EPPO Datasheet: *Rhynchophorus palmarum*

Last updated: 2020-09-02

IDENTITY

Preferred name: *Rhynchophorus palmarum*
Authority: (Linnaeus)
Taxonomic position: Animalia: Arthropoda: Hexapoda: Insecta: Coleoptera: Dryophthoridae
Other scientific names: *Calandra palmarum* (Linnaeus), *Cordyle barbirostris* Thunberg, *Curculio palmarum* Linnaeus, *Rhynchophorus barbirostris* (Thunberg), *Rhynchophorus cycadis* Erichson, *Rhynchophorus depressus* Chevrolet, *Rhynchophorus languinosus* Chevrolet
Common names: South American palm weevil, giant palm weevil, palm marrow weevil, palm marrow weevil, palm weevil
view more common names online...
EPPO Categorization: A1 list
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EU Categorization: A1 Quarantine pest (Annex II A)
EPPO Code: RHYCPA

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HOSTS

R. palmarum has been reported on at least 35 plant species in at least 12 different families. However, it is primarily found in association with palms (Arecaceae) (Esser & Meredith, 1987; Grif?th, 1987; Wattanapongsiri, 1966; Jaffé & Sánchez, 1990; Sánchez & Cerda, 1993). With respect to palms, *R. palmarum* is commonly reported as a pest. It has also been observed reproducing on sugarcane stems, a non-palm host, (Arango & Rizo, 1977; Restrepo *et al.*, 1982). Feeding damage by larvae to the apical meristematic region (i.e. the palm heart) causes palm mortality (Milosavljevi? *et al.*, 2019). When reported on other plants, *R. palmarum* adults were observed feeding on ripe fruit. This type of feeding on fruit by adult weevils is typically not a source of significant economic damage.

Breeding hosts: *R. palmarum* breeding is primarily restricted to palms (Arecaceae) and known hosts include: *Brahea edulis* (Guadalupe palm), *Cocos nucifera* (coconut), *Dypsis lutescens* (golden cane palm), *Elaeis guineensis* (African oil palm), *Euterpe edulis* (juçara, grown for hearts of palm), *Livistona australis* (cabbage tree palm), *Metroxylon sagu* (true sago palm), *Phoenix canariensis* (Canary Islands date palm), *P. dactylifera* (edible date palm), and *Washingtonia robusta* (Mexican fan palm). A notable non-palm host used for reproduction is *Saccharum of?cinarum* (sugarcane [Poaceae]).

Adult food hosts: Adult *R. palmarum* feed on a variety of ripe fruit, including avocado (*Persea americana* [Lauraceae]), banana (*Musa* spp. [Musaceae]), *Citrus* spp. (Rutaceae), cocoa (*Theobroma cacao* [Malvaceae]), guava (*Psidium guajava* [Myrtaceae]), mango (*Mangifera indica* [Anacardiaceae]), and papaya (*Carica papaya* [Caricaceae]). These hosts are not used for reproduction instead the fruit provide nutrition and energy to adult weevils. Adult *R. palmarum* can be kept alive in laboratory colonies for several months on a diet of cut apple pieces and banana chunks that have the skin left on. Adult weevils will burrow into the banana pulp to hide and feed.

Artificial diets and laboratory rearing: Rearing of *R. palmarum* eggs and larvae for use in laboratory bioassays is possible with the use of artificial diets (Santana *et al.*, 2014). A mixed diet of sugarcane and pineapple has been used to artificially rear *R. palmarum* (Giblin-Davis *et al*., 1991).

Host list: *Acrocomia aculeata*, *Arecaceae*, *Attalea cohune*, *Attalea maripa*, *Bactris gasipaes*, *Bactris major*, *Brahea edulis*, *Chamaedorea elegans*, *Chrysalidocarpus decaryi*, *Chrysalidocarpus lutescens*, *Cocos nucifera*, *Elaeis guineensis*, *Euterpe edulis*, *Euterpe oleracea*, *Gynerium sagittatum*, *Howea forsteriana*, *Hyophorbe lagenicaulis*, *Jubaea chilensis*, *Livistona australis*, *Manicaria saccifera*, *Mauritia flexuosa*, *Metroxylon sagu*, *Oenocarpus bataua*, *Phoenix canariensis*, *Phoenix dactylifera*, *Phoenix reclinata*, *Phoenix roebelenii*, *Rhapis excelsa*, *Roystonea oleracea*

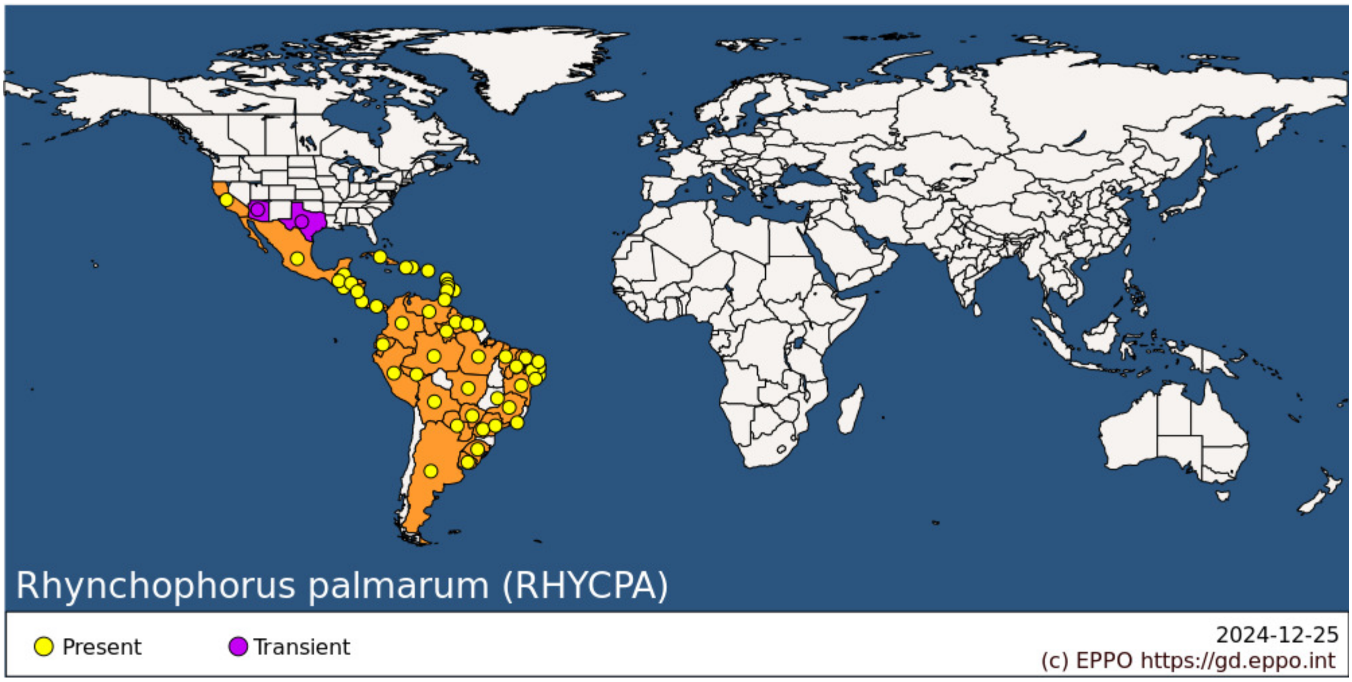
, *Roystonea regia*, *Sabal bermudana*, *Sabal palmetto*, *Saccharum officinarum*, *Syagrus coronata*, *Syagrus orinocensis* , *Syagrus romanzoffiana*, *Syagrus schizophylla*, *Syagrus vagans*, *Washingtonia robusta*

GEOGRAPHICAL DISTRIBUTION

The native range includes tropical parts of Mexico (e.g. Veracruz), Central (e.g. Costa Rica) and South America (e.g. Brazil and Colombia), and the Caribbean (e.g. Trinidad and Tobago). Despite the tropical distribution of this pest it has managed to invade distinctly non-tropical climates, most notably, southern California, USA. Invasion of arid semi-desert regions has been facilitated by human modification of the landscape. This modification includes irrigation of areas that are normally dry and the planting of a wide diversity and high density of palm species in urban areas where they do not naturally exist. In some instances, such as the desert-like Coachella Valley in California, commercial plantations of *P. dactylifera* may provide a suitable habitat for *R. palmarum* should it reach this area.

Invasion and establishment in California USA

Following the detection of *R. palmarum* infesting *W. robusta* in Todos los Santos in Baja California Sur (Mexico) in November 2000 (Garcia-Hernandez *et al*., 2003), this pest was found in December 2010, infesting *P. canariensis* in Tijuana, Baja California Norte, Mexico approximately 1,500 km north of Todos los Santos, and less than 3 km from the US border with San Diego County California. In the USA, adult *R. palmarum* were trapped in San Ysidro, California (approximately 5 km north of Tijuana) in May 2011; Alamo, Texas in March and May 2012; and Yuma, Arizona in May 2015. Established populations in San Ysidro were confirmed in 2015 (it is likely that populations had established earlier, perhaps in 2013-2014) and weevils have now established throughout large areas of San Diego County where they have killed thousands of ornamental *P. canariensis* in urban areas and naturalized *P. canariensis* in riparian areas. As of July 2020, there were no reports of established populations of *R. palmarum* in Arizona and Texas or palm mortality caused by this weevil. Locations of potential source populations for *R. palmarum* trapped in Arizona and Texas were not identified. *Bursaphelenchus cocophilus*, the red ring nematode, has not been detected in association with weevils captured in California, Texas, and Arizona.



North America: Mexico, United States of America (Arizona, California, Texas)
Central America and Caribbean: Barbados, Belize, Costa Rica, Cuba, Dominica, Dominican Republic, El Salvador, Grenada, Guadeloupe, Guatemala, Haiti, Honduras, Martinique, Nicaragua, Panama, Puerto Rico, Saint Lucia, St Vincent and the Grenadines, Trinidad and Tobago
South America: Argentina, Bolivia, Brazil (Acre, Alagoas, Amazonas, Bahia, Ceara, Distrito Federal, Maranhao, Mato Grosso, Mato Grosso do Sul, Minas Gerais, Para, Paraiba, Parana, Pernambuco, Piaui, Rio de Janeiro, Rio Grande do Norte, Rio Grande do Sul, Roraima, Sao Paulo, Sergipe), Colombia, Ecuador, French Guiana, Guyana,

Paraguay, Peru, Suriname, Uruguay, Venezuela

BIOLOGY

Life cycle

In the native range, *R. palmarum* is commonly found in urban areas, forests, and oil palm plantations. In invaded regions in southern California, *R. palmarum* is largely restricted to urban areas where it attacks ornamental palms (e.g. *P. canariensis*, and to a lesser extent, *B. edulis*). In the native range, the altitudinal range is from sea level up to 1200 m (Jaffé & Sánchez, 1990). Studies on the biology of this species are reported in Wilson (1963), Nadarajan (1988), Sánchez *et al*. (1993) and Hagley (1965). The larvae of *R. palmarum* feed exclusively on live palm tissue in the meristematic region. Under laboratory conditions (20–35°C and 62–92% relative humidity), a female may lay an average of 245 ± 155 eggs during a period of 30.7 ± 14.3 days. The egg incubation period is 3.2 ± 0.93 days and larvae have between six and 10 instars which develop over a period of 52.0 ± 10.0 days. The prepupal stage lasts 4–17 days, during which larvae make cocoons using palm ?bres. The pupal stage lasts 8–23 days and adults remain in cocoons for 7.8 ± 3.4 days before emerging. Adult males live for 44.7 ± 17.2 days and females for 40.7 ± 15.5 days. Hagley (1965) reported that a single female may lay up to 718 eggs, whereas Sánchez *et al*. (1993) reported a maximal oviposition of 697 eggs. Nadarajan (1988) and Sánchez *et al*. (1993) studied the biology of *R. palmarum* using arti?cial diets, and reported on mating and oviposition behavior observed in the laboratory.

Females can bore into palms with the rostrum to make oviposition holes. Females may also exploit damage wounds (e.g. pruning wounds or holes made by feeding insects) near or on the internodal area of the palm trunk next to the crown for oviposition. Eggs are oviposited into these holes. The egg rests in a vertical position in the hole which is sealed by the female with a secretion.

Adults are active during the day showing a bimodal daily activity cycle. Hagley (1965) reported major activity peaks between 07:00 and 11:00, and 17:00 and 19:00. Sánchez & Jaffé (1993) observed flight activity in the field, confirming the nature of the activity cycle, in which adults fly during the day, but avoid the hottest hours at noon and the early afternoon. Field observations showed that adults may fly at velocities of up to 6.01 m $s^{?1}$ (Hagley, 1965). Studies on the population dynamics of this species in Central America are reported by Chinchilla (1988), showing that the maximum adult population occurs during the dry season. Similar results were obtained by Schuiling & Van Dinther (1981) in Brazil.

Vector of red ring nematode

The threat caused by *R. palmarum* is amplified by its ability to acquire and vector a plant pathogenic nematode, *Bursaphelenchus cocophilus*, the causative agent of red ring disease which is lethal to palms (Griffith 1987; Gerber and Giblin-Davis 1990; Oehlschlager 2016). Nematodes may be phoretic and attached to outside of the weevil or they can be introduced into palms by adults when feeding or defecating. No other species of *Rhynchophorus* vector plant pathogenic nematodes. Up to 90% of adult *R. palmarum* collected from palms with red ring disease are infected with *B. cocophilus* (Gerber and Giblin-Davis, 1990) and nematode infections in coconut and oil palms in the neotropics result in annual losses of 10-15% from red ring disease (Giblin-Davis *et al.*, 2013). *B. cocophilus* is not vector-specific and can be spread by other species of weevils (e.g. *Dynamis borassi*) making it likely that other species of *Rhynchophorus* (e.g. the highly invasive red palm weevil, *R. ferrugineus*) could acquire and vector *B. cocophilus* should they become sympatric (Giblin-Davis *et al*., 2013).

DETECTION AND IDENTIFICATION

Symptoms

Weevil larvae feed in the palm crown which can kill the apical growing region. This feeding causes the central area of the crown to tilt then collapse, as this is happening fronds from this central region begin to fall from infested palms. This results in a halo of dying mature fronds encircling the top of the palm trunk. Basal sheaths that are found at the bottom of fronds are often perforated with large holes when weevil infestations are heavy. With respect to *P. canariensis*, the basal areas of dropped fronds can be heavily tunneled, and often pupal cases can be found tightly wedged into tunnels. When infestations are especially heavy, pupal cases may drop from palms and can be readily found on the ground under infested palms. In parts of the native range, *Dynamis borassi*, a sympatric and morphologically similar looking weevil, may cause similar damage (Jaffé *et al*., 1993; Chinchilla & Öhlschlager, 1992, 1993; Sánchez & Jaffé, 1993).

Morphology

The morphology of *R. palmarum* eggs, larvae, pupae, and adults are described by Wattanapongsiri (1966). A summary is provided below.

Eggs

Eggs are 1–2 mm in length and are laid inside soft plant tissue, near the apical area of the palm. Females seal oviposition wounds with a waxy secretion presumably to protect eggs. Eggs are white and oblong in shape when recently laid. As eggs mature they may exhibit undulatory movements as larvae prepare to emerge. Around this time larvae can be seen through the egg chorion.

Larvae

The larvae are legless and creamy white, they may reach 5–6 cm in length prior to pupation. Larvae are cannibalistic and possess sclerotized mouth parts with strong mandibles. Their body is slightly curved ventrally. Prepupal larvae become darker and migrate from feeding sites to areas (e.g. base of the palm frond) where they will excavate a pupal chamber within which the fibrous pupal cocoon is spun.

Pupae

Pupae are exarate and light brown. The abdomen continuously makes undulatory movements when disturbed. Pupae inhabit a cylindrical-ovoid cocoon that is built with strongly entwined palms fibres. The fibrous cocoon is approximately 7 cm long and 3–4 cm in diameter.

Adults

Adult *R. palmarum* are typically black. However, a small proportion of the population may exhibit orange and black markings that are very similar in appearance to *R. ferrugineus* (Löhr *et al.*, 2015). Adults are large, measuring 4–5 cm in length and are approximately 1.4 cm wide, weighing 1.6–2 g. The head is small with a characteristic long, ventrally curved rostrum. Adults show sexual dimorphism; males have a conspicuous batch of hairs on the antero-central dorsal region of the rostrum. Females lack rostral setae.

The morphological identification of *R. palmarum* is described in the EPPO diagnostic protocol *for Rhynchophorus ferrugineus* and *Rhynchophorus palmarum* (EPPO, 2007). Use of computer based tools (e.g. online keys, digital cameras attached to microscopes) and internet connectivity to access data bases, images, and experts via screen and image sharing software can aid in the rapid identification of *Rhynchophorus* spp. (Giblin-Davis and Roda, 2013).

Detection and inspection methods

Early detection of weevil infestations within palms is extremely difficult and often infestations are only confirmed once damage becomes visually obvious. Some early detection methods have explored the use of molecular and biochemical markers that palms or weevils produce as a result of attack. Another approach has been to use sensitive electronic equipment to 'listen' for acoustic signatures that typify weevil feeding. Changes in infrared spectral qualities of palms have also been assessed for diagnostic potential. Overall, early detection techniques have not been developed to a point where they are sufficiently accurate, cost effective, or easy and fast to use enabling the examination of many tens or hundreds of palms a day. Visual inspections for weevil infestations of small palms in containers is possible, but this approach is difficult for tall palms. Visual inspections of tall mature palms with binoculars can be done and drones flying over and around palms can provide high resolution images of the crown region for examination. However, accurately assigning the cause of frond damage (e.g. clipped ends of expanding fronds or notches) can be difficult as feeding damage by rats, for example, to immature fronds prior to expansion, can produce damage similar to that caused by *R. palmarum*.

PATHWAYS FOR MOVEMENT

The pest can be accidentally spread over long distances through the movement of infested palms for planting into new areas. Adult weevils are capable of localized short distance flights and long distance flight may be possible. Flight mill studies in the laboratory suggest that *R. palmarum* is a strong flyer. The average distance flown by males and females over a 24 hr period is approximately 41 km and 53 km, respectively (Hoddle *et al.*, 2020). In these flight mill studies, approximately 10% of females flew > 100 km in 24 h, with two (~4%) females flying > 140 km. The maximum recorded distance flown by a male weevil was 95 km. Flight activity was predominantly diurnal and flying weevils exhibited an average weight loss of approximately 18% over a 24 hr period (Hoddle *et al.*, 2020). It is unknown if *R. palmarum* undertakes long distance flights in nature. However, flight mill data suggest strongly that they are capable of flying long distances. This possibility should be carefully considered when establishing quarantine boundaries or setting up detection and monitoring programs.

PEST SIGNIFICANCE

Economic impact

R. palmarum is recognized as a serious pest of oil palms, coconuts, and ornamental palms. Countries reporting significant damage in oil palm (*Elaeis guineensis*) plantations include Central America (Costa Rica), Colombia, Venezuela and Brazil. (Grif?th, 1968, 1970; Dean, 1979; Fenwick, 1967; Sánchez & Cerda, 1993). In Veracruz (Mexico), *R. palmarum* is a pest of ornamental palms (Landero-Torres *et al.*, 2015). Economic tolerance for damage depends on the palm species and on the number of larvae infesting the plant. Fenwick (1967) and Grif?th (1968) reported that as few as 30 *R. palmarum* larvae are sufficient to cause the death of a mature coconut palm.

In addition to direct damage, *R. palmarum* causes indirect damage by vectoring red ring nematode, *B. cocophilus*. *R. palmarum* was first suspected to vector *B. cocophilus*, a nematode responsible for heavy losses in coconut plantations, in the early 1900s (Cobb, 1922). It is now well established that *R. palmarum* is the principal vector of *B. cocophilus*, and that reduction in weevil population densities is key to lower nematode infestation. Coconut palms 3–10 years of age die during the ?rst 2 months after inoculation with *B. cocophilus* (Grif?th, 1987). Thurston (1984) and Brathwaite & Siddiqi (1975) reported that infected plants take 23–28 days to show the symptoms of red ring disease, and typically die 3–4 months after showing the first symptoms. Esser & Meredith (1987) estimated that several million USD are lost annually due to the association of red ring disease and *R. palmarum*. They estimated that 800 ha of coconut plantations were abandoned in 1923 due to this disease, and that in Grenada 22% of the coconut palms had red ring disease.

Although *R. palmarum* is undoubtedly a plant pest, in South America, it can provide some benefits to human communities by being used as a source of food or for traditional medicine. In parts of Amazonia, *R. palmarum* larvae are cultivated and marketed by indigenous groups (Choo *et al.*, 2009; Delgado *et al*., 2019; Sancho *et al*., 2015).

Control

Trapping programs

Trapping programs utilize traps (e.g. bucket traps or cone shaped Picusan traps) loaded with commercially-available aggregation pheromone and baited with fermenting bait (e.g. sugarcane, dates and water, or pineapple chunks in syrup). The male produced aggregation has been identified as 2(E)-6-methyl-2-hepten-4-ol, (commonly known as rhynchophorol) (Rochat *et al*., 1991a,b; Öhlschlager *et al*., 1992a,b). Addition of ethyl acetate to traps loaded with pheromone and bait synergizes attractiveness (Jaffé *et al*., 1993). Recent studies by Milosavljevi? *et al.* (2020) demonstrated that ground deployed Picusan traps are 5 times more effective at catching *R. palmarum* than bucket traps that are suspended 1.5 m above the ground or placed on the ground. The design of the Picusan trap is significantly more effective at retaining weevils that enter this trap. The attractiveness of fermenting bait can be enhanced by the addition of yeast. Field trials demonstrated that baker's yeast, *Saccharomyces cerevisiae*, added to dates and water produced volatiles that were more attractive than those produced by *S. bayanus* and *S. pastorianus*. However, the additional cost of yeast to boost bait fermentation may not be warranted. Weevil captures were statistically similar between traps baited with: (1) dates and water, and (2) dates, water, and *S. cerevisiae*. Traps with dates, water and *S. bayanus* or *S. pastorianus* caught significantly fewer weevils. Weevils attracted to traps can be killed by drowning through the addition of 50% propylene glycol solution. This is needed for bucket traps with holes that don't prevent egress, but is probably unnecessary for Picusan traps as the funnel shaped ingress port effectively prevents egress after entry.

Mass trapping of *R. palmarum* at 1 trap/5-ha significantly lowered the incidence of red ring nematode infection vectored by the weevil in commercial oil palm plantations in the Americas (Öhlschlager *et al.*, 1993; Oehlschlager, 2016). With respect to ornamental palms in urban areas, trap placement with respect to palms of interest is a highly important consideration. If traps are placed too close to palms, weevils attracted to traps but not retained and killed in traps may attack nearby palms. If the goal of trapping is to detect *R. palmarum* activity in the general vicinity of palms of concern, then traps could be deployed outside the immediate area of interest, perhaps approximately 1 km away. If weevils are captured at this distance from the palms of concern, it likely indicates there is probably a risk of weevil attack and steps should be promptly considered and implemented to protect those palms.

Trap colour (i.e. white vs. black vs. yellow) does not significantly affect *R. palmarum* capture rates (Oehlschlager *et al.*, 1993). In order to maximize trap efficacy, traps should be placed in areas with partial or full shade. Full sun exposure, especially during the hottest parts of the day, rapidly diminishes trap efficacy (Navarro-Llopis *et al.*, 2018).

Biological control

Relatively little is known about the natural enemies associated with *R. palmarum* in its native range. However, one promising candidate is a parasitic fly, *Billaea rhynchophorae* (Diptera: Tachinidae), from Brazil that is reported to attack *R. palmarum* larvae and pupae (Moura *et al*., 1993; 2006). Very little is known about the biology and ecology of this fly but its population-level impacts on *R. palmarum* in Brazilian oil palm plantations appear to be significant with year round parasitism averaging 50% (range: 32-74%) and each parasitized *R. palmarum* pupa produces around 18 flies. Löhr (2013) provides a compelling argument for increased research into potential biocontrol agents attacking *R. palmarum* in the native range. *Billaea* spp. are obvious candidates in need of detailed study.

Sanitation

Removal and destruction of palms infested with *R. palmarum* can be done by mechanically chipping or grinding infested fronds and removal and destruction of infested crowns either by burying 1.5 m underground or cutting with a chainsaw and then mechanically chipping or grinding into small pieces. Chipping or grinding will kill larvae, pupae, and adults, and this process helps desiccate eggs. Burning infested palm crowns is difficult and not recommended. Palm trunks with crowns removed can be left standing. It is unlikely that these will be used for breeding by *R. palmarum* as the meristematic region, the preferred feeding site for larvae, is not available. Applications of contact insecticides to the tops of cut trunks that have had the crowns removed can be made. Insecticide residues will kill adult *R. palmarum* attracted by wound volatiles.

Insecticides

Insecticidal control of *R. palmarum* is difficult (Hagley, 1963). However, systemic insecticides applied as either trunk sprays or injections, soil injections or drenches, or as crown drenches are effective. If applied during the early stages of infestation, insecticides may be capable of 'curing' infested palms. A combination of systemic insecticides with different rates of movement in palms can be effective. A combination approach may use fast moving compounds that reach internal larval infestation sites first and slower moving compounds follow up to provide more persistent control. Systemic insecticides that have both insecticidal and nematicidal properties need evaluation as these types of products have the potential to provide protection against *R. palmarum* and *B. cocophilus*. Applications of contact insecticides to crown regions can provide some protection from adult weevils and can be used in combination with systemic insecticides. Cutting an observation 'window' into the crown may help with observations to determine treatment efficacy. 'Windows' are made by removing fronds at the base of the crown so access to the crown is possible. In extreme situations, all of the fronds can be removed from the crown region so that the top of the palm has a bulbous-looking appearance. Insecticide treatments can be applied to this 'bulb' and in the absence of fronds less insecticide is needed as there is reduced run off and applications are highly focused on the infested region.

IPM of R. palmarum

IPM manuals outlining control programs for *R. palmarum* in Brazil (Moura, 2017) and Colombia (https://www.ica.gov.co/getattachment/19e016c0-0d14-4412-af12-03eecfe398f2/Manejo-del-picudo--Rhynchophorus-palmarum-L--(Cole.aspx) are available.

Phytosanitary risk

R. palmarum presumably presents a significant risk to edible date palms in North Africa and the Middle East. This potential risk will be better understood should this weevil invade and establish in edible date growing regions of California (e.g. the Coachella Valley) and Arizona (e.g. the Bard Valley). *R. palmarum* is a serious problem afflicting ornamental palms, especially *P. canariensis*, in California. It is highly likely to threaten *P. canariensis* throughout the Mediterranean region and in the Canary Islands, the native range of this palm. The current problem with *R. ferrugineus* in these areas would be greatly amplified if *R. palmarum* invaded and carried with it *B. cocophilus* as it is likely that *R. ferrugineus* would be able to vector this palm killing nematode. *R. palmarum* could potentially be introduced into countries of the EPPO region through imported palms from infested areas.

PHYTOSANITARY MEASURES

R. palmarum was added in 2005 to the EPPO A1 list, and endangered EPPO member countries are thus recommended to regulate it as a quarantine pest. Imported plants for planting of palms should originate in a pest-free area or come from a pest-free place of production.

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