



Ganoderma Butt Rot of Palms¹

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Introduction

Palms are found throughout Florida in both natural and landscaped settings. One of the lethal diseases of palms is *Ganoderma* butt rot. In general, a plant disease has three requirements – the susceptible host, the virulent pathogen and an environment that is conducive for disease development. With *Ganoderma* butt rot, we consider all palms (with a few exceptions) as hosts for the pathogen, *Ganoderma zonatum*. However, we do not know what environmental or management factors are associated with disease development. While research has been initiated on this disease, obtaining results will be very slow, especially for those associated with control.

This bulletin provides the information known to date about *Ganoderma* butt rot. The distribution of *G. zonatum* in Florida is shown in Figure 1. While the disease is more prevalent in the southern half of the state where palms are in greatest abundance, it is certainly not restricted to that area. Although some counties are shown as *Ganoderma*-free, we suspect that the disease probably has occurred in virtually all counties of Florida, but may not have been reported. It is also known to occur in Georgia and South Carolina.

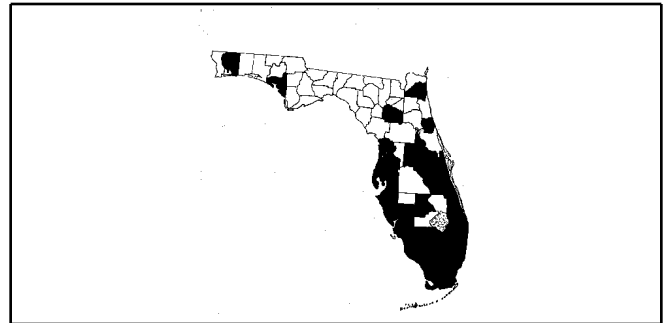


Figure 1. This map illustrates those Florida counties where *Ganoderma* Butt Rot, caused by *Ganoderma zonatum*, has been reported on palms. Information was obtained from the Florida Department of Plant Industry, University of Florida's IFAS Plant Disease Clinics and County Extension faculty. M. L. Elliott

The Fungus

The fungal genus *Ganoderma* is a group of wood-decaying fungi that are found throughout the world on all types of wood — gymnosperms, hard- and softwood dicots, and palms. There are many different species of this fungus, but only one is a pathogen of palms in Florida. That fungus is *Ganoderma zonatum*. Another fungal name that was associated with this disease in the first half of the 20th century was *Ganoderma sulcatum*. Recently, these two species have been grouped together as one, *G. zonatum*. The *Ganoderma* species often associated with live oaks in Florida is *G. lucidum*.

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The basidiocarp or **conk** is the most easily identifiable structure associated with the fungus. The conk originates from fungal growth *inside* the palm trunk. Figure 2 illustrates different stages in the development of the conk. When the conk first starts to form on the side of a palm trunk or palm stump, it is a solid white mass that is relatively soft when touched. It will have an irregular to circular shape and is relatively flat on the trunk or stump.

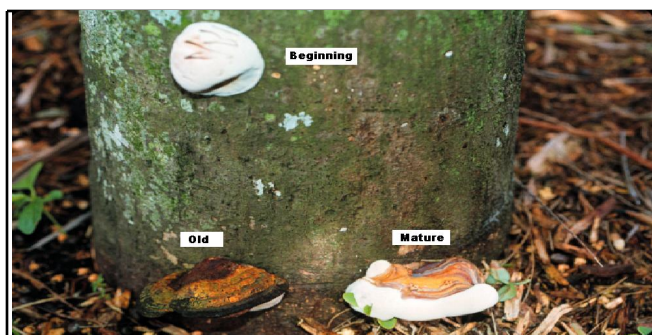


Figure 2. Three phases of basidiocarp (conk) development of *Ganoderma zonatum*. The white "button" near the top of the picture is the beginning stage of the conk. The lower-right structure is a mature conk. The lower-left structure is also a mature conk, but it is an old one; the underside of this conk is no longer white. M. L. Elliott



Figure 3. Basidiocarp (conk) of *Ganoderma zonatum*. Note glazed reddish-brown top surface and white undersurface. The "straight" side of the conk is directly attached to the trunk. There is no "stem" or "stalk" that attaches the conk to the trunk. M. L. Elliott

As the conk matures, a small shelf or bracket will start to form as the basidiocarp begins to extend or protrude from the trunk. It will still be white, both on the top and bottom surfaces. Eventually, it will form a very distinct shelf-like structure that is quite hard with a glazed reddish-brown top surface and a white undersurface (Figure 3). A mature conk will have distinct zones, hence the name *G. zonatum*. The conk will have a half-moon shape with the relatively "straight" side directly attached to the trunk. This is referred to as a sessile basidiocarp, as opposed to one

that has a stalk or stipe. Conks of *G. zonatum* can be up to 8 inches at their widest point and 2 inches thick. Microscopic basidiospores are produced in the "pores" present on the underside of the conk. When basidiospores are dropped en masse on a white surface, they will appear brownish-red in color. Objects immediately around a conk that has dropped its spores may appear to be covered with a rusty colored dust.

The conk of *G. zonatum* is considered an annual conk. Once the conk stops growing, it does not begin growing again at a later date. In other words, the conk does not increase in size each year. We have observed that mature, viable basidiospores are produced very early in the formation of the basidiocarp/conk. Spores were produced shortly after the conk began to protrude (form a shelf) from the trunk, while it was still white, and long before the top turned a reddish-brown color. In the southern half of the state, conks and spores may occur at any time of the year. They may appear on a more seasonal basis (i.e., warmer temperatures) in the northern half of the state.

We believe that the spores are the primary means of spread of the fungus, but that has yet to be proven. The diversity and isolation of locations in Florida where *Ganoderma* butt rot has occurred would also support the concept of spores as a primary method of spread. However, once a palm is infected with *G. zonatum*, the fungus will move with that palm to the location in which it is transplanted. It is also possible that soil associated with transplanted palms is infested with the fungus.

After spores are released, it is unclear exactly what happens next. We do not know if the spores become dormant in nature. In a laboratory setting, the spores do not show any dormancy and germinate readily on media after being dropped from the conk. However, in the real world, they may indeed become dormant or need specific substrates, temperature, relative humidity and so forth for germination to occur and the life cycle of the fungus to begin again.

The Host

While there are a few reports of *G. zonatum* on non-palm hosts, these reports are very limited. Therefore, palms are considered the primary hosts of this fungus. In general, if you observe a conk on a

palm trunk, it is probably safe to assume it is *G. zonatum* and not some other *Ganoderma* species. *Ganoderma* butt rot has been documented on 59 different species of palms (Table 1).

Although not all palm species known to be growing in Florida have succumbed to this disease, the majority of those species not on this list are relatively uncommon in Florida. Therefore, just because a palm is not listed in this table, it is *not* safe to assume that the palm is resistant to the disease. In fact, it is probably more logical to assume that all palms are susceptible to *G. zonatum*. The only possible exceptions would be palm species that do not form woody trunks — e.g., *Sabal minor*, some *Chamaedorea* spp., etc. Since *G. zonatum* kills by degrading wood, these palm species may not have any suitable tissue to serve as a substrate for the fungus.

What the Fungus Does to the Host

Ganoderma zonatum is a white rot fungus that produces numerous enzymes that allow it to degrade (rot) woody tissue, primarily lignin and cellulose. As the fungus destroys the palm wood internally, the xylem (water-conducting tissue) will eventually be affected. Therefore, the primary symptom that may be observed is a wilting, mild to severe, of all leaves but the spear leaf (Figures 4 and 5). Other symptoms can best be described as a general decline – slower growth and off-color foliage.

However, these symptoms alone should not be used for diagnosis of *Ganoderma* butt rot, since other disorders or diseases may also cause these symptoms. *Only* when these symptoms are accompanied by the development of the basidiocarp/conk (Figures 2 and 3) can the palm be diagnosed with *Ganoderma* butt rot. Also, it has been observed that conks can form prior to any obvious wilting or decline symptoms.

We do not know exactly how many months or years pass between initial infection of a palm and development of the conk. There is *no* method that can determine if a palm is infected with *G. zonatum*. Until the conk forms, there can be no confirmation of this disease. Therefore, it is not possible to guarantee that a palm is free of *Ganoderma* when first planted in the landscape.



Figure 4. *Sabal palmetto* (sabal palm) with wilted and desiccated leaves due to *Ganoderma zonatum* infection. M. L. Elliott



Figure 5. *Syagrus romanzoffiana* (queen palm) dying from *Ganoderma zonatum*. Only the spear and one other leaf remain green. M. L. Elliott

It should be emphasized that this fungus is not restricted to vascular tissue. The palm wilts because the vascular tissue as well as the surrounding tissue has been degraded by the fungus. This becomes

evident when a palm that has died or is dying from Ganoderma butt rot is cut down and cross-sections made of the trunk. Figures 6 and 7 are examples of the wood rotting and disease progression pattern observed.

The fungus colonizes and degrades the palm trunk tissue closest to the soil line first, expands in diameter at the base and moves up the center or near-center of the trunk. Therefore, the disease progression pattern within the trunk is best described as cone-shaped, widest at the soil line and narrowing to a pinpoint.



Figure 6. Cross-sections of lower trunk of *Syagrus romanzoffiana* infested with *Ganoderma zonatum*. Top-left section is bottom section (section 1) and remaining sections progress up the trunk. Note darkening of wood due to fungal degradation (rot). M. L. Elliott

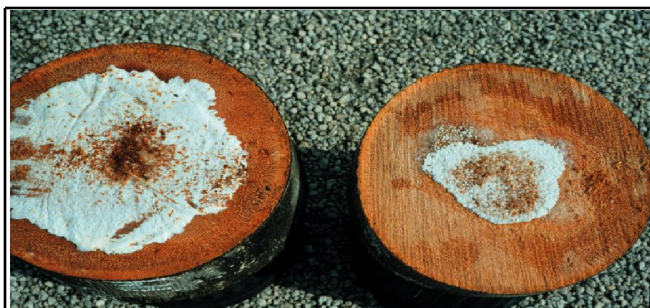


Figure 7. Sections 5 and 6 of Figure 6 (bottom row, left side) after incubation in a moist chamber for 4 days. White growth is mycelia of *Ganoderma zonatum* and corresponded with the discolored area of the cross-sections. M. L. Elliott

In general, we do not see the fungus extend more than about 5 feet up into the palm trunk. Although roots may eventually rot, especially after the palm dies, the lethal damage from the fungus appears to be associated with the trunk degradation. Ganoderma butt rot is a disease of mature palms (i.e., palms with trunks) and has not been observed to affect seedling or juvenile palms in natural or landscape settings.

It was previously thought that the location of the initial basidiocarp/conk formation was the entry point

for the fungus, perhaps from a wound to the trunk. We do not believe that is true. The location of the conk is where the fungus is *emerging* from the trunk. This means the degradation is occurring internally as the fungus moves from the lower center of the palm to the outside. This means that wounds are *not* a likely factor in disease initiation. Other external environmental factors associated with the trunk are probably not associated with disease development either, such as too much mulch around the trunk, irrigation heads striking the trunk, flowers or shrubs too close to the trunk, or painting the trunk.

Environments or Management Practices that Encourage Disease Development

To date, we have observed no common environmental conditions or landscape management practices that favor the development of Ganoderma butt rot. The disease has been observed in natural settings (palms never transplanted) and in highly-maintained, transplanted landscapes. It has been observed on palms that have been maintained very well nutritionally (no nutrient deficiencies) and on palms that were severely stressed by deficiencies. The disease has been observed in well-drained settings and in swamps. The fungus has killed trees that had no apparent mechanical injuries and those that had been severely damaged by, for example, weed trimmers. Soil type appears to have no relationship with disease either, as diseased palms have been observed on deep sands (both silica and calcareous), muck (peat), and limestone rock. There has been no discernible pattern to provide clues as to why palms become infected and die from *G. zonatum*.

Management Considerations

In general, the fungus will be located in the lower 4-5 feet of trunk. This has three implications. First, this means the fungus is not spread with pruning tools since the fungus is not associated with leaves. Second, this means that only the lower trunk portion should *not* be chipped and used for mulch. If possible, the diseased section should be placed in a legal landfill or incinerated. The remaining portion of the palm trunk could be immediately chipped and used for mulch in the landscape.

Third, only the lower 4-5 feet of trunk will need to be protected from the fungus. However, typical xylem-limited, systemic fungicides will not be effective unless they are capable of spreading beyond the vascular tissue and protecting *all* the wood in the lower portion of the trunk. We know of no fungicide with these capabilities. Also, no fungicide will be effective once the conks have formed, since a large percentage of the trunk cross-sectional area has already been destroyed. Since we have no means of predicting or determining which palms are infected with *G. zonatum*, this effectively eliminates the use of fungicides as a control method, either preventively or curatively, for the present time. **Therefore, there are no fungicide recommendations for this disease.**

Since basidiospores from the conks are probably the primary method of spreading the fungus, we urge people to monitor their palms closely, especially after a palm has died or been removed *for any reason*. The fungus will readily colonize and degrade palm stumps or dead palm trunks (Figure 8). Once the fungus becomes established in this dead wood, it will normally produce conks with millions of basidiospores. Recently at the FLREC, we observed *G. zonatum* conks on dead *Carpentaria acuminata* trunks. These palms had died from other causes. We also noticed that there was a *Carpentaria* palm in this same planting, about 3 feet away, that appeared wilted. When it was cut down, the center of the basal trunk area was already rotted from *G. zonatum*. We have also observed and been told on numerous occasions of *Ganoderma* butt rot occurring on *Dypsis lutescens* (areca palm) after some of the mature canes had been removed. In all probability, the fungus moves in on the dead stumps of these palms and spreads from there to living canes.



Figure 8. Cut palm stump with numerous basidiocarps of *Ganoderma zonatum* forming on it. M. L. Elliott

Therefore, monitor your palms for the conks. Remove the conk and place in a trash receptacle that will be incinerated or delivered to a landfill. Do not place in trash that will be recycled in the landscape. The earlier the conk is removed (i.e., before it becomes a distinct shelf-like structure), the less likely that spores will be released into the environment. If you have never observed *Ganoderma* butt rot on the property, monitoring the palms once every six months will be adequate. Once you have observed the conks on palms or have a palm cut or fall down for any reason, monitor your palms at least once a month. Also, monitor the entire neighborhood, not just your yard. These spores blow with the wind, so it should be a community effort to reduce the spread of the spores of this lethal fungus.

Once you observe a conk on a palm, the palm should be removed – primarily for safety reasons. This is especially important during the hurricane season. As indicated before, if conks are being produced on a live palm, it means that a significant portion of the trunk is already rotted. These palms are likely to be the first blown down in heavy winds. As much as you may want to keep the palm, it is probably best not to do so. When you remove the palm, remove as much of the stump and root system as possible. Any palm material left behind will be a host for the fungus.

Palm Replacement

The fungus obviously survives in the soil. It has been observed repeatedly that replacement palms planted into the same site where a palm died from *Ganoderma* butt rot also become diseased and die. Therefore, you are taking a major risk when replanting with another palm. No other plant species (pines, oaks, woody shrubs, etc.) are affected by *G. zonatum* – only palms. In other words, you should replace the diseased palm with any other plant except a palm.

We do not know how long you should wait before it is safe to plant another palm in a *Ganoderma*-infested site. We can say that the time is measured in multiple years, not months, since the fungus is probably capable of living in the soil almost indefinitely. It may be as long as 10 to 30 years. It is certainly is not less.

If you insist on replanting with a palm, follow these guidelines. Remove the stump and all roots from the site. Then, fumigate the soil. You can have this done professionally using a legally registered fumigant for the landscape. An example would be the product dazomet (trade name = Basamid). If the palm was located in a site surrounded by concrete (ex: a street median), also remove all of the old soil. Bring in new soil and then fumigate. However, this does not guarantee the new palms will remain free of *Ganoderma zonatum*.

Summary

- The cause of Ganoderma butt rot of palms is the fungus *Ganoderma zonatum*. In general, if you see a conk on a palm, it is this fungus.
- This fungus degrades or rots the lower 4-5 feet of the trunk. This disease is not a root rot.
- All palms are considered hosts of this fungus. At this time, **no** palm is considered resistant to this disease. This fungus is not a pathogen of any other plant species.
- Symptoms may include wilting (mild to severe) or a general decline. The disease is confirmed by observing the basidiocarp, commonly referred to as a conk. This is a hard, shelf-like structure that will be attached to the lower 4-5 feet of the palm trunk.
- A palm cannot be diagnosed with Ganoderma butt rot until the basidiocarp (conk) forms on the trunk.
- There is currently no method to determine if a palm is infected with *G. zonatum* until the conk forms. Therefore, there it is not possible to guarantee a palm newly planted in the landscape is free of *G. zonatum* or that it will remain free of this fungus.
- The fungus is probably spread by the spores, which are produced within the conk and then released from the conk.
- Conditions that are conducive for disease development are unknown.
- There is currently **no** method for preventing the disease or for curing the disease once the palm is infected. There are **no** fungicides that will prevent or cure this disease.
- A palm should be removed as soon as possible after the conks appear on the trunk. This is especially important during the hurricane season. Remove as much of the stump and root system as possible when the palm is removed.
- Community conk patrol:
 1. Within a neighborhood, monitor live palms, dead palms and palm stumps for conks.
 2. As soon as you start to see the conk form, remove it to limit production and spread of the fungal spores.
 3. Place conk in trash that will be incinerated or delivered to a landfill.
 4. Palms and palm stumps should be monitored every 6 months for conks. However, once the fungus has been observed on the property, monitor once every month.
- Because the fungus survives in the soil, planting another palm back in that same location is **not** recommended. Any other plant would be acceptable. We have no proof that any preplant preparations will eliminate the fungus from the soil or ensure a disease-free palm.

Table 1. Palms documented to have been infected with *Ganoderma zonatum*.¹

<i>Acoelorrhaphe wrightii</i>	<i>Carpentaria acuminata</i>	<i>Livistona merrillii</i>	<i>Sabal causiarum</i>
<i>Acrocomia aculeata</i>	<i>Caryota mitis</i>	<i>Livistona muelleri</i>	<i>Sabal mauritiiformis</i>
<i>Adonidia merrillii</i>	<i>Chamaerops humilis</i>	<i>Livistona saribus</i>	<i>Sabal palmetto</i>
<i>Aiphanes sp.</i>	<i>Coccothrinax sp.</i>	<i>Nannorrhops ritchiana</i>	<i>Sabal uresana</i>
<i>Arenga engleri</i>	<i>Cocos nucifera</i>	<i>Phoenix canariensis</i>	<i>Satakentia liukuensis</i>
<i>Arenga tremula</i>	<i>Copernicia curtisii</i>	<i>Phoenix dactylifera</i>	<i>Scheelea sp.</i>
<i>Arenga undulatifolia</i>	<i>Dictyosperma album</i>	<i>Phoenix reclinata</i>	<i>Serenoa repens</i>
<i>Attalea sp.</i>	<i>Dypsis cabadae</i>	<i>Phoenix roebelenii</i>	<i>Syagrus oleracea</i>
<i>Bactris major</i>	<i>Dypsis lutescens</i>	<i>Phoenix sylvestris</i>	<i>Syagrus picrophylla</i>
<i>Brahea berlandieri</i>	<i>Elaeis guineensis</i>	<i>Ptychosperma elegans</i>	<i>Syagrus romanzoffiana</i>
<i>Brahea brandegeei</i>	<i>Euterpe edulis</i>	<i>Ptychosperma macarthurii</i>	<i>Syagrus sancona</i>
<i>Brahea dulcis</i>	<i>Gastrococos crispa</i>	<i>Ptychosperma salomonense</i>	<i>Syagrus schizophylla</i>
<i>Brahea edulis x brandegeei</i>	<i>Hyophorbe indica</i>	<i>Roystonea altissima</i>	<i>Syagrus x costae</i>
<i>Butia eriospatha</i>	<i>Livistona benthamii</i>	<i>Roystonea oleracea</i>	<i>Washingtonia robusta</i>
<i>Butia capitata</i>	<i>Livistona chinensis</i>	<i>Roystonea regia</i>	

¹This information was obtained from *Diseases and Disorders of Plants in Florida*; Fairchild Tropical Gardens, Miami, FL; University of Florida's Tropical Research and Education Center and Fort Lauderdale Research and Education Center; Florida's Department of Forestry, Miami, FL.