

## Red Palm Weevil (*Rhynchophorus ferrugineus*): Proposition of a Simple and Low-Cost Control Workplan

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### ABSTRACT

**Nasraoui, B. 2020. Red palm weevil (*Rhynchophorus ferrugineus*): Proposition of a simple and low-cost control workplan. Flehetna (<http://flehetna.com>), January 2021, Tunisia, 12 pp.** [https://drive.google.com/file/d/1pMZxj4J\\_1ExwQWJdyIjQ0PV6n05iHLQh/view](https://drive.google.com/file/d/1pMZxj4J_1ExwQWJdyIjQ0PV6n05iHLQh/view)

Red palm weevil (RPW), *Rhynchophorus ferrugineus*, is the most dangerous pest that attacks palms. Almost whole its lifecycle hidden inside the host makes its control very difficult. In date palms, RPW attacks mainly the trunk and rarely the summit, but in ornamental Canary palms, it usually attacks the summit. Periodic and comprehensive inspection of date palms in plantations is a good way to monitor the state of the infestation level. Then, one of the control methods used for long time against the trunk infestation is the sanitation of the infestation place by removing whole the damaged tissue with all insect stages. Another possibility to control RPW trunk infestation is the trunk injection according to our proposed new method which is based on the injection of the trunk at the ground level by a non-diluted insecticide, Emamectin Benzoate 50 g/l (Proact 50EC at 50 ml/palm). For the control of the apical infestation in date palms, our proposition is to utilize the same trunk injection method applied to Canary palms using the non-diluted insecticide Emamectin Benzoate 50 g/l (Proact 50EC at 100 ml/palm). We also proposed the use of the trunk injection as the main technique for an eradication workplan of RPW in Canary palms in Tunisia.

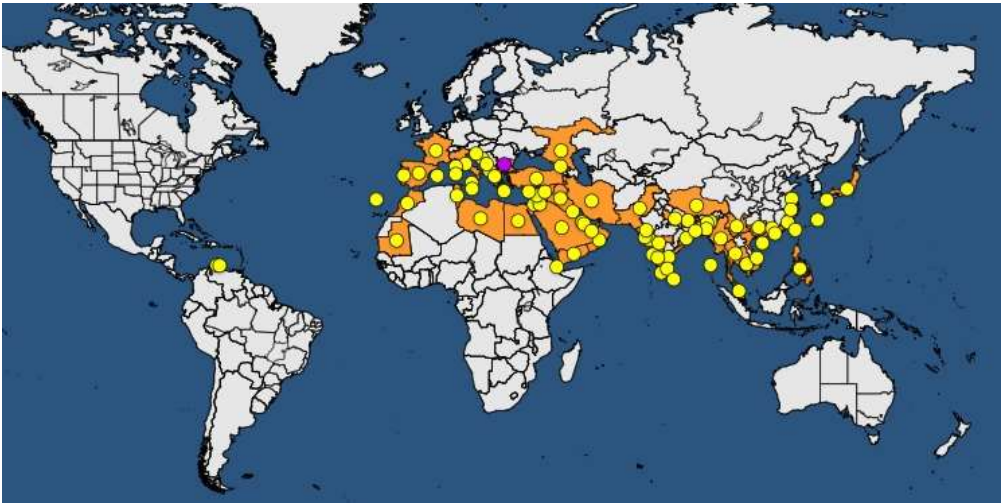
*Keywords:* Canary palms, date palms, red palm weevil, trunk injection, Tunisia

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### INTRODUCTION.

Red palm weevil (RPW), *Rhynchophorus ferrugineus*, is known as the most dangerous pest that attacks palms, because it spends most of its lifecycle hidden inside the palm tree, it is difficult to discover it early inside the palm tree because infestation symptoms do not appear before a certain time when the larva are very young, and when the infestation is found out, it is generally not easy to reach the insect inside the palm tree with chemical or biological insecticides. Also, if the pest is removed from the palm tree or killed in, this does not prevent the host from new infestations again. The adult stage of the insect spreads rapidly over multiple close distances by flying, and all its stages spread rapidly over long distances when carried by infested palm offshoots. Finally, if the infested palm tree is not treated and left alone, the damage always ends with its death within several months to about one year (Abraham et al. 1998; Salama et al. 2009; El-Mergawy and Al-Ajlan 2011; Dembilio and Jacas 2012).

Hence, as a palm tree killer, RPW differentiates itself from the rest of the date pests by its high danger and difficult control, so that it invaded many regions in the world where it propagated during a century beginning from South Asia, crossing the Middle-East to South Europe, reaching North Africa and recently North Europe (Fig. 1) (Faleiro et al. 2012; EPPO 2020). Some researchers have well summarized knowledge, management and challenge related to this pest (El-Shefie and Faleiro 2020; Faleiro 2006; Ferry and Gomez 2014).



**Fig. 1.** Geographic propagation of the RPW around the world (EPPO 2020)

The countries invaded by RPW tried to control it with various methods but failed to eradicate it, excepting Canary Islands and seemingly Mauritania for particular reasons such as the infested regions were isolated (by the sea or in the desert, respectively) and the control decisions were quickly executed. Many control methods used against RPW (such as the injection of the infested trunk using an electric or fuel engine, the fumigation of the infested trunk with aluminum phosphide, the periodical spray of the palms in the plantations, the biological control) are expensive with limited efficacy, and sometimes with negative impacts on the environment or unsafe (Salah et al. 2019; Nasraoui 2020). Hence, RPW became a big issue for the concerned countries almost without solution, and consequently, FAO proposed an international program for the surveillance and control of this pest (FAO 2017, 2019).

Regarding the lifecycle, RPW develops from egg to larva to nymph inside a cocoon and then to an adult stage. The total duration of RPW cycle is 3 to 4 months, depending on the season. Usually, the male and the female adults mate several times and the female often lays 200 to 400 eggs during its lifetime. The female digs holes in the palm tree with its mouthparts and lays eggs in. Few days later, small larvae emerge from the hatching eggs, and soon after, they start digging tunnels in the palm tree tissue to live inside them and grow through several phases. The larvae in their successive phases represent the harmful stage that digs tunnels and greedily feeds on tissue inside the palm by using strong biting mouthparts. Hence, the insect lives during its entire larval stage inside the palm and goes through a large number of molting, during a period of time ranging from 5 to 15 weeks, depending basically on the temperature.

After the larva reaches the last phase of its life, it makes a cocoon from the fibers and tissues of the palm tree for pupation. The nymphic stage in the cocoon lasts between 10 and 20 days without any activity. Gradually, the nymph turns from larval stage to adult stage which emerges from the cocoon to live usually 2-3 months. At its adult stage, the insect continues to live inside the infested palm tree until conditions change and become inappropriate. At such situation, the adult moves outside the palm tree and flies to another one, guided by pheromones released by other RPW individuals and/or by kairomones released by other palm trees (Faleiro et al. 2003; Kaakeh 2005; Soroker and Colazza 2017).

## **CONTROL OF R.P.W. IN DATE PALMS.**

### **Symptoms on date palms.**

Most of the damages due to RPW in date palm (*Phoenix dactylifera*) occur in the basal part of the trunk (FAO 2020) (Fig. 2). In this case, observed symptoms are:

- Ooze secretions seeping out of the date palm trunk that are first yellowish then turn into a dark brown color and dry up resembling to gum,
- Shewed tissue on the surface of the trunk at first wet then dry up over time,
- An unpleasant odor emanating from the infested place resulting from the decomposition of the tree tissue and the larva waste,
- Holes in the trunk of various sizes linked to tunnels and internal cavities filled with shewed tissue, especially when the infestation is advanced,
- Bases of damaged fronds lacerated and easily removed, as there are tunnels with larvae and cocoons inside them,
- When the damage reaches a severe degree, the trunk may break and fall down, facilitated by strong winds.

Other symptoms can be observed such as:

- Wilting, browning and drying of some offshoots, and when severely infested, lacerated from the bottom, then they die so that they are easily separated from the mother palm tree,
- Death of infested aerial offshoots,
- Some fronds of young date palms wilt, turn brown and dry completely, so they become easy to remove.

Although they are rare, apical infestations in date palm can occur according the following steps (Anonymous 2020; Nasraoui 2020) (Fig. 3):

- At first, imbalanced and deformed growth of some fronds with deviation from their original place, creating voids in the date palm summit,
- Fronds partially and then completely wilting and browning due to their damage at the basis level,
- Most of the fronds drying up and falling down, with cocoons scattered around the date palm trunk,
- Death of the growing apex of the date palm and inclination of the summit toward one side,
- Finally, the whole summit of the palm collapses and falls down on the ground.

### **Periodic and comprehensive inspection.**

Periodic and comprehensive inspection (every 45 days) results from the conception based on the principle of breaking the lifecycle of the weevil at the level of the larval and nymphic stages before it reaches the adult stage, as this insect cannot - in the shortest cases - complete its full lifecycle in less than two months, from egg to adult (Al-Shawaf 2020). During

the inspection, all the infested palms showing symptoms must be appropriately treated. But in symptomless cases, the palms might be healthy or might be recently infested without showing symptoms during a period of 2-3 weeks after the beginning of the attack. Since the examiner does not observe symptoms on a newly infested palm over a first inspection, when he returns again to the same palm after 45 days in a second inspection, he will easily detect the infestation symptoms while the insect does reach the adult stage yet, so that he can treat the palm appropriately and kill all insect pre-adult stages without any risk of their spreading to other nearby palm trees. Hence, at each cycle of inspection, the number of discovered infested date palm decreases more and more until it becomes insignificant. This visual periodic comprehensive inspection of the palms every 45 days (8 times/year), could replace the monitoring of the insect by the mass trapping technique.



**Fig. 2.** Trunk symptoms of RPW infested date palms. A: Brown ooze secretions seeping out of the date palm trunk, B: Shewed tissue on the surface of the trunk, C: Lacerated base of damaged frond.

### **Mechanical sanitation of the infested place.**

When RPW infestation symptoms are observed on the palm trunk, one of the simplest methods to cure the infestation is the mechanical sanitation (*Kasht* in Arabic) following these actions (Anonymous 2020; FAO 2020) (Fig. 4):

- Clean the infested place in a way to remove all damaged parts and tissues of the trunk and to leave only the healthy and white tissue,
- Kill all the pest stages found inside the removed trunk materials, collect all the operation remnants and bury them outside the plantation or burn them until they become ashes,
- Immediately after the trunk cleaning, it is imperative to locally spray the cleaned place until wash with a contact insecticide,

- Check the cleaned place one week later to be sure that the cleaned tissue dry well; if so, spray again and fill the cleaned place by mud; but in the case where it is not enough dry, it is necessary to spray again, to wait one more week before to spray a third time and to fill with mud,
- Complete the curative operations by well surrounding the trunk with plastic sheet and tying it around the trunk with strong thread for several months.

### **New trunk injection method.**

Based on some of our experiments on the control of the trunk and apical infestations of date palms, we propose here a simple, easy and low-cost new method of trunk injection that protect the palm tree over several months to one year (Fig. 4).

This new method is based on the injection of the insecticide in a manner similar to that used in the treatment of apical infestation of Canary palms (Chihaoui-Meridja et al. 2019; Gomez and Ferry 2019) and as a modified method used in the treatment of trunk infestation of date palms (Mashal and Obeidat 2019).

Our proposition is summarized into the following 4 steps:

- Dig 4 opposite inclined holes around the trunk at nearly 1 m above the ground level for the apical infestation or at the ground level for the trunk infestation,
- Each hole is 30 cm long for the apical infestation or 15 cm for the trunk infestation, and 1 cm of diameter for both,
- Inject in each hole 25 ml for apical infestation or 12.5 ml for trunk infestation of the insecticide Emamectin Benzoate 50 g/l (Proact 50EC),
- Close holes with mud.

This method that we used for the first time on date palm gave us 80-90% of success in healing apical infestation and more than 90% of success in curing trunk infestation, unless the infestation progression is too advanced. It is still to mention that there is no harm from this new injection method if the injected palm is male, but if the injected palm is female, it is necessary to discard the fruits and get rid of them in a safe way so that they are not consumed by human and animals or to conduct an analysis on the insecticide residues to ensure that the fruits are healthy or unhealthy for consumption.

### **Preventive actions.**

All good agricultural practices are unfavorable for RPW installation. But some of them are highly recommended such as:

- Creating new date palm plantations using offshoots coming from areas RPW free and each offshoot basis should be dipped in a container of insecticide for 30 min before planting,
- Fertilizer application and watering palm trees according to their only needs without excess, to put them in the best growing conditions and not exhausted,
- Avoiding, if possible, the flood irrigation method that can create a high wet environment favorable to RPW,
- Bury palm trunk basis with dry soil to avoid contact between the irrigation- or rain-water and the palm foot,
- Maintaining continuously clean basin around the palm tree by removing all weeds around the trunk,
- Removing as many offshoots as possible to aerate the basis of the trunk and to facilitate inspection and detection of the RPW infestation symptoms,



**Fig. 3.** Apical infestation of palms. Early infestation (A) then died tree (B) of date palms. Dying (C) and dead (D) ornamental Canary palms.



**Fig. 4.** Treatment of RPW infested date palms. A: Cleaning attacked place of the trunk and removing all infested tissue and insect stages, B: Digging hole in the trunk for the control of the apical infestation, C: Injecting the insecticide in the hole in the trunk for the control of the apical infestation.

- Inspecting palm trees periodically to remove all areal offshoots on the palm trunks to be not an entry for RPW,
- Taking good care of date palms through the first and the second pruning (*Taklim* and *Takrib* in Arabic), and after each pruning, spraying pruned palm trees in a way to wash all wounds on the trunk using a contact insecticide; this treatment prevents RPW to approach close to wounds and lay eggs,
- Cleaning the plantation by discarding all kinds of agricultural operation remnants (pruning, cutting, fertilizing, harvesting,...), by burying them far from the farm or burning them until they become ashes.

## **CONTROL OF R.P.W. IN ORNAMENTAL CANARY PALMS.**

### **Symptoms on Canary palms.**

RPW early symptom infestations in Canary palm (*Phoenix canariensis*) may show sharply cut, bitten or holed parts of fronds. Further symptoms can show absence of new fronds that creates partial voids leading to an asymmetrical summit of the palm tree. Finally, the already developed fronds wilt, turn brown and die, and the whole summit collapses (Soroker and Colazza 2017; FAO 2020) (Fig. 3).

### **Periodic and comprehensive inspection.**

Canary palms are ornamental palms that are used to beautify town streets, around hotels, buildings, stadiums,... They are not gathered in farm plantings, so they need to be managed differently under the responsibilities of their owners, of the municipalities and of the agricultural authorities, but not farmers. Nevertheless, it is good to watch and inspect Canary palms in the towns periodically to detect as early as possible the new infestations which are usually apical.

### **Trunk injection.**

The trunk injection against Canary palm apical infestation by RPW was used firstly by Hernandez-Marante et al. (2003) and this technique was inspired from the injection trunk used by Navarro et al. (1992) in olive tree to study the movement of the pesticide inside the trunk. Then, Gomez et al. (2009) improved and simplified this injection technique and called it "endotherapy". They utilize it as an important component of integrated RPW management. Later, the trunk injection, so known as endotherapy, became a common technique used against RPW (Estévez et al. 2011; Gomez and Ferry 2013; Ferry and Gomez 2014; Chihaoui-Meridja et al. 2019; Ferry et al. 2019; Gomez and Ferry 2019). This technique is based on the injection of the insecticide inside the low part of the trunk; then the insecticide migrates to the summit of the palm tree to act curatively by killing all RPW stages and/or preventively by protecting the summit for one year from any new RPW infestations (Chihaoui-Meridja et al. 2019; Gomez and Ferry 2019). It is also an easy, simple and low-cost method, that we simplify to the following steps:

- Dig 4 opposite inclined holes around the trunk at nearly 1 m above the ground level,
- Each hole is 30 cm long and 1 cm of diameter,
- Inject in each hole 25 ml of the insecticide Emamectin Benzoate 50 g/l (Proact 50EC),
- Close holes with mud.

## **CASE OF TUNISIA: AN EASY WORKPLAN FOR R.P.W. ERADICATION.**

Up to now in Tunisia, RPW infestations exist only on Canary palms and are still limited to Grand Tunis (including 4 governorates) and 3 governorates around it (Bizerte, Zaghouan and Nabeul). We propose to act firstly in Grand Tunis (Tunis, Ariana, BenArous and Manouba governorates) by presenting a workplan for the eradication of RPW based mainly on the trunk injection (endotherapy). The 3 remaining governorates can follow the same program. The aim of the program is to inject all palm trunks in one year and to repeat that 2 more years.

Although the absence of exact statistical data, many media and technical articles reported 35,000 Canary palms in Grand Tunis. But for more precaution in the implementing the workplan, let us consider this number 40,000 palm trees. Each agricultural authority



(CRDA) of the 4 governorates takes care of 10,000 Canary palms (as an average). To execute successfully the workplan, each CRDA will need the following human and logistical resources (as an independent and fast-moving team):

- 1 car,
- 1 engineer or technician (leading the team and working also as car driver),
- 3 workers,
- 2 drills,
- 500 hand-syringes,
- 1,000 liters of Emamectin Benzoate 50 g/l (Proact 50EC),
- Mud.

The worker team lead by the engineer or the technician should inject 40 palm trunks/day. Each Canary palm will require about 10 min for digging holes and about 10 min for injecting the insecticide and closing holes with mud. With 2 workers digging holes (+ 1 worker injecting insecticide and closing holes), a number of 12 palm trees may be treated in one hour and then 40 palm trees in less than 4 hours; the rest of the working time of the day (more than 4 hours) will be utilized for moving between palms.

If we consider 250 working days over the year, the RPW team of each CRDA can inject 10,000 Canary palms/year (40 palm trees per day  $\times$  250 working days). Hence, the 4 CRDA can treat all Canary palms of Grand Tunis in one year, and repeat that 2 more years. Since the insecticide can offer protection to Canary palms for one complete year (Chihaoui-Meridja et al. 2019; Gomez and Ferry 2019), it will likely be possible to eradicate RPW in Grand Tunis in 3 years. If a low infestation rate continues to occur, it will need to repeat the treatment for 1 to 2 more years.

It remains the problem of the very advanced infestation that needs to remove certain dead or dying palm trees. This activity could be under the responsibility of the central agricultural authority (DG/SVCIA) which should inspect Canary palms in all areas of Grand Tunis (without need for traps), and remove all infested palm trees that cannot be cured. The removal of each palm tree must be preceded by the spray until wash of the palm summit by an insecticide and the cut parts of the palm dipped in a container of insecticide for 30 min.

## CONCLUSION.

The present article describes a workplan based on simple and low-cost methods to control RPW that can be easily adopted by farmers (for date palms) and by palm owners, municipalities or local agricultural authorities (for Canary palms). The main advantages of this program are:

- Continual inspection of the palms by observing them frequently to guaranty an early detection of the infestations,
- Easy injection of the palm trunk in a safer way for the environment compared to sprays,
- Limiting the insecticide preventive sprays to only pruned palm trees, to minimize the environment pollution.

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## RESUME

**Nasraoui B. 2020. Le charançon rouge du palmier (*Rhynchophorus ferrugineus*): Proposition d'un programme de lutte simple et peu coûteux. Flehetna (<http://flehetna.com>), Janvier 2021, Tunisie, 12 pp.**

Le charançon rouge du palmier (CRP) est le plus dangereux ravageur qui peut attaquer les palmiers. Son cycle de vie quasi-totalement caché à l'intérieur de l'hôte rend son contrôle très difficile. Chez le palmier dattier, le CRP attaque principalement le tronc et rarement le sommet, mais chez le palmier ornemental canarien, il attaque généralement le sommet. Une inspection périodique et complète des palmiers dattiers dans les plantations est un bon moyen de surveiller l'état du niveau d'infestation. Ensuite, l'une des méthodes de contrôle utilisées depuis longtemps contre l'infestation du tronc est l'assainissement de l'endroit de l'infestation en enlevant tout le tissu endommagé avec tous les stades de l'insecte. Une autre possibilité de contrôle de l'infestation du tronc par le CRP est l'injection du tronc selon notre nouvelle méthode proposée qui est basée sur l'injection dans le tronc au niveau du sol d'un insecticide non dilué, Emamectin Benzoate 50 g/l (Proact 50EC à 50 ml/palmier). Pour le contrôle de l'infestation apicale chez les palmiers dattiers, notre proposition est d'utiliser la même méthode d'injection dans le tronc que celle appliquée aux palmiers canariens en utilisant l'insecticide non dilué Emamectin Benzoate 50 g/l (Proact 50EC à 100 ml/palmier). Nous avons également proposé l'utilisation de l'injection dans le tronc comme technique principale dans un programme d'éradication du CRP des palmiers canariens en Tunisie.

**Mots clés:** Charançon rouge du palmier, injection dans le tronc, palmiers canariens, palmiers dattiers, Tunisie

### ملخص

نصراوي، بوزيد. 2020. سوسة النخيل الحمراء (*Rhynchophorus ferrugineus*): اقتراح برنامج مكافحة بسيط ومنخفض التكلفة. [Flehetna \(http://flehetna.com\)](http://flehetna.com), Janvier 2021, Tunisie, 12 pp.

تعتبر سوسة النخيل الحمراء أخطر الآفات التي تصيب النخيل. تعيش هذه الآفة أغلب دورتها الحياتية مخبأة داخل النبتة العائلة مما يجعل مكافحتها صعبة جدا. عند نخيل التمر، تهاجم سوسة النخيل الحمراء الجذع ونادراً ما تهاجم القمة، ولكن عند نخيل الزينة الكناري، عادةً ما تهاجم القمة. يُعد الفحص الدوري والشامل لنخيل التمر في المزارع طريقة جيدة لمراقبة وضع مستوى الإصابة. بعد ذلك، إحدى طرق مكافحة المستخدمة منذ فترة طويلة ضد إصابة الجذع هي كشط مكان الإصابة وإزالة كامل الأنسجة المتضررة مع جميع أطوار الحشرة. وهناك إمكانية أخرى لمكافحة سوسة النخيل الحمراء التي تصيب الجذع وفقاً لطريقتنا المقترحة الجديدة وهي حقن الجذع على مستوى الأرض بمبيد حشري غير مخفف بالماء، إيمامكتين بنزوات 50 غ/ل (برواكت Proact 50EC) بكمية 50 مل/نخلة. ولمكافحة الإصابة القمية على نخيل التمر، اقترحنا استعمال نفس طريقة حقن الجذع المطبقة على النخيل الكناري باستخدام المبيد الحشري غير المخفف بالماء، إيمامكتين بنزوات 50 غ/ل (برواكت Proact 50EC) بكمية 100 مل/نخلة. كما اقترحنا استخدام طريقة حقن الجذع كتقنية أساسية لبرنامج استئصال سوسة النخيل الحمراء على النخيل الكناري في تونس.

كلمات مفتاحية: تونس، حقن الجذع، سوسة النخيل الحمراء، نخيل تمر، نخيل كناري، تونس

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