

MANAGEMENT OF PALM PESTS

The problem with palm pests is not entomological but

PLANT SANITARY MEASURES

The measures described below can be referred to both palm insect pests detected in Cyprus, namely red palm weevil *Rhynchophorus ferrugineus* and palm borer *Paysandisia archon*.

The Department of Agriculture during the year 2012-2013 continued its eradication campaign against red palm weevil.

During the year under review the campaign focused on the following measures:

- (a) Public awareness campaign: information provided through municipalities and communities, updating a webpage of the Department of Agriculture and informative leaflets/posters.
- (b) Cooperating with municipalities and communities as regards the application of plant protection products on palms located in infested areas, destruction/removal of heavily infested palms, by subsidizing the purchase cost of appropriate plant protection products for preventive and curative applications and for cutting and removing diseased palm trees.
- (c) The application of plant protection products on palms located in archaeological/historical grounds was carried out by personnel of the Department of Agriculture.
- (d) The monitoring of the population of the adult insect by having pheromone traps in all districts.

Data from the monitoring of the population and the number of palms where application of plant protection products and the number of palms removed were collected by the Department of Agriculture. As regards the legislation, the EU Decision 2010/467 on the emergency measures taken to eradicate this harmful organism is still in force, and according to its provisions the Department of Agriculture will inform the Commission and the EU Member States on the current situation of Red Palm Weevil in Cyprus. The Action Plan enforced by the Department of Agriculture, for the year 2012 was approved by the Council of Ministers.

The Plant Health Sector of the Department of Agriculture enforces the national legislation titled “Protective Measures Against the Introduction and Spread of organisms harmful to plants and plant products Laws” of 2003 until 2011, relevant Regulations and Orders. This legislation has adopted provisions of the EU Directive 2000/29/EC and other relevant Directives concerning the adoption on measures during the import from Third Countries and movement within the Community of plants and plant products subject to plant health control, for the prevention of the import and spread of harmful organisms. The competent authority designated for the enforcement of this legislation is the Department of Agriculture and the Director of the Department authorizes Plant Health Inspectors to implement the provisions of this legislation.

With this legislation, among others, there are provisions for obligations of producers, exporters, importers, traders, etc, for their registration in the Official Registry, procedures for carrying out physical control (plant health checks) of plants and plant products, procedures for the issuance of plant passports for certain plants and plant products moved within the Community, procedures for the issuance of phytosanitary certificates, for collecting fees, sanctions/penalties, etc.

Plant health control of plants and plant products imported into Cyprus from Third Countries is carried out at a frequency of 100% at the official points of entry. These points of entry have been officially recognized for this purpose and include Larnaca and Paphos airports, Larnaca, Limassol and Vasiliko ports and the central parcel office in Nicosia. Furthermore, plant health sector carries a 100% inspection on consignments exported from Cyprus at their place of production or packing houses.

It must be noted that plants and plant products imported into Cyprus must be accompanied by Phytosanitary Certificates, which must comply with the relevant phytosanitary requirements of the Community. For these products, at the point of entry, the importer must pay phytosanitary fees which include fees for documentary checks, identity checks and physical checks carried out by the plant health inspectors. Furthermore, plants and plant products destined for export must also be accompanied by the phytosanitary certificate which must comply with the phytosanitary requirements of the importing country. The exporter must also pay fees for the issuance of these phytosanitary certificates.

Plants and plant products moved within the Community and are listed in Annex V Part A of the EU Directive 2000/29/EC must be accompanied by a plant passport. The plant passport is an official document which can take the form of a label or an accompanied document and certifies the freedom of the consignment from harmful organisms. Consignments from other Member States are randomly checked at the place of destination. Traders and importers are obligated to inform in writing the competent authority for their intention to import/trade from another MS plants and plant products, in writing. According to their statement, Plant health inspectors organize their inspections.

Registration to the Official Registry is done after the interested party completes a registration form which is later approved by the Competent Authority. When a physical or legal person is approved, a unique number is given to that interested party which can be used on the plant passport. This registration obligates the interested party to adopt certain practices according to the relevant EU directive. This procedure aims to ensure the absence of harmful organisms from plants and plant products and/or the adoption of immediate emergency measures in case of findings of harmful organisms.

In cases of findings of any harmful organism, Member States are obligated to adopt immediate emergency measures in order to eradicate the harmful organism and to prevent its further spread. Furthermore, the Department of Agriculture must notify other Members States and the relevant EU Commission on these findings with a short description of the emergency measures enforced.

Every month the Commission meets to discuss various technical issues (including the discussion of the adoption of legal texts, such as regulations and decisions) related to plant health matters. It must also be noted that the Commission through a program of “Better Training for Safer Food” organizes training seminars for plant health inspectors. Finally, according to the EU Regulation 886/2004/EC for the crossing of persons and goods across the green line, plant health checks are carried out on all plant products arriving from the areas not under the effective control of the Government of Cyprus in the areas in which the Government exercises effective control.

SANITATION/CULTIVATING MEASURES

Carry out sanitation (pruning, trunk cleaning, removal of leaves, etc) in nurseries, gardens, landscapes, and other establishments **during winter** when no migration/flight activity appears. Use the following techniques:

- Cut into small pieces and burn
- Prune foliage 120 cm from base
- Always treat injuries with an insecticide and fungicide. Wounds should be quickly covered to stop the release of kairomones, which attract the adults. Female weevils will lay eggs in any opening
- Fertilizing, irrigation, control of soil and foliar diseases have no specific time application limitations

BURNING

- Destroy damaged palms at the first sign of RPW and *P. archon* larval infestations by cutting down, shredding into small pieces, and burning, all infested palms. This practice will prevent larvae from hatching and re-infesting an area (Giblin-Davis 2001).
- Burning the top of the tree alone does not kill the stages (especially eggs, larvae, etc) in the middle of the trunk, so heavily infested trees should be uprooted, split open to expose the different stages of the pest inside, and burned (Soroker et al. 2005).

INSPECTION/DETECTION

1) Bioacoustics method. Bioacoustics is a very useful tool for early detection of RPW and other palm insect pests with cryptic life cycle. An automated approach has been researched and implemented by the Consortium based on capturing and automatically recognizing the acoustic emission resulting from typical behaviour such as feeding of the target pests. After acquisition, the signals are amplified, filtered, parameterized and classified by advanced machine learning methods on a portable computer. In the case of palm pests, bioacoustics equipment can be used for the detection (by recording the feeding activity of larvae or adults) of various insects at entry points (i.e. ports). After detecting insect pests in imported palms (they are considered damaged) they can be rejected from being delivered to the final destination

within the island or can be destroyed (under the supervision of local authorities, i.e. Department of Agriculture) or sent back to the country of origin.

2) Visual inspection. In the field, inspect palm trees thoroughly for the signs of red palm weevil damage. Mainly inspect *Phoenix canariensis* and *P. dactylifera* (date palms) species under 20-years old for: a) visible damage symptoms by red palm weevil (i.e. damaged leaves' bases, damaged or dried central leaves, leaves under partial or total slope, brown fluid from the tunnels in the trunk and base of the frond petiole, cocoons in damaged leaves' bases or in the trunk, "umbrella" = palm crown falls over), b) the pest itself.

Regarding *Paysandisia archon*, mainly focus detection observations on *Chamaerops humilis*, *Phoenix roebelenii* and *P. dactylifera*. On *P. dactylifera* attention should be paid mostly on offshoots (dried chewed central leaves, pupa and exuvia, cocoons, dry or wet sawdust (debris). On other palm species same symptoms are observed, additionally check for bored, chewed leaves and leave perforations.

SENSITIVITY/TOLERANCE OF PALM SPECIES (EPPO 2008; Murphy and Briscoe 1999)

- betelnut palm *Areca catechu*
- queen palm *Arecastrum romanzoffiana*
- sugar palm *Arenga pinnata*
- toddy palm *Borassus flabellifer*
- palasan *Calamus merrillii*
- fishtail palm *Caryota cumingii*
- mountain fish tail palm *Caryota maxima*
- coconut *Cocos nucifera*
- gebang palm *Corypha utan* (= *C. gebanga* and *C. elata*)
- African oil palm *Elaeis guineensis*
- ribbon fan palm *Livistona decipiens*
- Chinese fan palm *Livistona chinensis*
- Chinese fan palm *Livistona chinensis* var. *subglobosa*
- sago palm *Metroxylon sagu*
- thorny palm *Oncosperma horrida*
- nibung palm *Oncosperma tigillarum*
- Cuban royal palm *Roystonea regia*
- Canary Island palm *Phoenix canariensis*
- date palm *Phoenix dactylifera*
- east Indian wine palm *Phoenix sylvestris*
- **Majesty palm *Ravenea rivularis* (new record in Cyprus)**
- regal palm *Roystonea regia*
- Hispaniola palm *Sabal blackburniana* (= *umbraculifera*)
- Chinese windmill palm *Trachycarpus fortunei*
- Washington palms *Washingtonia* sp.

Secondary hosts of red palm weevil

- American agave *Agave americana*
- sugarcane *Saccharum officinarum*

Resistant hosts

- *Washingtonia robusta*, *Chamaerops humilis* (Dembilio et al., 2009a).

TRAPPING/MONITORING

Red Palm Weevil *Rhynchophorus ferrugineus*

Pheromone trapping system using Ferrolure (Ferrugineol is the specific pheromone of red palm weevil) in food baited bucket traps containing (or not) insecticide(s), has become a vital component of the IPM strategy.

- Use 1 pheromone trap per 3 hectares
- Do not install pheromone traps in areas with no indications of RPW presence and/or visible palm damage
- Use various pheromone traps such as buckets, plastic jars, pitfall, funnel and other self-made types
- Add food baits to the trap liquid to greatly increase the attractiveness of the trap. Food baits can include dates, apples, palm stems (chopped into 3 to 4 cm pieces) or 10% molasses containing 1 teaspoon of baker's yeast. Food baits should be replaced every 2 to 3 weeks
- Service traps on a weekly basis and record adult captures (usually the number of captured females is higher than male captures)
- Attach burlap, ground cloth, or some other material, to the outside of the container to allow weevils to crawl up the outer surface (i.e. in the case of funnel traps)
- Holes large enough (approximately 3 cm) to permit weevil entry in the side of the bucket, cut near the rim
- Change pheromone dispensers depending on their type (liquid upon evaporation, solid – every 3-4 months depending on prevailing temperatures)

Palm borer *Paysandisia archon*

- **No commercialised pheromone exists for *P. archon* so far**
- Adults can be found captured during their flight period (April/May-August/September)
- Larvae can be found within the trunk and/or offshoots of date palms. Damage symptoms on leaves are visible all year round
- Dead/dry “heart” offshoot date palm leaves are seen during January-April

Various trap types for capturing/monitoring Red Palm Weevil



Plastic jar with a solid pheromone dispenser



Funnel trap with a solid pheromone dispenser



Funnel trap with a liquid pheromone



Pitfall trap with a solid pheromone dispenser



Plastic bucket



Adults captured in a plastic jar

BIOLOGICAL CONTROL (BIOLOGICAL CONTROL AGENTS)

- Use of entomopathogenic nematodes (mainly of the *Steinernema carpocapsae* species) (chitosan formulation), every 2-3 weeks during critical periods (Llácer et al. 2009; Dembilio et al. 2009b). Entomopathogenic nematodes can be safely used in public areas
- Apply 1 million nematodes/litre of solution (see product label for application instructions)
- Remove old leaves and generally keep palm crowns clean before nematode application
- Better effect is expected when both dendrosurgery (first time) and application of nematodes are conducted simultaneously
- Apply nematodes during the periods of April-June and September-November

Biological control agents that may be useful for the control of Red Palm Weevil (from Murphy and Briscoe 1999)

Bacteria: Pseudomonadaceae	<i>Pseudomonas aeruginosa</i>
Bacteria: Flexibacteraceae	<i>Bacillus laterosporus</i> <i>Bacillus megaterium</i> <i>Bacillus sphaericus</i> <i>Bacillus thuringiensis</i>
Fungi	<i>Beauveria bassiana</i> <i>Metarhizium anisopliae</i>
Hymenoptera: Scoliidae	<i>Scolia erratica</i>
Hymenoptera: Forficulidae	<i>Chelisoches morio</i>
Diptera: Sarcophagidae	<i>Sarcophaga fuscicauda</i>
Diptera: Tachinidae	<i>Paratheresia menezesi</i> <i>Paratheresia rhynchophorae</i>
Mites: Laelapidae	<i>Hypoaspis</i> sp.
Mites: Pymotidae	<i>Tetrapolypus rhynchophori</i>
Nematodes: Entaphelenchidae	<i>Praecocilenchus ferruginophorus</i> <i>Praecocilenchus raphidophorus</i>
Nematodes: Rhabditidae	<i>Heterorhaptitis</i> sp. <i>Steinernema abbasi</i> <i>Steinernema riobravae</i> <i>Steinernema feltiae</i> <i>Steinernema glaseri</i> <i>Steinernema anomali</i> <i>Steinernema carpocapsae</i>
Virus	Cytoplasmic polyhedrosis virus

CHEMICAL CONTROL (PREVENTIVE & CURATIVE APPLICATIONS)

****DO NOT APPLY INSECTICIDES DURING BEE ACTIVITY ON PALMS OR OTHER NEARBY CROPS***

Preventive applications (foliar/crown showers) - every 90 days by rotating: (a) chlorpyrifos 48% EC (25cc/10 litres of water), (b) imidacloprid* 20% SL (7.5cc/10 litres of water), and (c) endomopathogenic nematodes (1 million nematodes/1 litre of water)

Curative applications

a) Foliar/Crown showers: Every 40-45 days by rotating: (a) chlorpyrifos 48%EC (25cc/10 litres of water), (b) imidacloprid* 20%SL (7.5cc/10 litres of water), (c) thiamethoxam* 25% WG, (d) abamectin 1,8%EC

b) endotherapy: Every 45 days by rotating systemic insecticides: (a) imidacloprid 20%SL, (b) thiamethoxam 25%WG, (c) abamectin 1,8%EC, (d) lambda-cyhalothrin 2.5%EC (already registered for use in palms in Spain, Italy and France). Use these active ingredients mainly during RPW dispersion/flight activity periods (i.e. April-June, September-November)

* **imidacloprid and thiamethoxam** are under consideration for use in agriculture by the European Commission, due to their possible impact on bees.

Endotherapy¹ (for photos, VIDEO, please visit <http://www.sospalm.com>)

Solution	Product/No of injectors per palm					
	imidacloprid/ 2 injectors ²	abamectin/ 2 injectors ²	thiamethoxam/ 2 injectors ²	imidacloprid/ 3 injectors ³	imidacloprid/ 3 injectors ³	imidacloprid/ 3 injectors ³
Product quantity/palm	6 ml	10 ml	6 gr	10 ml	10 ml	10 ml
Distilled water/palm	20 ml	15 ml	20 ml	30 ml	30 ml	30 ml
Total solution /palm	26 ml	25 ml	26 ml	40 ml	40 ml	40 ml

¹ **2 injectors** are usually recommended for date palms, *Phoenix dactylifera* (thin trunk)

² **3 injectors** are usually recommended for Canary island date palms, *Phoenix canariensis* (fat trunk)

³ **Endotherapy** is effective in cases and areas where the population densities of RPW are **low to medium**. In cases of high population densities (based on population monitoring using pheromone traps and the frequency/number of damaged palms) **foliar/crown showers** should be applied. In this case and depending on the age of the palm, an average of 15-30 litres of insecticide solution per palm (see above for the recommended insecticides) should be applied.

CRUCIAL PERIODS FOR RPW DAMAGE/MIGRATION

Application schedule

- 1st – from end of April to mid-May**
- 2nd – from end June to beginning of July**
- 3rd – from mid September to end September**
- 4th – from mid November to end November**

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