Overview of the gaps, challenges and prospects of red palm weevil management

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Abstract

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The Red Palm Weevil (RPW) *Rhynchophorus ferrugineus* Olivier has emerged as a key pest of palms in diverse agro-ecosystems worldwide. RPW has its home in South and South-East Asia where it has been a major pest of coconut. Ever since it was reported on date palm in the Middle East during the mid-1980s, it has spread rapidly mainly through infested planting material. Recent reports of RPW invasion suggest that the pest is gaining foot hold in the Caucasian region where it is detected from Sochi in Russia and Abkhazia in the republic of Georgia and also from East Africa in Djibouti. The current RPW IPM programmes, based on pheromone/bait trapping among other techniques have been implemented with limited success. Gaps and challenges in almost all the components of the strategy, particularly with regard to early detection of the pest, developing and implementing phytosanitary measures, lack of farmer participation in the programmes and scarcity of data on socio-economic issues among several other factors have made RPW control and eradication extremely difficult. On the positive side, the pest has been eradicated in the Canary Islands and is approaching eradication in Mauritania. Eradication has also been obtained in various oasis in Oman but new introductions of infested palms have ruined these successes. The Food and Agriculture Organization of the UN during the Scientific and High Level Meeting on the Management of RPW in March, 2017 called for the urgent need to combat RPW by collaborative efforts and commitments at the country, regional and global levels to stop the spread of this devastating pest and formulated a framework strategy for eradication of RPW which aims to support efforts/programs of countries to stop its spread, to achieve a strong decline and if possible its eradication. This has led to the 'FAO Programme on RPW Eradication in the NENA Region' to intensify governance, monitoring, scientific research, capacity building and coordination. The program fosters the ongoing research on the applicable approaches of biological control and innovative detection and control methods. Furthermore, the 'FAO Global RPW management platform' aims mainly at monitoring the pest using mobile apps and GIS based techniques. This presentation highlights the gaps and challenges in the current RPW-IPM strategy with prospects for improving each component of the RPW-IPM program, based on a much better knowledge on the socio-economic situation and the participation of the farmers and other stakeholders.

Keywords: *Rhynchophorus ferrugineus*, area-wide management, regional, global, constraints, vision.

Introduction

The Red Palm Weevil (RPW) *Rhynchophorus ferrugineus* Olivier (Coleoptera: Curculionidae) is a key pest of palms that has expanded its geographical and host range during the last three decades, ever since it gained foot hold on date palm *Phoenix dactylifera* L. in the Middle-East during the mid-19980s (Faleiro, 2006; Giblin-Davis *et al*., 2013; Gomez and Ferry, 2002). Rhynchophorus palm weevils threaten agricultural areas and natural landscapes (Milosavljević *et al*., 2018) and RPW poses a major threat to palm species in diverse agro-ecosystems worldwide. Recently the Caucuses (Sochi in Russia and Abkhazia in Georgia-Faleiro, 2018) and East Africa (Djibouti: Personal communication from Mr. Yusuf Duhur on 16 June, 2018) have detected RPW on the Canary palm and date palm, respectively. The pest poses a major challenge to date palm farming in the Near East and North Africa (NENA) region which accounts for nearly 90 % of the global date production, threatening livelihood security of rural farming communities. RPW is known to move within national, regional and international boundaries mainly through infested planting material transported for farming and landscape gardening. This calls for the urgent development of quarantine protocols and strict implementation of phytosanitary measures, to restrict the spread of RPW and also to sustain control levels where the pest has been successfully controlled (Faleiro *et al*., 2012; Hoddle *et al*., 2013). Besides phytosanitary measures, the key to the success of any RPW control strategy is the early detection and treatment of infested palms. Currently detection of infested palms is done manually by visual inspections. A recent study (Pugliese *et al*., 2018) on the use of several early detection devices based on thermal imaging, digital camera, tree radar unit and densitometer, concluded that thermal cameras and densitometers hold promise for future RPW detection where detection accuracy levels were nearly 90 %.

Keeping in view the seriousness of the problem, the Food and Agriculture Organization (FAO) of the United Nations along with the International Centre for Advanced Mediterranean Agronomic Studies (CIHEAM) organized a Scientific Consultation and High Level Meeting during March, 2017 wherein a multi-discipline and multi-regional strategy to combat RPW was proposed (http://www.fao.org/3/a-ms665e.pdf). Although, many control means based on conventional and innovative technologies are today in place, FAO attributes the failure to manage RPW in most of the countries to the lack of awareness and systematic and coordinated control actions or management strategies that involve all stakeholders, which is related to inadequate human and financial resources available to combat the pest.

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In general, the failure to control RPW is often not due to the lack of technology but is largely related to socio-economic and operational issues (Figure 1). Very few quantitative data are available on the economic and social impacts of the RPW, at the local or at the national level. To establish such data constitutes an urgent priority. It will allow first to justify by an analysis the cost/benefit ratio to control this pest and, secondly, to identify the weaknesses of the present control programmes and to elaborate socio-economic solutions (Abdedaiem *et al*., 2017). Eradication of the pest conceived as a long-term goal is a strategic mistake that is not sustainable. Hence, upon recording the pest, it is essential to quickly provide the necessary resources (human and material) for the control and eradication of RPW in an adequate and timely manner for the rapid control of the pest (Ferry *et al*., 2018).

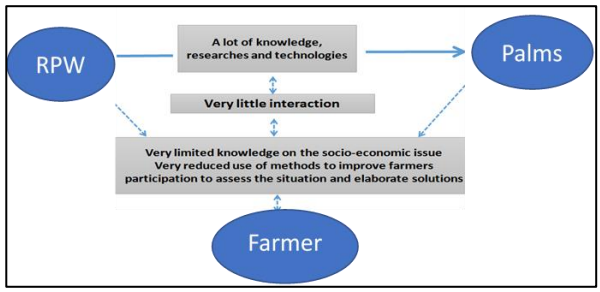

Figure 1. Socio-economic data at the local and national level on the impact of the RPW (Source: Ferry *et al*., 2018).

The current RPW IPM strategy was first tested in Saudi Arabia in date palm and proposed by Abraham *et al*. (1998). This strategy has evolved over the years (Aldobai and Ferry, 2017) and as illustrated in figures 2 and 3 is based on several components including detection of infested palm, pheromone trapping, chemical treatments, removal of severely infested palms, phytosanitary measures among other techniques; which has been implemented with limited success in several countries. The gaps and challenges in almost all the components of the strategy, particularly with regard to early detection of RPW, developing and implementing phytosanitary measures, lack of farmer participation in the programmes and scarcity of data on socio-economic issues, among several other factors, has made control and eradication of this lethal pest extremely difficult. On the positive side, the pest has been eradicated in the Canary Islands and is approaching eradication in Mauritania (Fajardo *et al*., 2017a and http://propalmes83.com/index.php/actualites2/105-en-mauritanie-nette-regression-du-charancon).

A recent report on *Rhynchophorus* palm weevils suggests that enhanced consideration should be given to exclusionary quarantine regulations, invasion monitoring, and eradication to prevent establishment and spread of *Rhynchophorus* spp. Furthermore, management strategies in the future need breakthroughs in surveillance, genetic modification of palm hosts, and new association of biological control (Milosavljević *et al*., 2018). During the Rome meeting in March 2017 the RPW-IPM strategy was deliberated thoroughly (http://www.fao.org/3/a-ms665e.pdf). The following is a summary of the major gaps and challenges in the current RPW-IPM strategy with prospects for improving each component of the RPW-IPM program (Table 1).

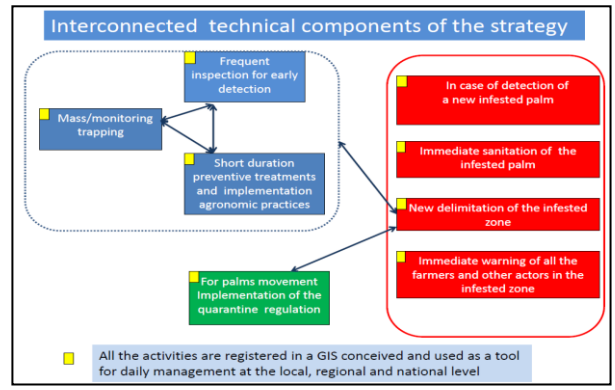

Figure 2. Interconnected components of the RPW-IPM strategy (Source: M. Ferry. http://www.fao.org/3/a-ms665e.pdf)

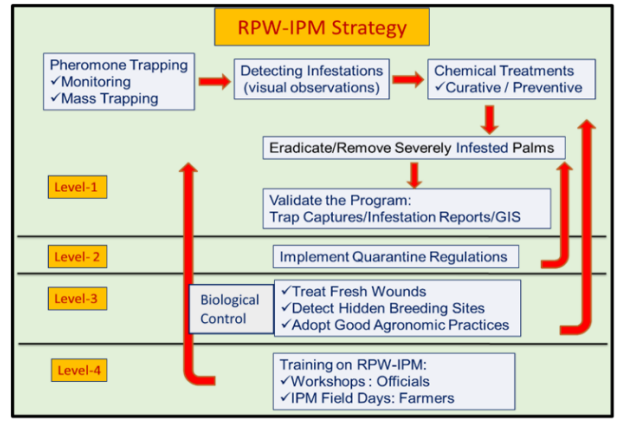

Figure 3. Operational details of the RPW-IPM strategy implemented at different levels (Updated from http://www.fao.org/3/a-ms665e.pdf)

Farmer Participation in RPW Management

Farmer participation in the RPW control programs in several Middle East countries is almost non-existing. Previous research suggests that for the efficient management of mobile insect pests in area-wide operations, farmer participation and cooperation is vital for the program to succeed (Yu and Leung, 2006). The challenge is therefore to enhance the involvement by farmers in the control of RPW in their farms and keep state support/participation in the program to the bare minimum. In this context it is essential to generate data on socio-economic aspects of RPW control through pilot studies on the participation by farmers in the RPW control program and also build capacities of farmers/ national staff on RPW control national/regional initiatives (FAO trust fund for NENA Region) so as to enhance farmer participation in the control of the pest through Farmer Field Schools (Abdedaiem *et al*., 2017; Aldobai and Ferry, 2017). It is pertinent to mention that besides building capacities of all stakeholders, increased awareness and extension campaigns on RPW management is essential in all the NENA countries to enhance farmer participation in the control program.

Table 1. Major gaps, challenges and prospects of the RPW-IPM strategy

Gaps, Challenges and Prospects	Selected References
Early detection, surveillance and monitoring	
Gap	http://www.fao.org/3/a-ms665e.pdf Pugliese *et al*., 2018 Mankin, 2017; Soroker *et al*., 2017
• Lack of a reliable, easy to use and cost effective RPW detection device. • Inadequate farmer/stakeholder participation in detection of RPW infested palms. • Guidelines to categorize palms in different stages of attack are lacking. • Surveillance and monitoring programs not standardized.	
Challenge	
• Develop a uniform protocol for visual inspection, surveillance and monitoring. • Improve farmer/stakeholder's involvement in detecting RPW infested palms. • Use of GIS platform to register the inspection/detection of infested palms.	
Prospect	
• Advanced early detection techniques (acoustics, thermal imaging, chemical signatures, laser induced breakdown spectroscopy, near infrared spectroscopy, biological and physiological indicators, sniffer dogs, remote sensing etc.) that are efficient, easy to use and low cost to be tested for their efficiency and cost effectiveness. • FAO initiative to establish a global RPW management platform that consists of the development of a mobile app tool for the collection and transmission of data on the inspection of palms. • Surveillance and monitoring of RPW standardized in the region and improved.	
Pheromone trapping/Semiochemical control	
Gap	Abraham *et al*., 1998; Vidyasagar *et al*., 2000; Elshafie and Faleiro, 2017; Al-Saroj *et al*., 2017; Soroker *et al*., 2015; Vacas *et al*., 2014
• Current technology is labor intensive and costly due to periodic servicing of the traditional traps. • In several countries RPW traps are serviced by the Department of Agriculture officials with no participation by the farmers. • Lack of systematic data collection and maintenance of the traditional trap. • Non-availability of a field worthy smart trap capable of transmitting weevil captures 24x7. • Insufficient scientific assessment of the new traps and lures.	
Challenge	
• Scientific assessment of efficient and cost-effective traps. • Improve farmer/stakeholder's involvement in servicing and maintain traps. • Incorporating long lasting synthetic kairomones/food baits to eliminate servicing required for the traditional trap. • Transmitting weevil capture data on a 24x7 basis through a smart and dry trap. • Improve the field longevity of pheromone lures.	
Prospect	
• Advanced semiochemical mediated systems involving Attract &Kill, Attract &Infect, Push &Pull etc., developed. • RPW pheromone trapping made efficient and cost effective.	
Preventive and curative chemical treatments	
Gap	Faleiro, 2006; Ferry and Gomez, 2014; Aldawood, *et al*., 2013; Ferry,2017; Al-Dosary *et al*., 2016; Milosavljević *et al*., 2018
• Excessive use of preventive chemical treatments on a calendar schedule. • Dearth of efficient natural products for RPW treatments. • Insecticide resistance developing in RPW to commonly used insecticides. • Improper use of insecticides leading to contamination of the environment and food chain. • Insecticide residues in dates beyond the permissible limits hampering trade of dates. • Lack of standardized protocol to treat RPW infested palms in early stage of attack.	
Challenge	
• To involve and train farmers on the right use of pesticides. • To keep preventive chemical treatments to the bare minimum. • Develop a harmonized protocol for preventive and curative chemical treatments in date palm and ornamental palms. • Evaluate new natural products and biological control agents. • Involve and train the farmers on chemical control measures against RPW especially the proper and safe use of aluminum phosphide in curative treatment. • Efficient use of pressure injectors to treat RPW infested palms and their comparison with the simple diffusion technique.	
Prospect	
• A harmonized protocol for preventive and curative chemical treatments against RPW developed. • Safe biological control agents tested and deployed for RPW control as against the hazardous chemical treatments. • Capacities of farmers/national staff with regard to the use of preventive and curative treatments of RPW infested palms developed through national/regional initiatives (FAO trust fund for NENA Region).	

Table 1. Cont…..

Gaps, Challenges and Prospects Early detection, surveillance and monitoring	Selected References
Removal (eradication) of severely infested palms	
Gap • Different protocols for the removal and disposal of severely infested palms. • Use of costly palm shredders to pulverize palms that are removed/eradicated. • Delayed removal of severely infested palms resulting in emergence/escape of adult weevils. • Escape of adult weevils on-route from the farm to shredding site during transportation of severely infested palms. ***Challenge*** • Involve and train the farmers to remove severely infested palms. • Develop a standard protocol that is cheap and easy to adopt for safe removal and disposal of severely infested palms in-situ (at the farm site). ***Prospect*** • A consistent protocol for eradicating severely infested palms developed. • Capacities of farmers/national staff built with regard to removal and disposal of severely infested palms.	Abraham *et al*., 1998; Faleiro, 2006; Al-Dosary *et al*., 2016; Milosavljević *et al*., 2018
Phytosanitary / Quarantine	
Gap • National/ regional phytosanitary /quarantine regulations against RPW are not adequately implemented. • Treatment protocols to treat palms prior to transportation and also after arrival at destination are not consistent. • Implementation of the regulations is weak due insufficient staff that is often not trained. • Certified planting material is difficult to get. ***Challenge*** • Spread awareness to involve the farmers and other stakeholders. • Develop phytosanitary/quarantine regulation against RPW and ensure implementation at the national, regional and international levels. • Availability of pest free palms through certified palm nurseries/ tissue culture laboratories. ***Prospect*** • Phytosanitary/quarantine regulations standardized at the national and regional levels. • Certified pest free planting material is produced. • Capacities of farmers/national staff with regard RPW quarantine measures built through national/regional initiatives (FAO trust fund for NENA Region).	Faleiro, 2006; Al-Dosary *et al*., 2016; Milosavljević *et al*., 2018; http://www.fao.org/3/a-ms665e.pdf
GIS/Periodic validation of the control program	
Gap • Data on the geo-reference localization of the palms, the RPW-IPM components and their evolution over time using GIS to elaborate maps and analysis of these data is lacking. • Periodic validation of RPW management programs at the local and national levels is lacking/inadequate. ***Challenge*** • Collect real time data on RPW management at the local, national level and the NENA region to serve as an effective early warning system. • Develop a mobile app to record geo-referenced data on RPW management. • Lack of adequately trained staff to use mobile apps/GIS for RPW management. ***Prospect*** • Real time data base and web portal for the management of RPW at the local, national and NENA Region developed. • A mobile app for android and iOS smart phones to record geo-referenced data at the field location on a standard form developed. • A training module for different categories of users of the tools (mobile apps, GIS, software) established. • Remote sensing for large scale monitoring for RPW infested plantations/palms carried out. • Periodic validation of the IPM program for judicious use of resources. • Capacities of farmers/national staff built with regard to the use of the mobile app to record and transmit RPW-IPM data resulting in efficient decision making (FAO trust fund for NENA Region/FAO global RPW management platform).	http://www.fao.org/3/a-ms665e.pdf Massoud *et al*., 2012; Fajardo *et al*., 2017b

Table 1. Cont…..

Gaps, Challenges and Prospects Early detection, surveillance and monitoring	Selected References
Biological control	
Gap	Mazza *et al*., 2014; Hajjar *et al*., 2015
• Known RPW biological control agents (fungi and nematodes) not adequately exploited for RPW control due to poor efficiency and sustainability in the field.	
Challenge	
• Deliver the biological control agent to the pest within the palm.	
• Increase the sustainability of the biological control agent particularly in the arid and hot climatic conditions of the oasis in the NENA region.	
Prospect	
• Effective parasites and predators in palm agro-ecosystems of the world against RPW identified.	
• The efficacy and sustainability of known and new RPW biological control agents tested and field validated through national and regional initiatives.	
• Capacities of farmers/national staff built with regard to biological control of RPW through national / regional initiatives (FAO trust fund for NENA Region).	
Agricultural practices	
Gap	Aldryhim and Al- Bukiri, 2003; Al-Ayedh, 2008; Sallam *et al*., 2012
• The influence of agricultural practices on RPW infestation and its management receives very little attention from the farmer and other stakeholders.	
Challenge	
• Sensitize all stakeholders in the region on the importance of adopting good agronomic practices (variety, palm density, irrigation, frond pruning, offshoot removal, detect hidden breeding sites etc.) in relation to RPW infestation and its management.	
• Generate data on the impact of agronomic in relation to RPW infestation and its management.	
Prospect	
• The importance of agricultural practices in relation to RPW infestation and its management right from planting stage appreciated and adopted by farmers/other stakeholders.	
• Capacities of farmers/national staff built on this aspect through national/regional initiatives.	

New RPW-IPM Tools

In recent years, a large number of new RPW-IPM tools (detectors, surveillance drones, pesticides, palm injectors, semiochemicals, biological control agents, palm shredders, micro wave treatment devices, etc.) became available in the market. These IPM tools need proper testing and validation at the national and regional levels so that only field worthy technologies that are not costly and easy to use are made available to the farmers.

Recent FAO Initiatives Against RPW

During 2018 there have been two major FAO initiatives against RPW that have arisen mainly as an outcome of the "*Scientific Consultation and High-Level Meeting on Red Palm Weevil Management"* held in Rome during March 2017.

1. FAO Programme on Red Palm Weevil Eradication

This project aims at creating a framework for cooperation and coordination of efforts at the regional level for supporting the integrated and sustainable management programs to control RPW; and to reduce its devastating effects on the environment and food security, and socio-economic impact on rural communities.

The objective of this project, is to support efforts/programs of countries in the NENA region to contain the spread and eradication of the pest. The key outputs of the project, revolve on the governance (policies and regulations in order to support the sustainable management of RPW, including phytosanitary and quarantine management practices for fast eradication of RPW and rational use of pesticides), monitoring (early warning, and risk assessment system of RPW control), scientific research (innovation for long-term solutions), capacity building (for stakeholders, farmers, and improved access to sustainable management practices for RPW) and coordination (RPW control response coordinated across countries and the region).

The program fosters ongoing research on the applicable approaches of biological control and innovative detection and control methods. Research priorities on RPW in the project will be identified on the criteria of innovation, applicability, transferability, field experience, sustainability, simplicity/practicality and user-friendly technologies.

2. FAO Global RPW management platform

This project aims to address critical shortcomings in the field for effective monitoring and management of RPW; to systematically collect standard geo-referenced data for which FAO is developing a global RPW monitoring and early warning system. This system consists of a mobile App for data collection in the field and GIS-based online system for data analysis and mapping combined with remote sensing imagery.

In conclusion it can be said that to take RPW control to new level, there is an urgent need to address the gaps and challenges of each of the RPW-IPM components, besides studying the socio-economic impacts and enhance farmer participation in the control program.

الملخص

فاليرو، جو رومينو، ميشيل فيري، ثائر ياسين وشوقي الدبعي. 2019. لمحة عامة حول الثغرات والتحديات وآفاق إدارة سوسة النخيل الحمراء. مجلة وقاية النبات العربية، 37 (2): 170-177.

برزت سوسة النخيل الحمراء Olivier *Rhynchophorus ferrugineus* كآفةٍ رئيسةٍ لأشجار النخيل في النظم البيئية الزراعية المتنوعة حول العالم. اتخذت سوسة النخيل الحمراء من جنوب وجنوب شرق آسيا موطناً حيث كانت آفةً رئيسةً لنخيل جوز الهند؛ ومنذ ذلك الحين فقد سجّلت على نخيل التمر في منطقة الشرق الأوسط منتصف الثمانينات، ثم انتشرت سريعاً وبشكلٍ أساسي من خلال تداول المادة النباتية المصابة. كما تشير التقارير الأخيرة المتتبعة لغزو هذه الآفة بأنّها قد أوجدت لها موطئ قدمٍ في منطقة القوقاز حيث تمّ الكشف عنها في كلٍّ من سوتشي في روسيا وأبخازيا في جمهورية جورجيا، وكذلك في شرق أفريقيا (جيبوتي). ومن بين التقنيات الأخرى، فقد طبّقت برامج المكافحة المتكاملة الحالية لسوسة النخيل الحمراء باستخدام المصائد الفيرمونية/الطعوم الغذائية ولكنّها لاقت نجاحاً محدوداً. إنّ الثغرات والتحديات المنضوية بمجملها تقريباً ضمن عناصر هذه الاستراتيجية (لاسيّما فيما يتعلّق بالكشف المبكّر للآفة، تطوير وتنفيذ تدابير الصحة النباتية، عدم مشاركة المزارعين في هذه البرامج، وندرة البيانات المتعلّقة بالقضايا الاجتماعية-الاقتصادية) كانت من بين عدّة عوامل أخرى ساهمت في جعل السيطرة على سوسة النخيل الحمراء واستئصالها عمليةً صعبةً للغاية. وفي الجانب الإيجابي، فقد تمّ استئصال هذه الآفة في جزر الكناري، وأوشك القضاء عليها في موريتانيا؛ كما تحقّق استئصالها ضمن واحاتٍ شتّى في كلٍّ من عُمان والأردن؛ بيد أنّ مدخلاتٍ جديدة لأشجارٍ مصابة قد قوّضت هذا النجاح. وخلال الاجتماع العلمي الرفيع المستوى والذي عقد خلال شهر آذار/مارس من عام 2017 حول إدارة سوسة النخيل الحمراء، فقد دعت منظمة الأغذية والزراعة (الفاو) التابعة للأمم المتحدة إلى وجود حاجة ملحّةٍ للتصدّي لسوسة النخيل الحمراء بتضافر الجهود والمواثيق على المستويات القطرية والإقليمية والعالمية لاحتواء انتشار هذه الآفة المدمّرة، وصياغة الاستراتيجية الاطارية لاستئصال سوسة النخيل الحمراء، والتي تهدف إلى دعم جهود/برامج البلدان لكبح انتشار الآفة، وتحقيق خفضٍ ملموس للآفة يفضي لاستئصالها. وقد نتج عن ذلك "برنامج منظمة الفاو حول استئصال سوسة النخيل الحمراء في منطقة الشرق الأدنى وشمال إفريقيا" لإحكام السيطرة، وتكثيف: المراقبة/الرصد، البحث العلمي، بناء القدرات، والتنسيق. ويرعى البرنامج الأبحاث الجارية بشأن المقاربات التطبيقية للمكافحة الحيوية والطرائق المبتكرة لكشف الآفة ومكافحتها. وعلاوةً على ذلك، فإنّ "منصّة منظمة الأغذية والزراعة العالمية لإدارة سوسة النخيل الحمراء" تهدف بشكلٍ أساسي إلى رصد الآفة باستخدام تطبيقات الهاتف الجوّال والتقنيات المعتمدة على نظم المعلومات الجغرافية. وسيضطلع هذا العرض بتسليط الضوء على الثغرات والتحديات الكامنة في الاستراتيجية الحالية للمكافحة المتكاملة لسوسة النخيل الحمراء مع آفاق تطوير كلّ عنصر مُدرج ضمن هذه الاستراتيجية؛ وذلك استناداً لمعرفةٍ أوسع حول الحالة الاجتماعية-الاقتصادية، ومشاركة المزارعين وغيرهم من أصحاب المصلحة.

كلمات مفتاحية: *Rhynchophorus ferrugineus*، نطاق الإدارة، إقليمي، عالمي، قيود، رؤية.

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