

New Palm Hosts for the Red Palm Weevil, *Rhynchophorus ferrugineus*, in Sicily

SANTI LONGO
*Dipartimento DISTEF –
Entomology Section, Catania
University,
Via S. Sofia, 100,
95123 Catania, Italy*

PATTI J. ANDERSON
*Florida Department of
Agriculture and Consumer
Services,
DPI, Botany Section,
P.O. Box 147100
Gainesville, FL 32614-7100,
USA*

TREVOR R. SMITH
*Florida Department of
Agriculture and Consumer
Services,
DPI, Cooperative
Agricultural Pest Survey,
P.O. Box 147100
Gainesville, FL 32614-7100,
USA*

JASON D. STANLEY AND
RENATO N. INSERRA
*Florida Department of
Agriculture and Consumer
Services,
DPI, Nematology Section,
P.O. Box 147100
Gainesville, FL 32614-7100,
USA*

The invasive Red Palm Weevil (RPW), *Rhynchophorus ferrugineus* (Olivier), is native to southern Asia and Melanesia. In 1985, this pest was accidentally introduced and established in the northern United Arab Emirates and has become widespread in that country (Ferry and Gomez 2002). It spread to Iran, Savaran region, in 1990 (Faghih 1996) and Egypt in 1993 (Cox 1993). In the same year, the weevil crossed into Europe, at first into southern Spain (Cox 1993, Barranco et al. 1995) and a decade later into Italy (Longo and Tamburino 2005), many southern European countries, and Turkey (Malumphy & Moran 2007). Recently, the RPW was detected in the Dutch Antillies and California, USA (USDA 2009, Ferry 2010).

The RPW is a key pest of coconut, *Cocos nucifera* L., in South and Southeast Asia (Maxwell-Lefroy 1906, Brand 1917, Viado and Bigornia 1949, Nirula 1956, Faliero 2006) and has attained major pest status on date palm in the Middle Eastern region since the 1980s (Abraham et al. 1998). A report of the RPW on date palm, *Phoenix dactylifera* L., from Iraq in 1920 (Buxton 1920) needs confirmation. Recently the RPW has become a very damaging insect of *P. canariensis* hort. ex Chabaud, in the Mediterranean Basin. Infestations of the RPW on ornamental palms in Italy seem to have originated from large, landscape palms that were imported into many European countries from Egypt and North Africa in violation of phytosanitary regulation (Conti et al. 2008).

Damage and symptoms of RPW infestations have been reported mainly on young palms, i.e., those below the age of 20 years (Nirula 1956, Abraham et al. 1998). Damaged palms exhibit the following symptoms: a) presence of tunnels in the trunk and at the base of frond petiole, oozing out a thick brown fluid, b) accumulation in and around tunnel openings of chewed plant tissues (and frass) giving off a typical fermented odor, c) presence of fallen empty pupal cases and dead adults at the base of heavily infested palms, and d) toppling of the crown and collapse of the trunk, in cases of severe and prolonged infestations (Fig. 1). In date palms, infested offshoots become dry, whereas, in coconut palms, wilting or yellowing of inner fronds may occur (Abraham 1998). In the field, these symptoms can be perceived visually, and the weevil can be detected by the sound of feeding grubs as well as the smell of the fermented frass.

Before 2003, the known host range of RWP included only the 18 palm species listed in Table 1, and the most often reported host species were the economically important coconut, *C. nucifera*, and date palm, *P. dactylifera* (Abraham et al. 1998). Because the RPW is spreading in many countries including the Western Hemisphere (Dutch Antillies and California), it is very important to obtain information on the host range of this invasive weevil. This information is crucial for regulatory purposes and the implementation of RPW exclusion programs. The objective of this note is to report new host data for the RPW obtained in Sicily from 2005 to 2009. These data are the result of extensive surveys conducted by the Sicilian Regional Plant Protection Services in botanical parks, downtown gardens and historic villas on the island. The surveys documented: 1) the spread of the insect infestations in the island; 2) the response and host status of palm species naturally infested by the RWP by assessing the insect population levels on selected palms soon after their death. The results of these studies are presented in this note.

Materials and Methods

A total of 20,000 palms, consisting mainly of *P. canariensis* and a small number of other species, was visually inspected from October 2005 to December 2009, at 450 sites within eight provinces (Agrigento, Caltanissetta, Catania, Enna, Messina, Palermo, Ragusa, Syracuse) in Sicily. Fieldworkers using a basket crane (a device with an open bucket or cage at the end of a hydraulic lifting system from which a worker can repair electrical lines, prune trees or perform other tasks high above

Table 1. Known hosts of the red palm weevil before 2003 (Esteban-Duran et al. 1998).

<i>Areca catechu</i> L.	<i>Livistona decipiens</i> Becc.
<i>Arenga pinnata</i> (Wurmb.) Merrill	<i>Metroxylon sagu</i> Rottb.
<i>Borassus flabellifer</i> L.	<i>Phoenix canariensis</i> hort. ex Chabaud
<i>Caryota maxima</i> Blume	<i>P. dactylifera</i> L.
<i>C. urens</i> L. (= <i>C. cumingii</i> Lodd. ex Mart.)	<i>P. sylvestris</i> (L.) Roxb
<i>Cocos nucifera</i> L.	<i>Roystonea regia</i> (Kunth) O.F. Cook (= <i>Oreodoxa regia</i> Kunth)
<i>Corypha utan</i> Lam. (= <i>C. elata</i> Roxb. and <i>C. gebanga</i> Blume)	<i>Sabal umbraculifera</i> (Jacq.) Mart.
<i>C. umbraculifera</i> Jacq.	<i>Trachycarpus fortunei</i> H. Wendl.
<i>Elaeis guineensis</i> Jacq.	<i>Washingtonia</i> sp.



1. Severe damage to the crown of *Washingtonia* sp.



2. Bucket crane used to observe the crown of an infested *Jubea chilensis*.

street level) examined the palm crowns and trunks for presence of larvae, cocoons and adults and for symptoms induced by the RPW (Fig. 2).

Fifteen naturally infested, dying palms belonging to nine species (Table 2) were selected to determine the insect population levels in the fronds, crown and trunk of each plant. The fronds and trunk of these dying plants were pruned, cut in pieces and coarsely ground in order to remove the insect developmental stages (larvae, pupae and adults) that were embedded in the palm tissues (Fig. 3). Plants were also ranked by height (from the base of the trunk to the crown) before chopping down the fronds and trunk.

The insects were dislodged from the chopped plant tissues and the fermented frass that resulted from larval feeding activity; then their number and life stages were recorded. The insect population levels were expressed as number of postembryogenic life stages per tree and per meter of trunk.

Results and Discussion

The number of infested palm trees increased 260-fold during the 5-year period from 2005 to 2009. Mortality induced by the RPW reached 85% of the infested palms (Fig. 4).

All of the palms listed in Table 2 were hosts for the RPW. Four palm species, *Chamaerops humilis* L., *Brahea armata* S.Watson, *B. edulis*



3. Large cocoon (upper left), adult (upper right) and larva (lower center) of the Red Palm Weevil.

S. Watson, *Howea forsteriana* (F. Muell.) Becc. and *Jubaea chilensis* Baill. are new host records. There was great variability in the population levels of the RPW observed among the palm species and also for individuals of the same species (Table 2). The highest insect populations per tree and per meter of trunk were observed in specimens of *P. canariensis*, *B.*

armata and *B. edulis* (Table 2). Weevils at all final population levels were able to kill the 15 infested palms. The small number of replicates in this study prevents a meaningful statistical comparison of the final insect densities on the various palm species or a valid host rating. The variability in the trunk diameter of the palms caused an imprecise assessment of the final

4. Red palm weevil infestations in ornamental palms and consequent mortality observed in Sicily from 2005 to 2009. Note, the palms found infested at the time of the survey did not survive the insect's invasion.

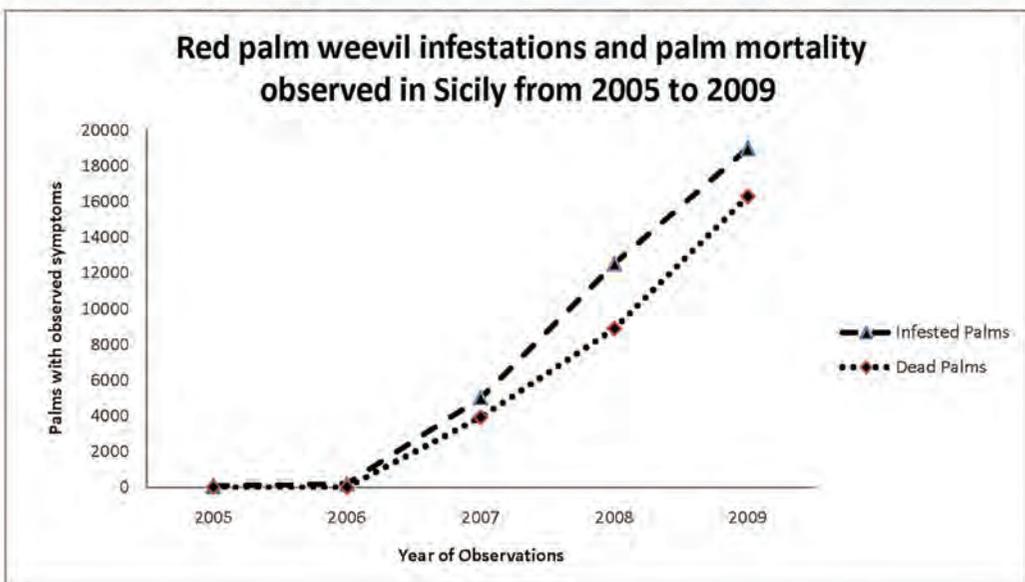


Table 2. Red palm weevil population levels in naturally infested declined palm species naturally infested with sever symptoms in Sicily.

Palm species	height (m)	RPW life stages/tree or (meter of trunk)			
		Larvae	Pupae	Adults	Total
<i>Chamaerops humilis</i> * ^Z	1.50	2 (1)	3 (2)	3 (2)	8 (5)
<i>Brahea armata</i> *	2.00	83 (42)	383 (192)	200 (100)	666 (333)
<i>B. edulis</i> *	4.00	83 (21)	383 (192)	200 (50)	666 (333)
<i>Howea forsteriana</i> * ^Z	3.00	3 (1)	18 (6)	5 (2)	26 (7)
<i>Jubaea chilensis</i> *	7.00	83 (12)	73 (10)	37 (5)	193 (27)
<i>Phoenix canariensis</i>	2.00	130 (65)	435 (213)	170 (85)	725 (362)
<i>P. canariensis</i>	1.00	72 (72)	85 (85)	96 (96)	252 (252)
<i>P. canariensis</i>	1.60	15 (9)	385 (240)	196 (123)	596 (373)
<i>P. canariensis</i>	6.60	150 (23)	85 (13)	97 (15)	332 (50)
<i>P. canariensis</i>	12.00	90 (8)	25 (2)	35 (3)	150 (13)
<i>P. canariensis</i>	10.00	47 (5)	95 (10)	48 (5)	190 (19)
<i>Sabal</i> sp.	1.50	13 (9)	23 (15)	6 (4)	42 (28)
<i>Sabal</i> sp.	1.00	7 (7)	18 (18)	12 (12)	37 (37)
<i>Trachycarpus fortunei</i>	3.00	14 (5)	20 (7)	6 (2)	40 (13)
<i>Washingtonia filifera</i>	6.00	27 (5)	33 (6)	8 (1)	68 (11)
<i>W. robusta</i>	4.00	13 (3)	33 (8)	10 (3)	56 (14)

*New RPW hosts.

^Z Plants concomitantly infested by the weevil *Paysandisia archon*.

insect density per unit of trunk height. However, these field observations show a broad host range of the RPW among palm species.

From field observations, it appears that palm mortality depends on which anatomical tissues are infested by the RPW larvae. If the apical meristem is not damaged by the weevil, the palm may survive even if the insect colonizes other parts of the trunk and/or the fronds. However, if the meristem becomes infested, eventually the palm will be irreparably damaged by the insect. On rare occasions, infestations localized at the base of the tree occurred and resulted in the toppling of apparently healthy plants.

In *Sabal* sp. palms, the RPW larvae burrow into the basal portion of the stem just above the roots and pupate in specialized chambers consisting of roots and soil. This behavior is reported for other palm weevils such as *Rynchophorus palmarum* (L.). We would like to add that agave (*Agave americana*) is reported as

a host for the RPW (Barranco et al. 2000); however, our attempts to rear Sicilian populations of the RPW on agave have failed.

Our findings are of special interest for many countries where palms are major components of their agricultural industry or where palms have great landscape value. In Florida, where *Sabal palmetto* (Walter) Lodd. ex Schult. & Schult. f. is the state tree, the accidental introduction of the RPW could jeopardize the landscape of the state as we know it today. The ability of the RPW to infest *C. humilis* may have devastating consequences for the survival of this palm, one of two native and endemic palm species in the Mediterranean region.

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