



Field curative control by (trunk base poured and root feeding techniques) by insecticides date palm trees infested with Red Palm Weevil, *Rhynchophorus ferrugineus* (Olivier) in Sharkia Governorate, Egypt

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Abstract

Experiments were carried out in Abo Hammad district, Sharkia governorate, Egypt to assess the effectiveness of two techniques (poured trunk base and root feeding with insecticides) for controlling the red palm weevil, *Rhynchophorus ferrugineus* (Olivier) under field conditions from 1/1/2023 to 31/12/2023. Results evaluated how different insecticides in their water solutions caused mortality for various stages of RPW inside infested trunk base date palm trees. The highly effective insecticide on the larval stage was 62.5 % by Emamectien benzoate 5.7%WG and the least 44.93% by Acetamprid 20% SP while the most effective on pupal stage 49.72% % was by Emamectien benzoate 5.7 % WG and the least was 37.82 % by Acetamprid 20% SP and efficiency on adult stage was the most effective was 32.14% by Emamectien benzoate 5.7% WG and the least was 20.21 % in Acetamprid 20% SP all insecticides were most effective on larval and pupal stages and low in adult stage and Emamectien benzoate 5.7% WG proved to be the best performer in terms of recovery rate was 70% and the least Acetamprid 20 %SP recovery was 50% in root feeding technique. Statically analyses were highly significant on different stages RPW and recovery % of date palm trees in season 2023.

Keywords: *Rhynchophorus ferrugineus* (Olivier), trunk base and root feeding techniques, insecticides

Introduction

The red palm weevil (RPW) *Rhynchophorus ferrugineus* (Coleoptera: Curculionidae) was initially identified in Egypt as a significant threat to date palm trees. In the final decade of the 20th century, this pest was first detected in date palm plantations in the Sharkia and Ismailia Governorates of Egypt, (Saleh, 1992 and Saleh and Gohar, 1993) [26, 27]. The majority of the damage caused by the red palm weevil in date palm, *Phoenix dactylifera* L., is found in the lower part of the trunk, with the symptoms well documented (Anonymous, 2020 and FAO, 2020) [6]. Infested palm trees typically exhibits several noticeable symptoms. Among these is the presence of a brown, sticky, and strong-smelling fluid that leaks in substantial amounts from holes in the trunks. These tunnels may also house cocoons, adult weevils both within and outside the cocoons, along with all developmental stages of the pest. (Saleh and Gohar, 1993; Olfat and Tahany, 2020) [24, 27]. Over the past decade, reliable sources of infestations have been identified, particularly when examining the trunk. It has been observed that many infested trunk bases harbor significant numbers of RPW survivors just below ground level. These parts of the trunk remain active long after the removal of the infested palm trees above ground, mainly due to the presence of annual roots and moist soil. These findings highlight the effectiveness of root feeding method as primary measures for controlling this pest, as noted by El-Sebay (2004). The evaluation of the chemical control protocol for the Red Palm Weevil (RPW) confirmed a significant reduction in infested date palms in Safwan, Basrah, (2017 – 2022). The insecticide used, Imidacloprid was mainly transported through the xylem of both monocotyledonous and dicotyledonous plant species. It affected the insects by

targeting their postsynaptic nicotinic acetylcholine receptors, ultimately led to their death Stein-Dönecke *et al.*, (1992) [28]. The infestation levels of RPW in the studied orchards showed variation in 2017. However, in 2022, there was a significant decrease in infestation, indicating the effectiveness of a control protocol that involved injecting the insecticide Imidacloprid in Safwan County of Basrah, Iraq. Alderawii, *et al.*, (2025) [5]. Many insecticides, including Imidacloprid, have been tested and evaluated for their effectiveness against RPW in field settings, Azam and Razvi (2001); Dembilio and Jaques (2012) [8, 12]. In a field study, Imidacloprid proved to be an effective insecticide at a concentration of 20 ml /4 liters of water per tree. The application was done through soil drench irrigation around the tree trunk, resulting in mortality rates of 61.9% for larvae and 42.6% for adults, after 25 days post treatment (Kaakeh, 2006) [21]. There are several methods for applying insecticides to date palm trees, and trunk injection is one alternative that involves administering insecticides directly into the tree trunks, Archer, *et al.*, (2022) [7]. Procedure for Root Feeding, Selection of Root: Identify a healthy, live, pencil-thickness fibrous root that is approximately 1-2 meters away from the trunk. Root Preparation: Gently expose the root and make a clean, sharp, slanting cut at an angle. Application: Insert the cut end of the root into a, sealed, 7 x 10 cm polythene bag containing 10 ml of water mixed with the required nutrient tonic or pesticide (e.g., 5% Calixin, 10ml Monocrotophos, or 30ml TNAU Coconut Tonic). Sealing: Securely tie the bag to the root using a cotton thread. Monitoring: After 24 hours, check if the solution has been absorbed. If not, select a different, fresh root for the process. It is highly effective in managing severe infestations of pests such as the red palm weevil,

black-headed caterpillar, and root-wilt disease; Divya Dharshini *et al.* (2026) ^[13]. Root feeding of the affected palm with monocrotophos 10 ml+ 10 ml water is effective in controlling the pest RPW stages inside the palm. Due to the residue problem of this systemic insecticide, a waiting period of 45 days is to be strictly adopted when this insecticide is used for root feeding in yielding palms. To save non-bearing palms this method can be adopted, Rajan, *et al.*, (2009) ^[25]. developed a very simple technique based on an infusion process to injection emamectin benzoate (EMA) formulation, at 3,5% concentration, and the results showed excellent efficiency under different experimental conditions, in addition, the palms of more than 8 meters height, 100% of the larvae were killed even 360 days after injection, compared to 11% in the control treatment. The performance of the developed hydraulic injection device was evaluated taking into consideration: controlling spent time and productivity, controlling efficiency, total consumed power, and the economic cost. Gomez and Ferry (2019) ^[19]. Root feeding (root feeding) began as a simple method and its requirements are available to deliver the pesticide to the palm to contribute to the control process. Yassen *et al.*, (2021) and Yaseen (2025) ^[29]. The objective study is field control of red palm weevil, *Rhynchophorus ferrugineus* (Olivier) using poured trunk base and root feeding with insecticides techniques and aimed to find a better field control schedule using insecticides and best techniques. The research will be conducted under field conditions in Sharkia governorate, spanning the period from 1/1/2023 to 31/12/2023.

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Materials and Methods

Field management of red palm weevil, *Rhynchophorus ferrugineus* (Olivier).

Field trials were conducted on infested farms areas of hayani date palm trees (*Phoenix dactylifera*), aged between 10 to 15 years, under irrigated condition separately in the Abo Hammad district, Sharkia governorate, Egypt. The trial was carried out on naturally infested date palm trees from 1/1/2023 to 31/12/2023.

Experiment design method: Visual examination:

To evaluate the efficiency of four insecticides, two application techniques—base trunk and root feeding—were used to combat larval and adult stages of the red palm weevil *R. ferrugineus*, (Olivier) infestation in palm trees. The affected trees were identified through visual examination of red palm weevil activity, targeting moderate infested specimens and shown out the presence of brown, sticky, foul-smelling fluid oozing in large volumes from tunnels inside the trunks containing cocoons, adults inside or outside the cocoons, all stages of the weevil, offshoots and outer leaves of the palm tree (Saleh and Gohar 1993; Olfat and Tahany, 2020) ^[24, 27].

Techniques of red palm weevil control:

In order to reduce as far as possible, the number of RPW weevils' survivors in the field mainly in certain invisible, especially in hidden sources which represents the initial new infestations such as removing infested root, two experiments were conducted, the first was carried out for getting rid of the hidden sources of infestation within the root's experiments were conducted at infested area in Sharkia governorate, Abo Hammad district from 1/1/2023 to 31/12/2023

To find a better field control schedule using insecticides and best techniques as follows:

First technique, infested trunk base date palm tree application:

Field trials were conducted at the base of infested removed palm tree trunks; each infested trunk base was opened deeply at various points from the top part using a sharp axe to allow the insecticide solution to penetrate downward through the tissues to the lower part where different stages of RP weevils were are survive, insecticides were dissolved in water, and the solution was applied at a rate of 5 to 10 liters per trunk base, depending on the size of the trunk base. This solution was poured into the trunk openings until saturation. A control experiment was also carried out using only water on 10 trunk bases. After Two weeks later, a loader machine picked up the treated trunk base and cut down into sections to allowing inspecting the presence of different a live insect stages inside the roots, in different tested insecticides according to method (El Sabay, 2004).

Second technique, root feeding application:

40 Locate a healthy, live, active, reddish-brown root near the base of the date palm tree infested, approximately 1-2 meters away from the trunk. Choose pencil-thickness fibrous roots and gently expose them and make a clean, sharp, slanted cut at an angle on the root tip to expose the vascular tissue, place the cut end of the root deep inside a heavy-duty, sealed 7x10 cm gradual flasks containing 10 ml of water mixed with insecticides. Tie the flasks mouth securely around the root using cotton thread or zip tie to prevent leaking and check after 24 hours according to the method Albaker (1972) ^[4], Jose, *et al.* (2008) and Yaseen (2025) ^[20, 29]. The percent recovery was calculated for trees were naturally and moderately infested. The selection process followed a randomized complete design for trials to ensure high recovery rates for each method. All treated trees were examined weekly days after application for 21 days.

Evaluation the efficiency of four insecticides with two techniques trunk base, feeding root for control red palm weevil, *R. ferrugineus* (Olivier):

Table 1: Common Name, Trade Name (Active Ingredient), rate of application concentration %, Form and Manufacture Company for four insecticides

Common Name	Trade Name	Concen. %	Form	Rate of Application (Trunk Base)	Manufacture/Distribution Company
Acetamiprid	As El Naser	20%	SP (Soluble Powder), W/W	4 grams per 1 Liter of water	Distributed by Shoura Chemicals
Emamectin benzoate	Aretor	5.7%	WG (Water Dispersible Granules)	3 grams per Liter of water	Syngenta / Local Registered Formulators

Concen. = concentration %=percentage WG= Water Dispersible Granule SP= Soluble Powder ml=mile SC =Suspension Concentrate)

The experiment applied 60 infested date palm trees, employing 10 trees for each insecticide tested (10 palm trees dedicated to 2 insecticides, with 2 techniques: trunk base and root feeding) moderately natural infested date palms were randomly selected for each method using randomized complete block designs. Two insecticides were applied with Acetamiprid 20% SP at 10 grams/L and Emamectin Benzoate 5.7% WG at 25 grams/L per trunk base technique before application on the trees and 20 moderate natural infested date palm trees were left untreated, serving as a control group and sprayed only with water (Abdel-Salam *et al.*, 2015).

The distinction between the two techniques, trunk base poured and feeding root, relied on the quantity, color, and odor of the fluid that oozed out. Quantity of damaged fibers, as well as the depth and width created by larvae, were assessed. Infested palms included in the experiments were identified, marked with paint spray, and tagged. The replicate number and date of application were recorded at the beginning of the experiments.

Recovered and non-recovered palm trees were counted and recorded. Following week days after the poured and root feeding with the tested insecticides, in all treated date palms were inspected. Observations the fluid oozing where from opaque or limpid, acrid odor or odorless, and thoroughly checked that the oozing has stopped or till loosening, disappearance of the most obvious infestation symptoms, i.e., dryness of yellowish-brown viscous liquid in the infested places of the palm trunk and dryness in the heart of the palm tree to determine as a recovery percentage of infested date palms.

Calculated percentages of mortality of red palm weevil: The mortality % of red palm weevil was calculated according to percentage:

$\text{Mortality \%} = \frac{\text{Number of mortality larval} \times 100}{\text{Total number of larval}}$

Total number of larval

According to formula Abbot (1925) and El Sabay (2004) Efficiency percentages of red palm weevil control:

The efficiency % of control was calculated according to percentage of recovery trees, 21 days of different treatments, as follows:

$\text{Efficiency (\%)} = \frac{\text{Number of recovery trees} \times 100}{\text{Total number of treated trees}}$

Total number of treated trees

According to formula Abbot (1925) and Abbas *et al.*, (2024) [1].

Statistical analysis:

Results were statistically analysed using a computer Costat programs (Costat, software, 1990) [11]. Where: analysis of variance.

Results and Discussions

1. Efficacy of insecticides on *R. ferrugineus* (Olivier) infestation by infested trunk base technique on orchards date palm trees, 2023.

This study was conducted in Abo Hammad district, Sharkia governorate, Egypt to assess the effectiveness of poured trunk base technique with insecticides for controlling the red palm weevil, *Rhynchophorus ferrugineus* (Olivier) by two

insecticides were applied with Acetamiprid, 20 % SP and Emamectin benzoate, 9.5% WG from 1/1/ 2023 to 31/12/ 2023.

Data presented in Table (2) and Fig.(1) showed that the highly effective insecticide on the larval stage was 62.5 % by Emamectin benzoate 5.7% WG and the least 44.93% by Acetamiprid 20% SP. while the most effective on pupal stage 49.72% % was by Emamectin benzoate 5.7 % WG and the least was 37.82 % by Acetamiprid 20% SP and efficiency on adult stage was the most effective was 32.14% by Emamectin benzoate 5.7% WG and the least was 20.21 % in Acetamiprid 20% SP all insecticides were most effective on larval and pupal stages and low in adult stage .Data in Table (2) reveal that the statistical analysis of the two insecticides Acetamiprid and Emamectin benzoate were affected highly significantly on larval and adult stages while significant on pupa stage. These results agree with Giblin and Howard (1989) [18]. Appearance that in general from above mentioned data, the effect of all insecticides was higher on larval and pupal stage, while were low on the adult stage. First its function as a good carrier for the insecticides throughout the wooden fibers i.e. deeply inside the inserted roots; second the physical action on the wood as dehydrated substance which caused root dryness faster than insect survive ;and third character is its effect on dehydration and toxic action on the cuticle of the insects .such results consider a guideline to control the insect in its hidden source inside trunk base and that may reduce the number of new infestation to new trees in the future. El-Sebaey (2004) suggested that the most effective chemical on the larval stage of RPW infested trunk base of date palm trees was demonstrated by cidial 57.1%, followed by Basodin (53.6%) ,Dursban ,Quick and stemex 49.2,46.7 and 44.26, respectively) while the most effective chemical on pupal stage 55.6 % was by Basudin followed Dursban 48% quick 42.7% cidial 37.2% and stemex 31.1% efficiency on adult stage was relatively equal among the four tested chemicals ;Dursban,Basudin ,cidial and quick (represented 26.3, 25.7,25.5 and 23.5%) Expect stemex which gave the lowest percent of mortality 13.8%. And the same author added that injection infested trunk date palm tree with Actara insecticide at 1000 ppm a reduction ranged between 80-100 % and statistical analysis using combined analysis showed that the response of the different stages was strongly significant on different insecticides. Gomez and Ferry (2019 [19]). Founded that a very simple technique was developed based on an infusion process to inject an emamectin benzoate (EMA) formulation at 3,5% concentration for the palms of more than 8 meters height, gave 100% of the larvae were killed even 360 days after injection, compared to 11% in the control treatment. Mashal and Obeidat (2019) [22]. Reported that in a previous work where emamectin benzoate was injected in the date palm trunk, no insecticide residues in the date fruits were detected. Chandrashekar, *et al.*, (2020) [10]. Indicated that palms have recovered to the extent of 81.25% by the application injection of Indoxacarb 14.50 SC, and Carbosulfan 25 EC 42.22 % have superior in controlling the infestation of red palm weevil to coconut by their recovery percentage over the untreated control. Nasraoui, *et al.*, (2024) [23]. Showed that injection of the date palm infested trunk by using non-diluted emamectin benzoate (50 g/L), indicated that 100% success in killing all RPW instars in the palm trunk and Felwa *et al.*, (2026) [17]. Reported that trunk injection of date palm trees with

Emamectin benzoate had recovery rates of 71.67% using injection method.

Table 2: Percent mortality of different stages of RPW inside treated roots (trunk base) with insecticides dissolved in water

Insecticides	Infested root (Trunk base),2023								
	Number of stages inside roots								
	Larva			Pupae			Adult		
	Mort.	Total	Mort. %	Mort.	Total	Mort. %	Mort.	Total	Mort. %
Acetamprid 20%SP	111 c	247 c	44.93% c	59 c	156	37.82% c	75 c	94 c	20.21% c
Emamectien benzoate 5.7% WG	170 a	272 d	62.50% a	91 a	183	49.72% a	76 a	112 b	32.14% a
Control	342d	342 a	0% d	2 d	114	1.75% d	83d	83 d	0% d
P	0.000 ***	0.000 ***	0.000 ***	0.000 *	0.000 ***	0.000 ***	0.000 **	0.000 ***	0.000 ***
LSD 0.05 %	2.59	2.037	2.95	5.02	1.553	5.02	4.80	1.251	4.80

%=percentage WG= Water Dispersible Granule Mor. %=mortality percentage SC= Suspension Concentrate SP=Soluble Powder

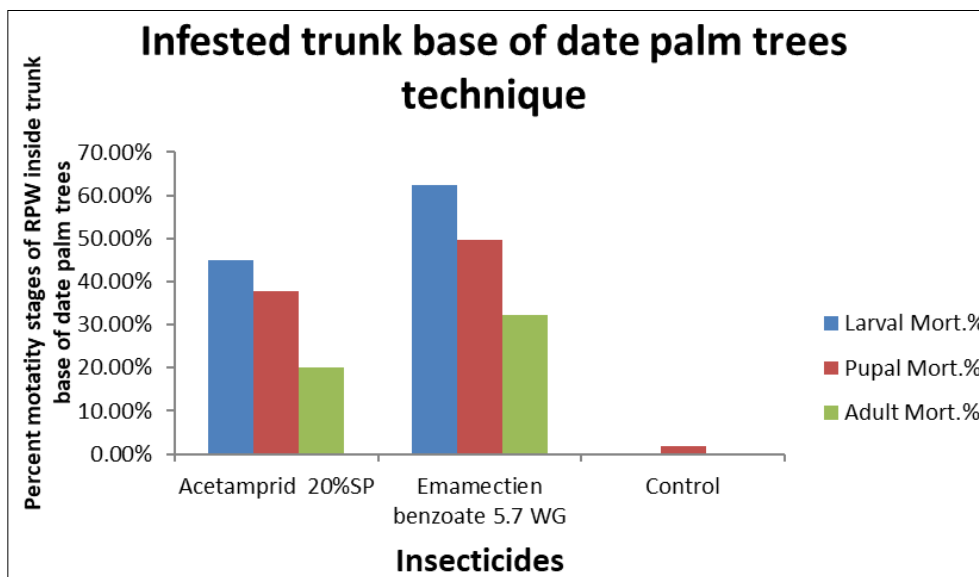


Fig 1: Percent mortality of different stages of RPW inside treated trunk base with insecticides dissolved in water

2. Efficacy of root feeding technique by insecticides on *R. ferrugineus* (Olivier) infestation on orchards date palm trees, 2023.

Field experiment was carried out in Abo Hammad district, Sharkia governorate, Egypt to assess the effectiveness of root feeding technique with insecticides for controlling the red palm weevil, *Rhynchophorus ferrugineus* (Olivier) by two insecticides were applied with Acetamprid, 20 % SP and Emamectien benzoate, 9.7% EC from 1/1/ 2023 to 31/12/ 2023.

Data in Table (3) and Figure (2). represent that Emamectien benzoate 5.7 % WG proved to be the best performer in terms of recovery rate was 70 % the least Acetamprid 20% SP recovery was 50 % in root feeding technique.

Data in Table (3) founded that the analysis revealed to, the two insecticides Acetamprid and Emamectien benzoate were affected highly significantly on number of palm

recovery and recovery mean percentages which $P=0.0001^{***}$ and $LSD\ 0.05\ \% = 0.357$ in number of palm recovery and was 3.577 in recovery mean percentages.

These results agree with Rajan, *et al.*, (2009) [25]. Reported that root feeding of the affected palm with monocrotophos 10 ml+ 10 ml water is effective in controlling the pest RPW stages inside the palm. Due to the residue problem of this systemic insecticide, a waiting period of 45 days is to be strictly adopted when this insecticide is used for root feeding in yielding palms. To save non-bearing palms this method can be adopted and Bouzid *et al.*, (2026) [9]. Studied that high efficacy of Emamectin Benzoate, Proact; Aretor 9.7% ME, and Proclain Super 5.7% ME injected into date palm trunk for control of RPW infestation against RPW with the recovery of most of infested date palm trees (80-90%). The insecticides Emactin 5% EC and Sivanto Prime 200 SL proved insufficiently effective (30-70 %).

Table 3: Efficacy of certain insecticides on *R. ferrugineus* (Olivier) infestation by root feeding technique on orchards date palm trees during one season, 2023

Type of insecticides	oot feeding,2023			
	Dose	No of palm treat	No. of palms recovered	recovery mean%
Acetamprid 20%SP	10 ml in 10 of water	10	5 b	50 b
Emamectien benzoate 5.7% WG	10 ml in 10 of water	10	7 a	70a
Control	10 ml water	10	0	0 c
P	-	-	0.0001***	0.0001***
LSD 0.05 %	-	-	0.357	3.577

%=percentage WG= Water Dispersible Granule No.=Number

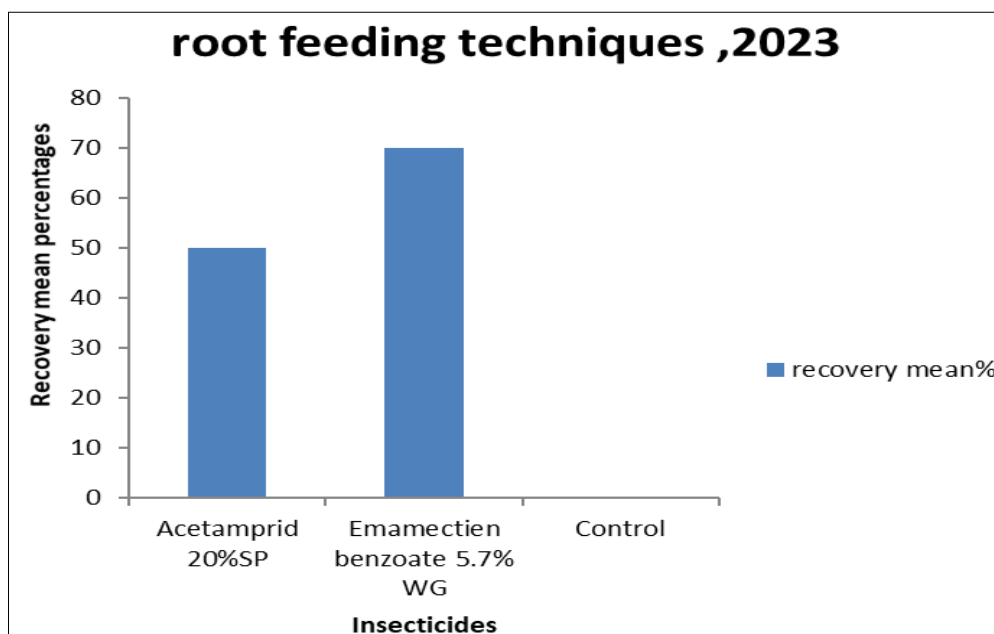


Fig 2: Recovery mean percentages of dates palm trees treated by insecticides on *R. ferrugineus* (Olivier) infestation by root feeding technique on orchards date palm trees during one season, 2023

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