The Positive Impact of Correcting Date Palm Farmers' Mistakes That Hinder the Control of the Red Palm Weevil (*Rhynchophorus ferrugineus*, Olivier)

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Abstract

This field study was conducted in two major oases in the New Valley Governorate, Egypt, to monitor farmers' mistakes that delayed control measures and contributed to an increase in *Rhynchophorus ferrugineus* (red palm weevil) infestations from 2020 to 2023. A total of 22 errors were identified and categorized into three groups: (a) factors delaying infestation detection and control actions, (b) improper horticultural practices, and (c) errors in treatment application. The primary reasons for delayed control included farmers' lack of awareness regarding pest symptoms and stages, their complete reliance on the Agriculture Directorate for control measures, and limited financial resources for palm pest management. Horticultural errors included the absence of preventive spraying after pruning and offshoot separation, transferring infested offshoots to healthy areas, and leaving infested palm waste along pathways, leading to reinfestation. Farmers also neglected to inspect and prune male and non-economic date palms, conduct monthly infestation checks, or control rodents, which contribute to pest spread. Treatment-related mistakes included the misconception that surface pesticide spraying, agricultural sulfur dusting, or burning infested palms could eliminate the weevil. Additionally, incorrect pesticide application, excessive pesticide concentrations, and improper mechanical injections at the palm's terminal bud (*Jumara*) resulted in palm mortality. To assess the positive impact of correcting these errors, a sector with 32,000 date palms (El Kharga 10) was selected, where farmers received extensive training to improve their pest management practices. The infestation rate decreased from 1% in 2020 to 0.7%, 0.47%, and 0.16% in 2021, 2022, and 2023, respectively, with reduction rates of 0.30%, 0.53%, and 0.84%.

Keywords: Date palm, red palm weevil, *Rhynchophorus ferrugineus*, control, farmer mistakes

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Introduction

Date palm is a vital economic crop in many oases of the Near East and North Africa region, playing a key role in sustaining farmers' livelihoods. The loss of date palms is not just an agricultural loss, but a direct threat to the income and future of local communities. Therefore, protecting date palms from devastating pests is crucial. The New Valley is the largest governorate in Egypt, accounting for 43% of the country's total area of nearly one million square kilometers. Located in the western desert, it is

divided into five administrative centers and has a dry climate. Date palms are the backbone of the agricultural economy in this region, with more than four million cultivated trees, primarily concentrated in the El-Kharga and El-Dakhla Oases (Statistics of Directorate of Agriculture, 2023). Common pests affecting date palms in the New Valley include *Arenipses sabella* (Hampson), *Batrachedra amydraula* Meyrick, *Virachola livia* (Klug.), *Ephestia cautella* Walker, *E. calidella* (Guenee), and *Oligonychus afrasiaticus* (McGregor) (Gameel *et al*., 2014; Temerak *et al*., 2014; Gameel, 2017; Elhalawany *et al*., 2020). The red palm weevil (*Rynchophorus ferrugineus*), however, is the most significant pest. First recorded in Egypt in 1992 in Sharkia and Ismailia governorates (Saleh, 1992), it gradually spread to other regions. In the New Valley, it was first reported in Farafra Oasis in 2005, followed by its spread to Kharga Oasis in 2008 and Dakhla Oasis in 2017. *R. ferrugineus* is a highly destructive pest in date palm cultivation across the Middle East and North Africa (EPPO, 2008). Female weevils lay their eggs at the base of the fronds, where the larvae feed inside the palm tree, weakening the crown and trunk and ultimately causing the tree's death. Since its introduction in Egypt, this pest has caused significant economic damage. By the year 2000, approximately 215,652 trees were infested, representing 2.2% of all date palms in the country, and 59,857 trees were completely destroyed (Saleh, 1992; El-Sebay, 2007). Moreover, infestations in Beheira (Egypt) ranged from 16.8% to 25% in affected plantations (Abbass & Gadalla, 2015). Despite the availability of preventive and curative measures, controlling *R. ferrugineus* remains a challenge due to the lack of awareness, knowledge, and adoption of control methods, as well as ineffective coordinated management strategies (Faleiro *et al*., 2018; Ferry *et al*., 2018). Farmers' knowledge of the pest's risks plays a crucial role in combating it. Studies show a gap in understanding farmers' adoption of integrated pest management (IPM) for *R. ferrugineus* and how their knowledge of pest symptoms affects their willingness to adopt IPM strategies (Kassem *et al*., 2020). Additionally, Faleiro *et al*. (2019) highlighted several gaps in the current RPW-IPM strategy and stressed the need for a better understanding of farmers' socio-economic situations and greater involvement of farmers and stakeholders in the management process. In the Luxor region of Egypt, Shakwar (2020) identified various factors that delay control efforts, including the lack of interest from officials in educating farmers and the farmers' reluctance to seek solutions. Additionally, farmers' lack of ownership of date palms has been a barrier to effective pest management. Sallam *et al*. (2012) recommended increasing farmer participation in the RPW management program and educating farmers on the latest management techniques, along with implementing agricultural quarantine regulations. In the New Valley, despite the efforts of the Ministry of Agriculture, research centers, universities, and international organizations, more focused work is still required to understand and address the challenges preventing effective control of *R. ferrugineus*. This study aims to evaluate the positive impact of correcting farmers' mistakes that hinder the control of the red palm weevil through targeted training and technical support. The training program, implemented over three years, sought to

raise awareness and improve farmers' technical capabilities in managing pest infestations.

Materials and methods

Field In 2020, ten training courses were organized (three days each) in El-Kharga and El-Dakhla Oases, New Valley Governorate, aimed at training 500 farmers on the integrated management of the red palm weevil. These courses were designed to address the lack of information and awareness about this dangerous pest. The courses focused on identifying the errors and obstacles that impede effective pest control, as well as modifying farmers' behavior to make them the first line of defense in combating the red palm weevil.

1. The main topics covered during these courses included:

1.1 The global, Arab, and local spread and danger of the red palm weevil.
1.2 The biological and environmental characteristics of the pest, such as its life cycle, number of generations, and flight capabilities.
1.3 How infestation occurs, the symptoms of infection, and methods for early detection.
1.4 Tools and devices used for detecting infestation.
1.5 Horticultural practices that protect against the red palm weevil, including mistakes to avoid during palm care to reduce damage.
1.6 Proper pesticide spraying techniques, timing, injection methods, fumigation of infested palms, and the use of pheromone traps.
1.7 Safe disposal methods for severely infested date palms.

At the end of each training course, farmers visited an infested palm farm to conduct integrated pest control operations and identify the mistakes that led to failed pest management in those areas. To assess the positive impact of these training courses on farmers' behaviors, a large sector of date palms (Al-Kharga 10) was selected for the study. This sector is severely infested with the red palm weevil, with over 32,000 palm trees planted, including 31,000 Saidi palms (a semi-dry, economic cultivar), 670 cereal date palms, and 570 male palms. Over the course of three years (2021–2023), the technical team from the Regional Agricultural Research Station in New Valley provided continuous technical support to the farmers.

Results and discussion

During the training courses on the integrated management of the red palm weevil (Figure 1), several mistakes that delayed the control of this pest were identified. More than 22 errors were observed, which can be grouped into three categories as discussed below:

2. Factors Delaying Infestation Detection and Control Measures

2.1 Lack of Awareness of the Pest's Threat: Many farmers fail to recognize the threat posed by the red palm weevil to date palm plantations, particularly in healthy areas. They often believe the danger is distant. There is limited knowledge

regarding the pest's behavior, such as its ability to fly (1-7 km) and the relationship between the smell emitted from wounds caused by pruning or offshoot removal, which attracts the pest to lay eggs in those areas. Additionally, farmers are unaware of the number of eggs a female weevil lays (approximately 300 eggs), the pest's developmental stages (egg, larva, pupa, adult), its generation cycle, and the key infestation symptoms.

2.2 **Dependence on the Directorate of Agriculture**: Farmers often rely on the Directorate of Agriculture's control departments for all pest management measures, despite these departments facing a severe shortage of technical staff, which hinders timely action.

2.3 **Lack of Budget for Pest Control**: There is no designated budget for controlling palm pests, especially the red palm weevil. Consequently, when an infestation occurs, control actions are delayed until funds are available, exacerbating the problem.

2.4 **Relying on Inaccurate Experience**: Many farmers depend on their own experiences with pest management, which are often based on ineffective control measures previously implemented by authorities. These past failures have led to a lack of trust in the recommended practices, resulting in farmers exchanging inaccurate information with one another instead of adopting proven control methods.

These factors contribute to delayed detection of infestations, slow implementation of control measures, and an increase in the severity and spread of the pest. To address these issues, farmers were trained on the basic biological and ecological characteristics of the red palm weevil, including the symptoms of infestation. This training was particularly important for palm owners in healthy areas. Moreover, farmers were encouraged to allocate a budget for pest control and to seek information from reliable, scientifically-backed sources.

Fig.1. Activity of the training courses

3. Influence of Wrong Horticultural Practices

3.1 **Lack of Protection Spraying after Pruning**: Protection spraying is not carried out following pruning activities. Typically, palms are pruned from mid-October to the end of January, but this is not followed by the recommended pesticide spraying or dusting with a mixture of agricultural sulfur and pesticides. As a result, the wound sites, which emit kairomones, attract red palm weevil insects that lay eggs, leading to new infestations in previously healthy date palm orchards.

3.2 Failure to Spray Offshoots after Uprooting: Preventive spraying or dusting is not applied immediately to the places where offshoots have been cut. Additionally, offshoots are not immersed in a pesticide solution for 15-20 minutes, which would help protect them from red palm weevil attacks.

3.3 Transfer of Infected Materials: Offshoots and palm leaves, which may contain various stages of the pest, are transferred from infested farms to healthy areas. This practice increases the spread of the pest and results in new infestations in previously unaffected fields.

3.4 Improper Disposal of Infected Palm Waste: Infested date palm waste, which contains pest stages, is often left on the edges of walkways and internal roads. This waste becomes a source of renewed infestation, spreading the pest to other areas of the farm.

3.5 Neglect of Male and Cereal Palms (Mantor): There is no effort to examine male and cereal palms (referred to as Mantor), which are scattered along roads and the edges of farms. These palms are left unchecked for years, and if they are infested, they can become a source of renewed infestation for well-maintained palms.

3.6 Use of Flooding Irrigation: Flooding irrigation, especially in older farms, increases the biological activity of the red palm weevil, as the pest is hydrophilic (water-loving). It was observed that palms irrigated using this method were more susceptible to infestation compared to those irrigated by drip systems.

3.7 Neglect of Aerial Root Coverage: There is no effort to cover the areas where aerial roots emerge, which provide favorable sites for the red palm weevil to lay its eggs.

3.8 Failure to Control Rodents: There is a lack of interest in controlling mice and rats, which are a catalyst for attracting the red palm weevil. The kairomone emitted from their feeding attracts the pest, contributing to its spread.

3.9 Infrequent Pest Inspections: The periodic examination to detect red palm weevil infestations is not carried out monthly as recommended, allowing infestations to go unnoticed and untreated for longer periods.

Fig.2. Protection spraying with pesticides after pruning

Fig.3.Immersing the offshoots in the pesticide solution for 15 to 20 minutes

Fig. 4. Transfer of offshoots and palm leaves from infested farms to healthy areas

Fig.5. Leaving palm waste on the edges of the walkways and internal roads

Fig. 6. Non-pruned male date palm

Fig.7. Severe injury in the crown of the palm male

Fig. 8. Severe injury in the trunk of cereal palm (Mantor)

Fig. 9. Aerial roots

Fig.10. A hole in the palm trunk as a result of mice and rats activity

4. Errors during Treatment Application:

4.1 Misconception about External Pesticide Spraying: Many farmers believe that external pesticide spraying alone can cure infestations inside the date palm, not understanding that the pest is primarily active inside the tree.

4.2 Belief That Dusting with Agricultural Sulfur Eliminates Pest Stages: Some farmers believe that dusting the palms with agricultural sulfur alone can eliminate the different stages of the red palm weevil, which is not effective.

4.3 Misunderstanding About Burning Infested Palms: There is a common misconception that burning the infested palm will completely eliminate the pest stages inside the tree, which is not always the case.

4.4 Death of Palm Heart Due to Overuse of Pesticides: The excessive use of high concentrations of pesticides can lead to the death of the palm's heart (Jumara), a critical part of the tree.

4.5 Use of Non-Recommended Pesticides: Some farmers use pesticides that are not recommended for red palm weevil control. These chemicals often lead to unsatisfactory results and may contribute to resistance.

4.6 Improper Injection into the Palm Heart: Incorrect injection methods into the palm's heart (Jumara) can cause severe damage, leading to the tree’s death.

4.7 Covering Infested Palm Trunks with Soil before Treatment: Covering the lower part of the infested palm trunk with soil before treatment hinders proper pest management and can exacerbate the infestation.

4.8 Use of Local Methods for Injection without Standards: Some farmers use local methods for pesticide injection, which involve adding high concentrations of pesticide to a plastic container (usually 20 liters) and delivering the solution to infested areas through fine plastic tubes. This method is not economical and may have toxic effects on the palm.

4.9 Lack of Cooperation among Farmers for Collective Control: Farmers in the same area often fail to cooperate in collective efforts to combat red palm weevil, undermining the effectiveness of control measures.

Fig.11. Severe injury in the palm heart(Jumara) despite repeated external spraying with pesticides

Fig,12. Treatment of the palm trunk despite repeated external dusting with agricultural sulfur

Fig. 13. Extracting the stages of the red palm weevil alive despite the palm burning procedure by the farmer

Fig.14. Death of the palm heart as a result of treating the infested palm with a high concentration of pesticide

Fig.15. Wrong injection in the heart of the palm tree (Jumara), which leads to its death

Fig.16. Using a local method for injection without any standards

5. Evaluating the Results after Training and Correcting Misconceptions

To evaluate the positive impact of correcting the errors mentioned earlier, a sector containing about 32,000 palm trees (El Kharga 10) was selected. Date palm farmers in this sector received comprehensive training aimed at raising their awareness and enhancing their technical skills in addressing these issues. As shown in Figure 17, before correcting the mistakes in managing red palm weevil infestations, the infestation rate was 1% in 2020. After three years of training and technical support, the infestation rates decreased to 0.7%, 0.47%, and 0.16% in 2021, 2022, and 2023, respectively. In other words, as illustrated in Figure 18, the reduction in infestation rates was 0.30%, 0.53%, and 0.84% in 2021, 2022, and 2023, respectively.

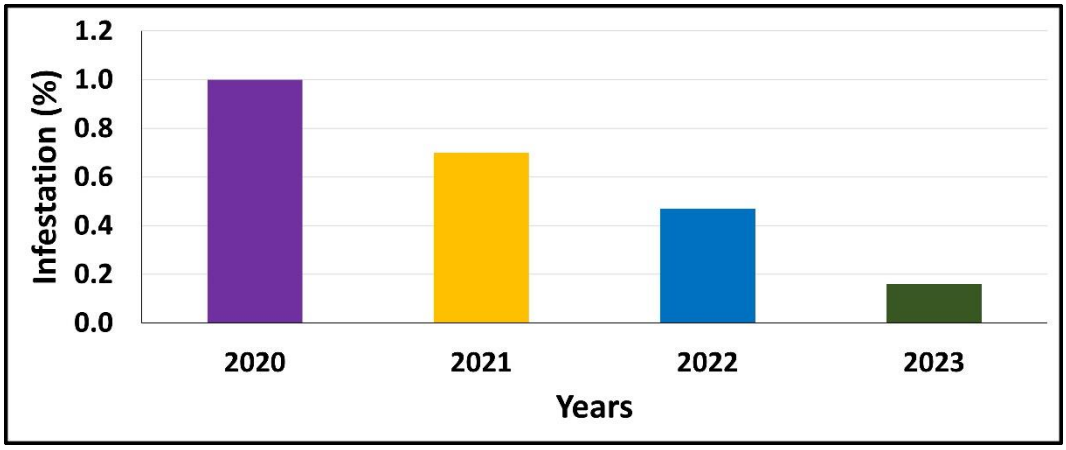

Fig.17. Annual percentage of the infestation with the red palm weevil, El-Kharga 10 sector

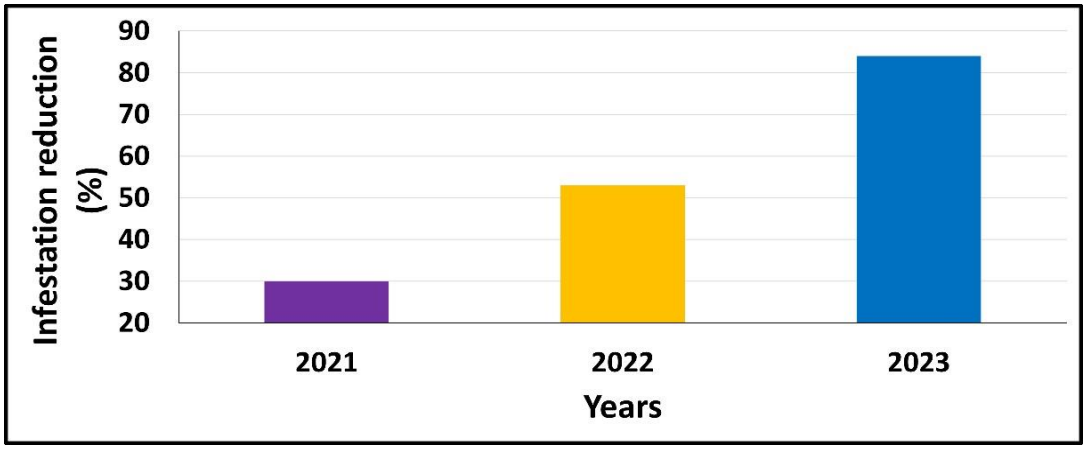

Fig. 18. Annual reduction percentage of the infestation with the red palm weevil, El-Kharga 10 sector

6. Evaluating the Success Factors for Red Palm Weevil Control

It is clear that changing farmers' behavior and raising their awareness plays a crucial role in reducing the damage caused by the red palm weevil. Recent reports by the Food and Agriculture Organization (FAO) have emphasized the critical importance of palm farms in implementing integrated control measures for the red palm weevil (RPW). The involvement of farmers as a key element in RPW control was highlighted, along with the need to devise an effective mechanism for including farm workers in the control process, especially in cases where farm owners are absent. Training and capacity building (for farmers, non-governmental organizations, and cooperatives) are essential components of successful RPW management programs. In Mauritania, a swift and coordinated response by national authorities, involving farmers and local communities with the support of FAO, has led to the rapid containment of the pest (FAO, 2017a). This effort also helped address challenges such as farmers' reluctance to implement plant quarantine procedures, their low participation in periodic visual inspections, and failure to adopt best agricultural practices that limit the spread of RPW (FAO, 2017b). In Al-Ahsa, Saudi Arabia, Kassem et al. (2020) found that most date palm farmers lacked sufficient knowledge to visually diagnose RPW symptoms and damage. Only 13.11% of farmers

had adopted pest management practices for RPW control and eradication. The study revealed a strong positive correlation between knowledge of RPW symptoms and the adoption of integrated pest management (IPM) practices. Farmers who were more knowledgeable about RPW symptoms were more likely to adopt effective IPM measures. Similarly, in the Luxor region of Egypt, Shakwar (2020) found that the knowledge level among surveyed farmers was moderately high (6.9%) regarding RPW control practices. To ensure the success of RPW control efforts, it is essential to assess the social and economic characteristics, as well as the awareness levels among palm farmers and stakeholders in each region. This will help identify both the positive and negative factors affecting RPW control and allow for the development of tailored technical recommendations. The success of raising awareness among palm farmers, who form the first line of defense against RPW, depends on several key factors, including:

6.1 Identifying and correcting errors to reduce the severity of the infestation.
6.2 Strengthening trust between palm farmers and technical support agencies (research and implementation).
6.3 Providing continuous technical support, training, and follow-up to quickly address errors and reduce pest severity.
6.4 Dividing palm farms into sectors to assess regional-specific issues hindering RPW control.
6.5 Creating a spirit of competition among farmers within the same sector.
6.6 Identifying an active contact point in each region for better communication with stakeholders and establishing a farmer database for outreach.
6.7 Surveying and monitoring infection rates, and analyzing data to inform decision-making.
6.8 Increasing technical and financial support for agricultural guidance and control departments.
6.9 Encouraging the active participation of the media (TV, radio, press, websites, and social media), sociologists, religious institutions, NGOs, and local businesses to raise awareness about RPW management programs and enhance public engagement.
6.10 Establishing an independent body for integrated RPW management in each governorate that includes all relevant stakeholders and possesses the authority to make effective decisions based on regional needs, thereby limiting the spread of this pest.

Conclusions

The training provided to farmers in the El-Kharga and El-Dakhla Oases has proven effective in reducing red palm weevil (RPW) infestations by enhancing farmers' knowledge and skills. The study emphasizes the importance of correcting misconceptions, improving horticultural practices, and using proper pest control methods. Success in managing RPW depends on better collaboration between farmers, technical agencies, and communities, along with continuous support and education. Strengthening farmer participation in integrated pest management (IPM) is key to controlling RPW and securing the future of date palm cultivation.

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الأثر الإيجابي لتصحيح أخطاء مزارعي نخيل التمر التي تعيق مكافحة سوسة النخيل الحمراء *Rhynchophorus Ferrugineus* (Olivier)

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الملخص العربي

أُجريت هذه الدراسة الميدانية في أكبر واحتين رئيسيتين في محافظة الوادي الجديد، مصر، لمتابعة الأخطاء التي يرتكبها المزارعون والتي تؤدي إلى تأخير إجراءات المكافحة وتُسهم في زيادة إصابات سوسة النخيل الحمراء (*Rhynchophorus ferrugineus*) في الفترة من عام ٢٠٢٠ إلى ٢٠٢٣. تم تحديد ٢٢ خطأ وتصنيفها إلى ثلاث مجموعات: (أ) العوامل التي تؤخر الكشف عن الإصابة واتخاذ إجراءات المكافحة، (ب) الممارسات الزراعية غير السليمة، (ج) الأخطاء في تطبيق العلاج. تمثلت الأسباب الرئيسية لتأخير المكافحة في عدم وعي المزارعين بأعراض وآثار الآفة، واعتمادهم الكامل على مديرية الزراعة في اتخاذ تدابير المكافحة، بالإضافة إلى الموارد المالية المحدودة لإدارة آفات النخيل. تضمنت الأخطاء الزراعية عدم القيام برش وقائي بعد التقليم وفصل الفسائل، ونقل الفسائل المصابة إلى مناطق صحية، وترك مخلفات النخيل المصابة على طول المسارات، مما أدى إلى إعادة الإصابة. كما أهمل المزارعون فحص وتقليم النخيل الذكري وغير الاقتصادي، وعدم إجراء فحوصات شهرية للإصابة، أو مكافحة القوارض التي تسهم في انتشار الآفة. أما الأخطاء المتعلقة بالعلاج فشملت الاعتقاد بأن رش المبيدات السطحية، أو رش الكبريت الزراعي، أو حرق النخيل المصاب يمكن أن يقضي على سوسة النخيل الحمراء. بالإضافة إلى ذلك، فإن التطبيق غير الصحيح للمبيدات، والتركيزات الزائدة من المبيدات، والحقن الميكانيكي غير السليم في البرعم الطرفي (الجُمَار) أدى إلى موت النخيل. لتقييم التأثير الإيجابي لتصحيح هذه الأخطاء، تم اختيار قطاع يحتوي على ٣٢,٠٠٠ نخلة (الخارجة ١٠) حيث تم تدريب المزارعين لتحسين ممارساتهم في إدارة الآفات. انخفض معدل الإصابة من ١% في عام ٢٠٢٠ إلى ٠,٧% و ٠,٤٧% و ٠,١٦% في الأعوام ٢٠٢١ و ٢٠٢٢ و ٢٠٢٣ على التوالي، مع نسب انخفاض بلغت ٠,٣٠% و ٠,٥٣% و ٠,٨٤%.

الكلمات الدالة: نخيل التمر، سوسة النخيل الحمراء، *Rhynchophorus Ferrugineus* ، المكافحة، أخطاء مزارعى نخيل التمر