

Diagnostics
Diagnostic

Rhynchophorus ferrugineus* and *Rhynchophorus palmarum

Specific scope

This standard describes a diagnostic protocol for *Rhynchophorus ferrugineus* and *Rhynchophorus palmarum*.

Specific approval and amendment

Approved in 2007/09.

Introduction

The genus *Rhynchophorus* currently contains nine species, of which six are known to attack palms. Two species, *R. ferrugineus* and *R. palmarum* are EPPO listed pests, with *R. palmarum* on the A1 list and *R. ferrugineus* on the A2 list.

Rhynchophorus ferrugineus is essentially a pest of palms. The known hosts include *Areca catechu*, *Arenga pinnata*, *Borassus flabellifer*, *Caryota maxima*, *C. cumingii*, *Cocos nucifera*, *Corypha gebanga*, *C. elata*, *Elaeis guineensis*, *Livistona decipiens*, *L. chinensis*, *L. subglobosa*, *Metroxylon sagu*, *Oneosperma horrida*, *O. tigillaria*, *Oreodoxa regia*, *Phoenix canariensis*, *P. dactylifera*, *P. sylvestris*, *Sabal umbraculifera*, *Trachycarpus fortunei* and *Washingtonia* sp. *R. ferrugineus* has also been found on rattan (specifically, *Calamus merillii*) in the Philippines (Braza, 1988) and is reported to attack *Agave americana* and *Saccharum officinarum* (Esteban-Duran *et al.*, 1998).

Rhynchophorus palmarum is common in Neotropical virgin forests and in agroecosystems exploiting oil palms, and has been reported on 35 plant species in 12 different families. It is, however, found predominantly on Arecaceae, the main hosts being, *Cocos nucifera*, *Elaeis guineensis*, *Euterpe edulis*, *Metroxylon sagu*, *Phoenix canariensis*, *Phoenix dactylifera*, and sugarcane *Saccharum officinarum*. Although only reported as a pest on palms and sugarcane (Arango & Rizo, 1977; Restrepo *et al.*, 1982), the adults also feed on ripe fruits of plants such as *Ananas comosus*, *Annona reticulata*, *Artocarpus altilis*, *Carica papaya*, *Citrus* spp., *Mangifera indica*, *Musa* spp., *Persea Americana*, *Psidium guajava* and *Theobroma cacao*, but without causing economic damage (OEPP/EPPO, 2005).

In the EPPO region, *R. ferrugineus* is present in Cyprus, Greece, Egypt, France, Israel, Italy, Jordan, Spain and Turkey. It is possible that it could establish across the Mediterranean part of the EPPO region.

Further information on the biology and ecology of the species can be found in Martin Monina & Cabello Garcia (2005) and the EPPO data sheets on *R. palmarum* (OEPP/EPPO, 2005) and *R. ferrugineus* (EPPO Website).

Identity

Name: *Rhynchophorus ferrugineus* (Olivier, 1790)

Synonyms: *R. signaticollis*, *R. vulneratus*, *Calandra ferrugineus*, *Curculio ferrugineus*

Taxonomic position: Insecta, Coleoptera, Dryophthoridae, Rhynchophorinae

EPPO computer code: RHYCFE

Phytosanitary categorization: EPPO A2 (339).

Identity

Name: *Rhynchophorus palmarum* (Linnaeus, 1758)

Synonyms: *R. cycadis*, *R. depressus*, *R. longuinossis*, *Calandra palmarum*, *Cordyle barbirostris*, *C. palmarum*, *Curculio palmarum*

Taxonomic position: Insecta, Coleoptera, Dryophthoridae, Rhynchophorinae

EPPO code: RHYCPA

Phytosanitary categorization: EPPO A1 (332).

Detection

Early signs of attack are distinctive but not easily visible: notches at the base of palm leaves with frass, cocoons inserted into the base of the palm leaves, eccentric crown growth, holes at the base of the cut palms and symptoms resembling those of drought stress (wilting, yellowing). Larvae and adults may destroy the interior of the palm tree, without the palm tree showing distinctive signs of deterioration. When attacked, the

Table 1 For identification of the genus *Rhynchophorus* see Arnett *et al.* (2002). Key to the species of Adult *Rhynchophorus* (after Wattanapongsiri, 1966) *Rhynchophorus vulneratus* is considered as a colour morph of *R. ferrugineus* (Hallett *et al.*, 2004).

1.	Mandible distally rounded or oval.	2
	Mandible distally toothed.	4
2.	Nasal plate absent; setae beneath the third tarsal segment covering one-sixth the entire area, pronotum oval posteriorly; gular suture narrowed; tip of rostrum not convex ventrally, slightly compressed or cylindrical, and not convex or oval baso-dorsally; submentum truncate distally.	3
	Nasal plate present, distinct rounded; setae beneath the third tarsal segment covering two-thirds the entire area; pronotum almost square and broadly rounded posteriorly; gular suture wide; tip of rostrum strongly convex ventrally, strongly compressed, convex and oval baso-dorsally; submentum oval distally (African).	<i>quadrangulus</i>
3.	Front tibia broad, flat, with two broad distal lobes; middle and hind tibia truncate distally; pronotum with sides curved and broadened before constricting anteriorly; rostrum quadrate and slightly compressed, dorsally concave or grooved at apex; submentum truncately concave distally; male rostral setae thick, erect (South American).	<i>ritcheri</i>
	Front tibia not flat; middle and hind tibiae not truncate; pronotum with sides straight before contracting anteriorly; rostrum cylindrical, oval or feebly convex at apex; submentum sharply concave distally, mandible broadly oval distally; male rostral setae absent, represented by tubercles dorsally (American).	<i>cruentatus</i>
4.	Pronotum produced at base (Fig. 8); pre-gular suture narrowed; ventral space between antennal scrobes narrowed; tip of rostrum dorsally grooved or nearly truncate; interocular space always one-third or less than one-third the width of rostrum at base.	5
	Pronotum oval or broadly rounded at base (Fig. 1); pre-gular suture widened; ventral space between antennal scrobes broadened; tip of rostrum not grooved but oval distally; interocular space not less than one-third the width of rostrum at base.	6
5.	Mandible deeply tridentate and sharply pointed distally; ventral space between antennal scrobes smooth, without setae; middle and hind tibia with distinct spines at base of uncus; pygidium flat dorsally; setae beneath third tarsal segment almost covering the entire area; submentum tridentate, sharply pointed and curved inwards; antenna small, slender; scutellum sharply pointed posteriorly; body ferrugineous with black patches (Asian).	<i>distinctus</i>
	Mandible with two broad lobes (Fig. 13); ventral space between antennal scrobes rugous with several long, slender setae (Fig. 14); middle and hind tibia without distal spines; pygidium convex dorsally; setae beneath third tarsal segment covering one-half the entire area (Fig. 15); submentum oval; antenna thick; scutellum produced posteriorly; body completely black (American).	<i>palmarum</i>
6.	Pygidium smooth; beneath third tarsal segment without two rows of lateral setae; interocular space nearly one-third the width of rostrum at base; base of pronotum broadly rounded, usually with two long red stripes extending the entire length; scutellum very narrowly produced posteriorly (African).	<i>phoenicis</i>
	Pygidium punctured (Fig. 16); beneath third tarsal segment with two rows of lateral setae (Fig. 17); base of pronotum oval or broadly oval, usually with one broad red or two small, short red stripes, or several spots on pronotum; scutellum somewhat pointed posteriorly.	7
7.	Pre-gular suture uniformly broadened to the base, mandible four-dentate; submentum truncate with small triangular median depression confined to the apex; body black, usually with small narrowed, short, red stripes on pronotum (Australasian).	<i>bilineatus</i>
	Pre-gular suture with elongate-oval shape before narrowing to the base (Fig. 18); mandible tridentate (Fig. 19); submentum truncately concave with narrowly elongate median depression, extending throughout its length; body black or ferrugineous, usually with a broad red stripe or spots on pronotum (Asian, Australian).	<i>ferrugineus</i>

trunk is structurally weakened, making the plant liable to collapse, thus the plant becomes a danger to the public. An attack on *Phoenix* leads, in the majority of the cases, to death of the palm trees whatever the size. Visual examination allows the detection of signs of attack such as notches on the base of palm leaves, frass, cocoons and holes but will not detect larvae and adults inside the trunk stipe. Adult populations can be monitored by pheromone traps, acoustic detection (Soroker *et al.*, 2004) or infra-red systems.

Identification

Morphological identification is the recommended method (see Tables 1 and 2 and Appendix 1), for which. A binocular microscope with $\times 50$ magnification is needed.

Rhynchophorus ferrugineus

Adult male (habitus Figs 1 and 2)

Length: 19 to 42 mm, width 8 to 16 mm. Body elongate-oval, general colour ferruginous to black, legs lighter coloured than

body; elytra dark red to black, shiny or dull, slightly pubescent; black spots on pronotum extremely variable.

Head: dull to shiny; smooth to finely punctured; interocular space slightly more than one-half width of rostrum at base.

Antennae: arising laterally from scrobe at base of rostrum; scrobe deep, broad and widely opened ventrally; scape elongate, longer than funicle and club combined or equal to one-half length of rostrum; funicle with 6 segments; antennal club large usually ferruginous or reddish-brown; broadly triangular with several setae dorsally and ventrally; inner side of spongy area with 8 to 15 setae.

Mouthparts: brown, mandible about one-half width of rostrum at base; tridentate distally and all teeth sharply pointed; apical and subapical teeth widely separated; maxillary palp segments flat-rectangular, palpifer triangular; stipe one-half as long as palpifer; cardo pointed at both ends, sinuated at both sides, more than three times as long as stipes; mala with narrow invagination at inner margin, gradually curved at outer margin.

Rostrum: varying from ferruginous to black; usually ferruginous; nearly four-fifths length of pronotum in males, in female longer, slender, more cylindrical; in profile straight,

Table 2 Key to known species of *Rhynchophorus* and *Dynamis* larvae (after Wattanapongsiri, 1966)

1. Labrum with 10 lateral setae; epipharyngeal setae 2 thick, distance between setae 2 twice as wide as between setae 1; epipharynx V-shaped; second segment of maxillary palpus with circular sensory spot distally; prothoracic sternum with crescent-shaped opening.	<i>Dynamis borassi</i>
Labrum with 16–30 lateral setae; epipharynx setae 2 simple, slender, distance between setae 2 as wide as or slightly wider than between setae 1; epipharynx not V-shaped; second segment of maxillary palpus with oval sensory spot distally; prothoracic sternum with median depression.	<i>Rhynchophorus</i> 2
2. Epipharyngeal sensory pores placed closer to epipharyngeal setae 2 than 1; labrum with 16–22 lateral setae.	3
Epipharyngeal sensory pores placed at or near the mid point between epipharyngeal setae 1 and 2; labrum with 24–30 lateral setae.	4
3. Labrum with 16 short lateral setae; distance from sensory pores to epipharyngeal setae nearly three times as long as setae 2; eight abdominal tergite without prodorsal setae; epipharynx without enlarged portion lateroanteriorly; mala with bifurcate dorsal setae.	<i>cruentatus</i>
Labrum with 22 long lateral setae; distance from sensory pores to epipharyngeal setae 1 less than twice as long as setae 2; eight abdominal tergite with four prodorsal setae; epipharynx with enlarged portion latero-anteriorly; mala with both bifurcate and trifurcate dorsal setae.	<i>ferrugineus</i>
4. Mandible toothed or bilobed; epipharynx broadened anteriorly; mala with 26–27 dorsal setae.	<i>palmarum</i>
Mandible not toothed or lobed; epipharynx narrowed or tapering anteriorly; mala with 18–20 dorsal setae.	5
5. Labrum with 30 lateral setae; mala with 20 dorsal setae; mandible large, very thick and stout; abdominal tergite eight with two prodorsal and two postdorsal setae.	<i>phoenicis</i>
Labrum with 24 dorsal setae; mala with 18 dorsal setae; mandible small, not stout; abdominal tergite eight without prodorsal or postdorsal setae.	<i>bilineatus</i>



Fig. 1 *Rhynchophorus ferrugineus* male.



Fig. 2 *Rhynchophorus ferrugineus* male rostrum (A) and pseudotetramerous tarsus (B).

broad at base, smooth to minutely punctured; viewed dorsally with apical or subapical thick, erect, setae; extending more than one-half length of rostrum; rows of tubercles present or not.

Pronotum: with sides gradually curved to apex and abruptly constricted anteriolaterally; slightly pubescent to shiny; posterior margin nearly rounded; colour mostly ferruginous

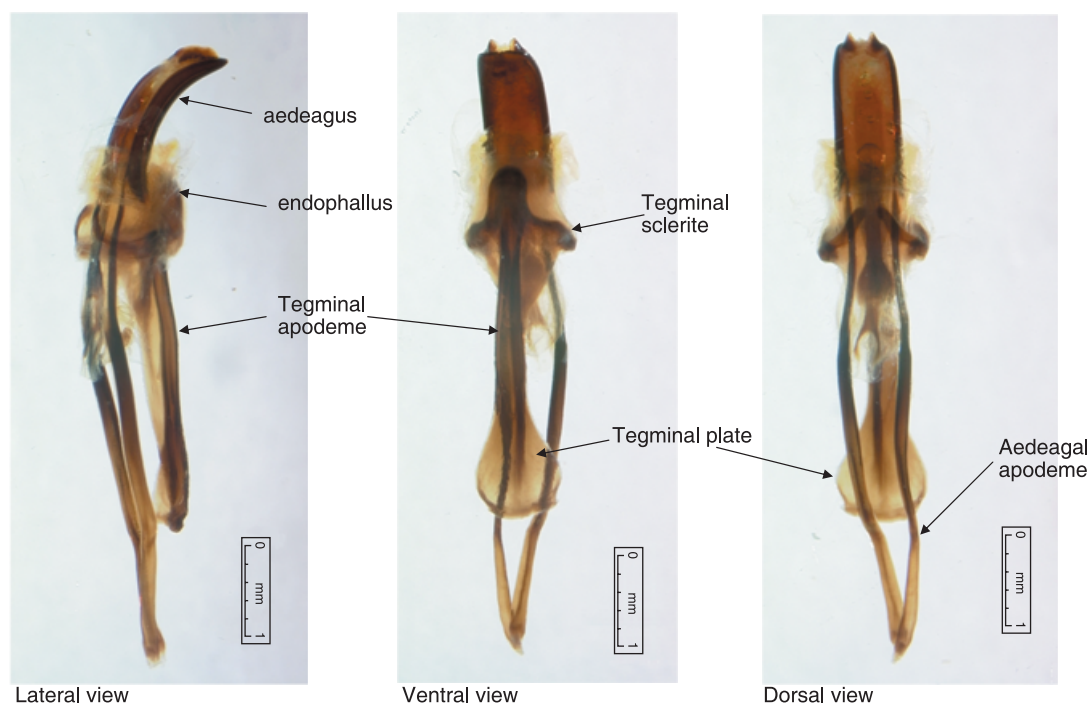


Fig. 3 *Rhynchophorus ferrugineus* male: aedeagus, endophallus and tegmen.

and varying to dark brown and black; underside of pronotum mostly ferruginous or dark brown, may vary to almost black, very minutely punctured. Scutellum varying from reddish-brown to black; somewhat pointed posteriorly, one-quarter to one fifth elytral.

Legs: usually punctured on outer edges of both femur and tibia; front coxa strongly globose, widely separated; middle coxa covered with soft reddish-brown hairs; front femur as long as middle but shorter than hind femur; fore tibia as long as hind and longer than the middle; tarsi pseudotetramerous (see Fig. 2), first tarsal segment twice as long as second and or slightly shorter than third; reddish brown setae beneath third segment; fifth segment as long as first 4 segments combined, with 9 to 12 setae ventrally.

Elytra: smooth or slightly velvety pubescent, nearly rectangular, with punctuation along the outer edges with 5 deep striae and traces of 4 laterally; length of each elytron two and one-third times its own width.

Abdomen: usually ferruginous, but may vary from ferruginous to almost black; first abdominal sternite as long as third and fourth combined but much shorter than second.

Pygidium: varying from ferruginous to nearly black, mostly ferruginous or dark brown, sparsely and minutely punctured posteriorly and dorsolaterally.

Genitalia: illustrated in Fig. 5. For a complete description, see Wattanapongsiri (1966). For preparation see Appendix 1.

Adult female (habitus Figs 3 and 4)

Length 26–40 mm, width 10–16 mm. Very similar to male in body size, colour, markings on pronotum, except rostral setae

absent; snout longer, slender and more cylindrical, setae on front femur absent and on front tibia much shorter.

Eggs

Whitish-yellow, smooth, very shiny, cylindrical with rounded ends, slightly narrower at the anterior end, averaging 0.98 by 2.96 mm.

Larvae (Fig. 6)

Piriforme, apodous, colour, creamy white to ivory, cephalic capsule brown russet-red to brilliant brown-black. Body slightly curved. Last instar is 36 to 47 mm in length by 15 to 19 mm in width.

Pupae (Fig. 7): protected in a cocoon made up of vegetable fibres, 4 cm long by 1.6 cm broad.

For a complete description of larvae and pupae, see Wattanapongsiri (1966).

Rhynchophorus palmarum

Adult male (habitus Figs 8 and 9)

Length: 29–44 mm, width 11.5–18 mm. Body elongate-oval, flat dorsally, convex ventrally, deep black; dorsum dull or shiny, except pronotum of some populations with velvety pubescence, venter shiny.

Head: dull to shiny, bulbous, almost rounded, posterior end trilobed, with interocular sulcus; interocular space narrowed about one-fifth the width of rostrum at base; frons finely punctured.

Antennae: arising laterally from scrobe at base of rostrum; scrobe deep, broad and widely opened ventrally; scape elongate,



Fig. 4 *Rhynchophorus ferrugineus* female.



Fig. 5 *Rhynchophorus ferrugineus* female rostrum.

longer than funicle and club combined or equal to one-half length of rostrum; funicle with 6 segments; antennal club large; broadly triangular with several setae dorsally and ventrally; inner side of spongy area with 8 to 10 setae.

Mouthparts: brownish-black and located at apex of rostrum; mandible two-thirds the width of rostrum at base, anteriorly bilobed, teeth deeply divided, basal tooth sometimes slightly depressed; maxilla brown, small, with 3 segmented maxillary palpi; first segment broad, nearly quadrate; second similar and half-size of the first; third truncate basally and oval distally, one-third size of the first; palpifer almost triangular, obtuse distally, truncate basally, with inner margin slightly concave; stipe quadrate, nearly one-half as long as palpifer; cardo elongate somewhat pointed distally, slightly sinuate basally; mala elongate, constricted distally.

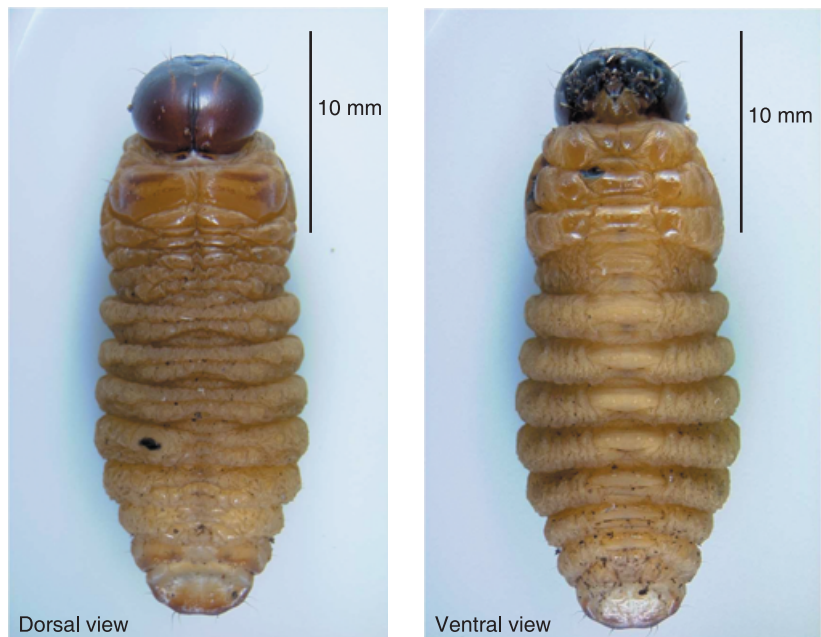


Fig. 6 *Rhynchophorus ferrugineus* larvae.



Fig. 7 *Rhynchophorus ferrugineus* nymph.

Rostrum: stout, shorter than pronotum; in profile, slightly arcuate at apex, broad at base and tapering to apex; apical half on upper surface with thick, erect, fulvous setae, or similar setae extending from anterior of antennal scrobes to apex.

Pronotum: black, longer than wide, flat, opaque, velvety to shiny, narrowed to apex and constricted anteriolaterally, base produced posteriorly, covered with brown setae, beneath the posterior border, bisinuate on either side, with fine raised margin; very finely and diffusely punctured, more strongly at sides and apex, with traces of a median longitudinal carina. In profile, margin convex ventrally; under side completely black, finely punctured punctures being close and rough on mesosternum and anterior parts of metasternum. Prosternum elevated. Scutellum always black, smooth, large, triangular-elongate, produced at apex, about one-fourth the length of elytron, concave anteriorly.

Legs: black with fine punctuation, front coxae separated by a distance equal to one-fourth width of a coxa, bulbous, almost rounded, with scattered fine fulvous hairs and punctuation; middle coxa similar to front coxa but covered with patch of long slender fulvous setae; hind coxa eye-shaped, widely separated. All trochanters triangular, pointed distally; femora flat, broad distally; front femur shorter than hind femur and about as long as middle femur; tibia slightly curved outward and tapering



Fig. 8 *Rhynchophorus palmarum* male.



Fig. 9 *Rhynchophorus palmarum* male rostrum.

distally, each with long recurved uncus and a small subuncus about one-fifth the length of uncus; front tibia as long as hind tibia but longer than middle; all tibiae similar in shape; tarsi pseudotetramerous, five-segmented; first segment elongate,



Fig. 10 *Rhynchophorus palmarum* female.

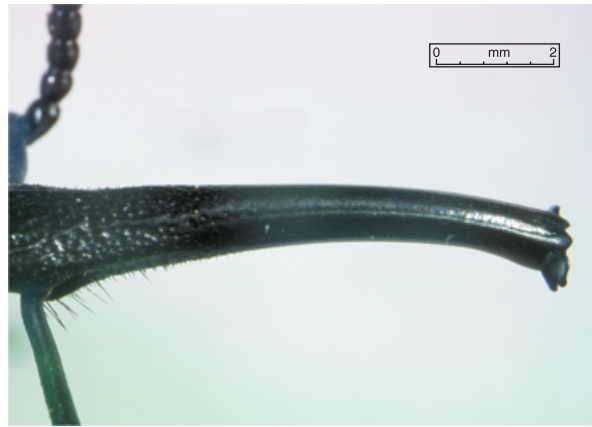


Fig. 11 *Rhynchophorus palmarum* female rostrum.

twice as long as second; third segment dilated, one-half of the entire area beneath covered with matted fulvous setae; fifth segment elongate, as long as the first 4 tarsal segments combined, with more than 10 slender fulvous setae scattered beneath; 2 simple, slender, movable claws. Setae on ventral side of femora, tibiae, and first 3 tarsal segments dark brown. These setae are conspicuous on the legs of the male. Femora with 2 to 3 long dark brown setae proximally; setae on first tibia twice as long as the setae on femora and longer than setae on middle or hind tibia.

Elytra: wider than pronotum, length of each elytron two and one-half times its own width, narrowed posteriorly with side

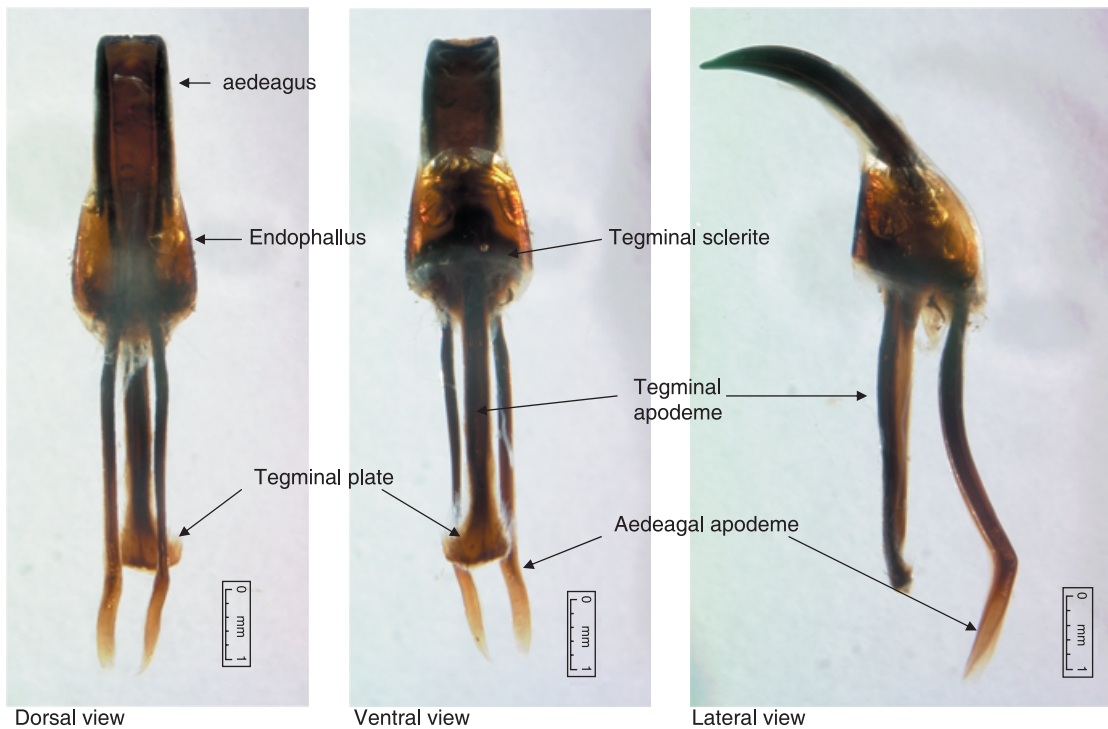


Fig. 12 *Rhynchophorus palmarum* male, aedeagus, endophallus and tegmen.

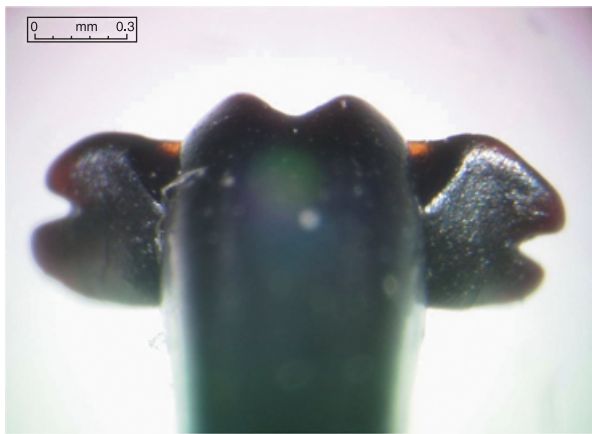


Fig. 13 *Rhynchophorus palmarum* mandible with two broad lobes.

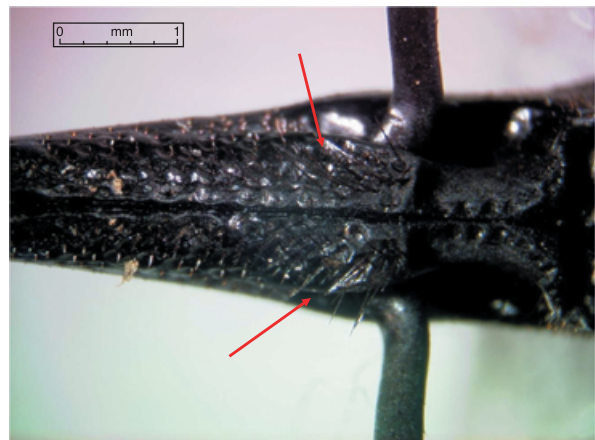


Fig. 14 *Rhynchophorus palmarum* ventral space between antennal scrobes.

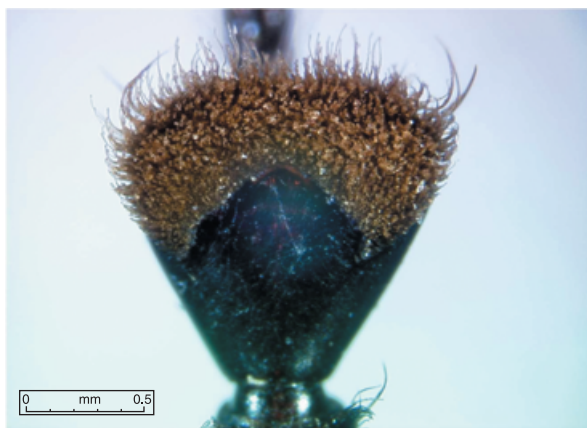


Fig. 15 *Rhynchophorus palmarum* setae beneath third tarsal segment.

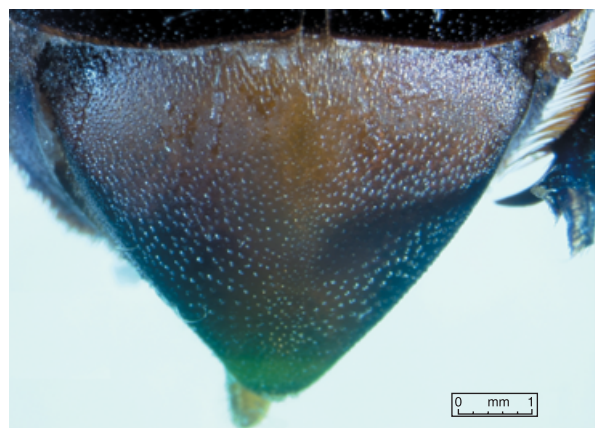


Fig. 16 *Rhynchophorus ferrugineus* pygidium punctation.



Fig. 17 *Rhynchophorus ferrugineus* third tarsal segment.

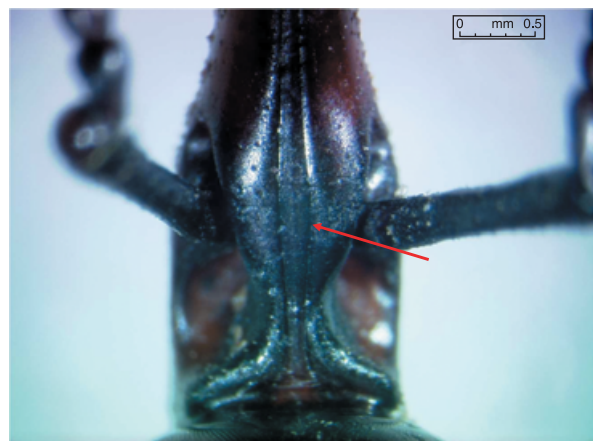


Fig. 18 *Rhynchophorus ferrugineus* preregular suture elongate oval shape.

almost straight, thence more abruptly narrowed, posterior border slightly emarginated. Wing brown, almost hyaline from lower part of median area to anal area; all veins dark brown, heavily sclerotized and thick.

Abdomen: completely black, ventrally convex, with 5 segments,

first abdominal sternite shorter and medially fused with second, the latter one and one-third times wider than third and fourth combined; fifth segment broad, almost triangular, fringed with a row of thick, long dark brown setae laterally, and without apical emargination; punctured dorsolaterally.

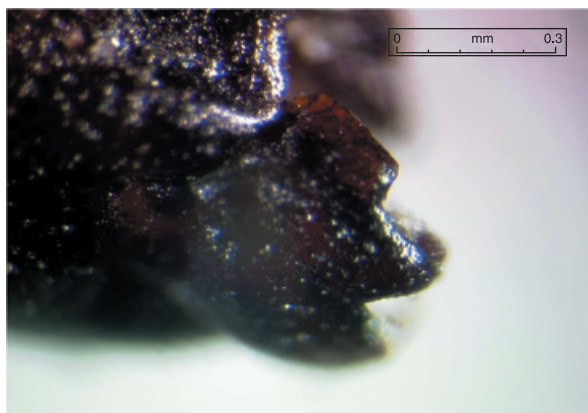


Fig. 19 *Rhynchophorus ferrugineus* mandible tridentate.

Pygidium: black, triangular with central elevation, strongly punctured at base, sides and apex; more diffusely at the middle; edged with lateral fucous setae; pygidium slightly wider than the female.

Genitalia: illustrated in Fig. 12. For a complete description see Wattanapongsiri (1966). For preparation see Appendix 1.

Adult female (habitus Figs 10 and 11)

Length 26 to 42 mm, width 11 to 17 mm. Similar to male except rostrum without setae; more slender and cylindrical, uniformly curved from posterior third to apex, punctuation weaker and less confluent; setae on first femur lacking. Pygidium narrowed and more pointed at apex.

Male genitalia

Prepared male genitalia is represented in Fig. 12. For a complete description, see Wattanapongsiri (1966). For preparation see Appendix 1.

Egg

Yellowish-brown, smooth, shiny, slender, cylindrical with rounded ends; averaging 0.9 by 2.5 mm (small, considering the size of the adult female); chorion very thin and hyaline; vitelline membrane yellowish-brown.

Larvae and pupae

For a complete description of larvae and pupae, see Wattanapongsiri (1966).

Larvae: similar to that of *R. ferrugineus*, body length 44–57 mm, width 22–25 mm. Pupae: light brown similar to that of *R. ferrugineus*, body length 40–51 mm, width 16–20 mm.

Reference material

Not appropriate.

Reporting and documentation

Guidance on reporting and documentation is given in EPPO Standard PM 7/77 (1) *Documentation and reporting on a diagnosis*.

Further information

Further information on these organisms can be obtained from:

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Acknowledgements

This protocol was originally drafted by J.-F. Germain, LNPV, Montpellier (FR).

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Appendix 1

Preparation of male genitalia for observation under a binocular microscope with × 50 magnification

Remove the terminal third of the abdomen and macerate by warming to dissolve the body contents in a 10% potassium solution for 10–20 min.

When the abdominal sclerites are sufficiently smooth, remove them leaving only the genitalia. Rinse the genitalia in cold distilled water and mount in 70% alcohol or glycerine in a cavity slide and observe.

The genitalia can be retained for future reference by enclosing them in a drop of glycerine in a glass or plastic microvial which is kept with the pinned specimen.