CAPS Datasheets provide pest-specific information to support planning and completing early detection surveys.

Bursaphelenchus cocophilus

Scientific Name

Bursaphelenchus cocophilus (Cobb, 1919) Baujard, 1989

Synonyms:

Aphelenchus cocophilus Cobb, 1919
Aphelenchoides cocophilus (Cobb, 1919) Goodey, 1933
Chitinoaphelenchus cocophilus (Cobb, 1919) Chitwood in Corbett, 1959
Rhadinaphelenchus cocophilus (Cobb, 1919) Goodey, 1960
Radinaphelenchus cocophilus (Cobb, 1919) Goodey, 1960 [spelling variant]

Common Names

Red ring nematode, coconut palm nematode
Cause of red ring and little leaf disease of palm

Type of Pest

Nematode

Taxonomic Position

Class: Chromadorea, **Order:** Rhabditida, **Suborder:** Tylenchina, **Infraorder:** Tylenchomorpha, **Family:** Aphelenchoididae

Notes on taxonomy and nomenclature:

The red ring nematode, *Bursaphelenchus cocophilus*, was first described by Cobb (1919) as *Aphelenchus cocophilus* from specimens in Grenada. Since that time, it has undergone several name changes including the change to *Rhadinaphelenchus cocophilus* by Goodey (1960). This name is still commonly used within the scientific literature. Giblin-Davis et al. (1989) presented morphological evidence supporting the similarities between *Rhadinaphelenchus* and *Bursaphelenchus*. Baujard (1989) synonymized the monotypic genus *Rhadinaphelenchus* with *Bursaphelenchus* creating the new combination, *B. cocophilus*. Molecular phylogenetic data presented by Ye et al. (2007) corroborate this synonymization.

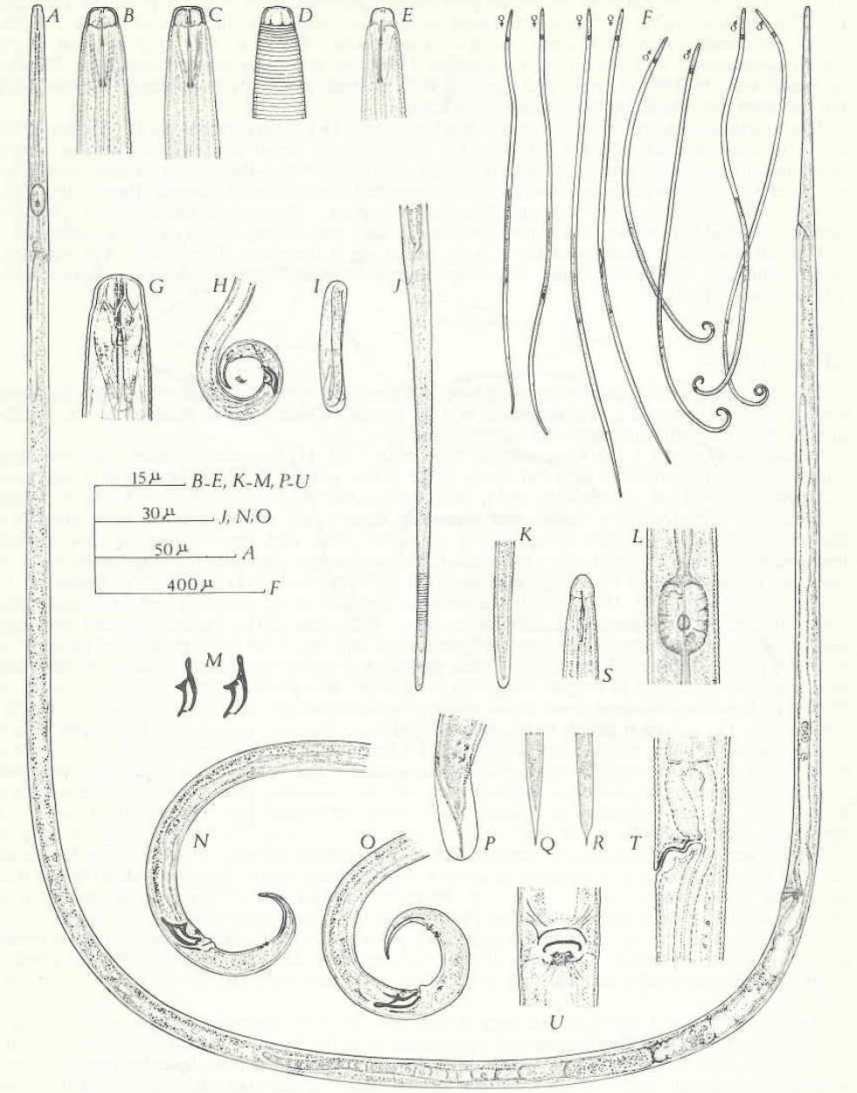
Pest Recognition

This section describes characteristics of the organism and symptoms that will help surveyors recognize possible infestations/infections in the field, select survey sites, and collect symptomatic material. For descriptions of diagnostic features, see the

Identification/Diagnostic resources on the AMPS pest page on the CAPS Resource and Collaboration website.

Pest Description

This nematode is too small to be observed in the field; therefore, surveys must instead focus on symptoms. However, when viewed under magnification, juveniles and adults of *B. cocophilus* are about 1 mm long and very slender (Fig. 1) (Brammer and Crow, 2002; Dean, 1979).



A & F. Adults; B–D & G. Female head ends; E. Male head end; H, N & O. Male tail ends; I. Egg; J. Female tail; K. Female tail tip; L. Female median oesophageal bulb; M. Spicules; P. Bursa in dorsal view; Q & R. Larval tail tips; S. Larval head end; T & V. Vulva in lateral and ventral view, respectively. G, H & I. after Cobb (38); T. original Siddiqi; rest after Siddiqi (28).

Figure 1. Line drawings *of B. cocophilus* (cited as *Rhadinaphelenchus cocophilus*) from Dean (1979).

Symptoms

Bursaphelenchus cocophilus causes general symptoms in palm hosts and distinct symptoms denoted as either red ring or little leaf disease. The specific symptoms for each disease are discussed separately below.

General symptoms

Infestations by *B. cocophilus* occur most commonly in trees that are 2.5 to 10 years old, with the greatest incidence occurring in trees between 4 and 7 years old (Griffith et al., 2005). The first external symptoms are visible about 28 days after inoculation but may take up to 2 months to appear (Giblin-Davis et al., 2002). External symptoms are generally not considered diagnostic of infection with *B. cocophilus* and are similar to symptoms caused by other pathogens or abiotic factors (e.g., nutrient deficiency or mechanical damage) (Chinchilla, 1991; Dean, 1979). Symptomatic leaves become short, deformed, and turn yellowish-bronze before turning deep reddish-brown (Fig. 2). The change in color typically starts at the leaf tip spreading towards the base, and leaves eventually wilt and die (Griffith et al., 2005). Older leaves will show symptoms before younger leaves. As symptoms progress, the oldest leaves usually break at the petiole (leafstalk), close to the trunk, and can remain hanging down for a long period of time (Fig. 3) (Chinchilla, 1991). In coconut palm (*Cocos nucifera*), premature fruit drop typically occurs at the same time or slightly before leaf symptoms develop (Giblin-Davis, 2001). Four to six weeks after symptom development, the palm crown will often topple over; however, this is associated with severe internal damage caused by the larvae of the weevil vector (Griffith et al., 2005). Therefore, this symptom may occur in absence of the nematode.

Red ring symptoms

The nematode causes reddish lesions to form within the stem. These lesions gradually enlarge and often form a red ring when the cut stem is viewed in cross section, for which the disease was named (Fig. 4). The ring occurs in the parenchymatous tissue (soft spongy core of the trunk) and can be ~1 to 2 in. wide, but the width varies depending on tree size (Griffith et al., 2005). The red ring typically occurs 14 to 21 days after inoculation with *B. cocophilus* (Giblin-Davis et al., 2002) and the color may vary from bright red to light pink, or cream to dark brown in African oil palm (*Elaeis guineensis*) (Brammer and Crow, 2005). The red ring can usually be seen when the infected palm is cut crosswise from 1 to 7 ft above the soil line (Brammer and Crow, 2002). But, it can also appear anywhere along the trunk and may not be continuous throughout the infected palm (Chinchilla, 1991). The ring may also be found in the cortex of the host roots and in the base of the palm fronds (Giblin-Davis, 2001). When diseased, the soft, white cortex of the roots becomes orange to faint red in color and dry and flaky in texture (Fenwick, 1969; Griffith et al., 2005).

Little leaf symptoms

Some African oil palms and older coconut palms will produce small, deformed leaves which remain green with no initial necrosis. Little leaf disease is a chronic condition that can lead to red ring disease development, and affected trees usually stop producing

fruit (Chinchilla, 1991; Giblin-Davis, 2001). Nematodes can be found in high numbers in young leaves, when the leaves are elongating. These leaflets eventually become partially necrosed and remain partially folded along the rachis (compound leaf stem).

Nematode location

Bursaphelenchus cocophilus primarily invades the parenchymatous tissue of host palms (red ring development site) and is relatively confined to this area. At the top part of the stem, where tissue is softer, it is possible to find the nematode both in discolored areas and adjacent tissues. Low numbers of nematodes may be found in the petioles. *Bursaphelenchus cocophilu*s can also infect the roots, where nematode numbers decrease as distance from the base of the stem increases (Duarte et al., 2008). The nematode population is also high in the crown of the plant, where *Rhynchophorus palmarum* (the South American palm weevil) excrement is found in larval tunnels (Duarte et al., 2008).

Easily Mistaken Species

The only other nematode known to cause severe damage in *Cocos nucifera* (coconut palm) is *Radopholus similis* (burrowing nematode) (Griffith et al., 2005). In coconut palms, *R. similis* causes non-specific general decline symptoms including stunting, yellowing, reduction in number and size of leaves and leaflets, delay in flowering, button (female flower) shedding, and reduced yield. Infestation by *R. similis* produces small, elongate, orange-colored lesions on tender, creamy-white roots (Griffith et al., 2005).

External symptoms caused by *B. cocophilus,* particularly during the early stages of infestation, are similar to symptoms caused by various other pathogens or abiotic factors (e.g., nutrient deficiency or mechanical damage); therefore, they are rarely diagnostic (Chinchilla, 1991; Dean, 1979).

Biology and Ecology

The life cycle of *B. cocophilus* lasts 9 to 10 days (Dean, 1979). The life cycle consists of an egg stage, four juvenile stages, and an adult stage (Chinchilla, 1991). The vector weevil, *Rhynchophorus palmarum*, transmits the dormant third stage juvenile of the nematode when it lays eggs in palm leaf axils or internodes (Chinchilla, 1991; Giblin-Davis et al., 2002). *Bursaphelenchus cocophilus* then propagates in the host plant. After *R. palmarum* eggs hatch, larvae ingest immature nematodes, where they can remain without further development while weevils undergo metamorphosis. Once mature, the weevils will leave the host palm, carrying dormant third-stage juvenile nematodes to infect other host palms.

Adult weevils can also acquire the nematode when visiting infected host palms, where they either ingest the nematode or carry them on the surface of their bodies (Chinchilla, 1991). *Bursaphelenchus cocophilus* have been found in the tracheal sacs of the weevil, where they can move to the ovipositor of females to be injected into host plant material (reviewed in (Griffith et al., 2005)). When inoculated directly into a new host by a weevil, 10 to 50 nematodes are sufficient to cause disease; however, ~5000 nematodes were

found to be needed to successfully establish through natural cracks or coconut petioles, likely due to the absence of already-damaged plant tissue they could easily penetrate (Griffith, 1968).

Rhynchophorus palmarum spread the nematodes when they fly to find new hosts, and the weevils are especially attracted to injured, infected, or dying palms (Giblin-Davis et al., 1996). These failing palms, including palms infected with *B. cocophilus*, produce semiochemicals (kairomones) that attract the weevils (Giblin-Davis et al., 1996).

Bursaphelenchus cocophilus can survive long periods of time in nut husks (16 weeks), seedling tissue (90 weeks), and within the weevil (until transmitted to the next palm host) (Brammer and Crow, 2005). Dean (1979) states that *B. cocophilus* can survive in freshwater films for 7 to 8 days and in sea water for 3 days. *Bursaphelenchus cocophilus* is susceptible to desiccation (Esser and Meredith, 1987).

Griffith et al. (2005) state that, “the heaviest losses due to red ring disease occur at the end of the wet season and in the first 2 or 3 months of the dry season.” Low, poorly drained areas have the highest incidence of red ring disease, while drought conditions impede disease progression (Esser and Meredith, 1987). The nematode survives best in wet, swampy areas and in clay rather than sandy soil (Esser and Meredith, 1987). Possible root-to-root transmission from trees infected with *B. cocophilus* to healthy trees has also been shown (Warwick and Bezerra, 1992).

Figure 2. Host palm showing chlorosis and wilting due to *Bursaphelenchus cocophilus* (R. Giblin-Davis).

Figure 3. *Cocos nucifera* with premature death of older leaves. (M. L. Elliott).

Figure 4. Cross-section of infected host palm. Characteristic red ring is visible as well as *Rhynchophorus palmarum* galleries (R. Giblin-Davis).

Known Vectors

Bursaphelenchus cocophilus parasitizes *Rhynchophorus palmarum* (Fig. 5), which serves as a vector. This weevil was found near San Diego, California in May of 2011 and Alamo, Texas in May of 2012. Delimitation surveys were initiated and other finds have been made in the same general geographic areas within 2.5 miles and 5 miles of the United States/Mexico Border, respectively (Bech, 2011; Bech, 2012).

In addition, other palm weevils are listed as vectors of *B. cocophilus*, including *Dynamis borassi* and *Rhinostomus* (*Rhina*) *barbirostris* (Dean, 1979; Martyn, 1953).

Other palm weevils could serve as potential vectors. For example, *Metamasius hemipterus* and *Rhynchophorus cruentatus* are both present in the United States. Although previous research found red ring nematode contaminating some *M. hemipterus* and proposed it may be a vector (Mora et al., 1994), another study found no correlation between *M*. *hemipterus* populations and disease incidence (Bulgarelli et al., 1998).

Dean (1979) lists other arthropods (including ants, termites, and spiders) that have been reported as vectors, but states that most of these may not be important in *B. cocophilus* movement. Griffith et al. (2005) conclude that these other arthropods are highly unlikely to be competent vectors of *B. cocophilus* based on their normal behavior.

Figure 5. Lateral view of the vector *Rhynchophorus palmarum* (top) and dorsal view (bottom) (Jennifer C. Giron Duque, University of Puerto Rico, Bugwood.org).

Known Hosts

This species is known to infect over 17 species in the Arecaceae (palm) family. The disease severity and symptoms will vary depending on the host species and environmental conditions (Giblin-Davis et al., 2002). Host palms 2 years and younger are generally not susceptible to *B. cocophilus* (Giblin-Davis, 2001).

The host list below includes cultivated and wild plants that 1) are infected or infested by the pest under natural conditions, 2) are frequently described as major, primary, or preferred hosts, and 3) have primary evidence for feeding and damage documented in the literature. Plants are highlighted in bold if they are commercially produced and the pest causes economically significant damage.

Preferred Hosts

***Cocos nucifera*[*] (coconut palm)** and *Elaeis guineensis*[*] (African oil palm) (Griffith et al., 2005).

Other Hosts

Bactris gasipaes (peach palm), *Euterpe edulis*, *Mauritia flexuosa*, *Oenocarpus distichus*, *Orbignya cohune* (syn. *Attalea cohune*, cohune palm), ***Phoenix canariensis*[*] (Canary Island date palm)**, ***P. dactylifera*[*] (date palm)**, and *Roystonea regia*[*] (royal palm) (Esser and Meredith, 1987; Faleiro et al., 2016; Griffith et al., 2005; Kanzaki et al., 2023; Schuiling and van Dither, 1981).

Known Distribution

Caribbean: Grenada, St. Vincent and the Grenadines, and Trinidad and Tobago. **Central America:** Belize, Costa Rica, El Salvador, Guatemala, Honduras, Nicaragua, and Panama (including the San Blas Islands). **North America:** Mexico. **South America:** Brazil, Colombia, Ecuador, French Guiana, Guyana, Peru, Suriname, and Venezuela (Ashby, 1924; Dean, 1979; Govindankutty and Koshy, 1979; Griffith et al., 2005; Liceras Zárate, 1967; Mora et al., 1994; Noriega et al., 1992).

Griffith et al. (2005) and EPPO (2026) state that records from the Bahamas, Barbados, Dominica, Dominican Republic, Haiti, Jamaica, and Puerto Rico are questionable; therefore, they are not included in the distribution information above.

Pest Importance

Palms are important landscaping plants in subtropical areas of the United States (Giblin-Davis et al., 2002). An introduction of *B. cocophilus* could potentially have an impact on both the landscape and tourism industries (Giblin-Davis et al., 2002).

In Trinidad, red ring disease can kill 35 percent of young coconut trees. In Venezuela, 35 percent of oil palms (*Elaeis* spp.) were killed by red ring disease over a 10 year period (Brammer and Crow, 2002). Chinchilla (1991) states that losses of 5 to 15 percent from *B. cocophilus* in oil and coconut palm plantations are common in several countries in Central and South America.

Bursaphelenchus cocophilus most often attacks *Cocos nucifera* trees that are 4 to 7 years old. These trees usually die 6 to 8 weeks after symptoms appear. Older trees may

[*] Hosts with known U.S. distribution.

last up to 20 weeks after symptom expression (Esser and Meredith, 1987). Some trees may live several years after infection. Compared to healthy trees, trees infected with red ring disease for more than 3 years are noticeably stunted (Chinchilla, 1991). In host plants, *B. cocophilus* blocks water pathways in the leaves, stem, and roots, thereby reducing host palm water absorption.

Bursaphelenchus cocophilus is listed as a harmful organism in Antigua and Barbuda, Chile, China, Colombia, Dominica, Honduras, Jamaica, and Saint Lucia (USDA-PCIT, 2026). At the genus level, *Bursaphelenchus* is listed as harmful organism in Australia and Nauru (USDA-PCIT, 2026). There may be trade implications with these countries if this pest becomes established in the United States.

Pathway

Bursaphelenchus cocophilus is most likely to spread while travelling with its vectors. Its main vector, *Rhynchophorus palmarum*, can move into new areas through infested plants (e.g., nursery stock) or naturally spread when adults fly to find new palm hosts (EPPO, 2005). Both sexes of *R. palmarum* are considered strong fliers and can fly over 0.5 miles in one flight (Hagley, 1965). Esser and Meredith (1987) state that *B. cocophilus* can also move through seeds, seedlings, tools, vehicles, and animals. Natural movement of the nematodes without a vector may also occur if they move through the soil from infected to non-infected roots, but are limited to very short distances and survival times outside of the host (Esser and Meredith, 1987; Warwick and Bezerra, 1992).

To reduce the risk of importation and dissemination of *B. cocophilus*, *Rhynchophorus ferrugineus*, and *R. palmarum*, a 2010 Federal Order prohibits the importation of all plants for planting of *Acrocomia, Astrocaryum, Attalea, Bactris, Brahea, Butia, Calamus, Chamaerops, Desmoncus, Euterpe, Manicaria, Mauritia, Metroxylon, Oncosperma, Roystonea, Sabal*[†], and *Washingtonia* from all foreign countries, with the exception of seed, until a pest risk analysis has been completed and determines whether effective mitigation measures exist (USDA-APHIS, 2010; USDA-APHIS, 2026a). All propagules of *Cocos nucifera* are prohibited under Not Authorized Pending Pest Risk Analysis (NAPPRA) except seed from Costa Rica and Jamaica (USDA-APHIS, 2026a). *Bursaphelenchus cocophilus* is known to occur in Costa Rica. Coconut seed without husk or without milk may be imported into the United States in accordance with 7 CFR §319.56-11 (USDA-APHIS, 2026b).

Giblin-Davis (1990) states that one pathway of *B. cocophilus* introduction is through the arrival of infested *R. palmarum*, undetected in coconut seed nut shipments. Giblin-Davis et al. (2010) also state that de-husked coconut fruit would not serve as a pathway for either *B. cocophilus* or its vector *R. palmarum*. There may be a risk of introducing *B. cocophilus* on imported, improperly composted and refined coir from areas where the nematode is present (Giblin-Davis et al., 2010).

[†] *Sabal palmetto* is an experimental host (Griffith et al., 2005).

Use the PPQ Commodity Import and Export manual listed below to determine 1) if host plants or material are allowed to enter the United States from countries where the organism is present and 2) what phytosanitary measures (e.g., inspections, phytosanitary certificates, post entry quarantines, mandatory treatments) are in use. These manuals are updated regularly.

Agricultural Commodity Import Requirements (ACIR) manual: ACIR provides a single source to search for and retrieve entry requirements for imported commodities.

Potential Distribution Within the United States

Based on the distribution of hosts, this species is likely able to establish in warmer areas of the United States, including the tropics, Arizona, California, and most of the South. The main host plant, *Cocos nucifera*, is found in Florida, Georgia, Hawaii, North Carolina, Puerto Rico, South Carolina, and the U.S. Virgin Islands (USDA-NRCS, 2026). *Elaeis guineensis* is only listed as occurring in Florida (USDA-NRCS, 2026). *Phoenix* spp. are found in Arizona, California, Florida, and Hawaii (USDA-NRCS, 2026) and *Sabal* spp. (an experimental host) are native to the United States, occurring in Alabama, Arkansas, Florida, Georgia, Louisiana, Mississippi, North Carolina, Oklahoma, Puerto Rico, South Carolina, Texas, and the U.S. Virgin Islands (USDA-NRCS, 2026). Most other host species do not occur in the United States.

Special attention should be focused on California and Texas because *B. cocophilus* is known to be present in southern Mexico and *R. palmarum* has been reported at low levels in these states near the U.S.-Mexico border (Bech, 2011; Bech, 2012).

Survey and Key Diagnostics

Approved Methods for Pest Surveillance*:
For the current approved methods and guidance for survey and identification, see Approved Methods for Pest Surveillance (AMPS) pest page on the CAPS Resource and Collaboration website.

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Versions

2013: Datasheet completed (Version 1)

2016: Updated mapping information (Version 1.1)

2017: Reviewed literature, updated datasheet (Version 2)

2026: Reviewed literature, updated datasheet (Version 3)

- Formatted document to new template.
- Revised the **Pest Description** section, removing details about microscopic pest characteristics.
- Revised the **Known Hosts** section, removing experimental hosts, replacing indirect citations with direct evidence for preferred hosts, and updating scientific names.
- Revised the **Pest Importance** section, adding list of countries that consider this pest a harmful organism.
- Revised the **Known Distribution** section, replacing indirect citations.
- Revised the **Pathway** section, updating with current import regulations, citations, and interception data.
- Revised the **Potential Distribution within the United States** section, updating host distribution with latest NRCS data.
- Revised the **Survey and Key Diagnostics** section for AMPS website, removing details about nematode extraction techniques and updating where samples should be sent.

Reviewers

Dr. Zafar Handoo (USDA-ARS)
Dr. Tesfamariam Mengistu (USDA-APHIS)