European and Mediterranean Plant Protection Organization
Organisation Européenne et Méditerranéenne pour la Protection des Plantes

Data sheets on quarantine pests
Fiches informatives sur les organismes de quarantaine

Rhynchophorus ferrugineus

Identity

Name: *Rhynchophorus ferrugineus* (Olivier, 1790).
Synonyms: *Calandra ferruginea* (Fabricius, 1801), *Curculio ferrugineus* Olivier, 1790, *Rhynchophorus signaticollis* Chevrolat, 1882.
Taxonomic position: *Insecta*: *Coleoptera*: *Curculionidae*.
Notes on taxonomy and nomenclature: the genus *Rhynchophorus* contains ten species, of which seven are known to attack palms (Booth *et al*., 1990), including, besides *R. ferrugineus*, the EPPO A1 action list pest *Rhynchophorus palmarum* (OEPP/EPPO, 2005). A key was provided by Wattanapongsiri (1966). Reginald (1973) considers *R. ferrugineus* as the typical *Rhynchophorus* species. In Papua New Guinea, *R. ferrugineus* has been described as subsp. *papuanus* (Mercer, 1994).
Common names: Asiatic palm weevil, coconut weevil, red palm weevil, red stripe weevil (English), picudo asiático de la palma (Spanish), charançon asiatique du palmier (French), Indomalaiischer Palmen-Rüssler (German).
EPPO code: RHYCFE.
Phytosanitary categorization: EPPO A2 action list no. 332.

Hosts

R. ferrugineus is essentially a pest of palms (*Arecaceae*), being recorded on *Areca catechu*, *Arenga pinnata*, *Borassus flabellifer*, *Calamus merillii*, *Caryota maxima*, *Caryota cumingii*, *Cocos nucifera*, *Corypha gebanga*, *Corypha elata*, *Elaeis guineensis*, *Livistona decipiens*, *Metroxylon sagu*, *Oreodoxa regia*, *Phoenix canariensis*, *Phoenix dactylifera*, *Phoenix sylvestris*, *Sabal umbraculifera*, *Trachycarpus fortunei*, *Washingtonia* sp., etc. It can also attack *Agave americana* and sugarcane (*Saccharum officinarum*).

Geographical distribution

EPPO region: Cyprus (since 2006), France (since 2006, Corse, Provence-Alpes-Côte d'Azur), Greece (since 2006, Kriti, Rhodos), Israel (since 1999, under eradication), Italy (since 2004, Campania, Lazio, Puglia, Sardegna, Sicilia, Toscana), Jordan (since 1999, under eradication), Spain (Andalucía since 1996, Comunidad Valenciana since 2004, Murcia, Islas Baleares and Islas Canarias since 2007), Turkey (since 2005, Mersin province).
Asia: Bahrain, Bangladesh, Cambodia, China (Guangdong), India (widespread), Indonesia (widespread), Iran, Iraq, Israel, Japan (since 2000, Kyushu only), Jordan (since 1999), Kuwait, Laos, Malaysia, Myanmar, Oman, Pakistan, Philippines, Qatar, Saudi Arabia, Singapore, Sri Lanka, Syria, Taiwan, Thailand, United Arab Emirates, Vietnam.
Africa: Egypt (since 1992, Ismaelyia and Sharkyia governorates)
Oceania: Australia (isolated record in Queensland), Papua New Guinea, Solomon Islands, Western Samoa
EU: Cyprus, France, Greece, Italy, Spain
See CABI/EPPO (2003).

Biology

Adults of *R. ferrugineus* are active during day and night, although flight and crawling is generally restricted to daytime. Leefmans (1920) reported that adults are capable of long flights and can find their host plants in widely separated areas; his studies suggested that they can detect breeding sites at distances of at least 900 m. Mating takes place at any time of day, and males and females mate many times during their lifetime. The pre-oviposition period lasts 1–7 days. Oviposition is generally confined to the softer portions of the palm and continues for approximately 45 days. During this period, the adult female lays an average of 204 eggs. Eggs are laid in wounds along the trunk or in petioles, and also in wounds caused by the beetle *Oryctes rhinoceros*. There is a short post-oviposition period of 10 days before the female dies. On hatching, the apodal larvae begin feeding towards the interior of the palm. In palms up to 5 years old, the larvae may be found in the bole, stem or crown. As palms advance in age, the grubs are generally confined to the portions of the stem close to the growing point. In palms more than 15 years old, the larvae are generally found in the stem about 1 m below the crown, in the crown and bases of leaf petioles. The larval period is 36–78 days (average 55 days) (Nirula *et al*., 1953). Jaya *et al*. (2000) recorded seven larval instars when *R. ferrugineus* was reared on sugarcane. When about to pupate, larvae construct an oval-shaped cocoon of fibre (Menon & Pandalai, 1960). The complete life cycle of the weevil, from egg to adult emergence, takes an average of 82 days in India (Menon & Pandalai, 1960).

After emergence from the pupal case, the adult remains inside the cocoon for 4–17 days (average 8 days) (Menon & Pandalai, 1960). According to Hutson (1933), it becomes sexually mature during this period of inactivity. Adults live 2–3 months, irrespective of sex. In captivity, the maximum life span of the adult was 76 days for the female and 113 days for the male. It has been suggested that a single pair of weevils can theoretically give rise to more than 53 million progeny in four generations in the absence of controlling factors (Leefmans, 1920; Menon & Pandalai, 1960). In Egypt, El Ezaby (1997) reported that the weevil has three generations per year, the shortest generation (first) of 100.5 days and the longest (third) of 127.8 days. The study also showed that the upper temperature threshold of the egg was 40°C.

For laboratory rearing of adults, freshly shredded sugarcane tissue served both as food and oviposition medium (Rananavare *et al*., 1975). Rahalkar *et al*. (1978) reported that an artificial diet containing sugarcane bagasse, coconut cake, yeast, sucrose, essential minerals and vitamins, agar, water and food preservatives maintained 12 generations of the weevil.

Detection and identification

Symptoms

The pest affects stems and growing points. It is very difficult to detect *R. ferrugineus* in the early stages of infestation. Generally, it is detected only after the palm has been severely damaged. Careful observation may reveal the following signs which are indicative of the presence of the pest: holes in the crown or trunk from which chewed-up fibres are ejected (this may be accompanied by the oozing of brown viscous liquid); crunching noise produced by the feeding grubs can be heard when the ear is placed to the trunk of the palm; withered bud/crown.

Morphology

Eggs
Creamy white, oblong, shiny; average size 2.62 × 1.12 mm (Menon & Pandalai, 1960). Eggs hatch in 3 days and increase in size before hatching (Reginald, 1973). The brown mouth parts of the larvae can be seen through the shell before hatching.

Larvae
Up to 35 mm long; brown head, white body composed of 13 segments; mouthparts well developed and strongly chitinized; average length of fully grown larvae 50 mm, and width (in middle) 20 mm.

Pupae
Pupal case 50–95 × 25–40 mm; prepupal stage of 3 days and pupal period of 12–20 days; pupae cream, then brown, with shiny surface, greatly furrowed and reticulated; average size 35 × 15 mm.

Adults
Reddish brown, about 35 × 10 mm, with long curved rostrum; dark spots on upper side of thorax; head and rostrum comprising about one third of total length. In male, dorsal apical half of rostrum covered by a patch of short brownish hairs; in female, rostrum bare, more slender, curved and a little longer than in male (Menon & Pandalai, 1960). See Booth *et al*. (1990) for a full description.

Pictures of the pest are available in the EPPO diagnostic protocol for *Rhynchophorus ferrugineus* and *Rhynchophorus palmarum* (OEPP/EPPO, 2007).

Detection methods

The Davis Red Weevil Detector is an electronic instrument capable of amplifying the noise made by *R. ferrugineus* larvae. This detector is essentially a low frequency amplifier. Conventional light traps do not attract *R. ferrugineus* (Sadakathulla & Ramachandran, 1992). In Sri Lanka, Ekanayake (in Reginald, 1973) found traps baited with split fresh coconut petioles to be effective in reducing the number of palms attacked by weevils and consequently recommended their use in estate practice. The Coconut Research Institute (1987) suggested regular surveys of all young palms up to 10–12 years of age as an inspection measure to detect weevil-infested palms.

Recently, aggregation pheromones have been used for mass-trapping and detection of adult weevils. Faleiro & Chellapan (1999) reported the use of ferrugineol-based pheromone lures for trapping *R. ferrugineus*. They also suggested that it was essential to use these together with food bait (sugarcane) to obtain higher catches of the weevil. Abraham *et al*. (1999) also found that weevil trapping is only effective if the pheromone is used with the food bait. A specially designed pheromone trap was described by Maheswari & Rao (2000). Rajapakse *et al*. (1998) found that a 5-L open plastic bucket baited with ferrugineol (4-methyl-5-nonanol)-pentanol, hung on coconut palm stems at 1.5 m caught significantly more adult weevils than ferrugineol-pentanol baited funnel and metal traps. Ferrugineol remained effective as bait for 12 weeks under field conditions. Hallett *et al*. (1999) found that trap catches were maximized by placing the traps at ground level or a height of 2 m and that vane traps were superior to bucket traps. Muralidharan *et al*. (1999) found a significant number of weevils were attracted to bucket traps baited with sugarcane, followed by traps baited with coconut exocarp; date fronds were the least preferred bait. Nakash *et al*. (2000) suggested the use of dogs to detect weevils infesting date palms in Israel. Bokhari & Abuzuhira (1992) developed a test for weevil-infested date palms in Saudi Arabia. In such palms, the rate of transpiration increased and diffusive resistance and water potential were reduced. All three factors could be monitored to detect infestation by *R. ferrugineus*.

Pathways for movement

The pest can be spread over long distances in infested plants for planting of host palms. Short-distance spread is possible by adult flight.

Pest significance

Economic impact

The larvae of *R. ferrugineus*, like those of the EPPO A1 action list pest *R. palmarum* (OEPP/EPPO, 2007), feed on the growing tissue in the crown of palms, often destroying the apical growth area and causing eventual death of the palm. Menon & Pandalai (1960) reported that *R. ferrugineus* is a serious pest of coconut (*C. nucifera*) in India and Sri Lanka. Ganapathy *et al.* (1992) observed *R. ferrugineus* damage in 34% of coconut groves in Kerala (IN), while Dhileepan (1992) reported that the weevil is a major pest of oil palm (*E. guineensis*) in the same state, and it is reported on this host more generally in India (Misra, 1998). Flach (1983) reported that *R. ferrugineus* and *R. vulneratus* are major pests of sago palm (*M. sagu*) in Malaysia (Sarawak). *R. ferrugineus* also causes serious damage on date palm (*P. dactylifera*) in the Middle East.

In the EPPO region, *R. ferrugineus* has already given rise to isolated outbreaks in date-producing countries (Israel, Jordan), while the outbreak in southern Spain is threatening the largest palm plantation in Europe, at Elche in Comunidad Valenciana, which is rated as a World Heritage Site by UNESCO.

Control

Chemical control

As damage by *R. ferrugineus* is difficult to detect during the early stages of infestation, emphasis is generally placed on preventive measures. The common and practical curative measure is the use of insecticides. Preventive and curative measures include: trunk injection with systemic insecticides; treatment of wounds with repellents and filling leaf axils with insecticide dusts mixed with sand; drenching of the crown of infested trees with insecticides. More modern products are being found also to be effective. Barranco *et al.* (1998) recorded the percentage mortality of *R. ferrugineus* larvae treated with different rates of fipronil and azadirachtin (neem). Laboratory trials conducted by Cabello *et al.* (1997) showed that imidacloprid was more effective against all stages of *R. ferrugineus* larvae than oxamyl.

Biological control

Reginald (1973) suggested that natural enemies do not play an important part in controlling *R. ferrugineus*. There were some attempts in the laboratory and field using the predacious *Chelisoches morio* in India (Abraham & Kurian, 1973). However, this did not provide a measurable impact on the weevil. Gopinadhan *et al.* (1990) reported that a cytoplasmic polyhedrosis virus infected all stages of the weevil in Kerala (IN); infected late-larval stages resulted in malformed adults and drastic suppression of the host population. Although various mites have been reported in India as parasites of *R. ferrugineus* (Nirula *et al.*, 1953; Peter, 1989), their impact on the population needs to be ascertained. There is no practical biological control at present.

Cultural and sanitary methods

These include prompt destruction of infested plant material (Kurian & Mathen, 1971) and prophylactic treatment of cut wounds (Pillai, 1987). Abraham (1971) suggested cutting leaves at or beyond the region where leaflets emerge at the base to prevent entry by the weevil into the stem. Azam & Razvi (2001) found that deep cutting to remove growing points of off-shoots (unwanted growths from the trunk) completely, then treating the cut surface with an insecticide such as formothion or dimethoate and covering it with mud reduced the level of infestation to less than 4% compared to 20% for an untreated control (cut at the trunk surface).

Pheromones and other behavioural chemicals

Pheromones are increasingly being used as a management tool against *R. ferrugineus*. Detailed protocols for pheromone-based mass trapping of the weevil are provided by Hallett *et al.* (1999). Faleiro *et al.* (1999) evaluated pheromone lures for the weevil in date plantations in Saudi Arabia and found that high release lures (Ferrolure and Ferrolure+) obtained from Chem Tica Natural, Costa Rica, attracted twice as many weevils as low release formulations. These pheromone lures were equally effective in attracting the pest and were on a par with Agrisense lures from the UK. Vidyasagar *et al.* (2000b), El Garhy (1996) and Faleiro *et al.* (1999) have reported on the use of the aggregation pheromones Ferrolure and Ferrolure+. Gunawardena *et al.* (1998) identified host attractants for the weevil from freshly cut coconut bark and found that a 1:1 mixture of gamma nonanoic lactone 1 and 4-hydroxy-3-methoxystyrene 2 were responsible. Perez *et al.* (1996) reported that there were no apparent differences between the pheromones of *R. ferrugineus* and *R. vulneratus*.

Sterile insect technique

Though there has been some research on use of sterile insect techniques against *R. ferrugineus* (Rahalkar *et al.*, 1973, 1975; Ramachandran, 1991), this has not led to any practical applications.

IPM programmes

Integrated pest management for *R. ferrugineus* has been developed and tested in coconut palms in India (Kurian *et al.*, 1976; Sathiamma *et al.*, 1982, Abraham *et al.*, 1989). Included in the IPM programme were: surveillance; trapping the weevil using pheromones lures; cultural measures such as plant and field sanitation; physical methods (preventing entry of weevils through cut ends of petioles and wounds; use of attractants and other chemicals (including filling of leaf axils with lindane and sand as a preventive measure). Abraham *et al.* (1989) found the

IPM approach very effective in reducing the number of infested palms in Kerala (IN). In the Al Qatif region of Saudi Arabia, Vidyasagar *et al*. (2000a) successfully developed an IPM programme which, in addition to mass pheromone trapping, included a survey of all cultivated gardens, systematic checking of all palms for infestation, periodic soaking of palms, and mass removal of neglected farms. Reviews of control strategies and IPM for *R. ferrguineus* have also been presented by various other authors (Nair *et al*., 1998; Ramachandran, 1998; Murphy and Briscoe, 1999).

Containment and eradication

In Israel (Hamburger *et al*., 2003), an outbreak on date palm which was detected in 1999 was rapidly delimited as a quarantine area. Within this contained area, the pest was suppressed by the following measures: mass trapping, chemical treatment of infested palms, destruction of heavily infested palms, preventive measures). After 4 years, catches were reduced from 324 in 2000 to 26 in 2002 and no new infested palm was found in 2002. It is possible that eradication can be achieved, and it is clear at least that the pest can be contained and suppressed.

Phytosanitary risk

R. ferrugineus attacks many species of palms, and causes serious damage by killing individual trees. It would probably be a serious pest in any EPPO country where palms are widely cultivated. On the basis of experience in Spain, Esteban-Duran *et al*. (1998) warned that *R. ferrugineus* could readily be introduced into other countries of the EPPO region with imported plants for planting. The date-producing countries are particularly at risk: Israel and Jordan have already had outbreaks, and the North African countries are clearly threatened. All Mediterranean countries which grow palms as amenity trees in towns and on sea fronts also face a serious risk. Fitzgibbon *et al*. (1999) identified the weevil as having potential for introduction and establishment in Northern Australia, as a pest of sugarcane. *R. ferrugineus* is actively extending its range.

Several other *Rhynchophorus* spp. attack palms in different parts of the world, in particular *Rhynchophorus bilineatus* and *Rhynchophorus vulneratus* in Southeast Asia, *Rhynchophorus phoenicis* in tropical Africa and *Rhynchophorus palmarum* in Central and South America. The last of these species has already been placed on the EPPO A1 action list (OEPP/EPPO, 2005). The risk from the other species has not yet been evaluated in detail. *R. ferrugineus* is probably the species which is potentially most damaging in practice. In addition, no native *Rhynchophorus* sp. are found on palms in the EPPO region.

Phytosanitary measures

R. ferrugineus was added in 2005 to the EPPO A2 action list, and endangered EPPO member countries are thus recommended to regulate it as a quarantine pest. Outbreaks have already occurred in several EPPO countries, but without rapid spread. It seems that, in the short term at least, domestic phytosanitary measures can contain these outbreaks if they are detected sufficiently early (see Containment and eradication above). However, it is clear that the best strategy for uninfested areas in the EPPO region is to exclude the pest altogether, by requiring all imported plants for planting of palms to originate in a pest-free area or pest-free place of production.

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