Ecological Factors Affecting the Spread of *Rhynchophorus ferrugineus* (Red Palm Weevil) in Eastern Sicily

Filadelfo Conti,
Franca Sesto,
Ernesto Raciti and Valentina Tamburino
Regione Siciliana,
Dip.to Interventi Strutturali
Servizio Fitosanitario Regionale
U.O. 54., Via Sclafani,
32 Acireale (CT), Italy
fconti@regione.sicilia.it

and

Santi Longo
Università degli studi.
Dipartimento di Scienze e
Tecnologie Fitosanitarie,
Via S. Sofia 100,
Catania, Italy
longosan@unict.it

The red palm weevil, *Rhynchophorus ferrugineus* (Oliv.) (RPW), is one of the most damaging pests of *Phoenix canariensis* Chabaud. It is native to southern Asia and occurs in many countries of the Mediterranean Basin, such as Egypt, Spain and Israel (Ferry & Gomez 2002). This paper describes the ecology of the weevil in Sicily.

Female palm weevils (Fig. 1) lay eggs in the axils and petioles of new leaves or in wounds caused by pruning or wind damage. The larvae burrow into the petioles and reach the terminal bud of the palm where they complete their life cycle. Tunneling and feeding by the larvae debilitate the infested trees, which die as a consequence of the build up of numerous generations attained by the insect (Ferry & Gomez 2002). Common symptoms of weevil infestation include leaf chlorosis, drop of green leaves that are no longer supported by the bored axils and collapsed canopy (Fig 2). Larval feeding activity and tunneling produce a typical sound that can be heard and detected with bio-acoustical devices. Infested trees can die in 4–6 months.

In Italy, *R. ferrugineus* was first detected in October 2004 in a palm nursery near Pistoia (Tuscany) (Sacchetti et al. 2006). In the following year, RPW spread to other regions in southern and central Italy including Sicily, where it was detected mainly in old *P. canariensis* palms growing along the eastern coast of the island (Longo & Tamburino 2005, Conti et al. 2006, Longo 2006).

RPW adults detected in Sicily are reddish with a very long rostrum; females average 31.8 mm long and males 30.1 mm. Different prothoracic

spots of diagnostic significance characterize the Sicilian populations (Longo 2006). In Sicily, RPW life stages have been found in the leaf axils and inside the terminal bud of the palm, but not inside the stem. The pupa is protected by a 47.5 mm long cocoon, consisting of palm fibers (Longo 2006). A phoretic mite, *Centrouropoda almerodai* Wisniewski & Hirschmann, has been found associated with adults of the populations studied (Longo & Ragusa 2006).

In many countries where the pest is considered of economic importance non-chemical and chemical approaches have been adopted to manage it. Non-chemical phytosanitary measures such as the removal of insect-infested palm material and wound protection with mastic are useful in suppressing the insect populations and preventing oviposition. The chemical approach, including the application of various chemical formulations, has resulted in inconsistent results and requires frequent chemical applications (Ferry & Gomez 2002). In Italy, pyrethrum and rotenone are registered for use on ornamentals in public sites, but their efficacy is very low. Chlorpyrifos and carbaryl, well known for their effectiveness, are restricted insecticides that are registered for use under special situations such as palm plantations or nurseries. The aim of this work was to determine i) the effect of ecological factors on the progression of RPW infestations in several sites in eastern Sicily, and ii) the population dynamics of the insect using an aggregation pheromone trap technique.

Materials and Methods

Survey and detection of RWP

A preliminary survey by visual inspection was initiated immediately after the first detection of RPW in a Sicilian historical town (Acireale), in the fall of 2005 (October) and was concluded in the spring of 2006 (May). The survey included heavily infested sites and bordering areas in botanical parks, downtown gardens and historic villas. 1140 *P. canariensis*, 81 *Washingtonia filifera*, 58 *P. dactylifera*, 50 *Howea forsteriana* and 6 *Chamaerops humilis* in 162 sites were visually inspected in an area encompassing about 150 km^2 in Catania province. These areas were surveyed again by visual inspection, in summer (July–September 2006) and fall (October– December 2006). Data collected during the three surveys were compared in order to assess the progression of the infestation over the year. Palms with symptoms were visually inspected, sometimes with the help of a lifting device and checked for the presence of larvae and cocoons. All trees were ranked for tallness with the aim of determining whether plant height was a predisposing factor to insect infestation and damage. For conciseness, all the homogeneous sites were grouped together and presented as

1 (left). Adult *Rhynchophorus ferrugineus*. 2 (right). *Phoenix canariensis* severely infested by Red Palm Weevil.

composite sites in Table 1 and Figs. 1–3. A few observations on chemical spray applications, where such programs have been implemented, are also reported.

Monitoring insect populations with pheromone traps

Since RPW adults are attracted by a male aggregation pheromone consisting of ferrugineol and minor components (Soroker et al. 2005), we placed pheromone traps in two different composite sites for monitoring the population dynamics of the insect. One of these sites (Acireale) was undisturbed, whereas the other (Acicatena) underwent chemical management. The pheromone used was Tripheron (Pheromone Trap System). Traps consisted of a 3-liter plastic bucket, covered with rough jute bag and containing the pheromone and an emulsion of water and mineral oil (Longo et al. 2007). No food baits were added because the traps were intended for monitoring the presence of RPW adults and not for mass trapping. The pheromone was changed every 3 months. Traps were hung at 2–3 meters on the palm trunks from May 2006 to January 2007. They were checked weekly.

Results

Survey and detection of RPW

The results of our survey by visual inspection indicate that *P. canariensis* palms are the only host of RPW in Sicily. No RPW were observed on *W. filifera*, *P. dactylifera*, *H. forsteriana*, or *C. humilis*. Male palms are usually more infested than females, which however, are also seriously damaged by the pest. Taller palm trees were more seriously infested than shorter ones (7.72 vs. 6.74 m in 2006). At the beginning (November 2005) of the first survey (October 2005–May 2006), the percentage of infested palms was highest at Acireale (Table 1 and Fig. 1). The percent of infested palms during this survey was variable at the other sites (Table 1). At the end of the first survey in May 2006 and beginning of the second survey in July 2006 we did not notice any increase in the number of infested palms compared to that recorded in November 2005. The cold temperatures during winter and spring time had an adverse effect on the biological activity of the insect and prevented further spreading of the infestation (Figs. 2, 4). However, a total of 71 trees were damaged by the weevil in 2005,

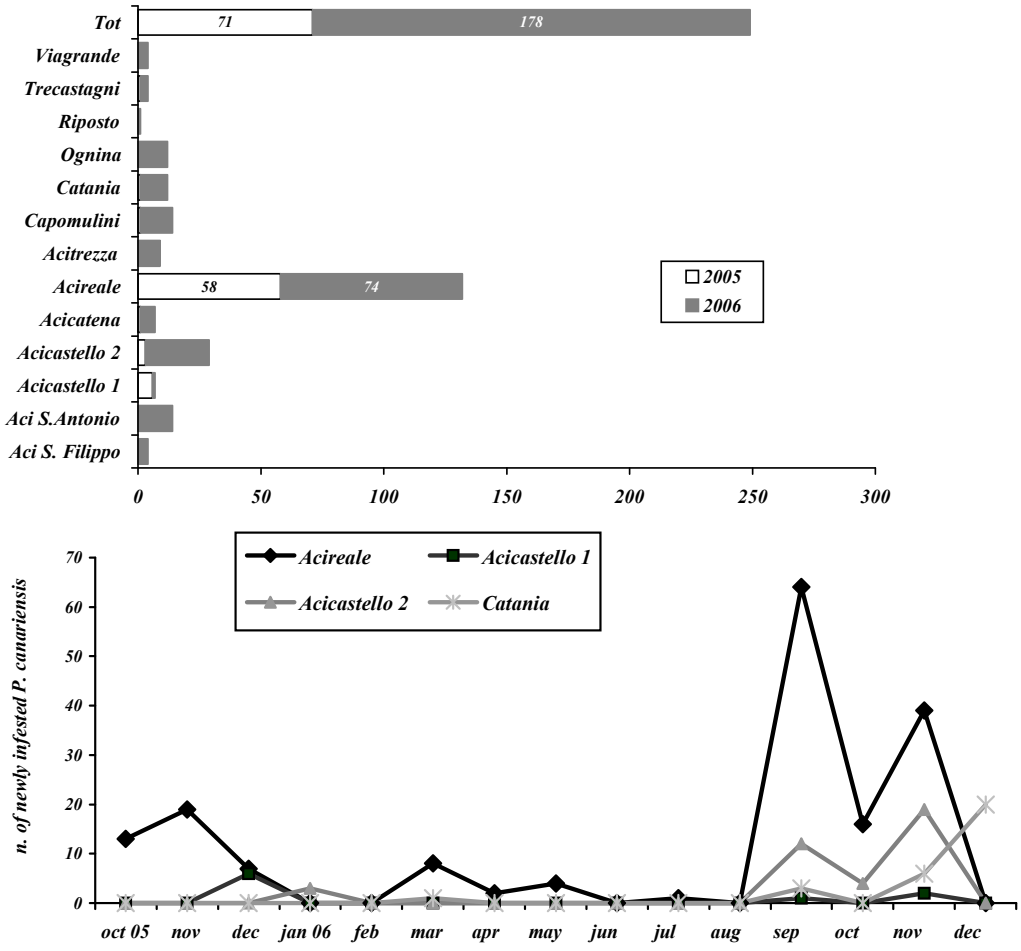
Table 1. Sites surveyed and percent of Canary palms infested by *Rynchophorus ferrugineus* during three different periods (2005–2006), in Eastern Sicily. Nr = not recorded.

Composite sites	Sites examined	No. trees examined	% infested (2005)*	% infested (2006-I)**	% infested (2006-II)***
Aci S. Filippo	5	31	0	12.9	16.0
Aci S. Antonio	7	59	0	23.7	Nr
Acicastello 1	4	59	10.17	6.8	15.0
Acicastello 2	17	130	2.31	20.8	29.9
Acicatena	4	20	5.0	35.0	46.7
Acireale	56	312	18.13	39.7	47.5
Acitrezza	9	24	0	37.5	Nr
Capomulini	3	39	2.56	35.9	73.9
Catania	33	128	0.78	9.38	14.7
Ognina	11	228	0	5.3	Nr
Riposto	4	67	0	1.5	Nr
Trecastagni	4	23	4.35	17.4	Nr
Viagrande	4	8	0	50	Nr
TOTAL	**162**	**1140**	**6.23**	**21.07**	**30.4**

* monitoring from Oct. 2005 to May 2006:

** monitoring from July 2006 to September 2006

*** monitoring from October 2006 to December 2006



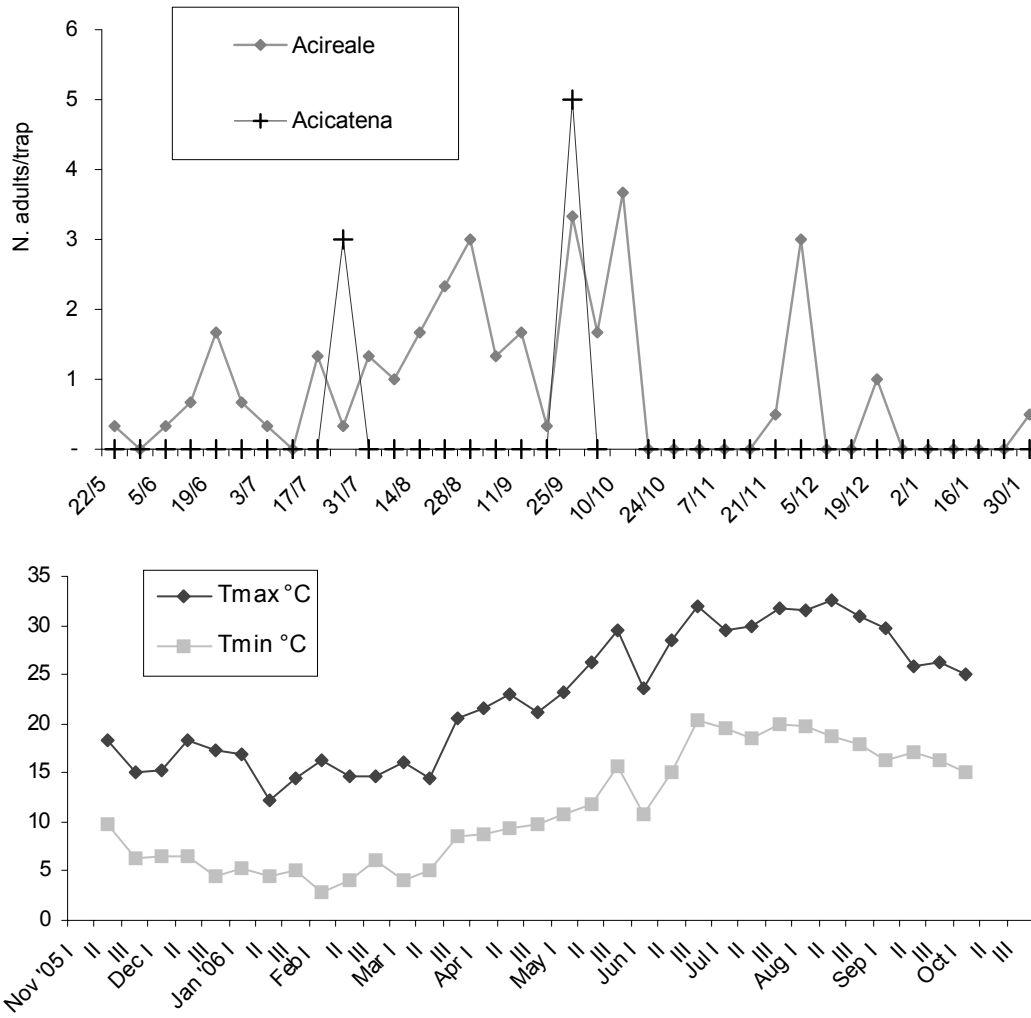
1 (top). Cumulative number of *Rhynchophorus ferrugineus*-infested Canary palms observed during three different surveys (2005–2006), in Eastern Sicily. 2 (bottom). Progressive number of newly infested trees observed from October 2005 to December 2006, at four sites in eastern Sicily.

mainly in the warm period of October–November (Table 1, Fig. 1). The number of infested palms increased dramatically in the summer 2006 (August) at all sites. The high summer temperatures favored the pest activity and its damage. The spread of the insect infestation resumed in July–August 2006 and peaked in September 2006 (Fig.2). Another minor peak occurred in November at the time of the third survey (October–December 2006) (Fig. 2). The highest infestation was again recorded at Acireale site (Table 1). During the infestation peaks young, mature larvae, pupae and adults were observed on the terminal crown of the infested palms. A total of 178 trees sustained RPW damage in the latter survey with a total final incidence of 30.4% of infested palms (Fig.1 and Table 1).

Our visual inspections indicate that, generally, some pyrethroid and organophosphate applications in winter 2005 and spring 2006, had some positive effects and favored sprouting of new vegetation by the infested palms. We suspect that these treatments only suppressed insect populations to levels undetectable by visual inspections. However, in the following autumn the same trees were infested again and died, indicating that the suppression effect of these insecticides is not persistent and repetitive chemical applications are needed to avoid insect population increase.

Monitoring insect populations with pheromones traps

The patterns of weevil captures in pheromone traps were similar at the two composite sites (Acireale and Acicatena) (Fig. 3). Although very few adults/trap were captured during the monitoring program, seven apparent population peaks were recorded at the



3 (top). Captures of *Rhynchophorus ferrugineus* adults in pheromone traps in undisturbed (Acireale) and chemically treated (Acicatena) sites in Eastern Sicily, 2006. 4 (bottom). Maximum and minimum temperatures (°C) in Acireale recorded during this study (data supplied by the Extension Service Office of Acireale).

undisturbed site (Acireale). Only two peaks were observed at the treated site, Acicatena, where several chemical treatments were applied in July–September, slowing down insect development and adult migration. The adults were captured both in the presence and in the absence of evident declining symptoms on the palms in proximity to the traps. However, in some weeks, no captures occurred even in the presence of high infestation symptoms.

Discussion

Since October 2005, when *R. ferrugineus* was first detected in Sicily, the pest rapidly spread over large areas of the island. The fast spread of the insect may be due to the accidental introduction of new RPW sources with infested or contaminated palms that are used in many sites for landscape purposes. The insect, in the monitoring period (October 2005–December 2006), has infested exclusively *P. canariensis*. The patterns of new infestations and adult captures indicate that, in Eastern Sicily, a strong reduction of adult activity occurs in winter and spring as a consequence of the low temperatures recorded in these two seasons. Then, a long period of time is required by the weevil to increase its populations, which reach damaging levels near the end of summer in September–October. Higher infestation rates were observed in the tallest palms compared to the shorter ones. Pheromone traps were not always effective in monitoring the insect population dynamics. In some cases they failed to detect RPW adults before the damage

occurred to the palms. Adult capture was not always in synchrony with the expression of symptoms by the palms. Only on two occasions, in September and November 2006, were two simultaneous peaks of captures and number of newly infested palms noticed. The numerous peaks of adult captures over the survey period could be assigned to overlapping generations of RPW populations.

Our visual inspections suggest that the application of organophosphates or pyrethroids resulted in an effective control of the pest only when the spray applications were repeated frequently and particularly on trees slightly infested. This kind of management strategy is not sustainable in urban areas as well as private gardens and villas because of the environmental and health risk that these treatments pose.

The implementation of rigorous phytosanitary measures is the most promising approach to manage this pest. Under the environmental conditions of Sicily, extensive surveys and the immediate elimination of the newly infested trees at the first insect detection, after the period of decreased activity of the pest in winter and early spring, can suppress drastically the insect populations and the damage to palms in the summer season. Extensive survey and insect monitoring are crucial for the success of this phytosanitary strategy.

Acknowledgments

The authors thank S. Furnitto and I. Zappietro of the Extension Service Office of Acireale and V. Messina for collecting meteorological data; G. Calvagno and S. Rocca for their generous assistance with trap monitoring. A draft of the manuscript was revised by R.N. Inserra and G. Steck at Florida Department of Agriculture and Consumer Services, DPI, Gainesville, Florida.

Literature Cited

Conti, F., E. Raciti, S. Privitera and S. Longo. 2006. Indagini preliminari sulla presenza di *Rhynchophorus ferrugineus* (Oliv.) (Coleoptera: Curculionidae), punteruolo rosso della palma in Italia. Incontri Fitoiatrici 2006 Torino: 57–58.

Ferry, M. and S. Gomez. 2002. The Red Palm Weevil in the Mediterranean area. Palms 46(4): 172–178.

Longo, S. 2006. Ulteriori acquisizioni sul punteruolo rosso asiatico dannoso alla Palma delle Canarie in Sicilia. Informatore Fitopatologico 10: 40–44.

Longo, S., P. Suma, F. Conti and F. Sesto. 2007. Impiego di trappole a feromoni per il monitoraggio di *Rhynchophorus ferrugineus* in Sicilia. XXI Congresso Nazionale di Entomologia, Campobasso, 228.

Longo, S. and S. Ragusa. 2006. Presenza e diffusione in Italia dell'acaro *Centrouropoda almerodai* (Uroactiniinae Uropodina). Boll. Zool. Agr. Bachic. Ser. II, 38(3): 265–269.

Longo, S. and V. Tamburino. 2005. Gravi infestazioni di punteruolo rosso della palma. Informatore Agrario 50: 73–74.

Sacchetti, P., A. Camera, A. Granchietti, M.C. Rosi and P. Marzialetti. 2006. Identificazione, biologia e diffusione del curculionide *Rhynchophorus ferrugineus* (Olivier). Informatore Fitopatologico 6: 35–40.

Soroker, V., D. Blumberg, A. Haberman, M. Hamburger-Rishard, S. Reneh, S. Talebaev, L. Anshelevich and A.R. Harari. 2005. Current status of Red Palm Weevil in date palm plantation in Israel. Phytoparasitica 33(1): 97–106.