustained sufficient losses over time that they are not recommended for widespread landscape use in areas where LY is known to occur.

Coconut cultivars, such as the 'Malayan Dwarf' or hybrid 'Maypan' (Malayan Dwarf x Panama Tall), have exhibited acceptable levels of resistance in most areas. However, recent reports of LY losses in 'Malayan Dwarf' and 'Maypan' of 70% and 83%, respectively, at localized sites in southeastern Florida and 95-99% for these cultivars in Jamaica cast doubt on the long-term resistance of these cultivars.

Many palm species are apparent non-hosts of LY and so provide important alternative choices for ornamental landscape plantings. To date, LY has not been reported on most palm species native to Florida or regions of the Caribbean Basin where LY has been active. These include *Sabal palmetto* (cabbage palm), *Roystonea regia* (royal palm), *Acoelorrhaphe wrightii* (Paurotis or Everglades palm), and *Thrinax* species (thatch palms).

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**Table 1.** Palm species susceptible to Lethal Yellowing (LY) disease.

<i>Adonidia merrillii</i>	<i>Dictyosperma album</i>	<i>Phoenix dactylifera</i>
<i>Aiphanes lindeniana</i>	<i>Dypsis cabadae</i>	<i>Phoenix reclinata</i>
<i>Allagoptera arenaria</i>	<i>Dypsis decaryi</i>	<i>Phoenix rupicola</i>
<i>Arenga engleri</i>	<i>Gaussia attenuata</i>	<i>Phoenix sylvestris</i>
<i>Borassus flabellifer</i>	<i>Howea belmoreana</i>	<i>Pritchardia affinis</i>
<i>Caryota mitis</i>	<i>Howea forsteriana</i>	<i>Pritchardia pacifica</i>
<i>Caryota rumphiana</i>	<i>Hyophorbe verschaffeltii</i>	<i>Pritchardia remota</i>
<i>Chelyocarpus chuco</i>	<i>Latania lontaroides</i>	<i>Pritchardia thurstonii</i>
<i>Cocos nucifera</i>	<i>Livistona chinensis</i>	<i>Ravenea hildebrandtii</i>
<i>Corypha taliera</i>	<i>Livistona rotundifolia</i>	<i>Syagrus schizophylla</i>
<i>Cryosophila warsecewiczii</i>	<i>Nannorrhops ritchiana</i>	<i>Trachycarpus fortunei</i>
<i>Cyphophoenix nucele</i>	<i>Phoenix canariensis</i>	<i>Veitchia arecina</i>