عـام التـسـامـح
YEAR OF TOLERANCE

جائزة خليفة الدولية لنخيل التمر والابتكار الزراعي
KHALIFA INTERNATIONAL AWARD FOR DATE PALM AND AGRICULTURAL INNOVATION

International Efforts to Combat

Red Palm Weevil

Life Cycle - Damage - Control Techniques

Supervised by: Prof. Abdelouahhab Zaid
Khalifa International Award for Date Palm and Agricultural Innovation

عـام التـسـامـح
YEAR OF TOLERANCE

جائزة خليفة الدولية لنخيل التمر والابتكار الزراعي
KHALIFA INTERNATIONAL AWARD FOR DATE PALM
AND AGRICULTURAL INNOVATION

International Efforts to Combat

Red Palm Weevil

Life Cycle - Damage - Control Techniques

Supervised by : Prof. Abdelouahhab Zaid
Khalifa International Award for Date Palm and Agricultural Innovation

International Efforts to Combat Red Palm Weevil
Life Cycle - Damage - Control Techniques

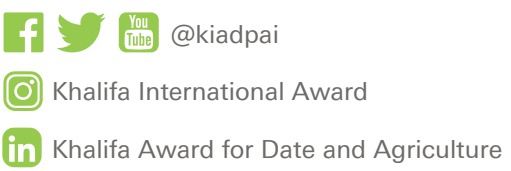
ISBN 978-9948-36-585-3

Supervised by: Prof. Abdelouahhab Zaid
Khalifa International Award for Date Palm and Agricultural Innovation

Designed by: Mohammed Issa

Cover Photo by: Yousef Al Habshi
as well as photos on:
Arabic pages: 20/21 - 34/35 - 52/53 - 62/63 - 74/75 English pages: 20/21 - 46/47 - 74/75 - 92/93 - 109 - 125
contact@uaemacro.com www.uaemacro.com 00971 55 9879123

P.O.Box: 3614 - Abu Dhabi - United Arab Emirates
Tel.: 00971 2 304 9999
Fax: 00971 2 304 9990
sg@kiaai.ae www.kiaai.ae



The late Sheikh

Zayed Bin Sultan Al Nahyan

May God bless his soul

H.H. Sheikh

Khalifa Bin Zayed Al Nahyan

President of the United Arab Emirates

Founder and Patron of the Award

(God Protect Him)

H.H. Sheikh

Mohammad Bin Zayed Al Nahyan

Crown Prince of Abu Dhabi

Deputy Supreme Commander

of the UAE Armed Forces

H.H. Sheikh

Mansour bin Zayed Al Nahyan

Deputy Prime Minister

Minister of Presidential Affairs

Main Sponsor of Date Palm Industry

H.H. Sheikh

Nahayan Mabarak Al Nahayan

Minister of Tolerance

Chairman of the Award's Board of Trustees

Contents

Convergence of International Efforts for Controlling the Red Palm Weevil

The Conference of the Ministers of Agriculture of the date palm producing countries, organized by Khalifa International Award for Date Palm and Agricultural Innovation and hosted by United Arab Emirates in Emirates Palace, Abu Dhabi on 09 March 2019, under the patronage of His Highness Sheikh Mansour Bin Zayed Al-Nahyan, Deputy Prime Minister and Minister of Presidential Affairs and in cooperation with FAO and the Ministry of Climate Change & Environment, constitutes a milestone in supporting the international efforts aiming at preparing the Framework Strategy to eliminate the Red Palm Weevil that threatens our food security and our ability to produce high quality and nutritious dates.

The significance of this conference stems from the major risk of the Red Palm Weevil in the Date Palm Sector. This cross-border pest is spreading like the wildfire all over the world and infests different kinds of trees such as the date palm and the coconut palm. We clearly notice in the region of the Middle East, North Africa and the Mediterranean basin, the severe harms of this pest. It negatively affects the date palm production and threatens our main sources of nutrition and food security. Further, it significantly affects our natural resources and our ability to make sustainable development in the agricultural sector, which necessitates preparing key measures and plans for controlling this pest in most date palm regions of the world.

We are very keen, here in UAE, to fully contribute to the support of all Red Palm Weevil Control Programs in cooperation with all countries interested in this matter and with all competent international organizations. We further strongly support the creation of a Trust Fund to provide the required financial support to execute the decisions adopted in this conference including the adoption of a proper framework strategy to eliminate the Red Palm Weevil. We also support FAO's efforts in hosting this exceptional multi-donor fund

and facilitating its governance and administration at the highest standards of efficiency and competence to achieve the most benefit of all experiences and expertise available and to provide the required help to all member countries; especially in the field of building the national capabilities in every country in order to control the Red Palm Weevil.

These significant initiatives are an embodiment of successful regional and international cooperation in the field of protecting palm trees and ensuring their important place in the social and economic processes for the date producing regions all over the world. From this point, I want to express my appreciation for the efforts of all Ministries of Agriculture in the affected countries. I further appreciate the efforts of the competent international organizations. It is really pleasuring to witness this outstanding regional and international cooperation together on the way of eliminating the Red Palm Weevil and its detrimental effects on all levels.

Nahayan Mabarak Al-Nahayan
Minister of Tolerance
and Chairman of the Board of Trustees
of Khalifa International Award
for Date Palm and Agricultural Innovation

The Red Palm Weevil "a Cross-border Pest"

The Red Palm Weevil is a major cross-border pest that infests Date, Coconut and Ornamental Palms. Although infection was detected in South Asia, it is spreading all over the world like wildfire. In the Near East, this pest severely damaged the date palm and affects the production and livelihood of almost 50 million farmers. Moreover, infection with the Red Palm Weevil was also detected in North Africa and the Mediterranean Basin. Hence, the Red Palm Weevil is considered one of the Quarantine Pests in the Near East, North Africa and, Latin America countries and thus it is targeted by the emergency measures of the Europe.

The weakness of quarantine measures and the difficulties facing the early detection of the date palm infected with the Red Palm Weevil have in turn contributed to the rapid spread of this pest that was not effectively controlled, despite the efforts exerted and resources provided by countries and organizations. In addition, extended researches have been conducted on the Red Palm Weevil control until it became significantly recognized that the challenges arising from the Red Palm Weevil must be treated as soon as possible on the national, regional and global level, which necessitates the enhancement of cooperation and solidarity between countries and regions; especially in the coordination of monitoring and control strategies.

From this point came the importance of holding the Ministries of Agriculture's Conference of the date producing countries in Abu Dhabi on 09 March 2019 organized by the General Secretariat of Khalifa International Award for Date Palm and Agricultural Innovation under the patronage of His Highness Mansour Bin Zayed Al-Nahyan, Deputy Prime Minister and Minister of Presidential Affairs and in cooperation with Food & Agriculture Organization (FAO) and the Ministry of Climate Change & Environment. This conference has resulted in a Declaration for the support of the Trust Fund and the Regional Program for controlling the Red Palm Weevil, which is a significant achievement and step on the right track in reducing the risk of the Red Palm

Weevil on the national economy, food security and livelihood for rural societies and the environment.

Out of the Award's General Secretariat's recognition of the cultural, social and economic dimensions of the blessed date palm tree, whose fruits were the main food of several countries of the region over centuries; it appreciates the great efforts exerted by the affected countries for supporting and improving the date palm sector, and further pays tribute to the donor countries and organizations for supporting the Trust Fund supporting the regional program. Again, we confirm our support for the Framework Strategy and the Regional Program for eliminating the Red Palm Weevil under the umbrella of FAO.

Prof. Abdelouahhab Zaid
Secretary General
of Khalifa International Award
for Date Palm and Agricultural Innovat

Abu Dhabi Declaration On Red Palm Weevil

We the Agriculture Ministers and Heads of Delegation of countries attending the donor ministerial meeting to support the trust fund and the regional program to combat Red Palm Weevil (RPW) convened on Saturday 9 March in Abu Dhabi:

Recognizing the cultural, religious, social, and economic dimensions of the blessed palm tree, the fruits of which have constituted the basic food for many nations in the arid regions of the Middle East and North Africa for centuries;

Valuing the great efforts that the countries of the region have made to support and develop the palm date sector in the region;

Aware of the threat that terrible pest of Red Palm weevil poses for date palm tree and its negative effects om national economy, on food security, and livelihoods of rural communities and on the environment;

Reaffirm our support to the framework strategy and the regional programme to eradicate RPW developed under the FAO auspices;

Commend donor states and organizations, such as the United Arab Emirates, Kingdom of Saudi Arabia,and the Sultanate of Oman, for their financial support to the trust fund aimed at supporting the regional programme;

Express high appreciation and gratitude to the leadership of UAE and the Khalifa International Award for Date Palm and Agricultural Innovation for hosting this meeting and for the warm hospitality

Extend warm gratitude to FAO, and Director General Jose Graziano da Silva, for its leadership in putting the sustainability of the date palm at the forefront of its sustainable development priorities .

Abu Dhabi, 9 March 2019

Photographed By: Yousef Al Habshi

Management of Red Palm Weevil in Date Palm in Pre and Post Invasion Situations

J. R. Faleiro
FAO Expert (Red Palm Weevil)
Goa, India

Management of Red Palm Weevil in Date Palm in Pre and Post Invasion Situations

Abstract

Date palm, *Phoenix dactylifera* L. is an important crop of the arid region of the world, providing lively hood security to rural agrarian communities in several countries of the Near East and North Africa (NENA) region where the crop tolerates severe abiotic stress conditions due to severe temperatures, decreasing water availability and increasing salinity levels. The NENA region accounts for over 60% of the world's date production. During the mid-1980s the red palm weevil (RPW), Rhynchophorus ferrugineus Olivier gained foot hold on date palm in the Gulf region of the Middle-East and has since spread throughout the NENA region mainly through infested planting material, becoming a severe pest of date palm that is a challenge to control. There are no accurate estimates on the loss incurred due to RPW. However, the direct and indirect losses due to RPW infestation in date palm could run into millions of dollars annually notwithstanding the actual expenditure incurred on RPW control through national RPW control programs in several countries. During March, 2017 the Food and Agriculture Organization of the UN organized a 'Scientific and High-Level Meeting on the Management of RPW' and through the 'Rome Declaration' 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. A framework strategy formulated for eradication of RPW at the Rome meeting aims to support national programs to control RPW.

This article gives an overview on the management of RPW in pre and post invasion situations based on country experiences in several date producing countries.

Introduction

The Red Palm Weevil (RPW) *Rhynchophorus ferrugineus* Olivier (Coleoptera: Curculionidae) is key invasive pest of palms causing wide spread damage to 40 palm species in diverse agro-ecosystems the world over

(Anonymous, 2013; Giblin-Davis et al., 2013). The geographical range of this pest is constantly increasing with recent first reports coming from Abkhazia in the Republic of Georgia where it was detected on the canary island palm and Djibouti in East Africa, where it has been reported to infest date palm. In the Middle East and North Africa (NENA region) RPW is a threat to the lively hood security of date palm farmers in rural communities, where it is designated as a category-1 pest by the Food and Agriculture Organization of the UN (FAO, 2019). Worldwide date palm is cultivated in nearly 1.0 million ha of which 60% is in the NENA region where nearly 50 million date palms are young and in the susceptible age group of less than 20 years. This makes RPW control in the region a huge challenge. Palms in the late stage of attack by RPW exhibit extensive tissue damage, do not respond to curative insecticide treatments and enhance dispersal of adult weevils resulting in new infestation foci. Besides early detection of infested palms, enforcing strict quarantine re-

Vast stretches of young date palm plantations in the NENA region makes RPW management a challenging task (Photo: J.R. Faleiro)

gimes to regulate movement of palms for farming and ornamental gardening is important to curtail spread of this cryptic pest (Faleiro, 2006; FAO, 2019). There is a clear lack of data on the socio-economic impacts of RPW (Abdedaiem et al., 2017). Furthermore, lack of farmer participation in the control program in several countries is a limitation for the successful management of this lethal pest (Aldobai and Ferry,2017; Faleiro et al., 2019).

During March, 2017 he Food and Agriculture Organization of the UN organized a 'Scientific and High-Level Meeting on the Management of RPW' and through the 'Rome Declaration' 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. A framework strategy formulated for eradication of RPW at the Rome meeting aims to support national programs to control RPW (FAO, 2019).

Although, there are several research publications and ongoing research programs on RPW, in many countries where the pest is endemic there is an urgent need to further intensify RPW research to develop user friendly technologies with respect to early detection, phytosanitary measures, new semiochemical techniques involving attract and kill and push-pull strategies, preventive and curative treatments, biological control, removal and disposal of severely infested palms and data collection using GIS for efficient decision-making that will foster farmer/homestead owner participation in the management of this deadly pest.

Red Palm Weevil Management: Challenges and Future Thrusts

A. Pre-Invasion: Non- Infested Countries/Areas

In order to keep RPW out of the non-infested areas it is essential to implement the following strategy that revolves around quarantine, monitoring/ surveillance and capacity building;

1. Quarantine: (implementing strict phytosanitary regimes where import of palms is prohibited and a strict watch is kept on the movement of palms within the country)

- No palm tree should leave nurseries/farms without movement certificate issued by the Competent Authority.
- Prohibit the import of palm trees in to a country where RPW doesn't exist.

- Permit palm trade only by officially certified nurseries.
- In order to localize infestation in case of an outbreak, movement of palms across the country should not be permitted.
- Plant nurseries should be inspected officially at least three times a year.
- Enhance /strengthen the level quarantine enforcement along the border, especially with neighboring countries/regions where RPW has been reported.

2. Monitoring / Surveillance: (monitoring based on periodic inspection of palms)

- Regular (every 45 days) visual inspection of palms in the susceptible age group of less than 20 years, in the non-infested areas.
- Pheromone traps need high level of expertise and supervision and should not be used to monitor RPW in non-infested areas.

3. Training and Capacity Building: (capacity building of all stakeholders (Government officials & farmers/ home dwellers) to control RPW if detected)

- Train and build capacity of all stake holders (farmers, home owners, Agriculture officers, Quarantine officials, NGOs, Cooperatives, Hotel owners etc.) on the RPW eradication strategy should be carried out/ intensified. Much attention needs to be given on building capacity of all concerned in the non-infested areas. Should infestation be detected, a control program needs to be implemented without delay.
- Build capacity with a goal to encourage farmer/home owner participation and involvement in the control program, especially with regard to detection of infested palms.
- Initiate a nationwide propaganda campaign to disseminate information on RPW through the electronic media (TV) / press (newspaper).
- Plan and undertake study tours for key officials working in the control program to countries/regions where RPW has been successfully controlled.
- Draft a contingency plan to be applied in the event that an infested or group of palm trees are detected in the non-infested areas is essential. In this case immediate removal and disposal (eradication) of the infested palms is strongly recommended irrespective of the stage of attack.

B. Post-Invasion:

Although RPW is difficult to control, there have been success stories in the NENA region where infestation levels in date palm have been maintained below the threshold of 1%infested palms (Hoddle et al, 2013; Al-Dosary et al., 2016) and in Mauritania the pest is nearing eradication. The management of RPW broadly revolves around the components as depicted in Figure 1.

There exist gaps and challenges in almost all the components of the current RPW-IPM strategy, particularly with regard to early detection of the pest, developing and implementing phytosanitary measures, lack of effective biological control agents in the field and poor farmer participation in the control programmes has made RPW control and eradication extremely difficult.

The components of the strategy are depicted at four levels in Figure1.

At ***Level-1*** of the strategy, components connected with the day to day operations in the field are highlighted (FAO, 2019). Here, detecting infestations through periodic 45 day interval inspection of date palms in the susceptible age group of less than 20 years old is vital to break the cycle of the pest by locating an infested palm before adults emerge. Due to the lack of an effi-

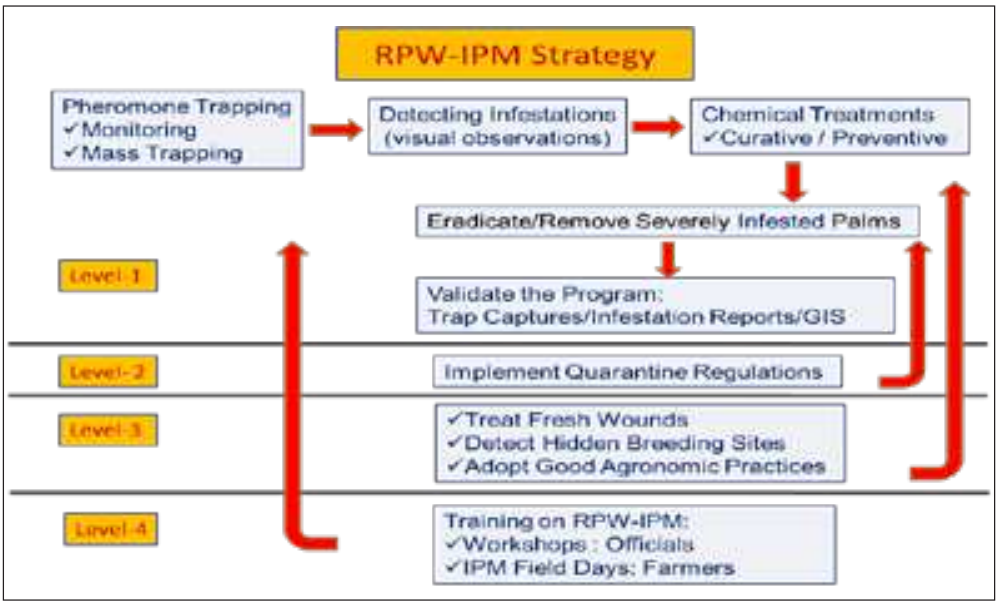
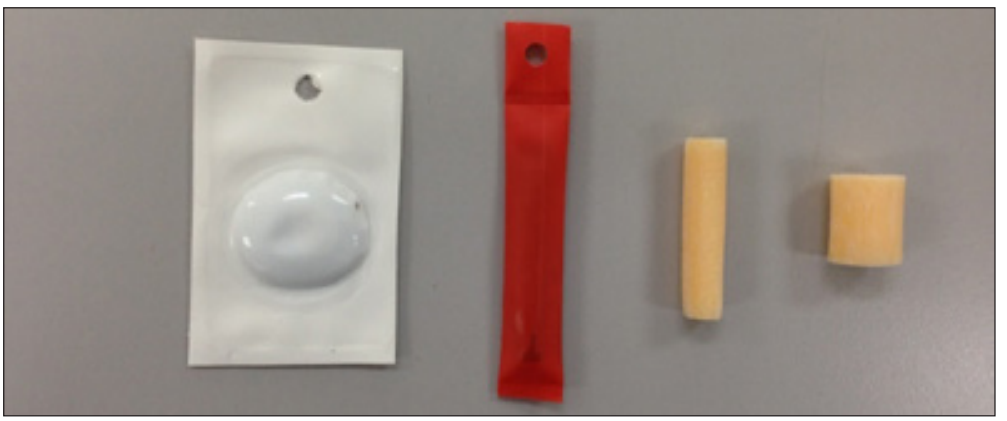


Figure 1. Operational details of the RPW-IPM strategy implemented at different levels
(Updated from http://www.fao.org/3/a-ms665e.pdf)

cient RPW infestation detection device, visual inspection to locate infested palms in the field is commonly adopted. This component of checking palms to locate infestations is to be supported by a mass trapping programme using food baited pheromone (ferrugineol) traps at a suitable trapping density. Current levels of infestation in the NENA region may warrant a trap density of four traps / ha to be deployed in the field with the best-known trapping protocols. In some countries, the pest is known to be managed below the acceptable threshold of 1% infested palms without the use of preventive chemical sprays. It is essential to keep preventive insecticide treatments at the bare minimum in and around plantations where a heavily infested palm is eradicated. In some countries where the pheromone trap work is outsourced to private agencies, bureaucratic procedures in issuing work orders to contractors often results in delays which needs to be addressed on priority. Un-serviced traps pose a risk to healthy palms in the vicinity of

the trap. Recently the bait and trap free technique of attract and kill has been used to curtail the emerging adult RPW population (El-shafie et al., 2011; Faleiro et al., 2016). The dry ElectrapTM is another service-less RPW dry trap that works without the food bait/water (Al-Saroj et al., 2017). Smart traps capable of recording and transmitting weevil capture data on a 24x7 basis have been developed (Aldhryhim and Al-Ayedh 2015) but have yet to be deployed on a large scale in control programmes.



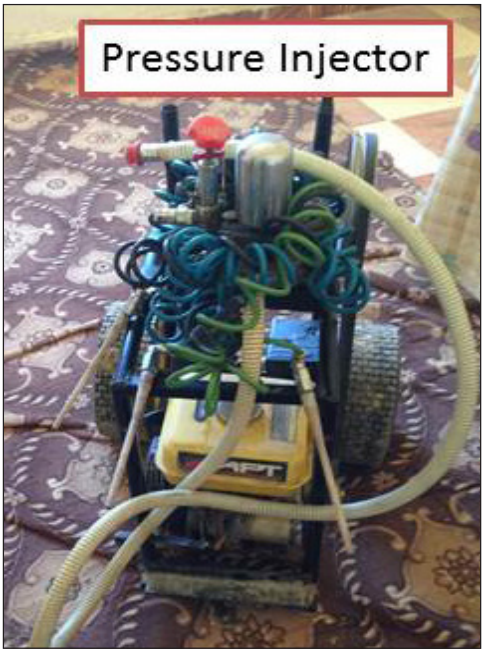
Field test commercial RPW pheromone lures for efficiency (attraction and longevity) before use (Photo: J.R. Faleiro)

1-Poorly maintained and 2- Wrongly installed RPW pheromone traps
(Photo: J.R. Faleiro)

Attract and Kill application in Mauritania: A trap-free and service-less RPW pheromone dispensing option (Photo: J.R. Faleiro)

Preventive insecticide treatments need to be deployed only on a need basis where weevil activity is high as visualized from the trap capture data and also on the basis of the number of severely infested palms removed and disposed (eradicated). Curative chemical treatments where palm tissue damage is less that 30% of the trunk diameter involves simple drilling of 3-4 slanting holes after light cleaning of the palm tissue around the infested site on the palm, inserting of a tube and pouring of the insecticide in the tubes is capable of killing all resident stages on an infested palm in the early stage of attack. While using pressure injectors to treat infested palms, care should be taken to ensure that the machine is operated at not more than 2bar. In some countries aluminum phosphide tablets are used to treat infested date palms. Utmost safety precautions need to be followed while using aluminum phosphide, besides ensuring the use of the lethal dose for the appropriate duration ensuring complete entrapment of the phosphine gas. Extensive field studies in Saudi Arabia showed that a single application of 10 aluminium phosphide tablets for 5 days inserted in air tight black plastic wrapping resulted in complete mortality of larva, pupae and adult stages of the pest (Al-Ballaa and Faleiro, 2019).

Tubes inserted in drilled holes around infested site on the palm to deliver insecticide: A low cost and effective technique adopted by the farmers in Siwa, Egypt to treat (stem injection) RPW infested date palms (Photo: J.R. Faleiro)



Central shoot (heart of the palm) dead due to tissue damage after being injected by a high-pressure injector (Photo: J.R. Faleiro)

Severely infested palms that have to be eradicated, often harbor adult weevils. These infestations contribute to adult dispersals in the field and dilute achievements of the control programme. With the present RPW control options available worldwide and best detection levels, around 20% of the palms are eradicated as these palms are in the late stage of attack harboring several stages of the pest and are beyond any treatment. In-situ (on farm site) removal and disposal of severely infested palm tissue by cutting into small pieces (20x10 cm) and soaking with insecticide is recommended (Ferry, 2017) to limit the dispersal of adult weevils while transporting the infested palm to the shredding site. Shredding machines are very expensive and need specialized staff to operate. In some countries where removal of severely infested palms is outsourced to private agencies, bureaucratic procedures in issuing work orders to contractors often results in delays which results in the spread of the weevil and also reversing success achieved in control of the pest.

Severely infested date palms by RPW waiting for removal (eradication): A source of new infestations (Photo: J.R. Faleiro)

Further, the abandoned and neglected plantations have to be closely monitored for incidence of RPW by intensive inspections campaigns and high-density mass trapping programmes. Farmer cooperation to assist in tackling the pest in neglected gardens should also be sought through persistent awareness programmes.

Validation of the strategy at periodic intervals to assess trap captures and infestation levels using GIS based models is essential to reinforce the IPM programme where required and re-deploy resources (men &material). In this context real time data base and web portal for the management of RPW at the local, national and NENA Region needs to be developed. Furthermore, a mobile app for android and iOS smart phones to record geo-referenced data at the field location on a standard form needs to be developed. FAO has made initiatives in this regard both at the regional (NENA) and global levels (Yaseen, 2018; Cressman, 2019).

At ***Level-2***, movement of planting material (offshoots/palms) for both farming and landscape gardening has to be strictly regulated where only treated and pest-free material is allowed to be transported within national boundaries (Faleiro, 2006; FAO, 2019). Although regulations/decrees to regulate the movement of palms for planting exist in several countries, implementing the decree in letter and spirit is often lacking (FAO, 2019; Balijepall and Faleiro 2019). In this context some of the European Union (EU) protocols governing palm trade in Europe in light of the RPW menace in the Mediterranean basin countries could be revised and adopted to suit needs of the NENA region. The EU guidelines are delimitation of survey and demarcated areas; three monthly official inspections; annual crop declaration; application of phytosanitary treatments; registration of planting material movement and use of plant passport to monitor trade of palms.

At ***Level-3*** of the strategy, adopting proper agronomic practices that discourage the inoculation and build-up of RPW is necessary (Sallam et al., 2012). Treating of fresh wounds on priority almost simultaneously after frond and offshoot removal is vital to discourage the gravid female weevil getting attracted to these sites for oviposition. Though crucial to curtail population buildup of the weevil, this component of the strategy often goes unrecognized. Another agronomic practice where palms are flood irrigated and the irrigation water touches the trunk at the ground often encourages adult weevils to oviposit in the collar region of such palms, resulting in new infestations. Enhanced ingroove humidity due


Open flood irrigation together with poor farm sanitation (excessive growth of fodder crop and weeds around the palms) facilitating RPW attack (Photo: J.R. Faleiro)

to flood irrigation and close planting is known to attract and harbor adult weevils (Aldryhim and Al- Bukiri, 2003). Although, date palm cultivars are reported to be tolerant/susceptible to RPW (Alayedh, 2008), farmers usually prefer to cultivate the most preferred commercial cultivar. Furthermore, identifying hidden breeding sites (cut palms) in closed gardens is also important to restrict buildup and spread of the pest. Although previous reports on the use of biological control agents against RPW are mostly restricted to laboratory or semi-field conditions (Mazza et al., 2014), the recent success in treating RPW infested palms with beneficial fungi and nematodes (Al-Dawood et al., 2018), needs to be further investigated.

At ***Level-4*** the strategy envisages to regularly disseminate the latest information on RPW-IPM to officials and farmers through training programmes and also the electronic and print media (FAO, 2019). Efforts need to be made to ensure as much as farmer participation in the control programme. In several Middle East countries, farmer participation in the RPW control programs is almost none. Farmer participation and cooperation is vital for any IPM 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 especially in the GCC countries and keep state support/participation in the program to the bare minimum.

Outsourcing RPW control to private companies:

In some countries RPW control work is outsourced to private companies. In such cases, there is a need for the Government authorities to efficiently supervise, monitor and evaluate the control program implemented by the private company, on a regular basis. There is also a need to ensure that the companies hire staff that are qualified and experienced in area-wide RPW control. Lack of proper supervision will result in waste of precious resources, besides proliferation of the pest. It has been observed in countries where RPW control is entrusted to private agencies that there is a delay in providing necessary inputs (pheromones, insecticides etc.) and also in issuing the new work order to continue the field operations on expiry of the previous order. Efficient control of RPW in the field calls for maintaining continuity of the field operations. Therefore, finalizing the tender/quotation for the ensuing period well in advance before the expiry

of the on-going tender is imperative, so that there is no break in the RPW control program.

Country Scenarios (Pre-invasion, Early-invasion, Endemic situation)

RPW gained entry in the NENA region in the mid-1980s when it was first reported from the UAE where it was introduced through imported palms and spread rapidly throughout the region during the next two decades mainly through infested planting material transported for date palm farming (offshoots) and ornamental gardening (large palms). National RPW control programms actively supported by international organizations including, FAO of the UN, Khalifa International Award for Date Palm and Agricultural Innovation (KIADPAI), International Centre for Agricultural Research in the Dry Areas (ICARDA), Arab Organization for Agriculture Development (AOAD) and the Near East Plant Protection Organization (NEPPO) have been striving to tackle the problem of RPW in date palm in the NENA region.

Algeria is the only country in the region that is still RPW free. Sudan is another important date producing country and has done well to keep this pest at bay in spite of being surrounded by several RPW infested counties. Mauritania has done well to contain the pest in its original foci in Tidjikja and is free of RPW since mid-2017. In Morocco and Tunisia RPW is reported on the Canary palm from Tangier and Tunis, respectively but poses a severe threat to the Southern date palm oasis of these countries. In Iraq, RPW infestation is confined to the South in Safwan region along the border with Kuwait, from where there exists a high risk of future RPW invasions in Safwan. This calls for the enhancement of regional cooperation between Kuwait and Iraq for the joint control of the pest in date farms along the border. There is another scenario where the pest is endemic and exists in almost the entire country (Egypt, GCC countries, Jordan etc).

Table 1 enlists the components of the RPW-IPM strategy where i) the pest is a threat but does not exist (Pre-invasion: Sudan/Algeria), ii) RPW is contained or nearing eradication due to actions implemented early (Early invasion- Morocco/Mauritania) and where the pest is endemic and exists for several years (GCC countries, Egypt, Palastine, Libya etc). Based on the country experiences of the author, major components of the action plan to contain and control RPW in the region is presented below.

Table 1. Prioritizing the RPW control program in Pre and post invasion situations

Pre-invasion	Post Invasion	
Pest is a threat but does not exist in the country: Sudan/Algeria	Pest contained or nearing eradication: Morocco/ Mauritania/Iraq	Pest endemic/Infestation exists for several years: GCC countries, Egypt, Libya, Jordan, Palestine, Iran etc.
Surveillance and monitoring (especially in countries where RPW does not exist)	Surveillance and monitoring	Implementing the control /IPM program
Quarantine	Quarantine	Quarantine
Build capacity of all stake holders		
GIS based data base on the palm resources	Implementing the control /IPM program (eradicate all infested palms)	Monitoring
	GIS based data base on the palm resources and the control program	Capacity building
	Build capacity of all stake holders	GIS based data base on the palm resources and the control program
	Meeting/Workshops for National experts	Meeting/Workshops for National experts
	Facilitate extension activities to disseminate knowledge on RPW control through the print (bulletins, pamphlets) and electronic media (TV)	Facilitate extension activities to disseminate knowledge on RPW control through the print (bulletins, pamphlets) and electronic media (TV)
		Research on RPW to develop practical solutions for the control of RPW
		Networking/establish linkages at the national, regional and global level
		Establish a repository [data base] of RPW experts

Should Infestation Occur in an RPW Free Country– What is to be Done?

In this case, the goal should be to contain the spread and eradicate the pest. To achieve this;

- Remove (eradicate) all infested palms. Cut infested portion of the palm into small bits (20x10 cm) and drench with insecticide in-situ (in the infested farm).
- Do not move the infested palm for eradication/disposal to another site.
- Establish a 10Km radius buffer zone.
- Intensify phytosanitory/ quarantine regulations.
- Inspect all palms in buffer zone at bi-monthly intervals.
- Mass trap the area [1Km radius from the infested palm] @ 1trap/ha.
- Deploy attract & kill if infestation is severe / 3 weevils/trap/week.
- Prohibit movement of all palms from the buffer zone.
- Intensify training on RPW- IPM.
- Strengthen extension programs through the print and electronic media to spread awareness about RPW.
- Encourage Farmer participation in the RPW-IPM program especially with regard to detection of infested palms.

Based on the international protocol, any country is to be declared pest (RPW) free if no new infestation/weevil is detected for three years.

Resources, Capacity Building, Monitoring and Reporting

1. Human Resource and RPW-IPM Tools

Although many control means based on conventional and innovative technologies are today put 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. Upon recording the pest, it is essential to quickly provide the necessary resources (men and material) for the control and eradication of RPW in an adequate and timely manner for the rapid control of the pest. In area-wide RPW control programs, the means (resources) to control the pest are directly correlated with the intensity of the pest. Three scenarios exist depending on the means (men & material) made available to control the RPW, considering of course that organizing and techniques are optimum and similar for the three scenarios (FAO,2019);

i) The means are superior to the needs (pest is controlled/eradicated)

ii) The means remain more or less equal to the needs (prolonged effort to control the pest over several years with little or no success) and;

iii) The means are inferior to the needs (failure to control the pest).

In all area-wide RPW control programs, providing adequate man power and material is a major challenge. In this context, every infested area should have at least one full time officer with support staff, to look after the day to day field operations, with regard to pheromone trapping, checking palms to detect infestations, need based preventive chemical treatments, curative treatments, removal and disposal of severely infested palms, phytosanitary inspections, data collection, compilation and record keeping. In this context, the team needs to be adequately supported with vehicles and the basic tools (power drills, chain saws, sickles, pheromone traps and lures, attract &kill products, insecticides, knapsack sprayers, motorized sprayer, etc) to carry out the field operations.

2. Capacity Building, Extension and Awareness Programs

- Intensify the training on RPW control to highlight new techniques among all stakeholders (officials, farmers, home owners, students).
- Intensify the extension & awareness on RPW among all stakeholders

(farmers, officials) through the electronic (TV) and print media (newspaper/ pamphlets etc.).

- Collaborate with the authorities in the region to prevent entry of infested palms across the border.

3. Monitoring and reporting arrangements

Monitoring and evaluation form the basis for clear and accurate reporting on the results achieved by the national programs. Currently most of the national RPW-IPM Programs lack the component of the Monitoring and Evaluation (M&E). This has an adverse impact on the success of the programs, sustaining the positive results achieved and judicious use of resources (FAO, 2019). In the context Fajardo, 2019 proposed to;

- Continuously assess (monitor & evaluate) the strategy at the implementation level by program coordinator.
- Continuously monitor the measures and results on the GIS web application and data base.
- Conduct weekly meetings with all worker to explain the outcome of the previous/current week and target of the next week.
- Generate monthly and yearly reports with the updated situation (including Info-graphs, tables). These reports are shared with all key stakeholders.
- Generate reports for extraordinary situations (severe outbreaks).
- The main tools to prepare the reports are the GIS web application and viewer.
- Pending use of GIS, it is essential to maintain an efficient manual / computer aided data base of all the operations carried out to control RPW in different areas.

Recent FAO initiatives against RPW

Based on the recommendations of the “Scientific Consultation and High-Level Meeting on Red Palm Weevil Management” held in Rome during March 2017, FAO has initiated two major projects against RPW during 2018.

1. FAO Programme on Red Palm Weevil Eradication

This regional initiative aims to support efforts/programs of countries in the NENA region to contain the spread and eradication of RPW. 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 boosts ongoing research on the applicable approaches of biological control and innovative detection and control methods (Yaseen, 2018).

2. FAO Global RPW management platform

FAO is developing a global RPW monitoring and early warning system. This project is an effort in this direction that aims to address critical shortcomings in the field for effective monitoring and management of RPW; to systematically collect standard geo-referenced data.

RPW-IPM data will be collected in the field through a system that consists of a mobile App for data collection and GIS- based online system for data analysis and mapping combined with remote sensing imagery (Cressman, 2019).

Conclusion

Considering that the RPW is extremely difficult to control, date palm growing countries that do not have the pest (Sudan, Algeria) but are in the vicinity of RPW infested countries need to adopt a pre-invasion strategy that revolves mainly around surveillance, quarantine and capacity building and also have a contingency plan in case RPW is detected. In the post-invasion situation, countries that have recently detected RPW (Mauritania, Iraq, Djibouti) need to quickly control (localize) and eradicate the pest by adopting the components of the post-invasion strategy besides adopting a robust RPW-IPM program and an extension campaign to sensitize all stake holders, while in countries where the pest is endemic (GCC countries, Egypt, Jordan) and exists for several years, area-wide control of RPW needs to be reinforced by providing adequate men and material. These countries could also intensify research on RPW to develop sustainable and user-friendly technologies. Geo-referencing of palms, infestation, traps etc. needs to be adopted in both pre and post-invasion situations for efficient data management to facilitate surveillance, monitoring and periodic validation of the strategy.

Farmer participation in the control program, will go a long way to control and eradicate the menace of RPW in date palm.

References

1 - Abdedaiem, S., Nasr, N. and Ferry, M. 2017. Socioeconomic studies and approaches to involve farmers in the fight against red palm weevil (RPW). Presented at the "*Scientific Consultation and High-Level Meeting on Red Palm Weevil Management*", organized by FAO and CIHEAM, Italy, 29-31 March, 2017, Rome, Italy.

2 - Aldhryhim,Y. N. and Al-Ayedh, H.Y. 2015. Diel flight activity patterns of the red palm weevil (Coleoptera: Curculionidae) as monitored by smart traps. Florida Entomologist, 98 (4) : 1019-1024.

3 - Al-Ayedh, H.Y. 2008. Evaluation of date palm cultivars for rearing the red date palm weevil, *Rhynchophorus ferrugineus* (Coleoptera: Curculionidae). *Florida Entomologist*, 91:353-358.

4 - Al-Ballaa, S. R. and Faleiro J.R. 2019. Studies on curative treatment of red palm weevil, *Rhynchophorus ferrugineus* Olivier infested date palms based on an innovative fumigation technique. Presented at the International Scientific Meeting on '*Innovative and sustainable approaches to control the Red Palm Weevil*', CIHEAM Bari, 23 - 25 October 2018, Organized by FAO and CIHEAM Bari, Italy. [Published in Arab Journal of Plant Protection, 37 (2): 119-123].

5 - Aldobai, S and Ferry, M. 2017. Proposed multi-disciplinary and multi-regional strategy for the management of red palm weevil. Presented at the "Scientific Consultation and High-Level Meeting on Red Palm Weevil Management", organized by FAO and CIHEAM, Italy, 29-31 March, 2017, Rome, Italy.

6 - Al-Dosary, N.M., Al-Dobai,S. and Faleiro, J.R.. 2016. Review on the Management of Red Palm Weevil *Rhynchophorus ferrugineus* Olivier in Date Palm *Phoenix dactylifera* L. *Emirates Journal of Food and Agriculture*, 28(1): 34-44

7 - Al-Saroj, S., Al-Abdallah, E., Al-Shawaf, A.M., Al-Dandan, A. M., Al-Abdullah, I., Al-Shagag, A., Al-Fehaid, Y., Ben Abdallah, A. and Faleiro, J.R. 2017. Efficacy of bait free pheromone trap (ElectrapTM) for managementof red palm weevil, *Rhynchophorus ferrugineus* (Olivier) (Coleoptera: Curculionidae). *Pest Management in Horticultural Ecosystems*, 23(1): 55-59.

8 - Aldryhim, Y. and Al- Bukiri, S. 2003. Effect of irrigation on within – grove distribution of red palm weevil *Rhynchophorus ferrugineus*. Sultan Qaboos Uni. J. Sci. Res. (*Agri. and Marine Sci.*) 8: 47-49.

9 - Aldawood, A.S., Rasool, K.G. and Tufail, M. 2018. Integrated approach for red palm weevil management: current status and future prospects. Presented at the International Scientific Meeting on 'Innovative and sustainable approaches to control the Red Palm Weevil', CIHEAM Bari, 23 - 25 October 2018, Organized by FAO and CIHEAM Bari, Italy.
10 - Anonymous 2013. Save Algarve palms. http://www.savealgarvepalms.com/en/weevil-facts/host-palm-trees (accessed on 24th March, 2013).
11 - Balijepall, S.B. and Faleiro, J.R. 2019. Is policy paralysis on quarantine issues in the Near East and North Africa region leading to the build-up and spread of red palm weevil? Presented at the International Scientific Meeting on '*Innovative and sustainable approaches to control the Red Palm Weevil*', CIHEAM Bari, 23 - 25 October 2018, Organized by FAO and CIHEAM Bari, Italy. [Published in Arab Journal of Plant Protection, 37 (2) : 83-88].
12 - Cressman, K. 2019. Red palm weevil monitoring and early warning system. Presented at the International Scientific Meeting on '*Innovative and sustainable approaches to control the Red Palm Weevil*', CIHEAM Bari, 23 - 25 October 2018, Organized by FAO and CIHEAM Bari, Italy. [Published in Arab Journal of Plant Protection, 37 (2) : 203-204].
13 - El-Shafie H.A.F., Faleiro J.R., Al-Abbad A.H., Stoltman L. and Mafra-Neto A. 2011. Bait-Free Attract and Kill Technology (Hook™ RPW) to Suppress Red Palm Weevil, *Rhynchophorus Ferrugineus* (Coleoptera: Curculionidae) in Date Palm *Florida Entomologist* 94(4), 774-778.
14 - FAO. 2019. Proceedings of the Scientific Consultation and High-Level meeting on Red Palm Weevil management - 29-31 March 2017, Rome, Italy. Rome, 200 pp. Licence: CC BY-NC-SA 3.0 IGO.
15 - Fajardo, M. 2019. FAO Mission to Abkhazia – Strategy and action plan to control red palm weevil (March, 2019). Mission report submitted to FAO, Georgia.
16 - Faleiro, J.R. 2006. A review of the issues and management of the red palm weevil *Rhynchophorus ferrugineus* (Coleoptera: Rhynchophoridae) in coconut and date palm during the last one hundred years. *International J. of Trop.Insect Sci*. 26:135-154.
17 - Faleiro J.R., Al-Shawaf, A.M., Al-Dandan, A.M., Al-Odhayb, A., Al-Rudayni, A., Abdallah, A.B., Peixoto, M.P., Vargas, R., Bottom, M., Chidi, S., Borges, R. and Mafra-Neto, A. 2016.Controlled Release Products for Man-

aging Insect Pests. *Outlooks on Pest Management*.
18 - Faleiro, J. R., Ferry, M, Yaseen, T. and Al-Dobai, S. 2019.Overview of the gaps, challenges and prospects of red palm weevil management. Presented at the International Scientific Meeting on '*Innovative and sustainable approaches to control the Red Palm Weevil*', CIHEAM Bari, 23 - 25 October 2018, Organized by FAO and CIHEAM Bari, Italy. [Published in *Arab Journal of Plant Protection*, 37 (2) : 170-177].
19 - Ferry, M. 2017. Recent advances in insecticide treatments against red palm weevil. Presented at the "*Scientific Consultation and High-Level Meeting on Red Palm Weevil Management*", organized by FAO and CIHEAM, Italy, 29-31 March, 2017, Rome, Italy.
20 - Giblin-Davis, R. M., Faleiro, J. R., Jacas J. A., Peña, J. E. and Vidyasagar, P.S.P.V. 2013. Coleoptera: Biology and management of the red palm weevil, *Rhynchophorus ferrugineus*. Pp. 1-34. In J. E. Peña [ed.], Potential Invasive Pests of Agricultural Crop Species. CABI Wallingford, UK.
21 - Hoddle M.S., Al-Abbad A. H., El-Shafie H.A.F., Faleiro J. R., Sallam A.A. and Hoddle C.D. 2013. Assessing the impact of pheromone trapping, pesticide applications, and eradication of infested date palms for *Rhynchophorus ferrugineus* (Coleoptera: Curculionidae) management in Al Ghowaybah, Saudi Arabia. *Crop Protection*, 53 :152-160.
22 - Mazza, G., Francardi, V., Simoni, S., Benvenuti, C., Cervo,R., Faleiro, J. R., Llácer, E., Longo,S., Nannelli, R., Tarasco, E. and Roversi, P. F. 2014. An overview on the natural enemies of *Rhynchophorus* palm weevils, with focus on *R. ferrugineus. Biological Control*, 77:83-92.
23 - Sallam, A.A., El-Shafie, H.A.F. and Al-Abdan, S. 2012. Influence of farming practices on infestation by red palm weevil *Rhynchophorus ferrugineus* (Olivier) in date palm: A case study. *International Res. J. of Agri. Science and Soil Sci*. 2: 370-376.
24 - Yaseen, T. 2018. FAO program for red palm weevil eradication. Presented at the International Scientific Meeting on '*Innovative and sustainable approaches to control the Red Palm Weevil*', CIHEAM Bari, 23 - 25 October 2018, Organized by FAO and CIHEAM Bari, Italy.
25 - Yu, R. and Leung, P. 2006. Optimal pest management: A reproductive pollutant perspective. *International Journal of Pest Management* 52: 3155-166.
26 - Moises Fajardo Moises Fajardo Moises Fajardo

Photographed By: Yousef Al Habshi

International Meeting:

Innovative and Sustainable Approaches for the Control of Red Palm Weevil

CIHEAM, Bari-Italy, 23-25 October 2018

International Meeting: Innovative and Sustainable Approaches for the Control of Red Palm Weevil

Background

Following the Scientific Consultation and High-level Meeting on Red Palm Weevil (RPW) Management that was held in FAO, Rome from 29-31, March 2017, and the RPW Steering Committee Meeting held in FAO-RNE Cairo, Egypt from 22-24 May 2017, a multi- disciplinary and multi-regional strategy document for the management of RPW, was prepared by RPW experts' team, with the support of FAO, CIHEAM and NEPPO technical officers. Among the proposed actions, the RPW experts highlighted the importance to organize an international meeting, which will focus on the identification and transfer of the applied innovative techniques, to control the RPW and form a multi-disciplinary international network of stakeholders. Relatively, the working group also proposed to postpone the 2nd FAO global meeting to 2019, in order to allow enough time for the establishment of the global platform and discuss the outcomes of the cited meeting.

Furthermore, during the 6th International Date Palm Conference (SIDPC) at Abu Dhabi (UAE), during March, 2018 orgnized by the Khalifa International Award for Date Palm and Agricultural Innovation (KIADPAI), a master session on RPW was organized, in which the importance of using a multi-disciplinary program with an integrated approach to control the RPW (i.e. regulation, awareness, inspection, mass trapping, preventive treatments and eradication of the infected palms) was highlighted. In the same session, the RPW trust fund was also presented and particular emphasis was given to the research, capacity development and knowledge transfer.

In this context, CIHEAM Bari and FAO organized In cooperation with (KIADPAI), a three-day meeting at the CIHEAM Bari during the period from 23-25 October 2018. An organizing committee and also a scientific committee was constituted to oversee the hosting and organizing of the meeting. This international meeting focused on the multidisciplinary approach, with a particular emphasis on the identification and transfer of the new technologies/innovative methods to control the RPW, including different specific

topics such as the socio-economic impact, the early surveillance and detection of the RPW, phytosanitation and eco-friendly control measures. The scientific committee selected and indicated during this meeting, the most promising scientific activities, for the efficient and sustainable application to control RPW in the main palm-cultivated agro- ecosystems.

The meeting was widely publicized through the CIHEAM website. A total of 167 participants from 31 countries from North Africa, Middle-East, Europe, Asia, North and South America were registered. Among them, 102 persons belonging to 24 countries (Algeria, Albania, Brazil, Colombia, Egypt, France, India, Israel, Italy, Jordan, Oman, Morocco, Netherlands, Pakistan, Palestine, Saudi Arabia, Serbia, Spain, Syria, Tunisia, United Arab Emirates, United Kingdom and United States of America), and seven international organizations (Food and Agriculture Organization of the United Nations (FAO), Mediterranean Agronomic Institute of Bari (CIHEAM), Khalifa International Award for Date Palm and Agricultural Innovation (KIADPAI), International Centre for Agricultural Research in the Dry Areas (ICARDA), Arab Organization for Agricultural Development (AOAD), Near East Plant

Protection Organization (NEPPO) and the Arab Society of Plant Protection (ASPP), attended the 3-day Meeting.

In this context, 78 abstracts were received and presented during the meeting, which included 10 technical sessions and 2 Poster sessions.

Opening Session

Mr. Maurizio Raeli, Director of the CIHEAM-Bari, welcomed all the participants and highlighted the importance of date palm in the Near East and North Africa (NENA) regions, representing the top 10 date-producing countries, with around 90% of the global date production. He also emphasized that date palm is considered as one of the most symbolic trees and was mentioned 20 times in the Holy Qur'an and 50 times in the Bible and the Torah.

He underlined the importance to strengthen regional and international cooperation, which can greatly contribute to the containment and eradication of Red Palm Weevil, (RPW), the most dangerous insect pest of economic palm trees, such as the date and coconut palms in Asia and Middle East, and ornamental palm trees in the Mediterranean basin and Europe.

He also emphasized the importance to use an integrated approach, which focuses on biological control, early detection, sanitation, information technology and socio-economic aspects.

Finally, after reviewing the main activities and research programs of the CIHEAM-Bari, Mr

M. Raeli, highlighted the fruitful collaborations between CIHEAM and FAO, particularly the co-organization of the scientific consultation and high-level event on RPW management (FAO, Rome, March 2017). The meeting focused on the identification and transfer of the applied innovative techniques to control the RPW and form a multi-disciplinary international network of stakeholders.

This speech was followed by the address of Mr. Mohamad Ali Bob from AOAD, who re- affirmed the support of his organization for the present meeting and the framework strategy finalized during the Rome meeting. Further, Mr M. Ali Bob, highlighted the importance of strengthening the date value chain in the NENA region and the urgent need to develop a sustainable strategy to control RPW in date palm trees.

Later, Mr. Michael Baum from ICARDA, presented the programs and

achievements of ICARDA during these last years, including date palm IPM programs in the Middle East and North Africa.

At the end of the opening session, Mr. Thaer Yaseen, FAO-RNE, Cairo, Egypt, overviewed the RPW trust fund programme for the eradication of this pest. In his address, Mr. Yaseen mentioned the objective of this project, supporting efforts/programs of countries to contain the spread and eradication of the pest. He also evidenced the key outputs of the project, which 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).

Mr Yaseen mentioned that the project, will also create 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.

Research priorities on RPW will be identified and suitable funding will be approved based on the following criteria:

- Innovation
- Applicability
- Transferability
- Field Experience
- Sustainability
- Simplicity/practicality
- User friendly technologies

Mr. Yaseen confirmed also that currently, the Kingdom of Saudi Arabia has pledged USD 2.0 million, while the contribution of Sultanate of Oman will be USD 0.1 million to the RPW trust fund.

The opening session was followed by the technical sessions and the highlights of each technical session were presented below.

Session 1.1. State of the art of the RPW invasion (World situation, policies)

There were five presentations in this session as listed below.

- The world situation and the main lessons learned of 30 years of fight against RPW- *M. Ferry*.
- State of the art of the RPW in EU-Med ornamental palms- *K. Djelouah*.
- Current regulatory framework of RPW in EU and Italy- *R. Griffo*.
- Policies to control RPW based on the recommendations of the Rome meeting- *S. AlDobai*.
- Is policy paralysis on quarantine issues in the Near East and North Africa region leading to the build-up and spread of red palm weevil?- *S.B.Balijepall*

The highlights of this session were as follows:

World situation:

The world situation on RPW is quite alarming. In the NENA region, only Algeria and Sudan are free of RPW while, Djibouti in East Africa were the latest countries to report RPW. Although there are success stories in many countries, new introductions have been reported.

Movements of palms are mainly responsible for new reports. Large-scale introduction of infested palm material still exists. Weak adoption of quarantine procedures is a serious problem.

Furthermore, there are serious socio-economic impacts. Containment of the pest must be with the aim for rapid control of the RPW. Eradication as a long-term aim is a strategic mistake. The RPW containment strategy has to be changed to win the race against this pest. There is a need to include socio-economists, participatory approach and use of GIS for better data management and decision-making.

All EU-Mediterranean countries are infested. RPW infestation in EU has resulted in huge environmental and social impacts. Palms worth 485 million Euros destroyed. Policies in EU revolve around requirements for imports, movements, surveys and demarcation of zones. There are difficulties in applying regulations. Few authorizations are allowed for the use of some pesticides in EU landscape environment.

RPW is no longer a quarantine pest in EU but a quality pest. All efforts to contain the pest are not efficient without cooperation of all stakeholders. Only three chemicals are authorized in Italy for foliage and endo-therapy treatments.

Policies:

FAO has a framework strategy for eradication of RPW. The policies for RPW control revolve around regulatory, phytosanitary, resources, program management, stakeholder involvement and awareness, research and development and monitoring and eradication. During the Rome meeting in March, 2017, recommendations were proposed to improve RPW policies/strategies. The FAO-CIHEAM Framework Strategy provides clear guidance for the effective policies to be adopted by countries to effectively manage and eradicate RPW.

Lessons from Algeria and Sudan, about phyto-sanitation, need to be learnt. It is pertinent to mention that Algeria has put a strong surveillance program after the pest was detected in Morocco along its border with Morocco and Tunisia. In addition, there is a ban on the importation of palms into Algeria. Although Sudan has a pre-invasion strategy in place, detection of RPW in Sudan is probably a matter of time. The status requires further and quick investigations to confirm RPW status draw lessons and urge the Sudanese authorities to tighten the measures.

Incentive-based phytosanitary based regimes for KSA could serve as a model for the region. Enforcement of plant quarantine protocols, specification of planting material produced and certified based on IPPC standard and establishment of tissue culture laboratories for RPW free planting material is essential to enhance the current phytosanitation regimes against RPW.

With regard to phytosanitation on RPW at the regional and international level, 10 regional PP organizations are coordinating at the regional level and IPPC coordinates at the international level. In Europe, the regulations to import are the same however, each country can include

additional measures. Several aspects of the strategy need further research and this is what to be identified during the meeting.

Session 1.2. Environmental and socio-economic impact of RPW invasions

There were two oral presentations during this session on the community preferences for the preservation of Canary palm from RPW infestation in the City of Bari and on the economic impact of RPW in Egypt entitled;

- Community preferences for the preservation of Canary Palm from Red Palm Weevil infestation in the City of Bari - *R. Sardaro*,
- The economic impact of Red Palm Weevil in Egypt - *M.K. Abbas*

In the city of Bari, over 30 % of the Canary palms were infested and killed by RPW. The citizens expressed their willingness to pay to increase the number of palms in various districts of the city. This kind of work is very important to convince decision makers to dedicate efforts and means for the preservation of the palms.

In Egypt, the percentage of infestation ranged from 2% to 35%. It would be of 23% in Bahria. In Sharkia, the control operations cost was estimated to 3 million US dollars from 1992 to 2000. Furthermore, 260 tonnes of pesticides have been sprayed.

During the discussion, the importance of economic impacts of the RPW was stressed and the need to obtain reliable data on infestation was also emphasized. Nevertheless, because of the disastrous consequences of this pest, it was suggested to prohibit the sale of palms from RPW infested countries. In this context, exporters have a responsibility but it is the duty of the importers and PPO from the importing country to efficiently oversee the technical guarantees presented by the exporter regarding the health status

of the palms. In many countries, due to lack of guarantees, imports of palms of more than 6 cm diameter are totally forbidden.

Session 1.3. Ongoing and future activities in the RPW infested countries

The following three topics were presented in this session

- Integrated approach for red palm weevil management: current status and future prospects. – *A.S. Aldawood*
- Management of the Red Palm Weevil *Rhynchophorus ferrugineus* (Olivier) using sustainable management options. - *M. Ali Bob*.
- Dates Value Chain Development and the control of red palm weevil in Egypt (FAO Project TCP/EGY/3603). - *M.K. Abbas*.

Trials carried out in Saudi Arabia indicated that both EPNs and EPFs were promising in the curative treatments of RPW infested date palms. Further trials are in progress. The research findings need to be published. Furthermore, in KSA, agricultural practises were found to play an important role in the management of RPW, where the pest was efficiently managed in a private plantation using a blend of control measures including early detection through visual inspection, pheromone trapping, adopting good agricultural practices, injecting palms in the early stage of attack with Emamectin benzoate and eradicating severely infested palms. While

in Egypt, where the situation due to RPW is alarming in date palm, importance of involvement of farmers in any strategy to control RPW was emphasized, besides training of farmers on the management of RPW.

Session 1.4. Pest-host interactions, RPW symbionts and associated organisms

There were three presentations in this session as mentioned below;

- Fungal endophytic communities and palm susceptibility to the red palm weevil in its invaded range. - *F. Monroy*
- The RPW and SAPW as vectors of nematodes.- *F. Porcelli*
- Characterization of CRISPR-Cas systems in *Serratia marcescens* isolated from *Rhynchophorus ferrugineus* (Olivier, 1790) (Coleoptera: Curculionidae). - *M. Scrascia*.

The highlights of this session were the following:

Studies on fungal endophytic communities and palm susceptibility

showed that *Washingtonia* palm is the least preferred by RPW. Fungal endophytic communities in the palm differed in their composition and chemical composition between palm species. Many times, endophytes cannot be cultured. Palm-associated microorganisms can determine host preference in RPW. 5-7 species of nematodes are associated and present in RPW. These are not EPNs but could be phoretic nematodes. *Serratia marcescens* is an important symbiont associated with RPW. Deeper analysis of the interaction between RPW and *Serratia marcescens* could identify new potential molecules to reduce RPW fitness. Care should be to taken to see that the symbionts do not develop resistance to the antibiotics.

Poster Session

The following posters were presented during the first day of the meeting:

- Welfare loss and social costs for the damage by Red Palm Weevil to Canary Palms in the City of Bari.-

- Use of entomopathogenic nematodes against adults of *Rhynchophorus palmarum* as potential tool for biological control of *Rhynchophorus ferrugineus* for Tropical America - *V.A. Dalbon*,

In city of Bari, the welfare loss and social costs due to the damage by RPW to canary palms revealed that between 2011-2013, the city of Bari lost a total of 164 Canary palms due to RPW infestation amounting to 2-2.5 million Euros. The annual cost of saving the remaining Canary palms in the city is justified.

Studies carried out on the use of EPNs against adults of *R. palmarum* show that the use of selected EPN species with host finding capacity and high pathogenicity, hold promise for future testing against *R. palmarum* with a potential to control RPW.

Session 2.1. Environmentally safe and sustainable tools for RPW management

During this session eight oral presentations, as mentioned below, were delivered;

- Pathogenicity of entomopathogenic nematodes against immature stages of *Rhynchophurus palmarum* as potential tool for biological control of *Rhynchophorus ferrugineus* for Tropical America. - *J.P.M Acevedo*.

- A simple and low-cost injection technique to protect efficiently ornamen-

tal Phoenix against the red palm weevil during one year. - *S. Gomez*.

- Effect of entomopathogenic fungi on mortality, fertility and fecundity of red palm weevil. - *W.Wakil*.

- Microwave heating: a promising and eco-compatible solution to fight the spread of Red palm Weevil. - *R. Massa*.

- Is the use of entomopathogenic fungi a viable option for the control of Red Palm Weevil? *M. El Bouhssini*.

- Direct and indirect manipulation of the fungal endophytic communities of *Phoenix dactylifera* and its associated effect on leaf chemistry. - *F. Monroy*.

- Importance of field operations for reducing RPW infestation on date palm. - *M. Ben Salah*.

The talk on the Pathogenicity of entomopathogenic nematodes against immature stages of *Rhynchophurus palmarum* (SAPW) as potential tool for biological control of *Rhynchophorus ferrugineus* was presented remotely

from Brazil via Skype, wherein experiences of using EPNs to control *Rhynchophurus palmarum* in South America were presented. Significant differences in pathogenicity were reported among nematode species and strains. EPNs hold a good potential of being used to control RPW.

Concerning the studies carried out in Southern France, relatively to the use of a very simple technique based on infusion of Emamectin benzoate (EMA) formulation at 3.5% concentration (one treatment /year), the method demonstrated to be very efficient, indeed, after one year the infestation % by RPW was less than 1.4% of the Canary palms. However, due to concerns arising from insecticidal residues, it was cautioned not to use this technique in date palm.

Studies carried out in Pakistan on EPFs showed that local isolates did not induce only high mortality of the pest but also reduced oviposition rate, fecundity, hatching and larval survival. Further, studies on fungal isolates of *Beauveria bassiana* collected from coastal areas of Syria showed that these isolates were effective against different stages of RPW under laboratory conditions. The most promising results were obtained with a combination of *Beauvera Bassiana* and *Metharhizium anisopliae*. Trials carried out in Italy on the manipulation of fungal endophytic communities of *Phoenix dactylifera* showed that the fungal endophytic communities of palm could be easily manipulated by means of commonly used pesticides and fertilizers, opening new avenues for pest control.

Microwave heating of infested palms as a curative treatment in Italy showed promising and eco-compatible solution in fighting RPW. However, concerns were raised about the ease of using this technique in the field and the high cost of microwave heating equipment. It could however be useful in quarantine treatments. Further, the impact of different agronomic and cultural practices on the incidence and intensity of date palm pests including RPW were presented. With regard to RPW, the importance of adopting proper plant density (spacing), irrigation methods, frond and offshoot pruning and removal were emphasized.

During the discussion, it was suggested that research on biological control against RPW should be given serious trials (field transfer) by a specialized working group that would test the best EPNs/EPFs using a uniform protocol in different RPW infested countries. The role of adopting good agricultural practices in date palm to combat RPW need further studies.

Session 2.2. Monitoring surveillance and phytosanitary measures

During this session five oral presentations as mentioned below were delivered;

- Comparison between dry traps efficiency in Napoli and Bari (Italy) urban areas. - *F. Nugnes*.
- Efficiency of food baits, synthetic attractants and trap type on *Rhynchophorus ferrugineus* (Olivier) trapping in palm Plantations of Ismailia, Egypt by aggregation pheromone traps. - *M.K. Abbas*.
- Red Palm Weevil monitoring and early warning system. - *K. Cressman*.
- Automatic localization of Phoenix by satellite image analysis. - *R. Cousin*.
- Nanomatrix powder dispenser for control red date palm weevil. - *H. El Mahy*.

The presentations on RPW traps indicated promising results from Italy using the dry Electrap™, which was found superior to the food baited Novored trap. The higher temperature inside the Electrap™ resulted in possible more intense lure dispersion. Studies from Egypt showed that the best RPW trap components was water, pheromone, palm tissue and 15% molasses in water. Ethyl acetate: ethanol (1:3) was able to generate high synergy with the pheromone and was almost as effective as the complete bait.

In order to address critical shortcomings to systematically collect standard geo-referenced data in the field for effective monitoring and management of RPW, 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. The possible name of the mobile app could be ‘Soosa-hamra’.

Further, an interesting presentation based on studies carried out in France demonstrated the automatic localization of Phoenix palms in urban areas by satellite image analysis. The results are accessible on a database and exploitable using GIS software. The web application will also allow locating RPW infested palm trees.

In the next presentation, Crop IQ Technology’s nano-matrix powder dispenser enhanced the delivery of the RPW pheromone by slowing down the release rate of the pheromone and is useful in RPW mass trapping programs.

Session 2.3. Innovative and emerging technologies in RPW control strategy

During this session, 10 oral presentations (including five from the private sector) were discussed;

- Novaluron, a potent IGR suppressing the growth and disturbing the antioxidant defense mechanism of *Rhynchophorus ferrugineus* (Olivier). - *A. M. AlJabr*.
- Studies on curative treatment of Red Palm Weevil, *Rhynchophorus ferrugineus* Olivier infested date palms based on an innovative fumigation technique. - *S.R. Al Ballaa*.
- Investigating the immunocompetence in Red Palm Weevil developmental stages and sexes. - *F. Cappa*.
- Studies on service free semiochemical mediated technologies to control red palm weevil *Rhynchophorus ferrugineus* Olivier based on trials in Saudi Arabia and India. - *J.R. Faleiro*.
- Innovative and emerging technologies in RPW control strategy. - *B. Löhr*.
- Innovative formulations of pheromone for RPW mass trapping: components, concentrations, longer controlled release. - *O. Guerret*.
- Sensors for early detection of Red Palm Weevil in palm trees- *E. Lipman*.
- CEO Artificial intelligence and internet of things to tackle Red Palm Weevil. - *M. Khalil*.
- Biorational control strategies for sustainable management of Red Palm Weevil, *Rhynchophorus ferrugineus*. - *N. Hassan*.
- Cloud based RPW Integrated Management System. - *S. Al Zaidi*,

This session started with the presentation on the studies of using insect growth regulator (Novaluron) as a potential RPW control, by inducing high mortality, growth and antioxidant response. The second presentation by a farmer from Saudi Arabia was dedicated to the applied curative treatment of RPW infested date palms based on a fumigation technique, with Aluminum phosphide tablets, ensuring complete entrapment of phosphine gas. The third presentation was dedicated to the investigation on the immune response of different developmental stages of RPW using both generic pathogen and entomopathogenic parasites, the trials revealed the most susceptible target of infection. Results showed that larvae were considerably more resistant than adults to bacterial challenge.

The next presentation concerned further studies, carried out in Saudi Arabia and India, which showed that attract and kill technology could be easily deployed in the field where additional food baited traps have to be installed. Also, the dry Electrap™, eliminates the cost of servicing food baited pheromone traps. Though, trap shut down studies identified potential RPW repellents, further studies are required to evaluate the extent of tree protection by RPW repellents when deployed in a push-pull strategy.

After that, an interesting talk was on Studies carried out by researchers from Colombia, which showed that the tachinid fly, *Billaea rhychophorae*, efficiently parasitizes the American palm weevil, and could be useful to make trials on the possible RPW control.

Following this talk, French researchers presented an interesting field studies in Tunisia which evidenced that RPW pheromone traps baited with M21 dispensers recorded better captures as compared to the ISCA lures. Paraffin when added to RPW pheromone traps, prevents escapes of captured adults.

Concerning the Private sector, the speakers presented their innovative tools, in order to integrate them in an efficient integrated management of the RPW. Firstly, Agrint, USA presented results on the field tests of a tree sensor capable of accurately identifying RPW infested palms. Whereas, the Platform Nakheel, UAE, presented an autonomous innovative system for the early detection of RPW, based on 'internet of things and artificial intelligence'. Furthermore, studies from Spain reported on the various aspects of a new biopesticide against RPW based on the patented *B. bassiana* strain 203. This EPF is currently produced commercially. Subsequently, Russell IPM- UK, presented various bio-rational strategies for the sustainable management of RPW, including a slow release pheromone, a natural product

based RPW repellent, and also an innovative hydraulic palm injection system to deliver insecticide into the palm.

This was followed by a cloud based RPW integrated management system from the same company that is supported by a mobile app for periodic health check of the palm, including timely alert of infestation and its subsequent treatment and progress.

Discussions that followed raised questions on the ease and cost of using the technologies and the real need to introduce at the earliest either these

advanced technological tools or the traditional methods, which if used correctly, could be sufficient for early detection of the infestation.

Whereas, some other participants asked about the sustainability of the sensors, the real price of these tools and the differences existing between the sensors presented by the different companies. In conclusion, the participants highlighted the importance of validating these innovative tools on a large scale in the field before their adoption in RPW control programs.

Poster Session

The following posters were presented during the second day of the meeting

- Environmentally safe preventive and curative control measures for *Rhynchophorus ferrugineus* Oliv. (Coleoptera : Curculionidae) in palm orchards in Egypt.- *S. M. Hashim*.

- The use of microwaves in the control of the red date palm weevil *Rhynchophorus ferrugineus* oliv. (Coleoptera: Curculionidae): effects on ovary and testis. - *M. Martano*.

- Monitoring *Rhynchophorus ferrugineus* (Olivier) in ornamental palm tree plantations in the north western coast of Egypt. – *S.M. Hashim*

- The effect of preventive measures in reducing red palm weevil infestation. – *M.K. Abbas*.

- Early detection and warning by ferrugineol combined with other volatile compounds for the biocontrol of *Rhynchophorus ferrugineus* (Coleoptera: Curculionidae): a quarantine pest in Brazil. – *V.A. Dalbon*.

- “RED ALERT” – How Brazil and Colombia are preparing themselves for the potential arrival of the Red Palm Weevil *Rhynchophorus ferrugineus*

(Olivier) (Coleoptera: Curculionidae). *E.C. Guzzo*.

The posters in this session were on a wide range of topics of RPW control including safe preventive control of RPW in Egypt, effects of micro wave treatment on the reproductive organs of RPW and also the preparedness for RPW emergence in the South American countries of Brazil and Colombia based on experiences to control *R. palmarum*.

Session 2.4. Innovative integrated approaches and technology transfer to control RPW.

There were six presentations during this session.

- Recent advances in palm weevil trap and lure design and A&K techniques for RPW, - *S. Kharrat*.

- Red Palm Weevil (*Rhynchophoru sferrugineus*) small scale laboratory rearing for its evaluation in a SIT program.- *M.Cristofaro*.

- An effective strategy to obtain very rapidly the red palm weevil decline in

an area planted with ornamental palms, *M. Ferry*.

- Next generation of feeding inhibition to control tree borers, particularly the Red Palm Weevil.- *S.Sermani*.

- Effects of two natural mix oils on the larval and adult stages of RPW.- *N. Metwaly*.

Technologies Ajman FZ|UAE) Electrap™.- *V.Russo*.

The main problem evidenced for mass trapping (MT), is the elimination of the food bait and the water losses, and its constant servicing requirements. Nevertheless, RPW can be successfully managed with mass trapping. The recommendation was that no need for the food bait for the Electrap™. There were two successful experiments on Attract and Kill (A&K) (India, Malaysia) for three months.

The main conclusions were:

- MT is effective to help eradicate RPW (Canary Islands)
- MT requires constant servicing and is problematic under high temperatures
- A&K provides a fast knockdown of RPW
- MT is supported by more than 2 decades of use
- A&K needs trials to define its optimal use (but looks like lasts 9 months)

The black dry trap collected more RPW than the red moist trap. The attractant was not really an aggregation pheromone but it attracted RPW nevertheless.

Area-wide strategies are not implemented because of a lack of efficient collective organization and costs are too high. Classical means are costly and complicated and eradication is very costly and there is often a mismanagement of the waste (palm residue). In order to reduce RPW populations, at least 75% has to be achieved; if only 50% is achieved, then the population remains stable –neither increasing nor decreasing. Studies were performed in five municipalities on the French Riviera (2011-2015) where mass trapping contributed to reduce RPW populations. Other examples were cited, in Tunisia and Israel on ornamental palms.

Following this presentation, a new, low-cost technology uses electricity that can hear the larvae scratching in the palm trunk was presented. It has shown the importance to work on the first larval stages in order to control

the RPW. The relative data can be collected using sensors during 2-3 months. Two videos demonstrated the response of the larva to the electricity, where only 2-3 volts were needed to kill them.

The use of natural oil mixes was investigated, showing that BRK6 resulted in high RPW mortality after 3-5 days and effective for 3-4 months. Several catch and release experiments were also presented.

Session 3.1. RPW management: gaps, challenges and prospects

In this session two presentations were delivered:

- Controversial aspects about Red date palm weevil- *H.Al Ayedh*.
- Overview of the gaps, challenges and prospects of red palm weevil management, *R. Faleiro*.

The major concern of the presented works concerning controversial aspects about RPW was about the use of Aluminium phosphide for treating RPW infested palms. Even though, this is a cheap insecticide, but very hazardous and should be used under restricted protocols. In addition, there has been resistance reported for this pesticide. Concerns related to traps and early detection and the “flooding” of technologies by the different companies on these two aspects of RPW management was highlighted. There is a need to rely on scientific evidence to select management approaches to use for the control of RPW.

The presentation on the overview of the gaps, challenges and prospects of RPW management highlighted the following;

- Need to know the socioeconomic impact of RPW infestation and control.
- The early detection devices should be cost-effective so that farmers can use them.

- Because of the problems associated with servicing traps, we need to move to dry traps, using push/pull and attract/kill approaches.
- Quarantine protocols need to be implemented and reinforced within and across countries.
- Farmers need to be involved in all the management aspects of RPW.
- Capacity building of plant protection personnel and farmers on IPM of RPW need to be developed

During the discussion of this session, it was pointed out that chemical residues in dates needs to be monitored.

Session 3.2. Future actions and recommendations

This was an open house session where participants deliberated and commented on various issues related to the control of RPW. Following are the significant actions (outcomes) and recommendations made by the participants in addition to the outcomes related to, farmers' participation in control of RPW / FFSs, research on RPW, networking/working groups, host plant resistance, phytosanitation/quarantine, socio-economic studies, extension and awareness and other related aspects.

Following are the Highlights of this session

Farmer Participation in Control of RPW / FFSs

- Develop the program for the benefit of the farmers with practical, easy to use and low- cost solutions. Technologies should be farmer friendly, accessible and affordable. It is for the farmer to decide if the technology tested is useful. Participatory approach among farmers and researchers is essential.
- Identify some solutions that can be delivered in the field.
- FFSs can play an important role in RPW control and can help facilitate the participatory approach.
- FFSs should be managed by farmers (down to top). Support technology transfer and FFSs by involving farmers, public sector, companies etc in selected areas.
- Implement a small participatory program (demonstration) with the best technologies for RPW control in KSA, Oman and UAE.
- The demonstration plots may have to be country specific.

- In the next meeting it is essential to involve farmers, other stakeholders and extension agencies.
- Farmers are confused and eager for solutions. There are too many technologies but how many can be used in the field? Concentrate on simplicity and cost.
- Farmers cannot implement costly technologies.
- From experience in Africa, before we go to the farmers through FFSs, we should know what is working in the field and develop a comprehensive package for the field.
- Important to look at the size of the farmer's holdings.
- Stakeholder involvement (other stakeholders, garden owners) in the control program is essential
- Participatory approach and not only FFSs is required. Make tailor made programs for participatory approach for each country.

Research on RPW

- All the research proposals should be tried in designated farms so that the technology is validated. Research is continuous and we should work on what we have in hand.
- Test the components in a package of the RPW-IPM.
- Start with the list of gaps. All technologies should be supported with scientific data.
- There is a need to support research on biological control of RPW.
- Need to cover both date palm and ornamental palms.
- Companies should cover their own cost for testing the technology.
- Need to have a multi-disciplinary approach.
- Cost of the technology is an important factor.
- Focus on the host plant to tackle the problem.

- There must be an end point for research.
- Biological control to be addressed on priority.
- Need to generate data on the damage / loss due to RPW.
- Studies on insecticide resistance are essential.
- Essential to validate the technologies in the field.

Networking/ Working Groups

- Establish small network (sub-groups) on biological control, pesticide application and resistance, application of Apps, agricultural practices, monitoring & surveillance and awareness & extension.
- In addition, add phytosanitary protocols, certified propagation material, monitoring and use of IT and Socio-economic study group. Create sub groups with same experts (1-2) for having connection between the groups.
- The sub-groups need to focus on a specialised topic.

Host Plant Resistance

- Pay attention to the host (palm) itself. Value of the Genetic resources to combat RPW to be assessed.

Phytosanitation/Quarantine

- Quarantine is very important for the eradication of RPW and to sustain control efforts.
- In March 2017, the quarantine laws have changed in EU with respect to RPW.
- Need to harmonize homogenize phytosanitary laws in the region.
- Incentive based phytosanitary system may be implemented.
- Look at certification of planting material and establish certified nurseries.
- Focus on quarantine laws and by-laws.
- Currently there is no enforcement of phytosanitary regulations.

Socio-economic studies

- Need to carry out socio-economic study urgently with quantification of the impacts.

Extension and Awareness

- Create awareness (pamphlets, guides etc.) on RPW and its control.
- Publish pamphlets on RPW control in language of workers.

- Update the manual with outcome of this meeting.

- In the RPW manual, we have some guidelines for phytosanitary measures.

Other points discussed

- Agricultural practices should also be focused upon. Crop and field sanitation and cultural practices are important to combat RPW.

- Use micro-wave technology to eradicate severely infested palms.

- Based on the gaps, analyse what is working in the field.

- Implement monitoring and smart solutions.

- Link the outcome of the meeting to solutions / recommendations.

- For trials by King Saud University, KSA, responsible farmers who will implement the technologies will be selected for the trials. Companies can join in these trials.

Side Session: Meeting of the organizing and scientific committees

The organizing and scientific committees met after the conclusion of the technical session to discuss the outcome of the meeting and put the light on the most promising technologies / innovative tools to control RPW with a proposal for field validation trials in the main palm growing areas. Accordingly, the following five topics were identified;

- Biological control (Lead Organization: ICARDA).
- Phytosanitary Systems – Border control, Protocols etc (Lead Organization: IPPC in collaboration with NEPPO and EPPO).
- Certified propagation material (Lead Organizations: NEPPO / CIHEAM).
- Monitoring, IT for early detection (Lead Organization: FAO).
- Socio-economy (Lead Organization: AOAD in collaboration with ICARDA).

It was decided to form Technical Working Groups (TWGs) on the above topics for which 'Concept Note' will be prepared by each TWG that will eventually develop into a research proposal for testing and validation in the field.

During this side session, members of the organizing and scientific committees also agreed upon the meeting declaration (Annex-1)

Annex-1 BARI DECLARATION

International meeting on

Innovative & sustainable approaches to control the Red Palm Weevil (RPW) - CIHEAM Bari, Italy, 23-25 October 2018

We, the representatives of the relevant organizations attending the International Meeting on Innovative and Sustainable Approaches to Control the Red Palm Weevil (RPW), jointly organized by FAO and CIHEAM Bari in collaboration with KIDPAI, ICARDA and AOADat CIHEAM Bari headquarters in Italy, during the period from 23-25 October2018:

Acknowledge the efforts of FAO and CIHEAM and their excellent initiative to organize this fruitful meeting bringing together all players from around the globe that are concerned or involved in the management of the RPW;

Recognize the serious threat posed by the red palm weevil to dates production, income and livelihoodoffarmercommunitiesaswellastheadverseef-

fectsontheenvironmentintheNear East and North Africa Region(NENA);

Highlight the need of assessing the socio-economic impact of the RPW;

ReaffirmtheimportanceofusinganintegratedapproachtoRPWmanagementincludinginter alia biological control, environment friendly tactics, economic sustainability along with information technology and remotesensing;

Agree on the need to focus on the identification, validation and transfer of innovative techniques, user-friendly, affordable solutions to farmers and other stakeholders for effective, successful management and containment of the RPW;

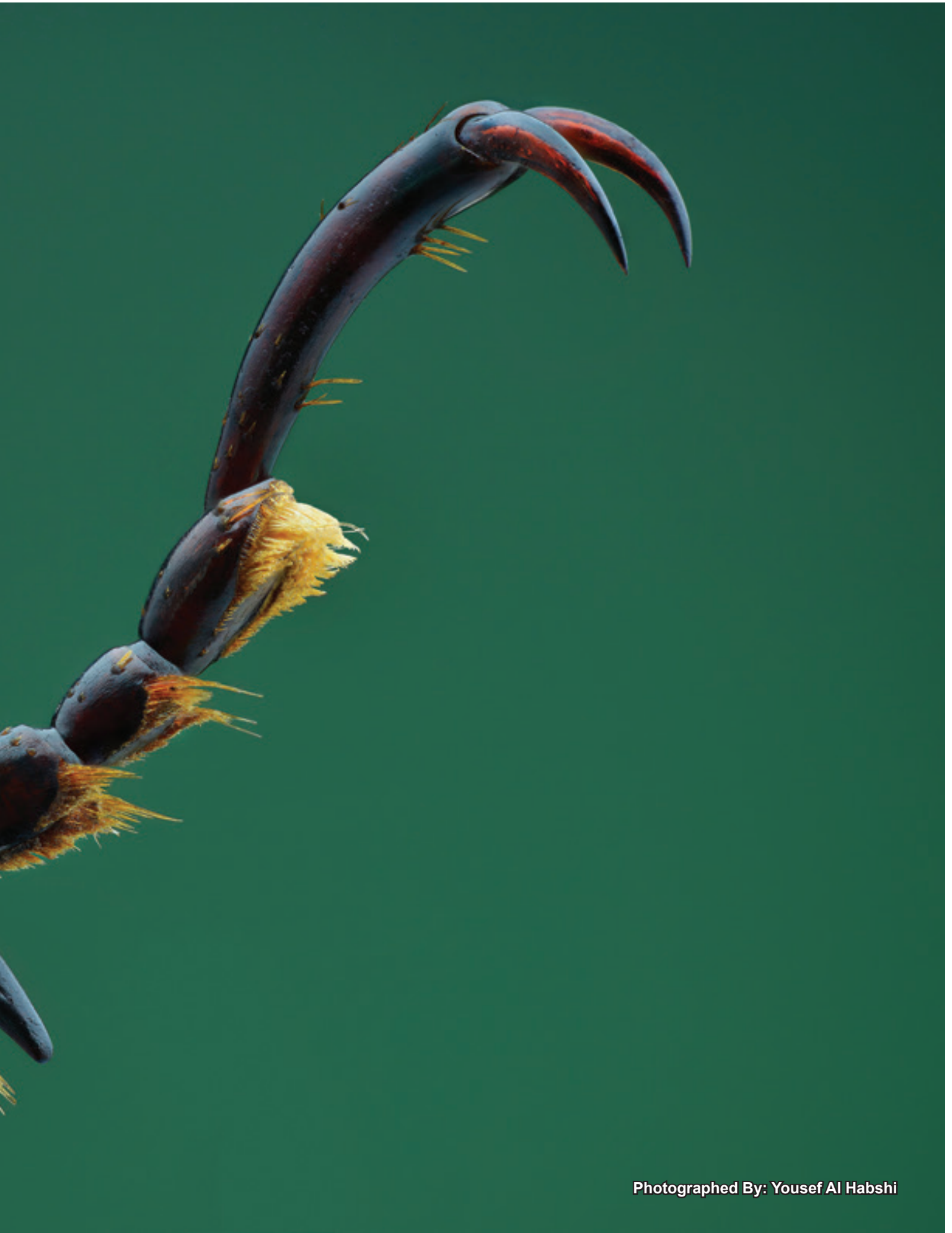
Value the efforts of FAO and CIHEAM Bari and other partners for the initiative to create a multi-disciplinary international network of experts to share the results of research and best practices;

Express our readiness for cooperation on the establishment and viable operation of a global platform on RPW management by sharing knowledge and expertise;

Value the commitment of international Funding/Government agencies to promote field validation of the most promising technologies/innovative tools to control RPW in the main palm growing areas across the NENA region;

Emphasizetheneedofcollaborativeeffortstodevelopandsupportasurveillanceprogramme based on the use of informationtechnology;

****



Photographed By: Yousef Al Habshi

Republic of Sudan

Ministry of Agriculture and Forestry

Agricultural Research Corporation (ARC)

Sudan Thematic Implementation Plan for Management of Invasive Red Palm Weevil (RPW), *Rhynchophorus Ferrugineus* (Olivier)

Dr. Mahdi Abdlerhman Ahmed

Shambat Research Station (ARC)

Republic of Sudan
Ministry of Agriculture and Forestry
Agricultural Research Corporation (ARC)

SUDAN THEMATIC IMPLEMENTATION PLAN FOR MANAGEMENT OF INVASIVE RED PALM WEEVIL (RPW), *RHYNCHOPHORUS FERRUGINEUS* (OLIVIER).

Abstract

Sudan is rich in biodiversity within diverse environmental systems making it endowed with flora and fauna which are being threatened by natural factors and human activities.

Date palm (*Phoenix dactylifera*) is believed to be cultivated in northern Sudan and upper Nubia since 3200 BC. Dry date cultivars might have originated in Southern Egypt and Northern Sudan. Date palm (*Phoenis dactylifera* L.) in Sudan is an economic and food security crop. Estimated annual date production from 8 million date palm trees is about 431.000 mt which is far below the country's potential. Sudan has been famous in the world for production of dry dates. Different local and old cultivars and seedling races are known in the country. Six good local commercial cultivars are available and research is coming up with better composition of cultivars by local selection and foreign introduction from tissue laboratories. Sudan is still free from-devastating red palm weevil - and the destructive bayoud caused by *Fusarium oxysporum* f.sp. *albedensis*.

Red palm weevil (RPW), *Rhynchophorus ferrugineus* (Olivier), is category-1 pest on date palms in the Middle-East countries. It is one of the biggest threats to global agriculture these days. These little crimson devils eviscerate coconut, date and oil palms, and are native to South Asia. Over the last three decades they've spread to more than 60 countries from the Caribbean to Southern Europe. For farmers across East Asia, North Africa, Europe and the Middle East, the red palm weevil evokes serious anxiety. These pests, which attack 40 different species of palm, have caused economic losses in the millions of dollars annually worldwide. One female weevil can lay up to 300 eggs — hiding them inside holes and cavities in the trunk of a palm.

Once they hatch, “the larvae burrow deep inside the palms,” munching their way through the tree, and destroying it from the inside. Sudan is expecting that RPW would come eventually.

The thematic implementation plan has the major components of a strategy to be adopted for a country that is not infested with RPW, which revolves around 1) Quarantine, 2) Monitoring/Surveillance and 3) Training/ Capacity Building. Here are some points that could be adopted to strengthen the aforementioned components besides a plan should infestation occur in Sudan. In this case, the strategy should be containing the spread and eradicating the pest.

Key notes: Sudan, Date palm, Red palm weevil, Strategy adopted

Introduction

Sudan: the geography and environment

Sudan is a vast country with an area of 1.8 million km2. It lies between latitudes 10° and 22° N and longitudes 22° to 38° E. Its landscape consists primarily of gently sloping plain, with the exception of Jebel Marra Massif, Red Sea Hills and Nuba Mountains. Mean annual temperatures vary between 26°C and 32°C across the country. The northern part is almost desert and semi desert with average annual temperatures around 30°C and average annual rainfall of about 150 mm. The central part is semi-desert to savannah with average annual temperatures around 27°C, and average annual rainfall of about 200 mm. Rainfall, which supports the majority of the agricultural activity, is erratic and increasing in amount southward. Sudan can be ecologically divided into five vegetation zones according to rainfall patterns from North to South .These are: Desert, Semi-desert, Low rainfall, savannah High and rainfall savannah.

Sudan is endowed with a wide range of ecosystems and species diversity. The ecological zones extend over a wide range from the desert in the extreme north to the savannah. According to Land Cover Atlas of Sudan (FAO, 2012), forests and rangelands represent 35.6% of the total country area.

Sudan is rich in biodiversity within diverse environmental systems making it endowed with flora and fauna which are being threatened by natural factors and human activities.

Date palm (*Phoenix dactylifera*) is believed to be cultivated in northern Sudan and upper Nubia since 3200 BC. Dry date cultivars might have originated

in Southern Egypt and Northern Sudan. Date palm (*Phoenis dactylifera* L.) in Sudan is an economic and food security crop. Estimated annual date production from 8 million date palm trees is about 431.000 mt (FAO, 2010), which is far below the country's potential. Sudan has been famous in the world for production of dry dates. Different local and old cultivars and seedling races are known in the country. Six good local commercial cultivars are available and research is coming up with better composition of cultivars by local selection and foreign introduction from tissue laboratories (Khairi, 2015).

However, the date palm industry is facing many serious problems, related to low yields, lack of appropriate packing and presentation as well as limited processing of date products. The low yields in most countries, including Sudan, are due to soil salinity, poor fertility, insect pests and diseases, lack of maintenance and care due to increasing cost of labour and to shortage of personnel trained in improved cultural practices. As a result of the high cost of production and low prices of the produce, farmers tend to neglect or even abandon their orchards. Although the commonly known, insect pests like devastating red weevil and the destructive diseases like bayoud caused by *Fusarium oxysporum* f.sp. *albedensis*, have not been reported, in Sudan (Ahmed 2013 , Felaero, 2017and Elhassan 2006), the date palm is affected by many biotic factors among which insects are the most important.

Insects diversity in Sudan

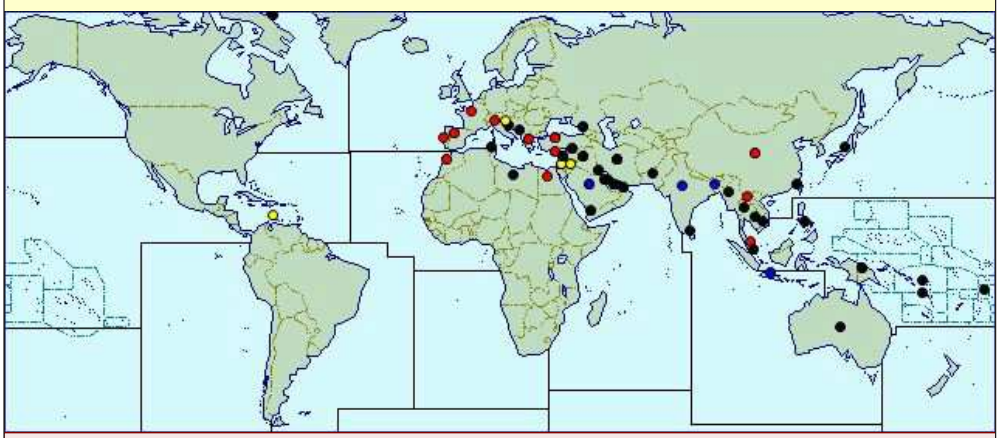
Welcome Tropical Research Laboratories in Khartoum started insect collection and identification efforts in Sudan in 1902. Since then, intensive surveys were made to cover all geographical regions. Although the National Insect Collection Unit of ARC is concentrating on insect species of agricultural and environmental importance, it is considered as one of the biggest and oldest insect collections in Africa. Over 5000 insect species belonging to 246 families and 15 orders. The order Coleoptera (beetles) which , contain about 69 family and 2089 species represent the most dominant insect species in Sudan, Based on their economic importance.

Red palm weevil (RPW)

Red palm weevil (RPW), *Rhynchophorus ferrugineus* (Olivier), is category-1 pest on date palms in the Middle-East countries. It is one of the biggest threats to global agriculture these days. These little crimson devils eviscerate coconut, date and oil palms, and are native to South Asia. Over the last

three decades they've spread to more than 60 countries from the Caribbean to Southern Europe. For farmers across East Asia, North Africa, Europe and the Middle East, the red palm weevil evokes serious anxiety. These pests, which attack 40 different species of palm, have caused economic losses in the millions of dollars annually worldwide Red palm weevil (RPW), *Rhynchophorus ferrugineus* (Olivier) is a lethal pest of date palm. The pest has its home in south and south east Asia where it has been a key pest of coconut, and is now reported from nearly 50 countries in all the continents on 40 palm species worldwide (Wattanapongsiri, 1966; Faleiro, 2006; Giblin-Davis et al., 2013; http://www.savealgarvepalms.com/en/weevil-facts/host-palm-trees). The global spread of RPW has been rapid during the last three decades especially through infested planting material and FAO has designated RPW as a category-1 pest of date palm. Early detection of infested palms is the key for the successful control this pest in countries where it occurs. In case of Sudan, enforcing strict external and internal quarantine regimes is vital to prevent the entry of the pest in to the country.

Distribution map



Present, no further details
Widespread
Localized
Occasional or few reports

Source: http://www.cabi.org/isc/datasheet/47472

Sudan is still free from
devastating red palm weevil

and the destructive bayoud caused by
***Fusarium oxysporum* f.sp. albedensis**

Sudan is expecting that RPW would come eventually.

e. There's good reason for all the panic, says Mark Hoddle, an entomologist at the University of California, Riverside. "Red palm weevils are notoriously difficult to detect — until it's too late," he says. One female weevil can lay up to 300 eggs — hiding them inside holes and cavities in the trunk of a palm. Once they hatch, "the larvae burrow deep inside the palms," munching their way through the tree, and destroying it from the inside, Hoddle explains.

The thematic implementation plan

The thematic implementation plan has the major components of a strategy to be adopted for a country that is not infested with RPW, which revolves around 1) Quarantine, 2) Monitoring/Surveillance and 3) Training/ Capacity Building. Here are some points that could be adopted to strengthen the aforementioned components besides a plan should infestation occur in Sudan. In this case, the strategy should be containing the spread and eradicating the pest.

1. Quarantine:

• Registration of nurseries/ importers: The Ministry of Agriculture / National Plant Protection Organization (NPPO) should keep a register for all palm nurseries/ importers (growers, nurseries, dealers, etc.) and establish a database on importation and destination of palms.

• No palm tree should leave nurseries without movement certificate issued by the NPPO.

• Prohibition of importation of palm trees from a particular origin (infested area/countries).

• Palm trees originating from authorized nurseries should only be imported, from non-infested countries.

• In case of date palm, only date palm from vitro propagation could be imported in test-tubes from officially certified nurseries.

• Offshoots produced within the country should be permitted to be transported under close supervision of NPPO, preferably after treatment (dipping of the bole of offshoots in 0.004% Fipronil for 30 minutes). A simple superficial

spray does not help.

• In case of tissue culture palms produced within Sudan, localize geographically (GIS) the mother tree, label it (each mother plant must be marked with the year, sampling area and serial number), under the supervision of the NPPO.

• Movement of offshoots from one oasis to another across the country should not be permitted, to localize infestation in case of an outbreak.

• Nurseries should be inspected at least three times a year.

• Import of offshoots should be banned from infested countries.

• Develop regulation manuals with clear requirements for import, movement and nursery certification.

• Support the establishment of tissue culture laboratories for the production and supply of RPW free planting material.

• Train Plant Quarantine Staff and other law enforcement authorities.

2. Detection:

1. Create awareness among farmers and other stakeholders about the seri-

ousness of the RPW issue.

2. Develop a protocol for visual inspection in a simple and easy to understand languages of the farmer and other support staff.

3. Urgent need to develop a quick and reliable, cost effective, and easy to handle early detection device for RPW. Remote sensing, acoustics, thermal imaging, chemical signatures, laser induced breakdown spectroscopy, near infrared spectroscopy, X-ray, biological and physiological stress indicators, sniffer dogs etc.

3. Measures to Surveillance, Monitoring and Control red palm weevil :

1. Regular inspection and monitoring.
2. Population disruption (pheromone trapping).
3. Plant quarantine.
4. Extension programs.
5. RPW-IPM

In addition to regular visual inspection of date palms in the susceptible age group (< 20 years), it is recommended to monitor the incidence of adult

weevils during peak activity of the weevil from March to May and again from September to November. This could be achieved by setting food baited pheromone traps in plantations along roads at a distance of 1Km between two monitor traps.

4. Awareness :

1. Strengthen extension programs, activities, knowledge sharing mechanisms, communications, and farmers' organizations.
2. Establish defined coordination mechanisms with NGO's, private sector, and cooperatives to make the program more effective.
3. Introduce participatory approach (Farmers Field School) for farmers and farm workers to empower them with knowledge and field practices.
4. Use of social media to expedite transmission of information.
5. Strengthen cooperation among institutions at the National level and initiate programs of cooperation at the Regional and International

5. Capacity Building:

Training and capacity building of all stake holders (Farmers, Agriculture officers, Quarantine officials, NGOs, Cooperatives, Farmer Groups etc.) on the RPW eradication strategy (should the pest be detected) should be carried out/ intensified.

Farmer participation and involvement in the RPW control programs in crucial for successful control of RPW.The advantage of involving the farmers and other stakeholders in the control program is considerable as they present in the farm and can assist in detecting infested palms in the early stage of the attack, an action that constitutes the key to control and eradicate the pest.

Pilot projects to experiment and demonstrate the feasibility to involve farmers/stakeholders could be initiated in all the major date palm oasis of Sudan

6. RPW-IPM programs:

1. Mass trapping to be taken up by lead / trained farmers.
2. Introduce attract and kill strategy in mass trapping programs.
3. Evaluate the dry trap using electro-magnetic technology.
4. Carry out a risk assessment of the area adopting visual observation and pheromone traps.

5. Develop good agronomic practices that limit RPW attack.

6. Preventive measures including sanitation, wounds treatment, removal of neglected orchards, pheromone trapping, and insecticide applications via spray and injection should be practiced.

7. Explore potential indigenous strains of entomopathogenic nematodes and fungi and develop an efficient delivery system.

8. Develop RPW-IPM programs and ensure farmers/stakeholder participation.

7. Data Management:

1. Develop a GIS and spatial data base to be used operationally by countries.

2. Managing mass trapping through the GIS with RFID (Bar coding) of traps.

3. Use a remote sensing imagery to geo-reference palm trees in countries to be used as primary base map in the GIS.

4. Develop a user friendly mobile application for reporting, data collection and transmission.

Should an infestation occur – What is to be done?

In this case the goal should be to contain the spread and eradicate the pest. To achieve this

- Remove (eradicate) all infested palms. Cut infested portion of the palm into small bits (20 cm long) and drench with insecticide in-situ.
- Do not move the infested palm for eradication to another site.
- Establish a 10Km radius buffer zone.
- Intensify phytosanitory/ quarantine regulations.
- Inspect all palms in buffer zone at bi-monthly intervals.
- Mass trap the area [1Km radius from the infested palm] @ 1trap/ha.
- Deploy attract & kill if infestation is severe / 3 weevils/trap/week.
- Prohibit movement of all palms from the buffer zone.
- Intensify training on RPW- IPM.
- Encourage Farmer participation in the RPW-IPM program especially with regard to detection of infested palms.
- The country is to be declared pest (RPW) free if no new infestation/weevil is detected for three years.

Distribution of RPW in the world

The weevil is now present in all continents of the world and in Africa; it exists in Egypt, Libya, Tunisia, Morocco, and Mauritania (recent detection).

The host range

RPW is reported to attack about 40 different species of palms including ornamentals.

The host range should be given attention with respect to quarantine measurements. The weevil could be introduced with hosts other than date palm and there is a possibility of being introduced as hitchhiker on imported ornamentals.

Challenges in red palm weevil mentoring

1. Early detection difficulties of RPW infestation.
2. Farming system.
3. Lack of adequate human and financial resources.
4. Lack of active involvement/ training of farmers.

Successful lesion from Sudan for control one of the exotic pest in Date palm

Sudan has good experience to deal with invasive pests, for example, the green date palm scale insect as an exotic pest appeared in Northern Sudan, Considered in the other palm groves of the world to be of minor or no importance, developed here in a very explosive way. Total number of infested trees is 1200; 000.Following intensive research an Integrated Pest Management (IPM) was starting with cultural practices or sanitary measures, supplemented with chemical control using systemic insecticides and impact of natural enemies together with plant quarantine legislations. Acomprehensive program by Plant Protection Directorate (PPD) has been conducted in infested areas. Sustainable biological control of the green pit scale was implemented based on results of surveys revealed that many natural enemies associated with insect have been recorded, the nitidulid beetle Predators found in all surveyed areas were Nitidulidae beetle *Cypocephalus dudichi* L., *lady bird Pharoscymnus numidicus* , *Chrysoperla* sp and *the parasitoid Metaphycus* sp. was found in association with green pit scale insect

Thematic implementation plan for management of invasive Red Palm Weevil

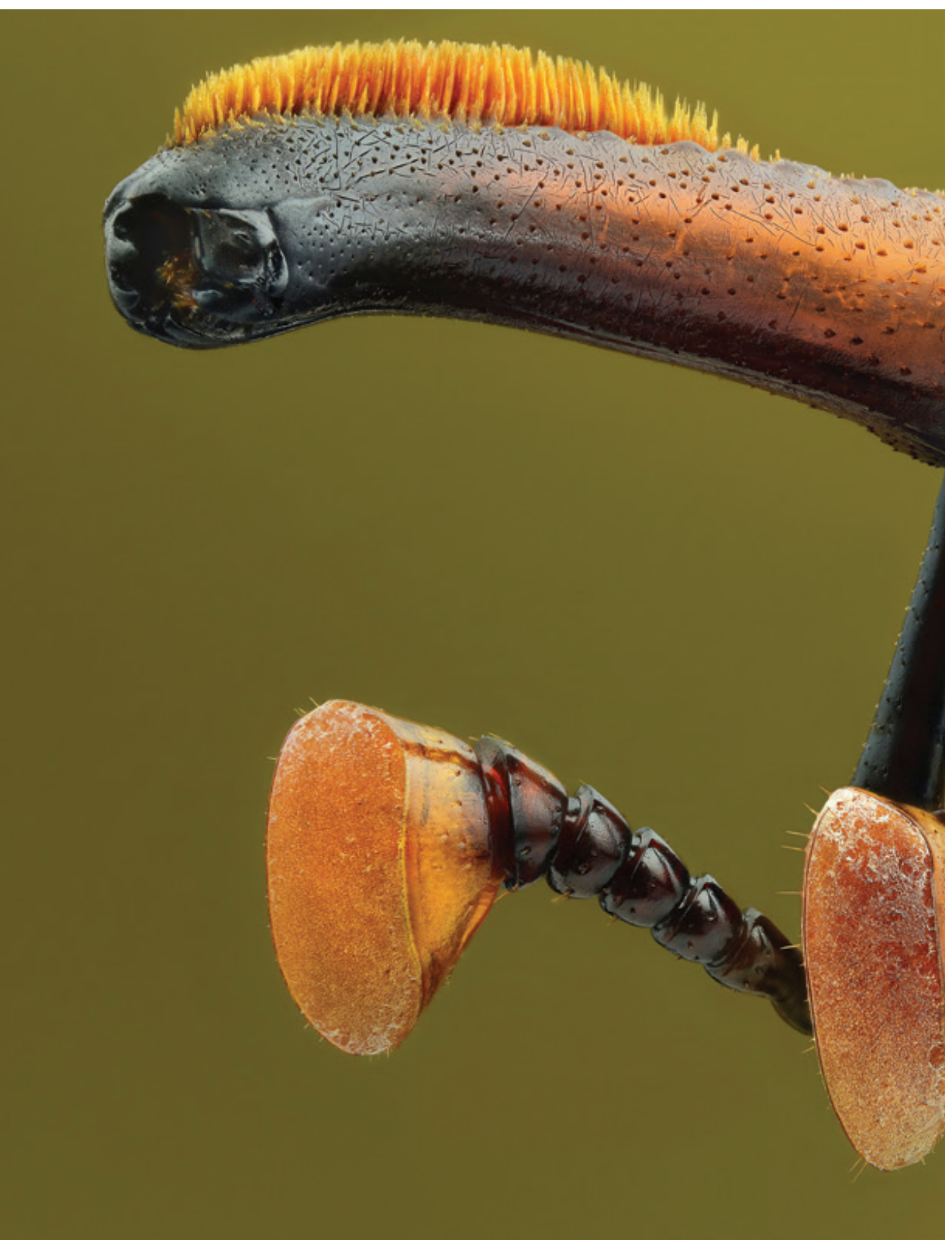
Theme	Recommended Actions	Implementing Agencies
Awareness, Training and Education	i. Develop and implement a public awareness program about that invasive insect and its impact on biodiversity and livelihood of the local communities . ii. Encourage media organizations and extension workers to participate in dissemination of information about the impact of this invasive insect ... iii. Support education institutions to incorporate issues of RPW, identification, prevention, eradication and management into their curricula. iv. Develop database of RPW, identification guides and make the information accessible to the Stakeholders . v. Qualify and train taxonomy specialists in insects.	M of Agric., M of Educ., NGOs, ARC, Universities.
Policies	i. Strengthen quarantine measures and border control to ensure that intentional introductions are subject to appropriate authorization. ii. Develop risk assessment and management programs and guidelines for newly introduced species. iii. Develop and implement effective response procedures for the prevention of new potential invasive species. iv. Encourage and support the involvement of all stakeholders in alien invasive species management program. v. Develop invasive species management plans that emphasize prevention of introductions, control and eradication of invasive species. vi. Develop effective systems and tools for monitoring and evaluation of invasive species.	M. of Agric.

Legislation	i. Harmonize state and sectoral rules and regulations relevant to invasive species and formulate policy and legislation for the control of introductions, movement and management of date palm. ii. Enforcing the international regulation for RPW.	M. of Agric. & PPD
Conservation	i. Identify RPW problems and recommend management actions. ii. Develop appropriate methods to monitor, prevent and stop spread of invasive RPW. iii. Assess the movement of RPW and develop maps of distribution of the invasive RPW. iv. Formulate and implement result oriented research on characterization of invasive RPW; vulnerability of ecosystems, social and economic impact; prevention, control, eradication and management methods. v. Promote research on the use of traditional knowledge in the development and implementation of measures to manage RPW.	ARC
Sustainable Use	i. Strengthen an existing institution to coordinate research, management and eradication of invasive RPW. ii. Produce an inventory of RPW and evaluate their economic, social and environmental impacts	M of SC, ARC, Universities

References

1. Ahmed, M.A; S.Gubara,S. Sanhuri K.gebrel and I Siddig (2013). The efficacy of two systemic insecticides against the green pit scale insect (*Palmapsis phoenicis* Bodenheimer (Green)) (Homoptera: Asterolecaniidae) infesting date palm in Northern Sudan *Proceedings of 72nd Meeting of the Pests and Diseases Committee, ARTC Conference Hall, Wad Medani, Sudan, December, 2013.*

2. El Hassan, E., M. (2006). Date Palm Diseases in Merawi and Debba Areas, in The Northern State, Sudan. *Crop protection Research Center Annual Report, 2006/2007* Agricultural Research Corporation (ARC) Sudan
3. FAO. (2002): Date Palm Cultivation .Edited and compiled by Abdelouahab Zaidand. Arias - Jimenez, E.J Date Palm Research and Developmen Programme . United Arab Emirates. *FAO Plant Production and Protection Paper*, No. 156 - 285 PP.
4. FAO. (2010): Agro-Statistics Database (http://faostat.fao.org/site/340/default.aspx).
5. Flint, M. Lowise, Steve H. Dreistadt, and Jack K. Clark. (2010).Parasitesof Arthropods In: Natural Enemies Handbook: The illustrated guide to biological control.p.64. http// books. Google .com. pp. 55-66.
6. J. R. Faleiro (2017). Report of Red Palm Weevil Mission to Sudan. On Behalf of *'Khalifa International Award for Date Palm and Agricultural Innovation'* The first International Sudanese Date palm Conference December, 2017 Khartoum, Sudan.
7. Faleiro, J.R. (2006). A review of the issues and management of the red palm weevil *Rhynchophorus ferrugineus* (Coleoptera: Rhynchophoridae) in coconut and date palm during the last one hundred years. *International J. of Trop.Insect Sci*. 26:135-154.
8. M. M. A. Khairi (2015). Date palm Status and Prospective in Sudan. Chapter 5 in Date Palm
   a- Genetic Resources and Utilization, J.M.Al- khayri (eds).Volume 1:Africa and the
   b- Americas . D01 101007/978-91-017-9694-1-5.Springer Science + Business.
   i- Media Dordrecht, 2015.
9. Giblin-Davis, R. M., J. R Faleiro, J. A. Jacas, J. E. Peña and P.S.P.V. Vidyasagar (2013). Coleoptera: Biology and management of the red palm weevil, *Rhynchophorus ferrugineus*. Pp. 1-34. *In* J. E. Peña [ed.], Potential Invasive Pests of Agricultural Crop Species.CABI Wallingford, UK.Wattanapongsiri, A. 1966. A revision of the genera *Rhynchophorus* and *Dynamis* (Coleoptera :Cuculionidae). Bangkok, Thailand: Department of Agriculture Science Bulletin 1, 328 pp.
10. Zaid, A., De Wet, P. F., Djerbi, M. and Oihab, A. (2002). Diseases and pests of date palm. In: Date Palm Cultivation. Zaid, A. (Editor). FAO Plant Production and Protection Paper no. 156, Rev. 1. FAO, Rome.



Photographed By: Yousef Al Habshi

Mass Rearing of Red Palm Weevil on Artificial Diet and Date Palm Offshoots

H. A. F. El-Shafie
Date Palm Research Center of Excellence,
King Faisal University, KSA

Mass Rearing of Red Palm Weevil on Artificial Diet and Date Palm Offshoots

Introduction

The red palm weevil (RPW) is originally from South and Southeast Asia (Wattanpongsiri, 1966). RPW had been described as a fatal pest on coconut and date palm more than 100 years ago (Lefroy, 1906; Brand, 1917). The weevil moved from its central origin to invade the rest of the world through different pathways including movement of infested planting materials (Faleiro, 2006). In the Middle-East RPW was first reported from Rass-El-Khaima in the UAE in 1985 (Zaid et al.,2002) and reached the eastern region of the Kingdom of Saudi Arabia in 1987 from where it spread to other areas of the country (Abuzuhairah et al. 1996, Al-Abdulmohsin, 1987). The first report of RPW from Africa came from Egypt in 1992 (Cox, 1993) while in Europe it was detected in southern Spain in 1995 (Barranco et al., 1996). The weevil has become the number one pest of date palm in the Middle East and North Africa during the last 30 years. RPW invaded and established its population in Europe, which is now considered a serious pest on the Canary Island date palm. Globally, the weevil is found in 42 countries from the Middle East, North Africa, Europe, South and South-east Asia, and the Americas (Curacao Islands- Caribbean). Although the weevil attacks many host plants, it is considered of great significance on coconut, date palm and Canary Islands date palm where serious damage occurs. Damage to date palm is mainly caused by the larval stage feeding within the trunk of palms. Adult females of RPW lay eggs in protected parts of the date palm tree, including wounds on the trunk of established trees, at the base of fronds, the crown of the tree and adjacent to offshoots (Faleiro 2006). The RPW is hidden palm tissue borer and the larvae feed voraciously on the internal tissues of the palm, and severe infestation may finally leads to palms death. The external symptoms of infestation by the RPW include oozing of brown fermented fluid, tunneling of tissues, drying of infested offshoots, presence of dead adults and pupae at the base of fronds, and appearance of mats of

brown loose tissues at the crown of young date palm (Fig. 1). The RPW management strategy comprises several components - monitoring and mass trapping with pheromone traps, early detection of infestations in the field, elimination of hidden breeding sites, preventive and curative chemical treatments, and eradication of severely infested palms, implementing quarantine regulations, training, and education.

Fig. 1: Visual symptoms of RPW damage on a young date palm

Purpose and objectives of RPW mass rearing

In many cases, the laboratory rearing and mass production of RPW is very important to maintain purity, age, physiological stage homogeneity, and sex-based selection to carry out lab, semi-field and field experiments. Mass rearing and production of RPW has the following objectives:

- Refining existing RPW rearing protocols to ensure the continuous availability of high quality RPW larvae and adults (free of insecticide residues) for bioassay tests and experimental purposes throughout the year. For example, studying toxicity of different insecticides to different developmental stages of the weevil including eggs, larvae, pupae and adults as well as the egg-laying preferences and response of females to kairomones of different date palm cultivars.
- Maintaining a self-sustaining reproductive culture of RPW control system.
- Studying important competitive biological traits of the weevil such as number of larval instars, fecundity of females, egg hatchability, adult longevity, survival, mating behavior and developmental periods of different stages. Construction of life table parameters of RPW such as intrinsic rate of increase (rm), doubling time (T), net reproductive rate (Ro) on different date

palm cultivars, the infinite rate of increase (ʎ), and sex ratio in the progeny. Information about life history of insects is important for understanding population dynamics, life table analysis, key factor analysis and other important investigations, to determine their community structure (Mohammadi, et al. 2010).

• Quantifying basic flight attributes of the weevil such as flight velocity, flight frequency, flight periodicity and distance flown. Testing response of adult males and females for attraction to aggregation pheromones and factors affecting these responses such as weevil sex, age, and mating status.

• Production of RPW larvae for human consumption. In Thailand, red palm weevil is commercially mass reared and harvested as food (Hoddle, 2015) (Fig. 2).

• The aforementioned data are useful for ecological studies and in the development of management strategies and their application for the control the red palm weevil in date palm groves.

Fig. 2: A meal of fried RPW larvae with sauce in Thailand (Source: M. S. Hoddle)

Rearing RPW naturally on bolts of date palm

Many investigators have reared RPW on natural host for experimental purposes (Kaakeh, 2005; Al-Ayedh, 2008; Ju, et al., 2010, Hagley, 1965, and Aldawood and Rasool, 2011; El-Shafie et al., 2013). Aldawood and Rasool (2011) described a protocol for rearing the red palm weevil on bolts (trunks) of different date palm cultivars. Here is the details of the protocol with some modifications. 3-4 years old date palm offshoots are used for the purpose of mass production of RPW. First, all fronds and fibers of the offshoots are removed using electric chainsaw. The bolt which then about 0.75 to 1 m long with varying trunk diameters is cut longitudinally into two equal halves. A cavity of about 20 cm X 20 cm is made in the inner surface of one of these halves (Fig. 3). Five male-female pairs of healthy active weevils are then inoculated into the cavity and covered with cotton mat to prevent escape of the weevils. The two halves of the bolt are then placed together and tightly wrapped with flexible steel wire. All opening in the cut

Fig. 3: Preparation of date palm bolts for inoculation with RPW

Fig. 4: Stacking of inoculated date palm bolts in the rearing cage

bolts are sealed with cotton to prevent rapid drying of the offshoots and simultaneously avoid escaping of weevils. The inoculated bolts are then kept in special cage made of weevil-proof double steel mesh (Fig. 4). The cage is enclosed in insect-proof plastic mesh with double doors to ensure high security against accidental escape of the weevils. The bolts are inspected three weeks after inoculation with the weevils to monitor larval development and harvesting of larvae. Schedule of reopening the inoculated bolts could be stipulated according to the desired larval age required or any other particular stage such as pupae or adults. If virgin females are required, pupae can be harvested and isolated individually in a separate plastic vial before being kept in an incubator at 27˚C and 60% R.H. for adult eclosion.

Rearing in plastic containers

In Thailand, farmers mass reared the RPW in closed plastic containers. They grind the coconut palm fronds (leaves) using a mechanical grinder and the resulting saw dust is soaked in water and the excess water is drained by squeezing the mash. Pellets of pig feed are added to the mash and the mixture is packed in plastic containers. Adult female weevils are introduced into the container and left to oviposit. Stabs of wood and barks are used to cover the inoculated containers and later provide materials for the larvae to construct their pupal cocoons (Hoddle, 2015). This rearing method is relatively simple and cost-effective in comparison to other methods of rearing.

The mash waste and drained liquids resulting after harvesting of the larvae can be used as compost fertilizer and for soil amendment.

RPW rearing on artificial diet

Rahalkar, et al. (1978) developed an artificial diet, for rearing RPW, consisting of sugarcane, bagasse, fresh coconut cake, brewer's yeast, sugarcane, potassium hydroxide, methyl parahydroxyl benzoate, and sorbic acid solutions. El-Sabey et al. (2003) developed an artificial diet for RPW consisting of potato, carrot, casein, agar, cereals, and vitamin B and D. Martin and Cabello (2006) used agar, brewer's yeast, wheat germ, corn flour, ascorbic acid, benzoic acid, amino acid-vitamin mix, chloramphenicol and nipagin to rear RPW. For mass production of RPW on artificial diet, a healthy vigorous colony of weevils should be available at hand to provide a continuous supply of fertile eggs. Additionally, a diet containing the essential nutritional elements for the development of the weevil as well as the optimal conditions for growth should be available.

Establishment of RPW colony in the lab and collection of eggs

Freshly collected adult females and males of RPW were brought from the Directorate of Agriculture in Al-Ahsa. Adult weevils were placed in perforated plastic containers and fed on sugar cane (Fig. 5). Weevils are sexed based on the presence of a tuff of fine bristles on the dorsal end of the rostrum in males and their absence in the females.

Fig. 5: A colony of RPW feeding on sugar cane

Sugar cane provides food for adult weevils and substrate for egg laying by the females.

The provided pieces of sugarcane are carefully inspected and peeled in search of eggs, which are collected and transferred into petri dishes lined with wet Watman papers using a fine camel hairbrush. To obtain the maximum hatchability percentage, only clean ivory colored and shining eggs should be collected. The eggs are then kept for three days in an incubator at 27◦C and 50% RH for hatching and the newly hatched larvae are then carefully transferred to cups containing artificial diet.

Ingredients and preparation of the artificial diet

The protocol most commonly used for mass rearing of RPW including the ingredients of larval diet has been developed by Martin and Cabello (2006) and modified by El-Shafie et al. (2013). The main ingredients of the diet include agar, yeast, wheat meal, corn flour, in addition to other basic ingredients. Chemical preservatives such as benzoic and sorbic acids are incorporated in the diet to prevent fungal and bacterial contaminations. Thirty-seven gram of agar is mixed in 875 ml distilled water in glass beaker. The mixture is then put in a microwave oven at maximum potency for 8 minutes and stirred using magnetic stirrer at minutes 2, 4 and 6 to dissolve the agar. The mixture is removed from the oven to facilitate each stirring and finally removed at minute 8. The main ingredients are mixed with agar jelly using a kitchen blender, previously washed with distilled water and surface sterilized with 0.5% sodium hypAochlorite (Table 1).

Table 1: Ingredients and amount needed to prepare one liter of RPW artificial diet (El-Shafie et al., 2013)

Ingredient	Amount
Distilled water	875 ml
Agar	18.5 g
Brewer's yeast	45 g
Wheat grains	45 g
Corn flour	45g
Sorcic acid	1.6 g
Ascorbic acid	4 g
Aminobenzoic acid	1.6 g
Pharmaton® capsule (1.55g/capsule)	2 capsules
Tetracycline (250 mg)	2 capsules
Amino/fatty acids additive	25 ml

Fig. 6: Artificial diet in plastic containers

The mixture is homogenized at high speed for 2-3 minutes and left to cool till 60 ◦C. As the diet cooled, two multi-vitamins (PharmatonTM) capsules and one tetracycline tablet are added while stirring the media. The diet is then poured into surface sterilized plastic containers while still warm, left to solidify (Fig. 6). To prevent spoilage of the diet, it should be kept in the refrigerator until use. The cups containing diet should be kept at room temperature to warm up before neonate larvae are introduced into them. Small tunnels may be made on the diet surface to facilitate establishment and burrowing of the neonate larvae. Large number of larvae with homogeneous weight and physiological age could be obtained on artificial diet (Fig. 7).

Fig. 7: Large number of RPW larvae produced on artificial diet

Provision of fibers for pupal cocoons

One of the challenges facing those who rear RPW on artificial diet is to get the final instar larvae to pupate. Entomologists have extensively used sugar cane stem for this purpose. However, the diameter of stem is a determining factor in the success of this process. Sugarcane stem with narrower diameter, in most cases, lead to small size adults in addition to its low efficiency (El-Shafie et al. 2013). The food-fiber pupation technique, as the name implies, consisted of two layers of date palm fiber and a layer of sugarcane pieces (15 cm long), split longitudinally and stacked side by side to make a mat 20 cm wide. The sugarcane pieces were sandwiched between the layers of date palm fiber and wrapped with fine plastic mesh. The sugar cane-date palm fiber mat was rolled into a cylindrical bundle resembling date palm offshoot (Fig. 8) (El-Shafie et al., 2013). The date palm fiber and the sugarcane there by simultaneously provided material for the construction of the cocoon for fully matured larvae that wanted to pupate and nutrients for those larvae that require additional time to complete their development. The sugarcane stem also provide a solid support that is required by the larvae during the cocoon spinning process. The food-fiber bundles are kept in

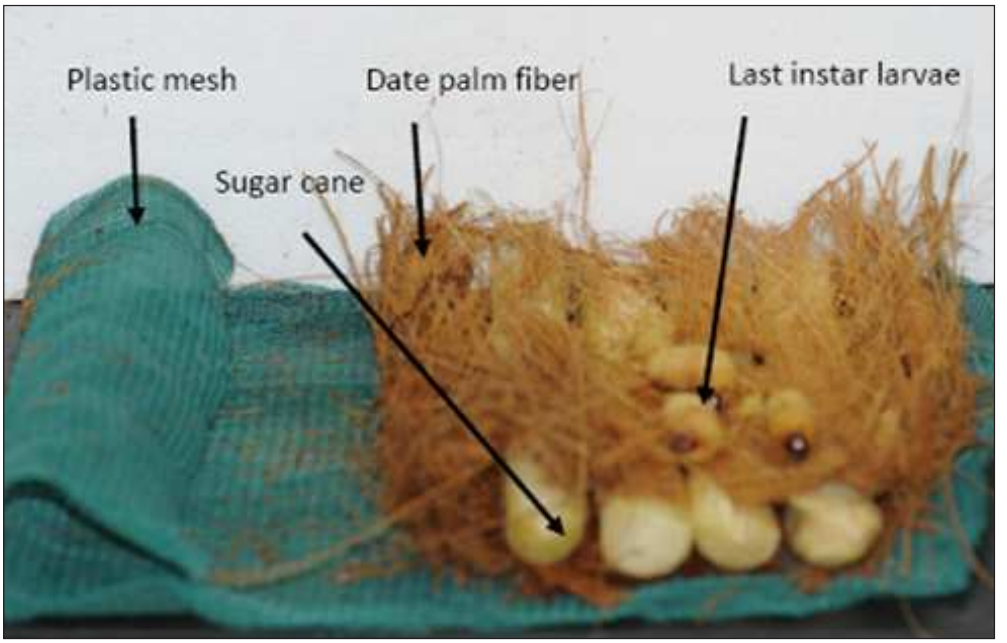


Fig. 8: RPW Food-fiber pupation technique (Source: El-Shafie et al., 2013)

30x20x14cm plastic container specially fabricated with 20 holes (5mm diameter; 8 on the lid, 4 at the bottom and 2 on each side below the container rim) to provide aeration and to conserve the required humidity. The bundles are checked carefully after three weeks for presence of cocoons without disturbing the pupating larvae. However, when fibers are unavailable for the larvae to spin cocoons, they may pupate even in the absence of such protective pupal cases (Fig. 9) (El-Shafie, unpublished data).

Fig. 9: An adult RPW successfully developed on artificial diet without pupal cocoon

Constraints of RPW mass rearing

The mass rearing of RPW on date palm trunks is laborious and expensive (Al-Ayedh, 2011). Moreover, the offshoots used in the rearing process should be healthy and free from infestation by other coleopteran borers such as the longhorn beetle and the fruit bunch borer. Infested offshoots may lead to the attack of the red palm weevil by phoretic mites (Fig. 10). Rearing of RPW on artificial diet is more difficult and labor intensive, because it requires diet preparation and replacement of the diet on regular basis, and handling of delicate larvae. Most of the artificial diets are susceptible to microbial contamination, which sometimes resulted in complete colony failure. Therefore, diet preservatives are needed that might have negative impacts on insect health (Aldawood and Rasool, 2011). Agar, which is commonly used in preparation of insect rearing diet, is expensive (Ahmed et al. 1998). Although there is some success in efforts to rear successive generations of economically important insects entirely on an artificial, in

Fig. 10: RPW adult and pupa severely infested by a phoretic mite

many cases they may lose their both fitness and reproductive potential which cause longer development times and lower fecundity (Coudron et al. 2002). In this respect, it has been found that the average size of red palm weevils reared on artificial diet and sugar cane is smaller than the size of those reared on date palm (Fig. 11) (El-Shafie et al., 2013). The larvae have to be transferred to containers with fiber and adhesive solid objects so that they can successfully spin their cocoons. This will add more work and makes the process of rearing labor intensive. Additionally, no numerical data is available at hand on the cost of rearing the RPW on either date palm offshoots or artificial diet. Therefore, future studies are needed to optimize rearing process in term of technical protocols and production cost.

Fig. 11: RPW adults reared on artificial diet (top) and on date palm bolt (bottom)

Conclusions

Mass production of high quality weevils on either date palm offshoots or artificial diet is possible and may be required for research and bioassay experiments. The main shortcomings of RPW mass rearing is the relatively high cost of production. As RPW is serious invasive palm pest, weevil-proof rearing facilities are needed to avoid the risk of adult weevils escaping into the environment.

References

1. Abozuhairah, R. A., Vidyasagar, P. S. P. V. and Abraham, V. A. (1996). Integrated management of red palm weevil, Rhynchophorus ferrugineus in date palm plantations of the Kingdom of Saudi Arabia, Proceedings, XX International Congress of Entomology, 25-36, August, Firenze, Italy.
2. Ahmed, K., khalique, F. and Malik, B. A. (1998). Modified artificial diet for mass rearing of chickpea pod borer, Helicoverpa armigera (H.). Pakistan

Journal of Biological Sciences 1:183-187.
3. Al-Abdulmohsin, A. M. (1987). First record of Red date palm weevil in Saudi Arabia. Arab World Agriculture. Arab World Agriculture 3: 15-16.
4. Aldawood, A. S. and Rasool, K. G. (2011). Rearing optimization of red palm weevil: Rhynchophorus ferrugineus (Coleoptera: Curculionidae) on date palm: Phoenix dactylifera. Florida Entomologist 94(4): 756-760.
5. Al-Ayedh, H. (2008). Evaluation of date palm cultivars for rearing the red date palm weevil, Rhynchophorus ferrugineus (Coleoptera: Curculionidae). Florida Entomologist 91: 353-358.
6. Al-Ayedh, H. (2011). Evaluating a semi-synthetic diet for rearing the red palm weevil Rhynchophorus ferrugineus (Coleoptera: Curculionidae). International Journal of Tropical Insect Science 31(1-2): 20-28.
7. Barranco, P., De la Peña, J. A., and Cabello, T. (1996). El picudo rojo de las palmeras, Rhynchophorus ferrugineus (Olivier), nueva plaga en Europa. (Coleoptera: Curculionidae). Phytoma-España 76: 36-40.
8. Brand, E. (1917). Coconut red weevil. Some facts and fallacies. Tropical Agriculturist and Magazine of the Ceylon Agricultural Society 49 (1): 22-24.
9. Cox, M. L. (1993). Red palm weevil, Rhynchophorus ferrugineus, in Egypt. FAO-Plant-Protection-Bulletin 41 (1): 30-31.
10. Coudron, TA, Wittmeyer, J. Kim, Y. (2002). Life history and cost analysis for continuous rearing of Podisus maculiventris (Heteroptera: Pentatomidae) on a zoophytophagous artificial diet. Journal of Economic Entomology 95: 1159-1168.
11. El-Sebay, Y., El-lattef, M. A. K. and Makhlouf, T. M. (2003). Laboratory rearing of red palm weevil Rhynchophorus ferrugineus Oliv. (Coleoptera: Curculionidae) on artificial diet. Egyptian Journal of Agricultural Research 81: 551-554.
12. El-Shafie, H. A. F., Faleiro, J. R., Abo-El-Saad, M. M. and Aleid, S. M. (2013). A meridic diet for laboratory rearing of red palm weevil, Rhynchophorus ferrugineus (Coleoptera: Curculionidae). Scientific Research and Essays 8(39): 1924-1932.
13. Faleiro, J. R. (2006). A review of the issues and management of red palm weevil Rhynchophorus ferrugineus (Coleoptera: Rhynchophoridae) in coconut and date palm during the last one hundred years. International Journal of Tropical Insect Science 26 (3):135-154.

14. Hagley, E. A. C. (1965). On the life history and habits of the palm weevil, Rhynchophorus palmarum. Annals of the Entomological Society of America 58, 22-27.
15. Hoddle, M. S. (2015). Red palm weevils-Food or foe? Palms 59(1): 21-30.
16. Ju, R. T., Wang, F., and Wan, F. H. (2010). Effect of host plant on development and reproduction of Rhynchophorus ferrugineus (Olivier) (Coleoptera: Curculionidae). J. Pest Sci. DOI 10.1007/s10340-010-0323-4, Springer-Verlag 2010.
17. Kaakeh, W. (2005). Longevity, fecundity, and fertility of red palm weevil, Rhynchophorus ferrugineus Olivier (Coleoptera: Curculionidae) on natural and artificial diets. Emirates Journal of Agricultural Science 17(1): 23-33.
18. Lefroy, H. M. (1906). The important insects injurious to Indian Agriculture. Govt. Press, Calcutta, India.
19. Martin, M. M and Cabello, T. (2006). Manejo de la cría del picudo rojo de la palmera, "Rhynchophorus ferrugineus" (Olivier, 1790) (Coleoptera, Dryophthoridae), en dieta artificial y efectos en su biometría y biología. Boletín de Sanidad Vegetal. Plagas. 32: 631-642.
20. Mohammadi, D., Pour Abad, R. F., Rashidi, M. R. and Mohammadi, S. A. (2010). Study of cotton Bollworm, Helicoverpa armigera Huebner (Lepidoptera: Noctuidae) using Dyar's Rule. Munis Entomology & Zoology, 5(1): 216-224.
21. Rahalkar, G.W., Tamhankar, A. J., and Shanthram, K. (1978). An artificial diet for rearing red palm weevil, Rhynchophorus ferrugineus Oliv. Journal of Plantation Crops 6: 61-64.
22. Wattanapongsiri, A. (1966). A revision of the genera Rhynchophorus and Dynamis (Coleoptera: Cuculionidae). Bangkok, Thailand: Department of Agriculture Science Bulletin 1, 328 pp.
23. Zaid, A., De Wet, P. F., Djerbi, M. and Oihabi, A. (2002). Chapter XII: Diseases and pests of date palm (Chapter XII). In: Date palm cultivation. A Zaid (ed.). FAO plant production and protection paper 156, Review 1. (Available on http://www.fao.org/DOCREP/006/Y4360E/y4360e0g.htm#bm16)

****

Photographed By: Yousef Al Habshi

EFFECT OF DISTANCES BETWEEN TRAPS IN INFESTED AREAS OF DATE PALM TREES AND PHEROMONE TYPES ON THE NUMBER OF RED PALM WEEVIL, *Rhynchophorus ferrugineus* (OLIVIER) ADULTS ATTRACTED TO PHEROMONE TRAPS.

Olfat, E. Arafa*[1]; M.A.El-Deeb[2]; M. M. El-Zohairy[2] and Abbas, M.K.A.[1]

1. Plant Protection Res. Inst., ARC, Dokki, Giza, Egypt.
2. Plant Protection Dept., Fac. Agric., Zagazig Univ., Egypt.

EFFECT OF DISTANCES BETWEEN TRAPS IN INFESTED AREAS OF DATE PALM TREES AND PHEROMONE TYPES ON THE NUMBER OF RED PALM WEEVIL, *Rhynchophorus ferrugineus* (OLIVIER) ADULTS ATTRACTED TO PHEROMONE TRAPS.

ABSTRACT

The red palm weevil (RPW) *Rhynchophorus ferrugineus* (Olivier) (Curculionidae: Coleoptera) is the most important pest attracting date palm trees in Egypt. Aggregation pheromone traps were distributed in three areas; 450, 900 and 1350 m2 in three farms at EL-Kassasein district (Abo-Nagi) Ismailia governorate during 2013 season. Pheromone traps were placed at different spaces arranged discerningly as follows: Traps at 450 m2 (trap / 150 m2) was the best to attract RPW where the numbers of captured beetles were 988 adults represented 43.81% of the total catch, followed by 900 m2 (trap /300 m2.) that caught about 725 adults represented 32.15% of the total catch, and 1350 m2 (trap/450 m2) caught about 542 adults represented 24.04% of the total catch. These results also revealed that the number of females captured were more than males, where the male sex ratio percentage were 41.59% ,44.41% and 41.88% for 450, 900 and 1350 m2 ,respectively. In the same season three types of pheromones were hanged in aggregation pheromone traps, they were Costa Rica, France and Spain pheromones. Costa Rica pheromone was the best to attract RPW where the number of captured beetles were 725 adults represented 41.05% of the total captured compared with France pheromone where it caught about 523 adults represented 29.61% of the total catch. Spain pheromone caught 518 adults represented 29.33% of the total catch.In all traps the number of females captured were more than males, where the male percentages were 41.38%, 39.96% and 17.95% for Costa Rica, France and Spain, respectively.

Keyword: *Rhynchophorus ferrugineus* **(Olivier) type area, 450, 900, 1350 m2, type pheromone, Costa Rica, France, Spain.**

INTRODUCTION

Date palm, *Phoenix dactylifera* (Linn.), is one of the most important fruit crops in the Middle East. It has been cultivated since ancient times (Lee, 1963 and Riad, 2006). It is thought to be a native of Shat El-Arab or Persian Gulf region. From this regions, the date palm was distributed to other parts of the world .The date palm cultivation in Egypt goes back thousands of year. (Sharif and Wajih, 1982).

Date palm trees are liable to be attacked by many insect pests and mites which cause serious damage to the different parts of roots, trunks, leaves and fruits and causing economic loss to date fruit yield. The red palm weevil, *Rhynchophorus ferrugineus* (Olivier) (RPW) (Family: Curculionidae, Order: Coleoptera) was first recorded in Egypt in date palm plantations of Sharkia and Ismailia Governorates by Saleh (1992). The main recorded host plants are coconut palm (*cocos nucifera*), date palm (*Phoenix dactylifera*), sago palm (*Metroxylon sago*), sugar palm (*Arenga saccharifera*),canary island palm (*phoenix canariesis*), indian date palm (*phoenix sylvestris*), California palm (*Washingtonia filifera*),palmyra palm (*Borassus flabellifera*) and oil palm (*Elaeis guineesis*) as reported by Banks (1906), Ghosh (1912), Buxton (1920), Leefmans (1920) and Rahalkar et al. (1985).

The present investigation was carried out during one year from January 2013 until December 2013 in Abo Nagi farm at El-Kassassin, Ismailia Governorate, The aims of the study were: effect of distances between traps on infested areas of date palm trees and pheromone types on the number adults of red palm weevil, *Rhynchophorus ferrugineus* (Olivier) attracted to pheromone traps.

* Corresponding author: Tel.: +201207176937
E-mail address: olfatelsayed@yahoo.com

MATERIAL AND METHODS

1. Experimental field.

The experimental area was 15 feddan at El-Kassassein (Abo-Nagi farm), Ismailia Governorate during one year (2013).Eighteen aggregation pheromone -baited traps were placed equally spaced and a part 100 m., as one in each block.

The recommend bucket traps were distributed uniformly in the selected severely infested area. Records were kept in the experimental date palm field area with Zaghloul, Hayani, Samani, Bent-Esha and Amry varieties. The field trials were carried out for one date palm growing season during, 2013.

1.1. Trap design and related compounds

Funnel bucket traps were used in the present study consists of plastic bucket (9 liter in size). The bucket was punctured around its wall with 4 holes each of 2.5 cm diameter at 15 cm from the bottom to allow adult weevils' entry inside the trap safely and easily. Applying funnel without cover 8 cm in diameter on the top of bucket traps and placed tightly on soil surface (Plate 1).

1.2. Aggregation pheromone

1.2.1. Synthetic aggregation pheromone lures

The commercially used pheromone "Ferrugineol" is a synthetic pheromone lures. It is a mixture of 4-methyl–5-nanol and 4–methyl–5- nanone (9:1). It is imported from Chem Tica Natural; Costa Rica was used for the present field

Plate (1): Trap design and related compounds
Plate (3): Ethyl acetate (Kairomone) in pheromone trap

study. Pheromone sac was placed underside trap top surface. The pheromone releases its active chemicals blames through a plastic membrane (3-10 mg/day) from 400 and 1500 N/tube, respectively under laboratory conditions of 27°C and 50% R.H. (Plate 2).

Plate (2) / Plate (4):: Costa Rica pheromone

1.2.2. Ethyl acetate (Kairomone)

Selected Kairomone was used as a synergist to activate the potent ability of releasing ethyl acetate blooms. Ethyl acetate bags were hanged from the underside surface of the trap top releasing chemicals through a fine plastic tube (as 100 and 128 mg/day) (Plate 3).

1.2.3. Reduce surface tension material

Liquid soap was mixed with top water used in the inside bucket trap.

1.3. Effect of infested areas of date palm trees on the number of attracted adults to pheromone traps

Three pheromone traps (holes and funnel without cover and height at ground level and 5 date palm trees trunks varieties being, Zaghloul, Hayani, Samani, Bent-Esha and Amry were distributed in three covering areas were 450, 900 and 1350 m2 in three farms at EL-Kassasein (Abo-Nagi) in which date palm trees were extensively distributed for one year (2013). Three pheromone-baited traps / area were observed.

The collected weevils caught in the pheromone traps was counted, sexed and recorded weekly. While the mixture water liquid soap was replaced bi-weekly kairomone (Ethyl acetate) and pheromone capsules within each trap were changed by other fresh ones every two months during the trapping period from 1/1/2013 until 31/12/2013. Nine pheromone traps holes and funnel without cover were used in the present study (Fig.1). Traps were finally placed on soil surface.

1.4. Effect of pheromone types on capturing

Three types of pheromones were chosen in experiments as follows: (Costa Rica, France and Aspani pheromones) produced from different companies. The experimental area at EL-Kassasein district (Abo-Nagi) was chosen for one year of 2013. Nine pheromone traps holes and funnel without cover and height at ground level and 5 date palm trees trunks varieties being, Zaghloul, Hayani, Samani, Bent-Esha and Amry were distributed (3 traps/ for each pheromone) and arranged as one trap/100 m in every types.

1.4.1. Synthetic aggregation pheromone lures

1.4.1.1. Costa Rica pheromone

The commercially used pheromone "PO28 Ferrolure+" is a synthetic pheromone lure, (a mixture of 4-methyl–5-nonanol and 4–methyl–5-nonanone (9:1). Purity of both > 95%. Components imported from ChemTica International S.A., Costa Rica was used. Pheromone sac was hanged on the underside of trap top surface. The pheromone releases its active chemicals blames through a plastic membrane. Release Rate (3-10 mg /day). Minimum 700 mg / lure total mixture from 400 and 1500 N/tube, Bubble formulation one lure per pack. Colorant and stabilizer added. Respectively under laboratory conditions of 27°C and 50% R.H. under identical conditions. (Hallet, *et al*., 1993) (Plate 4).

1.4.1.2. France pheromone

Was determined by numbers of captured RPW adults based on aggregation pheromone traps in selected area. The number of collected weevils caught in the pheromone traps was counted weekly and sexed and recorded. Kairomone (Ethyl acetate) and pheromone capsules within each trap were changed by new fresh ones every two months, while the water soap solution was replaced with fresh one weekly. (Plate 5).

Plate (5): France pheromone

1.4.1.3. Spain pheromone

The commercially used pheromone “Pheromone Dispenser” RPW nominal dose per dispenser 200 mg. AgriSense BCS Ltd., Taffs Mead, Treforest Industrial Estate, Pontypridd, Mid-Glamorgan, CF37% SU. (Plate 6).

Plate (6): Spain pheromone

IV-RESULTS AND DISCUSSION

1. Effect of distance between traps in infested areas of date palm trees on the number of attracted adults to pheromone traps

1.1. Evaluation of the efficiency of areas spaces

Data in Table (1) and illustrated by Fig. (1) based on weekly numbers of both adult sexes captured in aggregation pheromone traps placed in date palm tree orchards zone in Abo-Nagi farm, El-Kassassein, Ismailia Governorate, during 2013 season.

1.1.1. Spaces areas

The trap placed in different spaces may be arranged discerningly as follows: Trap pheromone sited in 450 m2 (trap / 150 m2.) was considered the best to attract RPW where the number of captures were 988 adults represented 43.81% of the total catch, followed by 900 m2 (trap /300 m2.) it caught about 725 adults represented 32.15% of the total catch, and best in 1350 m2 (trap/450 m2) caught about 542 adults represented 24.04% of the total catch.

Three different spaces included 450 m2, 900 m2 and 1350 m2 were the relative efficienient of number of captured adults increased in traps in 450 m2 and 900 m2 than 1350 m2, considered with the number of infested date palm trees. Data agree with Faleiro et al. (2011) but disagreed with those Al-Eryan et al. (2010) who found that the occurrence of adults of RPW was in the center of Tobruk and El-Gaghboob oasis ,300 km south Tobruk.The

mean recorded numbers ranged between 0.33-7.91 adults/trap/ week . The total numbers of collected adults was 565 during the investigation period. Traps placed at Tobruk borders and El-Gaghboob oasis, more than 15 km from the city center did not record any adults.

1.2. Adult population densities and sex ratios

Results in Table (1) revealed that high number of male weevils was recorded when traps placed as trap/150 m2 where 988 (411 ♂ representing 42.81%) of total males captured, followed by traps as trap/300 m2.where 725 (322♂ representing 33.54%) and the least number was recorded by traps in 1350 m2 trap /450 m2 542 (227 ♂representing 23.65%).

The results also revealed that the number of females captured more than males, where the male sex ratio percentage was 41.59%, 44.41% and 41.88% for 450, 900 and 1350 m2, respectively. Data agree with Faleiro et al. (2011) and disagreed with those Bue et al. (2010) who placed 47 pheromone traps at the rate of 1 trap / 200 m. Twenty-one traps were placed along the city coast; and twenty-six in the city center. In total, 4010 adults of RPW were captured. The sex ratio was female biased 1:2.1. Traps in the city center caught about 10 times more than traps located along the city coast.

Table (1): Monthly average number of *R.ferrugineus* (Oliv.) adults captured by nine pheromone traps without cover and with four holes top placed in 3 different areas placed on ground level in a date palm orchard during 2013 season at Abo-Nagi farm, El-Kassassein, Ismailia Governorate.

Space	(Trap/150 m².)					(Trap/300 m².)					(Trap/450 m².)				
Date	M	F	Total	% of ♂	Acc. No.	M	F	Total	% of ♂	Acc. No.	M	F	Total	% of ♂	Acc. No.
Jan.	3	6	9	33.33	9	3	3	6	50	6	0	3	3	0	3
Feb.	5	4	9	55.56	18	4	8	12	33.33	18	6	5	11	54.55	14
Mar.	42	55	97	43.29	115	40	39	79	50.63	97	26	24	50	52	64
Apr.	58	78	136	42.65	251	52	58	110	47.27	207	37	35	72	51.39	136
May.	52	59	111	46.85	362	34	36	70	48.57	277	29	26	55	52.73	191
Jun.	45	64	109	41.28	471	41	45	86	47.67	363	32	38	70	45.71	261
Jul.	29	68	97	29.89	568	25	42	67	37.31	430	29	44	73	39.73	334
Aug.	32	54	86	37.21	654	26	38	64	40.63	494	20	30	50	40	384
Sep.	33	41	74	44.59	728	27	32	59	45.76	553	16	33	49	32.65	433
Oct.	35	47	82	42.68	810	30	33	63	47.62	616	14	14	28	50	461
Nov.	56	58	114	49.12	924	20	45	65	30.77	681	9	46	55	16.36	516
Dec.	21	43	64	32.81	988	20	24	44	45.45	725	9	17	26	34.62	542
Total	411	577	988a			322	403	725b			227	315	542c		
Mean	34.25	48.08	82.33			26.83	33.58	60.42			18.92	26.25	45.17		
% of ♂	41.59	58.40				44.41	55.59				41.88	58.12			
%	42.81	44.56	43.81			33.54	31.12	32.15			23.65	24.32	24.04		
S.E.±	5.20	6.53	11.36			4.13	4.49	8.35			3.38	4.09	6.73		

M=male F=female Accu. =accumulation %=percentage S.E.±=-standard error L.S.D.0.01=1.703 ♂=male m=meter

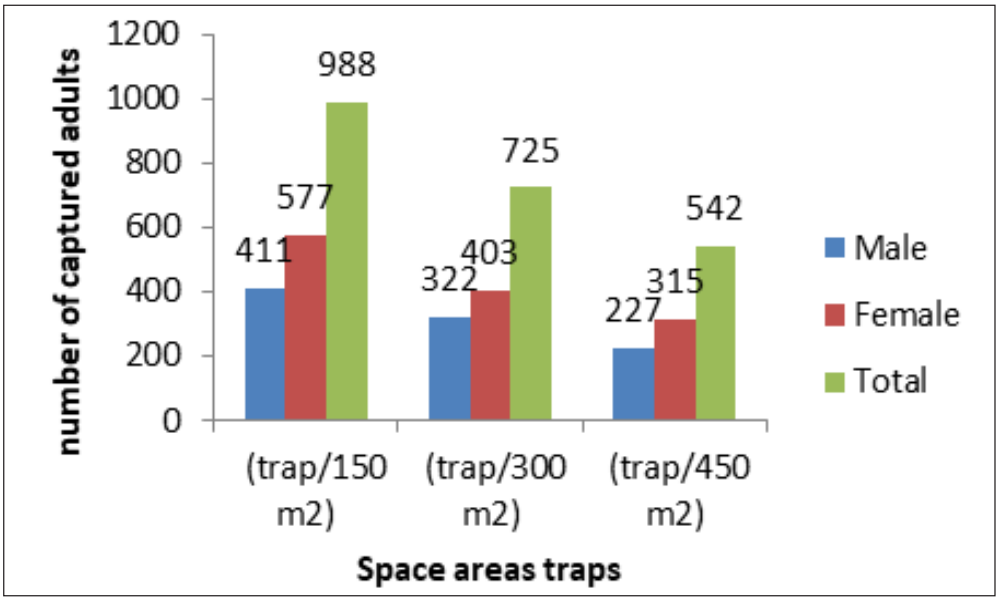


Fig. (1): Numbers of captured red palm weevil adults in pheromone traps placed at 3 different space levels (450 m2, 900 m2and 1350 m2) placed at a date palm orchard during 2013 at Abo-Nagi farm, El-Kassassein, Ismailia Governorate.

2. Effect of pheromone types on capturing

2.1. Evaluation of the efficiency of pheromone

Data in Table (2) and illustrated in Fig. (2) are based on the weekly numbers of both sexes captured by different pheromones in date palm tree orchards during 2013 in Abo-Nagi, Ismailia Governorate.

2. 1. 1. Pheromones

Costa Rica pheromone was considered the best to attract RPW where the number of captures were 725 adults represented 41.05% of the total captured compared with France pheromone that caught 523 adults representing 29.61% of the total catch. Spain pheromone caught 518 adults representing 29.33% of the total catch.

Data obtained agreed with Abbas and Al-Nasser (2012) but disagreed with data obtained by Sujatha et al. (2006) who reported that Chem Tica pheromone lure is significantly superior in catch of the adult weevils RPW showing total number of weevils trapped in Chem Tica lure (1865 nos. with an average catch of 155.4 /trap).

2.1.2. Effect of different pheromone on population densities and sex ratio

Results in Table (2) revealed that highly number of males of weevils was recorded with Costa Rica traps 725 (300♂ representing 49.83% of total males captured) followed by France traps 523 (209 ♂ representing 34.72%), and the least number was recorded during Aspani traps 518 (93 ♂representing 15.45%).

Also, results revealed that the number of females captured was more than males, where the male percentages were 41.38%, 39.96% and 17.95% for Costa Rica, France and Spain, respectively. Obtained data agree with those obtained by Abbas and Al-Nasser (2012) indicated that the high release rate pheromone obtained from Chem Tica Natural, Costa Rica type pheromone was more attractive for RPW than France and Spain types' pheromone. Results also, appeared that the captured females contain eggs that were not deposited. The mean number of egg per female attracted and newly female was 220.2 and 261.8 eggs, respectively. No significant differences were found between numbers of eggs for the newly female and the female attractive. The sex ratio of male to female was 1:2.

Table (2): Monthly average number of *R.ferrugineus* (Oliv.) adults captured by pheromone traps with different pheromone placed on ground level in a date palm orchard during 2013 at Abo-Nagi farm, El-Kassassein, Ismailia Governorate.

Phero-mone	Costa Rica					France					Aspani				
Date	M	F	Total	% of ♂	Acc. No.	M	F	Total	% of ♂	Acc. No.	M	F	Total	% of ♂	Acc. No.
Jan.	3	3	6	50	6		3	5	40	5		3	4	25	4
Feb.	5	8	13	38.46	19		4	8	50	13		8	9	11.11	13
Mar.	31	27	58	53.45	77		31	51	39.22	64		27	37	27.03	50
April	53	57	110	48.18	187		35	72	51.39	136		57	70	18.57	120
May	35	44	79	44.30	266		28	53	47.17	189		44	52	15.38	172
Jun.	28	45	73	38.36	339		30	62	51.61	251		45	59	23.73	231
Jul.	30	50	80	37.5	419		37	60	38.33	311		50	57	12.28	288
Aug.	24	34	58	41.38	477		22	37	40.54	348		34	41	17.07	329
Sep.	23	23	46	50	523		23	33	30.30	381		23	30	23.33	359
Oct.	33	36	69	47.83	592		24	44	45.45	425		36	45	20	407
Nov.	10	73	83	12.05	675		58	68	14.71	493		73	83	12.05	487
Dec.	25	25	50	50	725		19	30	36.67	523		25	31	19.35	518
Total	300	425	725a				314	523b				425	518c		
Mean	25	35.42	60.42				26.17	43.58				35.42	43.17		
% of ♂	41.38	58.62					60.04					82.05			
%	49.83	36.51	41.05				26.98	29.61				36.51	29.33		
S.E.±	4.02	5.77	8.47				4.23	6.31				5.78	6.68		

M = male F = female Accu. = accumulation % = percentage
S.E.±= standered error L.S.D.0.01 = 0.32149 ♂ = male

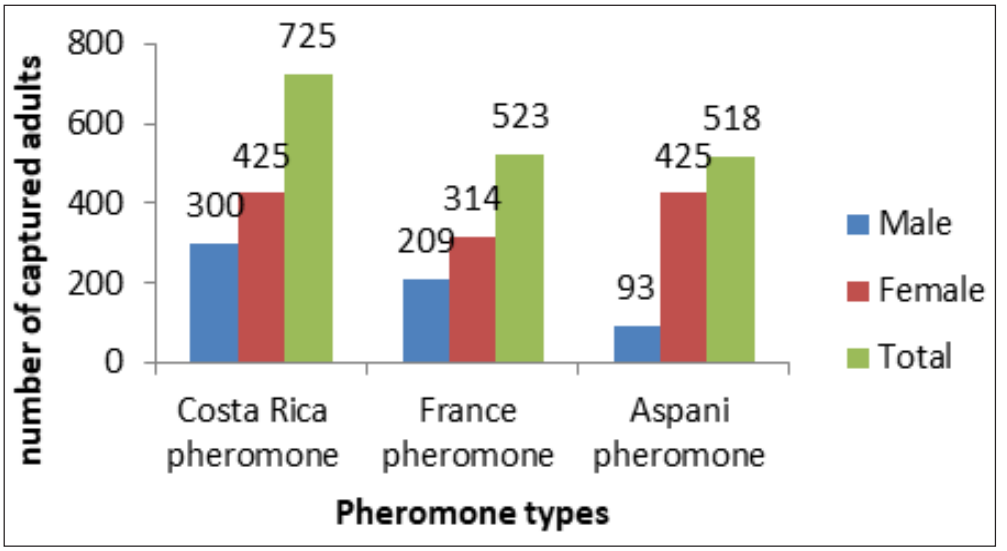


Fig. (2): Number of captured red palm weevil adults in pheromone traps supplied with different pheromones (Costa Rica, France and Aspani) placed in a date palm orchard during 2013 at Abo-Nagi farm, El-Kassassein, Ismailia Governorate.

REFERENCES

1. Abbas, M.K.A. and A. S.Al-Nasser (2012). Ecological studies and evaluation of some aggregation pheromone types with measuring the potential of female reproductive system in red palm weevil, *Rhynchophorus ferrugineus* (Olivier). Nat. Sci., 10(12):188-193.

2. Al-Eryan, M.A.S.; I. M. El-Ghariani, A. Massry; H.A. Agleyo; S. A. Mohamed; A.A. Ikraem and S.S. Ismail (2010). First record of the red palm weevil, *Rhynchophorus ferrugineus* Oliv. (Coleoptera: Curculionidae) in Libya. Acta Horticultural, 882: 413-418.

3. Banks, C.S. (1906). The principal insects injurious to the coconut palm .Philippine Jour.Sci.1:143-158.

4. Bue, P.L.; S. Guarino; P. Lucido ; E. Peri ; M. Pulizzi and S. Colazza (2010). Trapping of the red palm weevil with traps baited with pheromone and allomones in urban areas. Protezione delle Colture, 4:46-49.

5. Buxton, P.A. (1920). Insect pests of dates and the date palm in Mesopotamia and elsewhere. Bulletin of Entomological Research, 11 (3):287-304.

6. Faleiro, J.R.; M.A. El-Saad and A.H. Al-Abbad (2011). Pheromone trap density to mass trap *Rhynchophorus ferrugineus* (Coleoptera: Curculionidae/ Rhynchophoidae / Dryophthorinae) in date plantations of Saudi Arabia. International Journal of Tropical Insect Science, 31 (1/2):75-77.

7. Ghosh, C.C. (1912). Life Histories of Indian Insects-III, The rhinoceros beetle (*Oryctes rhinoceros*) and the red palm weevil, (*Rhynchophorus ferrugineus*). Memoirs of the Dept. Agric. India (Ent. Ser.), II (10):205-217.

8. Hallet, R.H.; G. Gries; R. Gries; J.H. Borden; N.P.D. Angerilli and A.Rauf (1993). Aggregation pheromone of two Asian palm weevil, *Rhynchophorus ferrugineus* and *R.vulneratus*, Naturwissenschaften, 80:328-331.

9. Lee, D.R. (1963).”Date cultivation in the Coachella valley California” the Ohio Journal of Sciences, 63(2):82-87.

10. Leefmans, S. (1920). De palmsnuitkever (*Rhynchophorus ferrugineus* (Oliv.)) The palm weevil, *R.ferrugineus*. Medded. Inst. Plantenziekten Buitenzorg, 43: 1 -90.

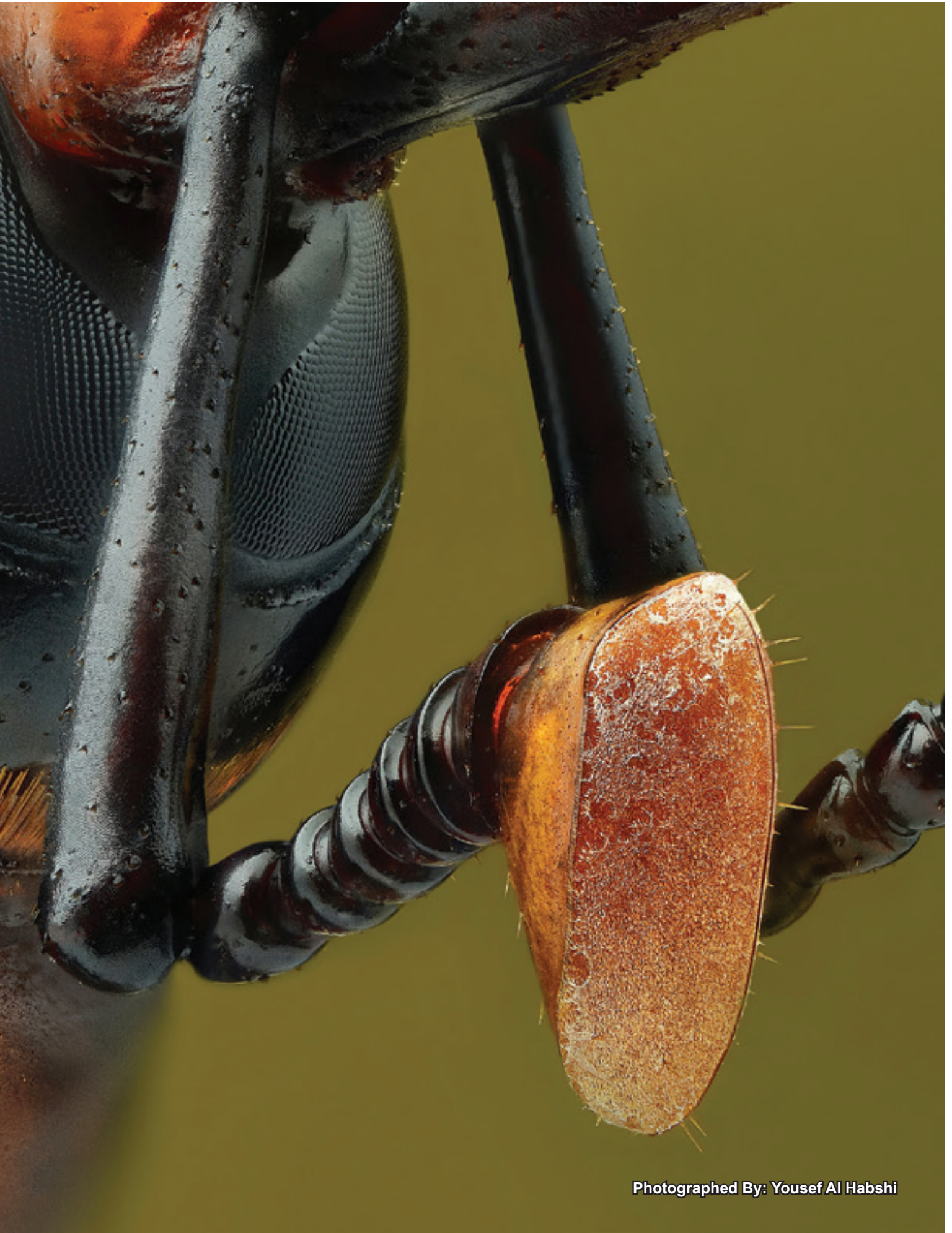
11. Rahalkar,G.W.; M.R. Harwalker; H.D. Rananavare; A.J. Tamhnkar and K. Shantaram (1985). The biology of red palm weevil, *Rhynchophorus ferrugineus* Olivier, A handbook of insect rearing, Pritam Singh and R.F.Moore (Eds.). Elsevier Sci. Pub., B.V. Amsterdam, Vol. 1: 279-286.

12. Riad, M. (2006) .The date palm sector in Egypt, Ciheam - Options Mediterraneennes, 45-53.

13. Saleh, M.R.A. (1992). Red palm weevil, *Rhynchophorus ferrugineus* (Olivier). The first record for Egypt and indeed the African Continent, List No. 10634 Africa, Collection No. 22563. British Museum Report of International Institute of Entomology, 56 Queen’s Gate, London, SW 75 JR UK: 1p.

14. Sharif, M. and I. Wajih (1982). Date palm pests and diseases in Pakistan. The First Symposium on Date Palm in Saudi Arabia: 440-450.

15. Sujatha, A.N.; B.V.C. Rao and D.V.R. Rao (2006). Field evaluation of two pheromone lures against red weevil, *Rhynchophorus ferrugineus* (Oliv.) in coconut gardens in Andhra Pradesh. Journal of Plantation Crops, 34 (3): 414-416.



Photographed By: Yousef Al Habshi

The red palm weevil *Rhynchophorus ferrugineus* (Olivier) in Italy

Claudio Littardi[1] and Fernando Monroy[2]

1 Centro Studi e Ricerche per le Palme, Sanremo, Italy. E-mail: claudiolittardi@gmail.com

2 CREA – Council for Agricultural Research and Economics, Corso degli Inglesi 508, 18038 Sanremo, Italy. E-mail: fernando.monroy@crea.gov.it

The red palm weevil *Rhynchophorus ferrugineus* (Olivier) in Italy

Introduction

The Red Palm Weevil (RPW) *Rhynchophorus ferrugineus* (Olivier) was reported for the first time in Italy already 15 years ago (Longo and Tamburino, 2005). In Europe, this exotic beetle (Coleoptera: Curculionidae), native from South East Asia and Melanesia (Murphy and Briscoe, 1999), has spread from initial outbreaks in Spain (Barranco et al., 1996) followed by subsequent colonization throughout the Northern Mediterranean basin and the Atlantic coast causing the death of thousands of plants. There is no updated census of the total number of dead palms in Italy; previous reports pointed to estimates of about 40 000 individuals (Griffo, 2011), but current data indicate more than 50 000 infested palms just in the Sicily region (Figure 1). As a result, the urban landscape of many Mediterranean cities has dramatically changed. This observed transformation is largely because one the most preferred hosts for the RPW, the palm species *Phoenix canariensis*, is also the most abundant palm in city areas due to its undisputed ornamental value.

The spread of the RPW in the Mediterranean basin is a good example of the observed increase in the number of biological invasion events during the last century, which are linked to the intensification of trading and transport of commodities on a global scale (EPPO database, 2015). The first records of *R. ferrugineus* date back to the end of the 19th century in India (Ridley, 1889), where the insect was reported to infest coconut palms (*Cocos nucifera*, L.) and also date palms (*Phoenix dactylifera*, L.). In 1985, the RPW was found in the Arabian Peninsula, later spreading to Egypt (Cox, 1993) and afterwards to Israel, Syria, Jordan, Algeria, Libya and Morocco. In 2004 it was reported in northern Italy (Sacchetti et al., 2005) and successively in Sicily, where it was causing important damage (Lo Verde and Massa, 2007). After spreading into the Lazio and Campania regions, the RPW showed up in the Liguria region (northwestern Italy) in the summer of 2007

(Littardi and Nario, 2009). In the following years, the infestation range of *R. ferrugineus* extended into the French Côte d'Azur. Nowadays, the presence of the RPW can be reported in most of the Mediterranean coastal areas of Spain, France and Italy.

The introduction and spread of *R. ferrugineus* were facilitated not only by the favourable environmental conditions found in Italy, but also by the difficult detection of the early stages of infestation and by uncontrolled trading of infested palms from unaware nurseries (Cangelosi et al., 2012; Suma et al., 2013). The abovementioned preference of the RPW for the abundant palm species *P. canariensis* was another important factor contributing to the spreading of this insect pest (Longo et al., 2011) (Figure 1). A specific preference of the RPW for male individuals of *P. canariensis* has been hypothesized based on observational data (Littardi, 2006; Uribarrena, 2013), but little is known about the biological factors that could determine such choice.

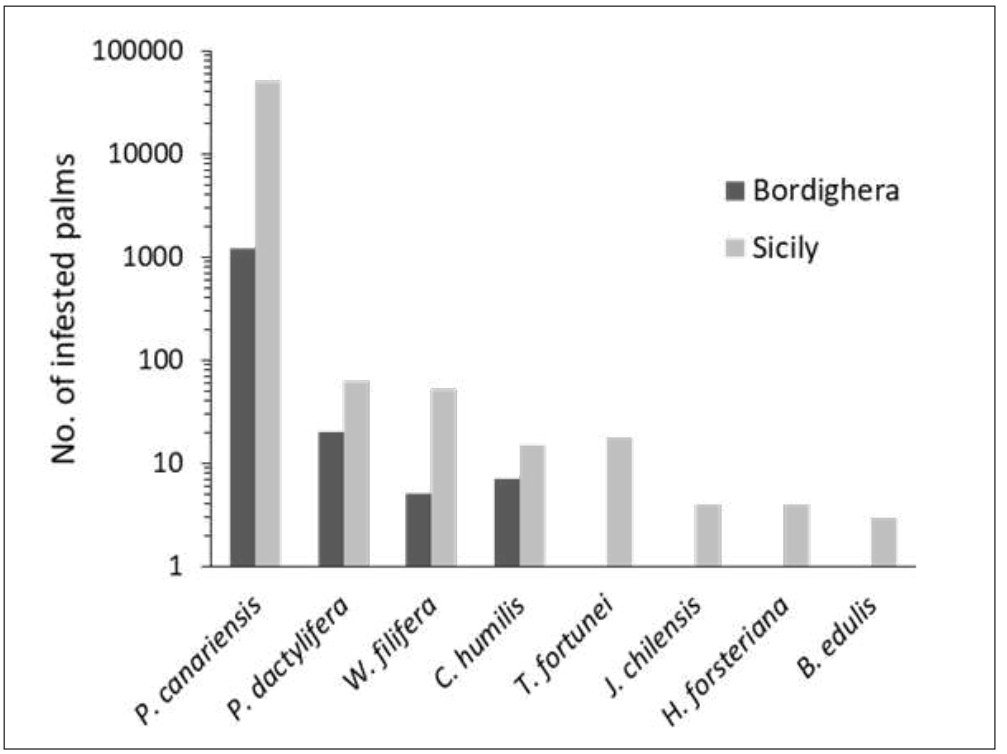


Figure 1: No. of RPW infested palms reported between the years 2005-2018 in the Sicily region (Santi Longo, personal communication; updated from Longo et al., 2011) and between the years 2007-2016 in the city of Bordighera (source: municipality of Bordighera), Liguria region, Italy. Note the logarithmic scale (log10) of the y-axis.

The economic impact of RPW infestations in Italy and in other European countries is mainly related to their negative influence on tourism (Pimentel et al., 2001). Except for the species *Chamaerops humilis* L., palm trees are not native to the Italian territory. In areas like that between the northwestern cities of Sanremo and Bordighera, there is evidence of an ancient presence of the date palm that dates back to the 14th century (Calvini, 1983; Viacava, 2001). At that time, date palms were cultivated not for date production but for the harvesting of palm leaves which were commercially exported for their use in Christian and Jewish religious events (Littardi, 2015). In the 19th century, the Italian Riviera became an important area for the acclimatization of palm species from tropical and subtropical zones. This introduction process made possible the cultivation of over 30 species (Deleuze and Jacquemin, 1995) and today their presence, both in public and private gardens, represents a main component of the urban landscape. In the last years, this extraordinary cultural and naturalistic heritage is being seriously threatened by the establishment of the RPW.

Preventive actions

A detailed program of control actions has been initially issued by the European Union through the EU directive 365/CE of 25 May 2007, including guidelines for the application of specific phytosanitary measures (Griffo, 2011). Despite the efforts made by national and regional administrations, RPW outbreaks became more frequent, in part due to logistic reasons such as the number and size of palm trees and because of the need of reliable methods for the early detection of the infestations (Littardi et al., 2013). On a national level, the Italian Ministry of Agriculture, the MiPAAF, has financed two main research projects (PROPALMA and DIPROPALM) in order to develop new and specific control methods to contain the spread of the weevil. In parallel, many dissemination actions were organized to enhance the awareness of public and private institutions and for the general public. Unfortunately, most of these activities led to non-conclusive results from the point of view of the containment of the pest, as in other areas with the same problem (Jaques et al., 2017). An inadequate degree of coordination among the different actors involved in the control programs has been pinpointed as one of the significant factors to explain the limited success of the adopted measures (Littardi, 2009). The obligation, by private owners and public bodies, to inform the competent phytosanitary services of the presence of infestations has not always been respected (Nardi et al., 2011). Irresponsible behaviours, such as the conservation of heavily infested palms or parts of dead plants, and the irregular disposal of plant material resulting from demolition or rehabilitation of infested individuals (Nario, 2012), were neither in compliance with the EU directives nor with the recommendations of the phytosanitary services. In this context, the invaded range of the RPW is still expanding after 15 years, posing a serious risk to the remaining palm groves.

Dendrosurgery or mechanical sanitization

The mechanical sanitization technique (Littardi, 2007) was initially tested in the northern city of Bordighera and in Sicily (La Mantia et al., 2009). It can be performed on palms at the early stages of infestation and consists in the removal of larvae and pupal cells in the infested tissues. In the case of the Canary palms, where sanitization often implies the removal of the canopy, the growth of the shoot apex can be seen after a relatively short period. The regrowth rate depends on the age of the plant, the degree of infestation and

the season in which the intervention took place. Since the risk remains that the sanitized palm is infested again (Littardi, 2008), mechanical sanitization requires repeated pesticide treatments to protect the plant at least during the regrowth phase. Unfortunately, more than 80% of the palm trees that have undergone mechanical sanitization in the Liguria region have died during the following two years, as in Palermo and Sicily (La Mantia et al., 2010).

Pheromone traps

Pheromone traps (Hallet et al., 1999, Faleiro et al., 2011) are useful to detect the presence of the RPW in areas where the insect has not yet been reported and to identify optimal periods for carrying out phytosanitary treatments. The density and the position of the traps requires a detailed planning in order to maximize the number of captures. Research into the use of pheromone traps contaminated with entomopathogenic fungi has been undertaken in Italy, among others, by the CREA of Florence (Francardi et al., 2014).

Chemical control

Chemical control programmes for the RPW are based on the preventive and repeated application of synthetic insecticides by spraying the palm canopy or through endotherapy into the palm trunk (Polizzi et al., 2009). Their main limitations are the small number of active substances authorized for use and the difficulties associated to the logistics of the treatments in populated areas. Most of the palms are in urban zones, where treatment restrictions are particularly severe. In large palm trees, chemical treatments are mostly applied using a pipe system fixed along the trunk and equipped with sprayers at the canopy level. In that way, the selected insecticide can be placed in a ground tank and pumped onto the top of the palm, minimizing treatment costs. The use of endoxylematic injections for the transport of insecticidal compounds through the trunk until the palm canopy is still controversial (Sacco et al., 2011), due to the limited opportunity for that kind of transport in the discontinuous vascular systems of monocot plants.

Biological control

The presence of palms in urban zones tends to favour the use of biological control methods against the RPW (Murphy and Briscoe, 1999; Dembilio and Jacas, 2013; Mazza et al., 2014). At present, the use of entomopathogenic nematodes (EPNs) (Llácer et al., 2009) is authorized in Italy against

the RPW. EPNs can be found in different commercial formulations, including those enriched with chitosan, a natural polysaccharide able to preserve the viability of these organisms for longer periods of time (Dembilio et al., 2010a). The use of EPNs has led to satisfactory results in some cases, but adverse climatic conditions can interfere with the effectiveness of this type of treatment (Saleh and Alheji, 2003). The use of entomopathogenic fungi (EPFs), like the ascomycete *Beauveria bassiana* is also a valid option to the use of nematodes (El-Sufty et al., 2009; Dembilio et al., 2010b; Jaques et al. 2017). Although the authorization for their use in Italy is still pending, EPFs – alone or in combination with EPNs – are a sustainable alternative to the application of chemical pesticides. EPFs can be inoculated into the host plant (McKinnon et al., 2017) or applied using "attract and infect" traps (Hajjar, 2015). The use of drones has been recently proposed as a quick method to inoculate palm trees with extreme precision (Besse et al., 2016), although the use of these devices can be limited in gardens located close to roads and inhabited buildings.

Prospects for RPW control

The pervasive presence of the RPW in the Italian territory has led to the abrogation, from 1st October 2018, of the Ministerial Decree 7/2/2011 containing emergency measures for the control of the RPW. This decision makes necessary a reassessment of the criteria for the replacement of dead palm individuals in order to avoid new outbreaks of this pest (Littardi and Cangelosi, 2010). The new palms should be chosen among those species less susceptible to the RPW, with a plain exclusion of *P. canariensis* and *P. dactylifera*. Observational data provides information about the occurrence of palm genera, species and/or hybrids less susceptible to the attacks of the RPW (Gros-Balthazard, 2013; Raciti et al., 2013) (Figure 1). There is evidence that this lower susceptibility could be explained by the presence of certain chemical compounds (Cangelosi et al., 2015, 2016), suggesting that the RPW might be able to adapt to the new palms. Accordingly, special attention should be paid to the early detection of infested plants (Pontikakos et al., 2017).

The systematic replacement of dead palms by palms from other species has been already experimented in many Italian cities. Replacement programs such as the Jericho Project (*Progetto Gerico*) are an example of this alternative approach to reduce the impact of the RPW on the urban landscape. This project is part of an initiative undertaken by the Sanremo Research Center for Palm Trees in collaboration with municipalities and research institutions for the mass production, through seeds, of thousands of young palm trees (Littardi, 2016). The propagated palm species have been chosen in view of their observed lower susceptibility to *R. ferrugineus* (Raciti et al., 2013), which could be explained by the effect of toxic compounds present in the palms (Cangelosi et al., 2016) or by other undefined mechanisms able to constrain either oviposition or early larval development (Dembilio et al., 2009). An approximate number of 10 000 palm trees have been sown, using seeds from different locations in order to maximize their genetic variability. The young seedlings are donated free of charge to citizens or public and private bodies that request it. Since young individuals are in general more susceptible to the RPW, the replacement process must be accompanied

by a program of preventive treatments. In a context of sustainability and integrated pest management (IPM), priority should be given to the use of biological agents to prevent the formation of new RPW outbreaks.

In conclusion, the RPW problem in Italy and in Europe in general is mainly associated to the historical, naturalistic and ornamental value of the infested palms, which represent an important touristic resource for the cities of the northern Mediterranean basin. In other countries, where the RPW can infest not only urban areas but also oases and date palm cultivations, the spread of this insect may still result in unprecedented ecological and economical losses. The repeated use of chemical pesticides in large cultivation areas must be reassessed in order to minimize future environmental impacts and negative effects on the quality of date production. The sustainability of the programs for the preservation of oases from RPW outbreaks should be also taken in consideration. Future actions should follow an IPM approach based on the experience accumulated by the different countries regarding the control of this insect pest. In this regard, the new IPM strategy recently developed under the sponsorship of the Food and Agriculture Organization of the United Nations (FAO, 2017) should become a reference point for the next years.

References

1. Barranco P., De La Peña J.A., Cabello T. (1996) El picudo rojo de las palmeras, *Rhynchophorus ferrugineus* (Olivier), nueva plaga en Europa. (Coleoptera, curculionidae). Phytoma España 76: 36-40.
2. Besse S., Panchaud K., Grimaud E., Vanie J. (2016) Associer drones et biocôntrole sur les palmiers. Phytoma 697, 16-19.
3. Calvini N. (1983) Statuti comunali di Sanremo 1435. Casino Municipale di Sanremo, Sanremo, Italy, pp 221-222.
4. Cangelosi B., Clematis F., Curir P., Monroy F. (2016) Susceptibility and possible resistance mechanisms in the palm species *Phoenix dactylifera*, *Chamaerops humilis* and *Washingtonia filifera* against *Rhynchophorus ferrugineus* (Olivier, 1790) (Coleoptera: Curculionidae). Bulletin of Entomological Research 106, 341-346.
5. Cangelosi B., Clematis F., Monroy F., Roversi P.F., Troiano R., Curir P., Lanzotti V. (2015) Filiferol, a chalconoid analogue from *Washingtonia filifera* possibly involved in the defence against the Red Palm Weevil *Rhynchophorus ferrugineus* Olivier. Phytochemistry 115, 216-221.

6. Cangelosi B., Littardi C., Curir P. (2012) Suscettibilità di alcune specie di palme nei confronti di *Rhynchophorus ferrugineus* (Olivier). Proceedings of the meeting “Cosa ci hanno insegnato 7 anni di lotta al Punteruolo rosso delle palme”. Sanremo, November 29.
7. Cox M.L. (1993) Red palm weevil, *Rhynchophorus ferrugineus* in Egypt. FAO Plant Protection Bulletin, 41: 30-31.
8. Deleuze J., Jacquemin D. (1995) Palmiers pour le climat méditerranéen. Editions Champflour, Marly-le-Roi, France, 144 pp.
9. Dembilio Ó., Jacas J.A. (2013) Biological control of *Rhynchophorus ferrugineus*. AFPP - Palm Pest Mediterranean Conference, January 16-18, Nice, France, pp. 101-106.
10. Dembilio Ó., Jacas J.A., Llácer E. (2009) Are the palms *Washingtonia filifera* and *Chamaerops humilis* suitable hosts for the red palm weevil, *Rhynchophorus ferrugineus* (Coleoptera: Curculionidae)? Journal of Applied Entomology 133, 565-567.
11. Dembilio Ó., Llácer E., Martínez De Altube M.M., Jacas J.A. (2010a) Field efficacy of imidacloprid and *Steinernema carpocapsae* in a chitosan formulation against the red palm weevil *Rhynchophorus ferrugineus* (Coleoptera: Curculionidae) in *Phoenix canariensis*. Pest Management Science 66, 365-370.
12. Dembilio Ó., Quesada-Moraga E., Santiago-Alvarez C., Jacas J.A. (2010b) Potential of an indigenous strain of the entomopathogenic *fungus Beauveria bassiana* as a biological control agent against the Red Palm Weevil, *Rhynchophorus ferrugineus*. Journal of Invertebrate Pathology 104, 214-221.
13. El-Sufty R., Al-Awash S.A., Al Bgham S., Shahdad A.S., Al Bathra A.H. (2009) Pathogenicity of the fungus *Beauveria bassiana* (Bals.) Vuill. to the Red Palm Weevil, *Rhynchophorus ferrugineus* (Oliv.) (Col.: Curculionidae) under laboratory and field conditions. Egyptian Journal of Biological Pest Control 19, 81-85.
14. EPPO (2015) EPPO Global Database, https://gd.eppo.int
15. Faleiro J.R., El-Saad M.A., Al-Abbad A.H. (2011) Pheromone trap density to mass trap *Rhynchophorus ferrugineus* (Coleoptera: Curculionidae/Rhynchophoridae/Dryophthoridae) in date plantations of Saudi Arabia. International Journal of Tropical Insect Science 31, 75-77.

16. FAO - Food and Agriculture Organization of the United Nations (2017) Proposed Multi-disciplinary and Multi-regional Strategy for the Management of Red Palm Weevil. URL: http://www.fao.org/3/a-mt054e.pdf. Accessed 30 January 2019.
17. Francardi V., Benvenuti C., Barzanti G.P., Roversi P.F. (2014) Controllo microbiologico di *Rhynchophorus ferrugineus* (Olivier) (Coleoptera Curculionidae) mediante impiego di una trappola "attract, infect and release". Atti Accademia Nazionale Italiana di Entomologia, Anno LXI, 205-209.
18. Griffo R. (2011) Diffusione del *Rhynchophorus ferrugineus* in Italia e linee guida per l'adozione delle misure fitosanitarie. Proceedings of the VI Biennale Europea delle Palme *Dies Palmarum*. Sanremo 18-20 Nov. 2010, 16-19.
19. Gros-Balthazard M. (2013) Hybridization in the genus *Phoenix*: A review. Emirates Journal of Food & Agriculture 25, 831-842.
20. Hajjar M.J., Ajlan A.M., Al-Ahmad M.H. (2015) New approach of *Beauveria bassiana* to control the Red Palm Weevil (Coleoptera: Curculionidae) by trapping technique. Journal of Economic Entomology 108, 425-432.
21. Hallet R.H., Oehlschlager A.C., Borden J.H. (1999) Pheromone trapping protocols for the Asian palm weevil, *Rhynchophorus ferrugineus* (Coleoptera: Curculionidae). International Journal of Pest Management 45, 231-237.
22. Jaques J.A., Riolo P., Neil A., Barroso J.M., Dembilio O., Isidoro N., Minuz R.L., Nardi S., Navarro Llopis V., Beaudoin-Ollivier, Quesada Moraga E. (2017) Control Measures Against *Rhynchophorus ferrugineus* and *Paysandisia archon*. In: Soroker V., Colazza S. (eds.) Handbook of Major Palm Pests: Biology and Management, pp. 255-279.
23. La Mantia G., Caldarella C.G., Musacchia D., Lo Verde G. (2009) Il risanamento meccanico delle palme attaccate dal punteruolo rosso. Proceedings of the XXII Congresso Nazionale Italiano di Entomologia, Ancona, 15-18 June, p. 313.
24. La Mantia G., Sauro G., Caldarella C., Spatafora A., Musacchia D., Lo Verde G. (2010) Lotta e prevenzione del punteruolo rosso a Palermo. Proceedings of the VI Biennale Europea delle Palme *Dies Palmarum*. Sanremo, 18-20 November, pp. 41-42.

25. Littardi C., Nario G. (2009) Puntuale il Punteruolo Rosso è arrivato anche in Liguria. Il Floricultore, n. febbraio.
26. Littardi C. (2008) Potatura delle palme: un profumato cocktail per il punteruolo rosso. Clamer informa 11, 13-16.
27. Littardi C. (2006) Emergenza punteruolo rosso: il sesso fa la differenza? Flortecnica 12, 92-95.
28. Littardi C. (2007) Dendrochirurgia in chioma. Una nuova opportunità nella lotta al punteruolo rosso delle palme. Flortecnica 12, 11-12.
29. Littardi C. (2009) Riviera dei Fiori, ultimo baluardo contro il famigerato Punteruolo Rosso. Il Floricultore, n. novembre, p. 36.
30. Littardi C., Cangelosi B. (2010) Il punteruolo rosso cambierà il paesaggio della Riviera? Lineaverde 7, 24-27.
31. Littardi C., Cangelosi B., Lucido P., Sacco M., Pasini C., Pozzi L. (2013) Propagation of *Rhynchophorus ferrugineus* in Italy and contribution to the early detection of infestations by the use of electronic nose. Acta Horticulturae 994, 53-57.
32. Littardi C. (2015) Palme di Liguria. Carocci Editore, Roma, 296 pp.
33. Littardi C. (2016) Gerico: un progetto per ricostituire il patrimonio palmicolo della Liguria. Sherwood 216, 14-15.
34. Llácer E., M. M. Martínez De Tube, Jacas J.A. (2009) Evaluation of the efficacy of *Steinernema carpocapsae* in a chitosan formulation against the red palm weevil, *Rhynchophorus ferrugineus*, in *Phoenix canariensis*. BioControl 54, 559-565.
35. Lo Verde G., Massa B. (2007) Note sul punteruolo della palma *Rhynchophorus ferrugineus* (Olivier, 1790) in Sicilia (Coleoptera Curculionidae). Bollettino di Zoologia Agraria e Bachicoltura Ser. II, 39: 131-149.
36. Longo S., Anderson P.J., Smith T.R., Stanley J.D., Inserra R.N. (2011) New palm hosts for the red palm weevil, *Rhynchophorus ferrugineus*, in Sicily. Palms 55, 15-20.
37. Longo S., Tamburino V. (2005) Gravi infestazioni di punteruolo rosso della palma. Informatore Agrario 50, 73-74.
38. Mazza G., Francardi V., Longo S., Nannelli R., Tarasco E., Cervo R., Benvenuti C., Roversi P.F. (2014) Controllo biologico del punteruolo rosso delle palme *Rhynchophorus ferrugineus* (Olivier). Atti Accademia Nazionale Italiana di Entomologia. Anno LXI, 211-217.

39. McKinnon A.C., Saari S., Moran-Diez M.E., Meyling N.V., Raad M., Glare T.R. (2017) *Beauveria bassiana* as an endophyte: A critical review on associated methodology and biocontrol potential. BioControl 62, 1-17.
40. Murphy S.T., Briscoe B.R. (1999) The red palm weevil as an alien invasive: biology and prospects for biological control as a component of IPM. BioControl 20, 35-45.
41. Nardi S., Ricci E., Lozzi R., Marozzi F., Ladurner E., Chiabrando F., Granchelli L., Verdolini E., Isidoro N., Riolo P. (2011). Control of *Rhynchophorus ferrugineus* (Olivier, 1790) according to EU Decision 2007/365/EC, in the Marche region (Central-Eastern Italy). EPPO Bulletin 41, 103-115.
42. Nario G. (2012) Ma quanto ci costa il punteruolo rosso? Proceedings of the meeting "Cosa ci hanno insegnato 7 anni di lotta al Punteruolo rosso delle palme". Sanremo, November 29.
43. Pimentel D., Mc Nair S., Janecka J., Wightman J., Simmonds C., O'Connel C., Wong E., Russel L., Zern J., Aquino T., Tsomondo T. (2001) Economic and environmental threats of alien plant, animal, and microbe invasions. Agriculture Ecosystems & Environment 84, 1-20.
44. Polizzi G., Fruscione C., Parlavecchio G., Morabito M., Longo S. (2009) Efficacia dell'endoterapia a pressione per il contenimento del punteruolo rosso delle palme nel centro urbano di Catania. In: Regione Siciliana (ed.) La ricerca scientifica sul punteruolo rosso e gli altri fitofagi delle palme in Sicilia 1, 179-184.
45. Pontikakos C.M., Kontodimas D.C., Tsiligiridis T. (2017) A location aware system for integrated management of *Rhynchophorus ferrugineus* in urban systems. Computers Environment and Urban Systems 50, 74-88.
46. Raciti E., Conti F., Carta Cerrella D., Morabito M., Li Destri A., Malfitana S., Romano D. (2013) Palm species potentially resistant to Red Palm Weevil attacks in sites of eastern Sicily heavily infested. AFPP - Proceedings of the Palm Pest Mediterranean Conference, Nice, France, January 16-18.
47. Ridley, H.N. (1889) Report on the destruction of coco-nut palms by beetles. Journal of the Straits Branch of the Royal Asiatic Society 20, 1-11.
48. Sacchetti P., Camera A., Granchetti A., Rosi M. C., Marzialetti P. (2005) Prima segnalazione in Italia del curculionide delle palme, *Rhynchophorus ferrugineus*. Notiziario Centro Sperimentale per il Vivaismo di

Pistoia 144, 6-9.
49. Sacco M., Cangelosi B., Arato E., Pasini C., Littardi C. (2011) Prove di semi-campo e di laboratorio condotte a Sanremo per la lotta contro il Rincoforo. Proceedings of the VI Biennale Europea delle Palme *Dies Palmarum*. Sanremo, 18-20 November, pp. 35-37.
50. Saleh M.M.E., Alheji M. (2003) Biological control of red palm weevil with entomopathogenic nematodes in the eastern province of Saudi Arabia. Egyptian Journal of Biological Pest Control 13, 55-59.
51. Suma P., Longo S., La Pergola A., Soroker V. (2013) Monitoring strategies for the detection of *Rhynchophorus ferrugineus* infestations. Atti Accademia Nazionale Italiana di Entomologia, Anno LXI, 225-232.
52. Uribarrena, B.S. (2013) Local intervention procedure providing the coordination of support, control and handling activities of the red palm weevil in the municipality of Valencia, Spain. AFPP - Proceedings of the Palm Pest Mediterranean Conference, Nice, France, January 16-18, pp. 179-196.
53. Viacava L. (2001) Le palme negli scritti di Giorgio Gallesio. Academia dei Georgofili, Firenze, Italy, pp 85-90.

****

جائزة خليفة الدولية لنخيل التمر والابتكار الزراعي
KHALIFA INTERNATIONAL AWARD FOR DATE PALM AND AGRICULTURAL INNOVATION

عام التسامح
YEAR OF TOLERANCE

الجهود الدولية لمكافحة

سوسة النخيل الحمراء

دورة حياتها - أضرارها - سبل مكافحتها

تنسيق وإشراف / أ. د. عبد الوهاب زايد

بدعم جائزة خليفة الدولية لنخيل التمر والابتكار الزراعي

عـام التـسـامـح
YEAR OF TOLERANCE

جائزة خليفة الدولية لنخيل التمر والابتكار الزراعي
KHALIFA INTERNATIONAL AWARD FOR DATE PALM
AND AGRICULTURAL INNOVATION

الجهود الدولية لمكافحة

سوسة النخيل الحمراء

دورة حياتها – أضرارها – سبل مكافحتها

تنسيق وإشراف/ أ. د. عبد الوهاب زايد

بدعم جائزة خليفة الدولية لنخيل التمر والابتكار الزراعي

الجهود الدولية لمكافحة سوسة النخيل الحمراء
دورة حياتها - أضرارها - سبل مكافحتها

رقم التصنيف الدولي للكتاب
ISBN 978-9948-36-585-3

تنسيق وإشراف/ أ. د. عبد الوهاب زايد
بدعم جائزة خليفة الدولية لنخيل التمر والابتكار الزراعي

الإخراج الفني والتصميم/ محمد عيسى

صورة الغلاف بعدسة يوسف الحبشي
إضافة للصور في الصفحات التالية:
عربي: 21/20 - 35/34 - 53/52 - 63/62 - 75/74 إنجليزي: 21/20 - 47/46 - 75/74 - 93/92 - 109 - 125

00971 55 9879123 www.uaemacro.com contact@uaemacro.com

صندوق بريد: 3614 - أبوظبي - الإمارات العربية المتحدة
هاتف: 00971 2 304 9999
فاكس: 00971 2 304 9990
www.kiaai.ae sg@kiaai.ae

@kiadpai
Khalifa International Award
Khalifa Award for Date and Agriculture

المغفور له بإذن اللّه الشيخ

زايد بن سلطان آل نهيان

طيب الله ثراه

صاحب السمو الشيخ

خليفة بن زايد آل نهيان

رئيس دولة الامارات العربية المتحدة

مؤسس الجائزة وراعيها

(حفظه الله)

صاحب السمو الشيخ

محمد بن زايد آل نهيان

ولي عهد أبوظبي

نائب القائد الأعلى للقوات المسلحة

سمو الشيخ

منصور بن زايد آل نهيان

نائب رئيس مجلس الوزراء - وزير شؤون الرئاسة

الداعم الأول لزراعة النخيل

معالي الشيخ

نهيان مبارك آل نهيان

وزير التسامح

رئيس مجلس أمناء جائزة خليفة الدولية لنخيل التمر والابتكار الزراعي

الفهرس

تضافر الجهود الدولية لمكافحة سوسة النخيل الحمراء

يشكل مؤتمر وزراء الزراعة في الدول المنتجة للتمور الذي نالت شرف تنظيمه جائزة خليفة الدولية لنخيل التمر والابتكار الزراعي، استضافته العاصمة أبوظبي بفندق قصر الإمارات يوم 09 مارس 2019 برعاية سمو الشيخ منصور بن زايد آل نهيان، نائب رئيس ملس الوزراء، وزير شؤون الرئاسة، وبالتعاون مع منظمة الأغذية والزراعة للأمم المتحدة ووزارة التغير المناخي والبيئة، علامة فارقة في دعم الجهود الدولية بهدف إعداد الاستراتيجية الإطارية، لاستئصال سوسة النخيل الحمراء، التي تشكل تهديداً على أمننا الغذائي وقدرتنا على إنتاج التمور ذات الجودة والقيمة الغذائية العالية.

إن الأهمية القصوى لهذا المؤتمر، إنما تنبع من الخطر الكبير، الذي تمثله سوسة النخيل الحمراء، على قطاع نخيل التمر هذه الآفة العابرة للحدود، تنتشر بسرعة، في جميع أنحاء العالم، وتصيب مختلف أنواع الأشجار منها على سبيل المثال شجرة نخيل التمر، وجوز الهند، وإننا في منطقة الشرق الأوسط، وشمال أفريقيا، وحوض البحر المتوسط بالذات، نلاحظ بكل وضوح، الأضرار الواسعة لهذه الآفة، فهي تؤثر سلباً على إنتاج نخيل التمر. وتهدد مصادرنا التغذوية الرئيسية وأمننا الغذائي وتؤثر بشكل كبير على مواردنا الطبيعية وقدرتنا على تنمية مستدامة للقطاع الزراعي مما يتحتم عليه إعداد تدابير رئيسية وخطط لمكافحتها، في معظم مناطق العالم.

إننا في دولة الإمارات العربية المتحدة، حريصون كل الحرص، على الإسهام الكامل، في دعم كافة برامج مكافحة سوسة النخيل الحمراء، بالتعاون مع جميع الدول المهتمة بهذا الأمر، ومع كافة المنظمات الدولية المختصة، ونساند بكل قوة، إنشاء صندوق ائتمان، من أجل توفير الدعم المالي اللازم، لتنفيذ ما يتقرر في هذا المؤتمر، من استراتيجية إطارية ملائمة، لاستئصال سوسة النخيل الحمراء، كما ندعم جهود منظمة الأغذية والزراعة للأمم المتحدة (الفاو) لاستضافة هذا الصندوق الاستئنائي متعدد المانحين، وتسهيل حوكمته وإدارته على أعلى مستوى، من الكفاءة والفاعلية، في إطار من الحرص، على تحقيق الفائدة الكاملة، من كافة الخبرات والتجارب المتاحة لديهما، من أجل تقديم المساعدة اللازمة، لجميع الدول الأعضاء، وبالذات، في مجال بناء القدرات الوطنية في كل دولة، لمكافحة سوسة النخيل الحمراء.

إن هذه المبادرات المهمة، هي تجسيد حي، للتعاون الإقليمي والدولي الناجح، في مجالات حماية النخلة، وتأكيد مكانتها المهمة، في المسيرة الاقتصادية والمجتمعية، في الأقطار المنتجة للتمور في العالم، وهنا، أريد أن أعبر عن تقديري الكبير، لجهود كافة وزارات الزراعة، في الدول الشقيقة والصديقة، وأحيي كذلك، جهود المنظمات الدولية المختصة، إنه لما يبعث على السرور حقاً، أن نشهد معاً، هذا التعاون الإقليمي والدولي المرموق، في سبيل استئصال سوسة النخيل الحمراء، والقضاء على آثارها السيئة، على كل المستويات.

نهيان مبارك آل نهيان
وزير التسامح، رئيس مجلس أمناء الجائزة

سوسة النخيل الحمراء آفة عابرة للحدود

تُعَدُّ سوسة النخيل الحمراء آفة رئيسية عابرة للحدود تُصيبُ نخيل التمر وجوز الهند ونخيل الزينة. رغم اكتشاف الإصابة بها في جنوب آسيا، إلا أنها آخذة في الانتشار بسرعة في جميع أنحاء العالم. وفي الشرق الأدنى، تتسبب هذه الآفة في إحداث أضرار واسعة النطاق في نخيل التمر وتؤثر على الإنتاج وسبل عيش ما يقرب من 50 مليون مزارع. كما اكتُشفت الإصابة بها أيضًا في شمال أفريقيا وحوض البحر المتوسط. لذلك، تعتبر سوسة النخيل الحمراء من آفات الحجر الصحي في دول الشرق الأدنى وشمال أفريقيا وأمريكا اللاتينية، بالتالي فهي هدفًا لتدابير الطوارئ في الاتحاد الأوروبي.

فقد ساهم ضَعْفُ إجراءات الحجر الصحي وصعوبات الكشف المبكر عن المواد النباتية المصابة بسوسة النخيل الحمراء في الانتشار السريع لهذه الآفة، التي لم تتم مكافحتها بفعالية رغم الجهود المبذولة والموارد المقدمة من الدول والمنظمات. كما أجريت بحوث موسعة حول مكافحة سوسة النخيل الحمراء حتى أصبح هناك إدراك واسع بوجوب معالجة التحديات الناتجة عن سوسة النخيل الحمراء على وجه السرعة على المستويات الوطنية والإقليمية والعالمية وضرورة تعزيز تآزر وتعاون البلدان والمناطق، ولاسيما من أجل تنسيق استراتيجيات المراقبة والرصد.

من هنا جاءت أهمية انعقاد مؤتمر وزراء الزراعة في الدول المنتجة للتمور في العاصمة ابوظبي 09 مارس 2019 الذي نظمته الأمانة العامة لجائزة خليفة الدولية لنخيل التمر الابتكار الزراعي برعاية كريمة من سمو الشيخ منصور بن زايد آل نهيان، نائب رئيس مجلس الوزراء، وزير شؤون الرئاسة. وبالتعاون مع منظمة الأغذية والزراعة للأمم المتحدة ووزارة التغير المناخي والبيئة. حيث تمخض هذا المؤتمر عن إعلان من أجل دعم الصندوق الاستئماني والبرنامج الإقليمي لمكافحة سوسة النخيل الحمراء. وهذا بحد ذاته انجاز كبير وخطوة في الاتجاه الصحيح للحد من خطر سوسة النخيل الحمراء على الاقتصاد الوطني والأمن الغذائي وسبل العيش للمجتمعات الريفية والبيئة.

الأمانة العامة للجائزة إذ تقر بالأبعاد الثقافية والاجتماعية والاقتصادية لشجرة النخيل المباركة، والتي كانت ثمارها الغذاء الأساسي للعديد من الدول في المناطق القاحلة بالشرق الأوسط وشمال أفريقيا على مدى قرون؛ تثمن الجهود العظيمة التي بذلتها بلدان المنطقة لدعم وتطوير قطاع تمر النخيل في المنطقة؛ وتثني على الدول والمنظمات المانحة، لدعمها المالي للصندوق الاستئماني الذي يهدف إلى دعم البرنامج الإقليمي؛ ونؤكد مجدداً دعمنا للاستراتيجية الإطارية والبرنامج الإقليمي للقضاء على سوسة النخيل الحمراء تحت مظلة منظمة الأمم المتحدة للأغذية والزراعة (الفاو).

أ. د. عبد الوهاب زايد
أمين عام جائزة خليفة الدولية لنخيل التمر والابتكار الزراعي

إعلان أبوظبي بشأن سوسة النخيل الحمراء

نحن، وزراء الزراعة ورؤساء وفود البلدان المشاركة في الاجتماع الوزاري للمانحين من أجل دعم الصندوق الاستئماني والبرنامج الإقليمي لمكافحة سوسة النخيل الحمراء والمنعقد يوم السبت الموافق **9** مارس/ آذار في أبوظبي:

إقراراً بالأبعاد الثقافية والدينية والاجتماعية والاقتصادية لشجرة النخيل المباركة، والتي كانت ثمارها الغذاء الأساسي للعديد من الدول في المناطق القاحلة بالشرق الأوسط وشمال أفريقيا على مدى قرون؛

وتثميناً للجهود العظيمة التي بذلتها بلدان المنطقة لدعم وتطوير قطاع تمر النخيل في المنطقة؛

وإدراكاً للتهديد الذي تشكله آفة سوسة النخيل الحمراء الرهيبة لشجرة نخيل التمر وآثارها السلبية على الاقتصاد الوطني والأمن الغذائي وسبل العيش للمجتمعات الريفية والبيئة؛

نؤكد مجدداً دعمنا للاستراتيجية الإطارية والبرنامج الإقليمي للقضاء على سوسة النخيل الحمراء تحت رعاية منظمة الأمم المتحدة للأغذية والزراعة (الفاو)؛

نثني على الدول والمنظمات المانحة، مثل الإمارات العربية لمتحدة، المملكة العربية السعودية وسلطنة عُمان لدعمها المالي للصندوق الاستئماني الذي يهدف إلى دعم البرنامج الإقليمي؛

ونعبر عن أسمى آيات التقدير والعرفان لقيادات الإمارات العربية المتحدة وجائزة خليفة الدولية لنخيل التمر والابتكار الزراعي لاستضافة هذا الاجتماع ولكرم الضيافة؛

ونعرب عن الامتنان الحار للفاو والمدير العام للمنظمة السيد/ جوسيه غراتسيانو دا سيلفا للدور القيادي من أجل وضع استدامة نخيل التمر على رأس أولويات التنمية المستدامة.

تحريراً في أبوظبي 09 مارس 2019

عدسة: يوسف الحبشي

وزارة البيئة والمياه والزراعة
Ministry of Environment Water & Agriculture

برنامج مكافحة سوسة النخيل الحمراء
في المملكة العربية السعودية
الواقع والطموح

برنامج مكافحة سوسة النخيل الحمراء في المملكة العربية السعودية.. الواقع والطموح

مقدمة

النخلة شجرة مباركة ورد ذكرها في القرآن والسنة النبوية ولها مكانة كبيرة على المستوى الديني والاجتماعي والثقافي لدى مجتمع المملكة العربية السعودية. يتجاوز مجموع النخيل في المملكة 28 مليون نخلة ويغطي حوالي 12 % من إجمالي المساحات المزروعة احتلت به المملكة المرتبة الثانية عالميا في انتاج التمور (14 % من الإنتاج العالمي) وبمعدل إنتاج يساوي معدل الإنتاج العالمي (6,2 طن/هكتار). وتعتبر سوسة النخيل الحمراء (*Rhynchophorus ferrugineus*) من أهم الآفات التي تهدد زراعة نخيل التمر ليس فقط في المملكة العربية السعودية وإنما في جميع مناطق زراعته. وتكمن خطورة هذه الحشرة بالمقارنة مع غيرها من الحشرات الأخرى في كونها تعيش أكثر من 80 % من دورة حياتها مختفية داخل جذع النخلة حيث من الصعب جدا تمييز الإصابات في المراحل الأولى ويصعب الوصول إلى أطوار الحشرة داخل جذع النخلة.

عُرفت سوسة النخيل الحمراء في أواخر القرن التاسع عشر في مناطق جنوب آسيا واستطاعت منذ ذلك الوقت أن تنتشر شرقا إلى حدود أستراليا، بينما اكتسحت في اتجاه الغرب مناطق الشرق الأوسط وشمال إفريقيا ثم جنوب أوروبا ومنه إلى أقصى شمال فرنسا وبعد ذلك وصلت إلى جزر الكاريبي في القارة الأمريكية. ظهرت الحشرة في بعض دول الخليج سنة 1985 ومنها دخلت إلى المملكة العربية السعودية حيث سُجلت لأول مرة سنة 1987 في محافظة القطيف ومنها انتقلت إلى بعض مناطق زراعة النخيل داخل المملكة وتسببت في خسائر كبيرة تقدر حاليا بأكثر من 65 مليون ريال سعودي سنويا. وكانت المملكة العربية السعودية قد انطلقت في اتخاذ الإجراءات وإعداد الخطط لمكافحة هذه الآفة منذ تسجيل دخول الحشرة إلى المملكة من خلال إجراءات تنظيمية مختلفة.

الإجراءات التنظيمية التي قامت بها المملكة

إن أهم الإجراءات التي قامت المملكة بتنظيمها على امتداد العقود الثلاثة الماضية كانت كما يلي:

- تشكيل لجنة فنية موحدة:

شُكلت هذه اللجنة المركزية الموحدة من أعضاء يتبعون الجهات التطبيقية والعلمية ذات العلاقة وذلك لتوحيد الجهود في تسيير ومتابعة تنفيذ أعمال مكافحة الحشرة بعد ظهور الإصابة في المنطقة الشرقية. بعد ذلك ولمزيد من الكفاءة في العمل الميداني، حُولت مهام هذه اللجنة إلى فروع وزارة البيئة والمياه والزراعة ومديرياتها في جميع المناطق المسجل فيها إصابات، حيث أُحدثت فيها برامج فرعية لمكافحة سوسة النخيل الحمراء.

- وضع تشريعات الحجر الزراعي الداخلي:

بهدف منع انتشار الحشرة إلى مناطق سليمة عن طريق الفسائل المصابة، قامت المملكة بتعزيز المكافحة التشريعية بوضع تشريعات الحجر الزراعي الداخلي وتعميمها على الجهات الزراعية والأمنية والبلديات لتطبيقها. وتنتمي هذه النصوص الحجرية إلى مستويات متعددة منها الخليجي (قانون الحجر الزراعي لدول مجلس التعاون لدول الخليج العربية) والوطني (اللائحة التنفيذية رقم 26825 بتاريخ 8-6-2005) والوزاري والإداري (تعاميم عديدة صدرت منذ سنة 1990). كما قامت الوزارة بإنشاء عدة مراكز للحجر الزراعي الداخلي منذ سنة 2000.

- إدراج مشروع تحول إلى برنامج مكافحة سوسة النخيل الحمراء:

أطلقت المملكة في سنة 1991مشروع لمدة خمسة سنوات لمكافحة الحشرة ثم حولت هذا المشروع بعد ذلك إلى برنامج مستمر لمكافحة الحشرة ووفرت له ميزانية سنوية دائمة.

- استشارات فنية محلية ودولية: باعتبار سوسة النخيل الحمراء من الحشرات الغازية والجديدة، قامت المملكة بالاستعانة منذ سنة 1990 بكثير من الخبراء الدوليين والمحليين من الجهات العلمية إلى أن تطورت خبرات وطنية سعودية أخرى وأصبحت تساهم بكفاءة عالية في المجهود العام لمكافحة الحشرة الذي تقوم به المملكة.

- الاستعانة بمنظمات عربية ودولية وبمؤسسات وطنية:

في نطاق إضفاء المزيد من الكفاءة على برنامج مكافحة الحشرة، استضافت المملكة عدة منظمات أهمها الفاو على الصعيد الدولي والمنظمة العربية للتنمية الزراعية على الصعيد العربي، للاستفادة من كفاءاتها إضافة إلى توجيه المؤسسات العلمية، مثل جامعة الملك فيصل وجامعة الملك سعود ومدينة الملك عبدالعزيز للعلوم والتقنية، إلى إجراء بحوث على الحشرة والاستفادة من نتائجها.

- إنجاز برامج إرشادية:

قامت المملكة بتنظيم العديد من البرامج الإرشادية في شكل مطويات وكتيبات وأشرطة ولقاءات إذاعية وتلفزيونية وكذلك ورَش عمل ومحاضرات تدريبية والتي كان لها الأثر الإيجابي على المزارعين ولعبت دورا أساسيا في رفع الوعي بخطورة الحشرة وسبل الوقاية منها ومكافحتها.

الحشرة الكاملة والطور اليرقي الضار

الطرق الفنية التي اعتمدتها المملكة

قامت المملكة باعتماد العديد من الطرق الفنية على مدى ثلاثة عقود فتراكمت لديها خبرات عالية في مكافحة الحشرة يكمن تلخيصها كالآتي:

- استعمال المبيدات للرش الوقائي والعلاجي:

استعملت المملكة المبيدات لرش الأشجار المصابة والسليمة كمكَون أساسي لمكافحة الحشرة خاصة خلال السنوات الأولى بعد دخول الآفة إلى المملكة من 1987 إلى 1994.

- استعمال المصائد الفيريومونية:

استخدمت المملكة المصائد الفيريومونية بصفة خاصة لمكافحة الحشرة خلال السنوات ما بين 1995 و1999. ومكنت هذه الطريقة من تخفيض جيد في نسبة الإصابة (من 7 % سنة 1993 في بعض المناطق الموبوءة في المملكة إلى 3 % سنة 1997).

- استعمال المكافحة الحيوية:

اعتمادا على نتائج معملية مشجعة، قامت المملكة باستخدام المكافحة الحيوية ما بين سنوات 1999 و2006 باستعمال الفطريات والنيماتودا. إلا أن النتائج الحقلية لم تكن إيجابية بصورة كافية.

- استعمال المبيدات للحقن الشامل الوقائي والعلاجي:

كانت قلة كفاءة الرش بالمبيدات زيادة عن تلوث البيئة وكذلك ضعف نتائج المكافحة الحيوية حافزا للمملكة لتعديل برنامج مكافحة الحشرة والاعتماد على المبيدات من جديد ولكن لحقن جذوع الأشجار المصابة والأشجار السليمة المحيطة بها. واستُعملت هذه الطريقة غير الملوثة للبيئة كعنصر أساسي للمكافحة من سنة 2010.

- تطوير طرق المكافحة المتكاملة:

طورت المملكة برنامج المكافحة المتكاملة عن طريق إثرائه بطرق جديدة ذات كفاءة عالية في المكافحة تُستعمل لأول مرة ضد سوسة النخيل الحمراء. ومن بين هذه الطرق يمكن ذكر ما يلي:

• المكافحة الميكانيكية بالفرم:

تم تطوير عنصر المكافحة الميكانيكية بإدخال عملية الفرم للتخلص السريع من النخيل المصاب بشدة بعد إزالته وذلك بأسرع وقت ممكن لضمان القضاء على الحشرة بكافة أطوارها بطريقة فنية سليمة.

• التبخير بفوسفيد الألومينيوم:

تعود أول تجارب استعمال فوسفيد الألومينيوم في المملكة إلى أكثر من عقد. وقد أخذ التبخير بفوسفيد الألومينيوم يأخذ حيزا هاما من اهتمام الوزارة خصوصا خلال السنوات

القليلة الماضية. فالتجارب التي قامت بها مؤسسات جامعية وخاصة في الأحساء وفي القصيم وأعطت نتائج باهرة، جعلت الوزارة تتجه نحو اعتماد هذه الطريقة مستقبلا بعد أن قامت بتجربة هذه الطريقة بالتعاون مع جامعة الملك فيصل ومدينة الملك عبدالعزيز للعلوم والتقنية.

• الكشف الدوري الشامل:

تبنت الوزارة هذه الطريقة في مكافحة الآفة بعد النتائج الجيدة التي تحصّل عليها مركز النخيل والتمور بالأحساء في منطقتيّ المراح والعيون والتي اعتمدت أساسا على الكشف الدوري الشامل مع الكشط للقضاء على الحشرة بعد سنة ونصف من التطبيق ودون الاستعانة بالمبيدات. فنتائج التجربتين بينت أن 12 دورة فحص شاملة (كل 45 يوم) مكنت من التخفيض في نسبة الإصابة من 0,18 % إلى 0,01 % وفي عدد الإصابات من 114 إلى 7 وفي عدد النخيل المزال من 23 إلى 3. وتُعتبر هذه الطريقة الجديدة بمثابة قفزة نوعية في مكافحة الحشرة لأنهما زيادة على كفاءتها العالية، لا تلوث البيئة بتاتا وتكلفتها منخفضة جدا بالمقارنة مع طرق المكافحة الكلاسيكية. وهذا التطوير الناجح في مكافحة الحشرة والذي كانت المملكة العربية السعودية سباقة في إنجازه، سيكون من المؤكد مثالا تحتذي به كل الدول التي لديها نخيل تمر مصاب بهذه الآفة.

• تشريك الجمعيات التعاونية:

تتجه المملكة حاليا إلى تشجع الجمعيات التعاونية العاملة في ميدان الزراعة على القيام ضمن نشاطاتها بتنفيذ أعمال مكافحة ضد سوسة النخيل الحمراء وهذا ما تم فعلا مع جمعيتان تقومان بتطهير فسائل النخيل في محافظتيّ العلا بمنطقة المدينة المنورة والزلفي بمنطقة الرياض.

النشاطات البحثية التي مولتها المملكة

نظراً لأهمية العمل على إيجاد حلول تقنية متطورة لمكافحة سوسة النخيل الحمراء ولما تشكله هذه الآفة من أضرار اقتصادية واجتماعية، تولت المملكة القيام بدعم الأبحاث الموجهة لمكافحة الحشرة بهدف إيجاد حلول سريعة وفعاله وذات تكلفة اقتصادية مناسبة. وكانت مدينة الملك عبدالعزيز للعلوم والتقنية الأولى في إطلاق برامج بحثية بالتعاون مع الوزارة وتلتها في ما بعد مؤسسات جامعية أخرى من بينها جامعة الملك عبدالله للعلوم والتقنية.

- إنشاء برنامج وطني موجه لدعم البحوث:

في سنة 2016، تم وضع برنامج وطني موجه لدعم البحوث حول مكافحة الحشرة وتم لهذا الغرض تكوين لجنة إشراف عليا مختلطة بين الوزارة ومدينة الملك عبدالعزيز للعلوم والتقنية. وتم رسم استراتيجية بحثية وخطة عمل تتناسب مع الأولويات المقترحة من قبل

الـوزارة ومـع الدراسـة المسـحية التـي قامـت بهـا مدينـة الملـك عبدالعزيـز للعلـوم والتقنيـة. وتم تحديـد المراكـز البحثيـة المتميـزة علـى المسـتويَيْن الوطنـي والدولـي وكذلـك ترتيـب الأولويـات البحثيـة التاليـة، (1) الفحـص المبكـر والتنبـؤ بالإصابـة بالحشـرة، (2) المراقبـة والمكافحـة والحـد مـن انتشـار الحشـرة، (3) العلاقـات الثنائيـة والإيكولوجيـة البيئيـة للسوسـة مـع النخيـل العائـل، (4) الدراسـات الجزيئيـة والوراثيـة للحـد مـن انتشـار الحشـرة والقضـاء عليهـا. وبعـد تقـديم العديـد مـن المقترحـات البحثيـة، تمـت الموافقـة علـى دعـم 8 مشـاريع بحثيـة بتكلفـة إجماليـة تفـوق 14 مليـون ريـال سـعودي.

- دعم الأبحاث وتطوير التقنيات الواعدة:

في سـنة 2017 وفي نفـس الاطـار، أنشـأت الـوزارة شـراكة بحثيـة وطنيـة أخـرى مـع جامعـة الملـك عبـدالله للعلـوم والتقنيـة وذلـك لمـا تمتلكـه هـذه الجامعـة مـن مكانـة عالميـة. وتم وضـع نفـس الأولويـات البحثيـة التـي حُـددت سـابقا مـع مدينـة الملـك عبدالعزيـز للعلـوم والتقنيـة. وانطلـق مؤخـرا في هـذا الإطـار عمـل فريـق مشـترك مـن قبـل جامعـة الملـك عبـدالله والمركـز

أعراض الإصابة داخل جذع النخلة

الوطني للنخيل والتمور بالأحساء لتطوير جهاز ولاقط صوتي للكشف المبكر عن تواجد سوسة النخيل الحمراء داخل جذع النخلة. وقامت الوزارة بتوفير جميع الإمكانيات اللوجستية للأبحاث الخاصة بمكافحة الحشرة وذلك من خلال مراكزها المنتشرة في جميع أنحاء المملكة بالإضافة الى قدرتها على الوصول إلى مَزارع النخيل في كافة المناطق.

- توفير الخدمات اللوجستية للبحث والتطوير:

امتداداً للحرص على تطوير البحث العلمي لما يتناسب مع الاحتياجات الوطنية والأهميات الملحة في قطاع الزراعة، كلفت الوزارة مركز النخيل والتمور بالأحساء بتخصيص إمكانيات حقلية ومعملية لخدمة أبحاث مكافحة سوسة النخيل الحمراء ومجالات أخرى متعلقة بالنخيل. وقام المركز بعمل العديد من التجارب مثل اختبارات بعض التقنيات الحديثة لمكافحة الحشرة وتطويرها بالإضافة الى المساهمة في نشر بعض التقنيات الواعدة لمكافحة الحشرة عن طريق التواصل مع أصحاب المصلحة ونقل هذه المعلومات إليهم بالطرق المناسبة. وفي خلال السنوات الماضية بلغ عدد الأوراق العلمية التي تم نشرها في مجلّات عالمية خمسة عشر بحث علمي محكم.

رؤية واستراتيجية وأهداف جديدة للمملكة

إن مثابرة ونجاح المملكة في السيطرة على سوسة النخيل الحمراء أديا إلى انخفاض نسبة الإصابة من 7 % سنة 1993 إلى أقل من 1 % حاليا. هذا ما جعل الوزارة تعزز برنامج مكافحة الحشرة في سنة 2018 بوضع استراتيجية وطنية متكاملة وخطة تنفيذية واضحة للسيطرة على هذه الآفة، بناء على الخبرات المتراكمة خلال ثلاثة عقود من مكافحة سوسة النخيل الحمراء.

وتعتمد هذه الاستراتيجية لمكافحة الحشرة حاليا على أربعة محاور هي (1) منع انتشار الحشرة في مواقع سليمة في المملكة، (2) تكثيف عمليات المكافحة في المناطق المصابة، (3) تطوير البحوث في مجالَيْ الوقاية من الحشرة ومكافحتها، (4) إشراك العديد من الجهات الحكومية والخاصة. كما ترتكز هذه الاستراتيجية من ناحية أخرى على 12 مكون هي:

- برنامج للتدريب وبناء القدرات:

إجراء تشخيص تشاركي لتحديد الاحتياجات التدريبية وإعداد خارطة توجيهية للعمل ثم تشكيل فرق تدريبية جاهزة للتنفيذ.

- نظام للمراقبة الميدانية والكشف الدوري والإبلاغ عن الحشرة:

إعداد بروتوكول ممارسات سليمة في استخدام مصائد المراقبة وتنفيذ برامج التدريب وإجراء بحوث ودراسات والقيام بحملات توعوية.

- قاعدة للبيانات ونظام للمعلومات الجغرافية والاستشعار عن بعد:

إنشاء قاعدة بيانات ونظام معلوماتي جغرافي وتطوير تطبيق هاتف محمول سهل الاستخدام وتخصيص رابط للمزارعين.

- آلية لمشاركة المزارعين وجمعياتهم التعاونية:

إجراء دراسة تشاركية لتشخيص وضع المزارعين وجمعياتهم التعاونية ووضع آلية وحوافز لضمان مشاركتهم واختيار وتأهيل مزارع نموذجية تشاركية.

- برنامج للإعلام وحملات للتوعية:

تحليل الوضع وصياغة خطة إعلامية وإنشاء قنوات تواصل اجتماعي وتنظيم حملات إعلامية متكاملة.

- إدارة متكاملة لمكافحة الحشرة:

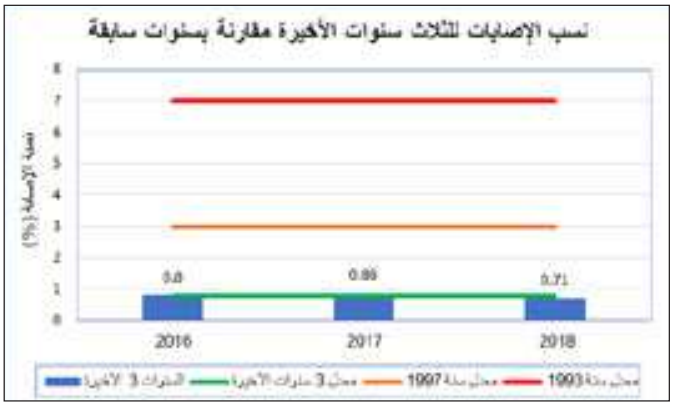
وضع وتنفيذ إجراءات متكاملة لمكافحة الحشرة وإحداث آلية لإشراك المزارعين.

- مشـــاتـل للفســـائـل والشتلات النسيجية:

إجـراء مسـح ميدانـي لتقديـر احتياجـات المزارعـين مـن الفسـائل وإنشـاء مشـاتل معتمـدة ووضـع سياسـة ومبـادئ توجيهيـة باسـتخدام المعاييـر العالميـة لإنتـاج الفسـائل النسـيجية.

- أنظمة للحجر النباتي ولإجراءات الصحة النباتية:

وضع لوائح تنظيمية للحجر الصحي النباتي وتشكيل فرق للحجـر الداخلـي وتدريبهـا علـى إجـراءات تنفيـذ اللوائـح.



- ممارسات وقائية جيدة:

صياغـة مبـادئ موحـدة للممارسـات الزراعيـة الجيـدة وتدريـب المزارعـين والعمـال عليهـا ووضـع سياسـة لتحفيـز المزارعـين علـى تبنيهـا.

- نظام للرصد والمتابعة والتقييم:

تحديـد طـرق وتطويـر أدوات لجمـع البيانـات الخاصـة بمؤشـرات أداء الخطـط التنفيذيـة وإنشـاء نظـام رصـد وتقييـم الكتروني مركزي.

- برامج للبحوث والإرشاد وتوثيق وتبادل المعرفة:

إنشـاء وحـدة للتوثيـق والمشـاركة المعرفيـة وإعـداد وتنفيـذ برامـج إرشـادية متكاملـة وإجـراء بحـوث ودراسـات تشـاركية.

- آلية لتنسيق وإشراك القطاع الخاص والجهات المعنية:

تشـخيص وحصـر الشـركاء مـن مؤسسـات حكوميـة وجهـات بحثيـة ومزارعـين ومسـتثمرين وجمعيـات تعاونيـة ووضـع آليـة للمشـاركة والتنسـيق بينهـم وتنفيذهـا من خلال خطـة عمـل تشـاركية.

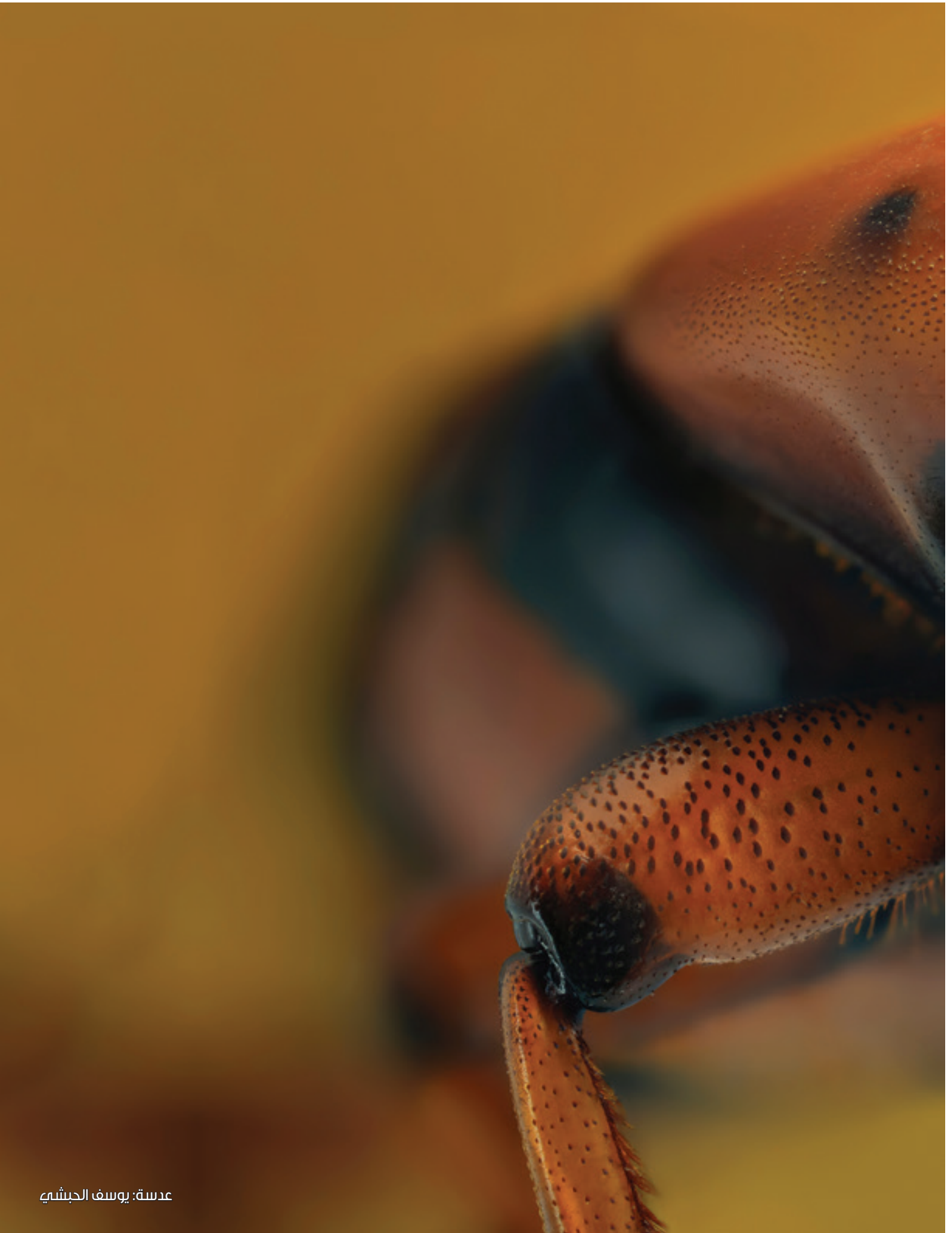
وتتـدرج كل هـذه الأعمـال في نطـاق رؤيـة مسـتقبلية واضحـة للمملكـة تهـدف في النهايـة إلـى

القضاء على الحشرة في المملكة بمشاركة المزارعين والجمعيات ومراكز البحوث والقطاع الخاص. وقد أطلقت الوزارة مبادرة في إطار التحول الوطني لتحقيق رؤية المملكة 2030 وذلك للتمكن من تخفيض نسبة الإصابة إلى 0,5% كهدف مرحلي.

وفي إطار هذه الاستراتيجية الجديدة لمكافحة الحشرة، قامت الوزارة بتحسين تنفيذ إجراءات مكافحة الحشرة من خلال:

- وضع دليل إجرائي فني شامل للإدارة المتكاملة لسوسة النخيل الحمراء، والذي يحتوى على كل الجوانب الفنية التطبيقية لعمليات المكافحة الميدانية في شكل مسارات تدفق عمليات و بروتوكولات فنية تطبيقية معززة بصور توضيحية ميدانية.
- إعداد خطط تنفيذ الأعمال لكل المناطق حسب مستوى الإصابة فيها وتعتمد هذه الخطط على المكونات الأساسية المضمنة بالاستراتيجية الوطنية لمكافحة الحشرة.
- إثراء وتنويع برامج التدريبات الموجه للمهندسين والفنيين والمزارعين والعمال.
- وضع آلية للمتابعة والتقييم الدوري لجميع أنشطة برنامج المكافحة في المناطق.
- وضع دليل إجرائي إداري ومالي لتحسين تسيير البرنامج خاصة في المناطق.

****



عدسة: يوسف الحبشي

وزارة الأشغال وشؤون البلديات والتخطيط العمراني
Ministry of Works, Municipalities Affairs and Urban Planning
وكالة الزراعة والثروة البحرية
Agriculture and Marine Resources

مشروع حصر ومكافحة سوسة النخيل الحمراء

في مملكة البحرين

2016-2018

علي أحمد العصفور، حسين جواد الليث، عبدالعزيز محمد عبدالكريم
وكالة الزراعة والثروة البحرية، وزارة الاشغال وشئون البلديات والتخطيط العمراني
مملكة البحرين

مشروع حصر ومكافحة سوسة النخيل الحمراء في مملكة البحرين 2016-2018

المقدمة

حشرة سوسة النخيل الحمراء (*Rhynchophorus ferrugineus* Olivier)، التي تتبع رتبة غمدية الأجنحة (Coleoptera) فصيلة السوس (Curculionidae) من الحشرات التي تصيب جميع أنواع النخيل ومنها نخيل التمر (*Phoenix dactylifera* L). تعتبر السوسة من الحشرات الدخيلة أو الغازية (Invasive Species)، والتي يقصد بها أن الحشرة لم تكن موجودة من قبل وأدخلت من دون كوابحها الحيوية عن دون قصد لتبدأ العيش في بيئة جديدة. وتتمتع الحشرة بخصائص الكائنات الدخيلة والتي تشمل القدرة على الاستيطان التفاعل مع الظروف البيئية الجديدة، والتغذية والتكاثر والانتشار.

تم اكتشاف حشرة سوسة النخيل الحمراء في منطقة الخليج العربي لأول مرة في دولة الإمارات العربية المتحدة عام 1985، وانتشرت بعد ذلك لتصل لسائر دول مجلس التعاون لدول الخليج العربية. ولم يتوقف وصول الحشرة إلى دول مجلس التعاون فقط بل انتشرت لتشمل سائر الدول المنتجة للتمور وكذلك الدول المطلة على البحر الأبيض المتوسط بما فيها دول المغرب العربي.

واكتشفت حشرة سوسة النخيل الحمراء في مملكة البحرين في عام 1995، ومنذ ذلك باتت الحشرة تثير القلق لدى المزارعين والمهتمين بزراعة نخيل التمر وصناع القرار. ولا يمكن تجاهل السوسة وأضرارها وتركها دون رصد ومكافحة الأمر الذي قد يؤدي إلى استفحال الإصابة وتكون النتيجة فقدان أعداد كبيرة من النخيل مما يترتب عن ذلك مخاطر اقتصادية وبيئية واجتماعية. وتتمثل المخاطر الاقتصادية في ارتفاع تكاليف المكافحة، ارتفاع تكاليف الحجر الزراعي، وتشديد إجراءات الاستيراد التي تشكل عبء إضافي على المستوردين وتؤدي إلى رفع التكلفة في السوق المحلي. أما المخاطر البيئة الناجمة عن الإصابة بسوسة النخيل الحمراء تشمل إزالة النخيل المصاب، التسبب في خلل التنوع الحيوي، زيادة التلوث البيئي. ونظراً لأهمية هذه الآفة بات من الضروري اتخاذ كافة الإجراءات الاحترازية اللازمة للحد من تفاقم مخاطرها.

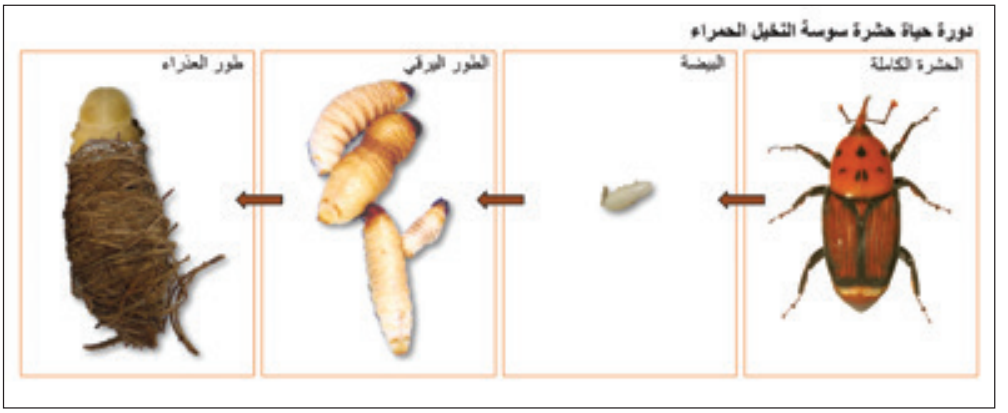
ظهور النشارة الخشبية

تجويف جذع النخلة

كسر جذع النخلة

آثار المادة الهلامية على جذع النخلة

الأعراض الخارجية للإصابة بحشرة سوسة النخيل الحمراء



أهدف مشروع حصر ومكافحة سوسة النخيل الحمراء:

تساهم عملية الحد من الإصابة بحشرة سوسة النخيل في المحافظة على ثروة البلاد من اشجار وفسائل النخيل، وزيادة الإنتاجية من التمور للأصناف الجيدة من حيث الكم والنوع، والزيادة من دخل المزارع، والمحافظة على الأصول الوراثية المميزة لأصناف النخيل في مملكة البحرين بالإضافة إلى أهداف أخرى يمكن إيجازها في الآتي:

- الحفاظ على البعد الاجتماعي والبيئي والتراثي والجمالي لشجرة نخيل التمر.
- السيطرة على مستوى الإصابة بسوسة النخيل الحمراء.
- الحد من انتشار الإصابة.
- إدخال مفهوم نظم التحكم في الآفات لدى المزارعين
- بناء كوادر فنية قادرة على إدارة برامج نظم التحكم بحشرة شوشة النخيل الحمراء وإمكانية نقل مثل هذه البرامج في مكافحة آفات النخيل الأخرى خاصة الحفارات.
- حث المزارعين على تبنى ممارسات سليمة للاهتمام بشجرة نخلة التمر من خلال البرامج الإرشادية
- تطبيق وتفعيل التشريعات اللازمة للحد من انتقال الآفة على المستوى الخارجي والداخلي.
- إنشاء قاعدة معلوماتية تشمل كافة بيانات المشروع، والدراسات والبحوث التطبيقية ذات العلاقة في مملكة البحرين ودول الخليج وكذا في مناطق تنفيذ المشاريع ذات طبيعة بيئية مماثلة.

الإنجازات

مشروع حصر ومكافحة حشرة سوسة النخيل الحمراء في مملكة البحرين مبني على أساس تطبيق نظم الإدارة المتكاملة للآفة (Insect Pest Management). بدأ المشروع في تنفيذ ثلاثة برامج تشمل الرصد، والمسح، والمكافحة والعلاج. يستعرض هذا التقرير انجازات برامج المشروع المنفذة خلال الفترة 2016-2018.

برنامج المسح والجرد المكثف والعلاج والإزالة

من المحاور الأساسية لمشروع حصر ومكافحة حشرة سوسة النخيل الحمراء المسح المنتظم لأشجار النخيل. تعهدت وكالة الزراعة والثروة البحرية من خلال فرق المسح تكثيف الجهود من خلال الزيارات الميدانية وبصورة دورية في مسح مزارع النخيل المنتشرة في المحافظات الأربع في مملكة البحرين بغرض تحديد بؤر الإصابة للحشرة من عدمها؛ مع اتخاذ الإجراءات اللازمة في تقييم حالة النخيل وتحديد طريقة المكافحة والعلاج. ويتم الاستدلال على النخيل المصاب من خلال تواجد السائل الصمغي على جذع النخلة المصابة، أو من خلال تواجد النشارة الخشبية عند منطقة الإصابة على الجذع أو أسفل الجذع عندها يتم إعدامها في حال الإصابة الشديدة للنخلة. أما في حال اكتشاف الإصابة المبكرة يتم علاج النخلة بسهولة وذلك بتحديد بدايات الأنفاق وإزالة الاهتراءات، وإزالة ما بينها من يرقات ومن ثم عملية التبخير والتي تتم من خلال وضع أقراص فوسفيد الألمنيوم فيها للقضاء على ما تبقى من أطوار الحشرة داخل جذع النخلة، أو من خلال حقنها بالمبيدات الكيميائية في حالة الإصابة الخفيفة. أما المكافحة الكيميائية تتم من خلال رش النخيل رشاً وقائياً من حين لآخر وذلك للتقليل من فرص إصابتها (شكل1).

(أ) علاج النخيل بفوسفيد الألمنيوم
شكل رقم (1) علاج النخيل المصاب بسوسة النخيل الحمراء

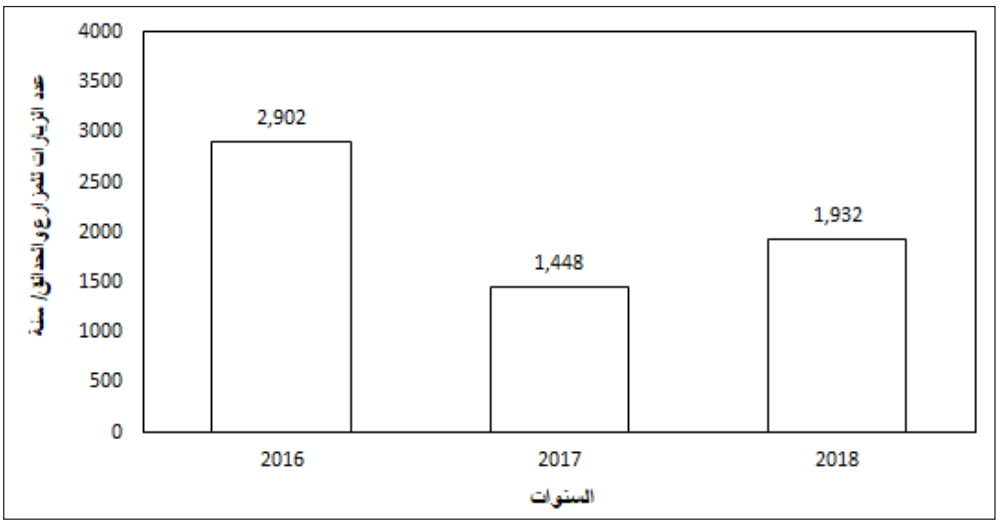
(ب) ثقب النخيل للحقن بالمبيدات

(ج) رش النخيل وقائياً

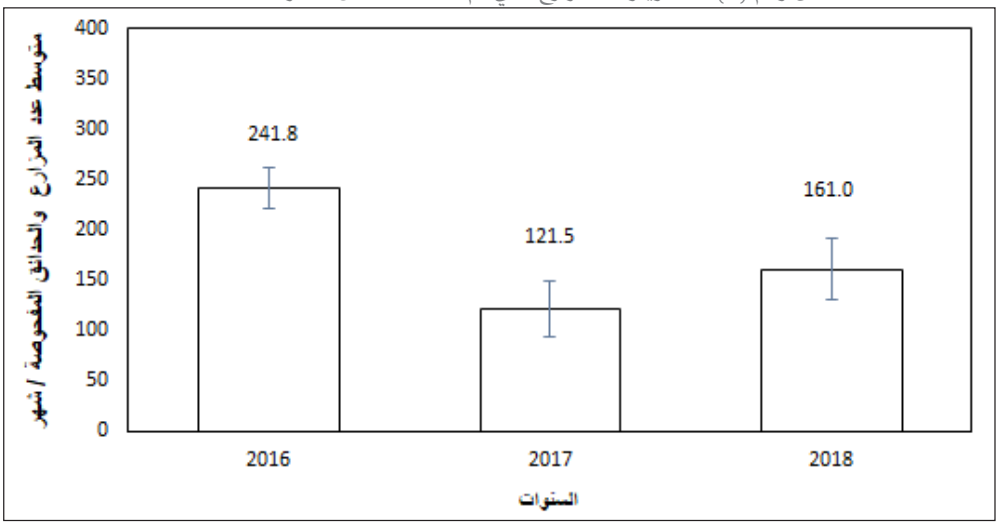
تابع شكل رقم (1) علاج النخيل المصاب بسوسة النخيل الحمراء

إنجازات برنامج المسح والجرد المكثف في تحديد انتشار ونسبة الإصابة بسوسة النخيل الحمراء 2016-2018

يتطلب العمل في مشروع حشرة سوسة النخيل الحمراء تجميع العديد من القراءات والتي تشمل على مسح البساتين من خلال الفحص المباشر للنخيل. ولقد بلغ عدد الزيارات لبساتين النخيل في المحافظات الأربع (العاصمة، الجنوبية، الشمالية، والمحرق) خلال الأعوام 2016-2018 نحو 2,902، 1,448، 1,932 على التوالي، وذلك بمتوسط شهري بلغ نحو 241,8، 121,5، و161,0 زيارة على التوالي خلال الثلاث سنوات (شكل 3-2).

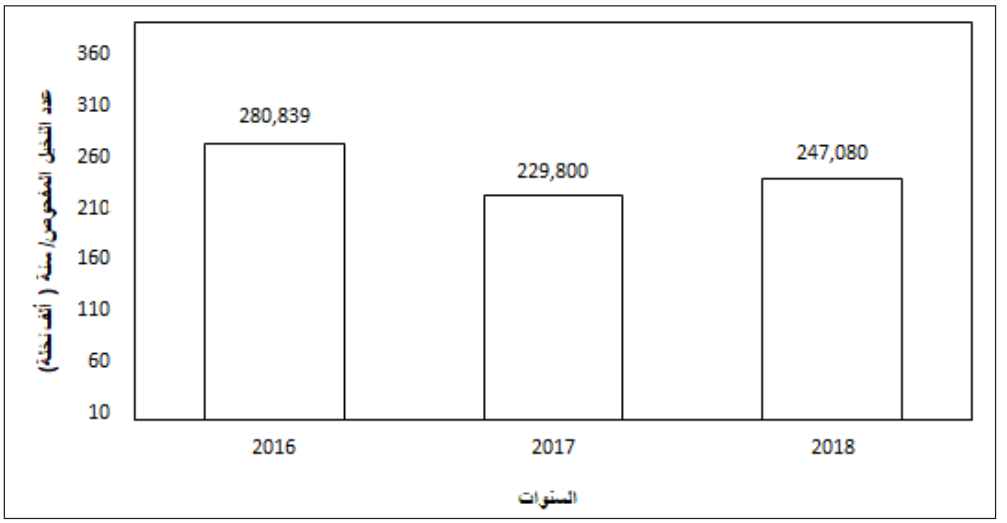


شكل رقم (2) عدد زيارات المزارع التي تم مسحها خلال الفترة 2016-2018



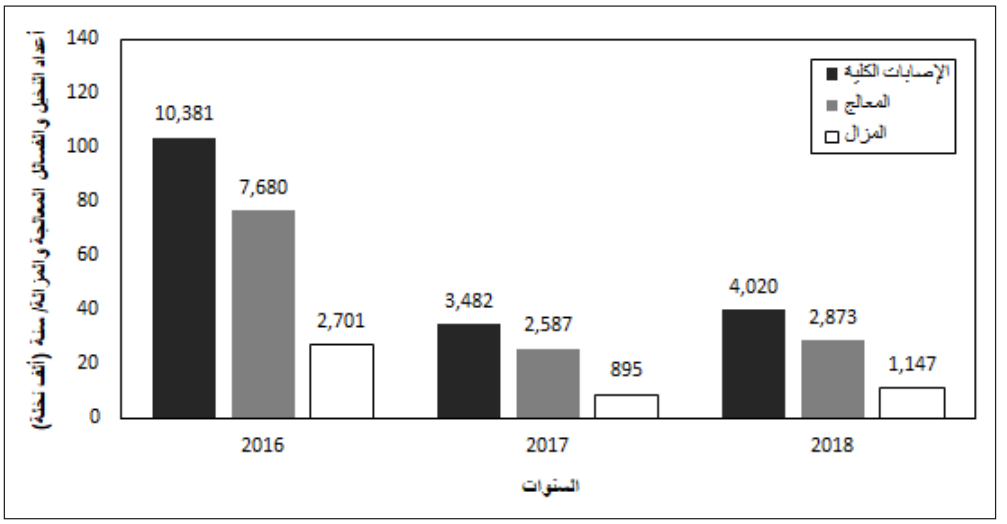
شكل رقم (3) متوسط عدد زيارات المزارع التي تم مسحها بصورة شهرية خلال الفترة 2016-2018

ومن خلال تلك الزيارات خلال الأعوام الثلاثة (2016–2018) تم مسح عدد من أشجار النخيل بلغ نحو 280,839، و229,800، و247,080 على التوالي (شكل 4).



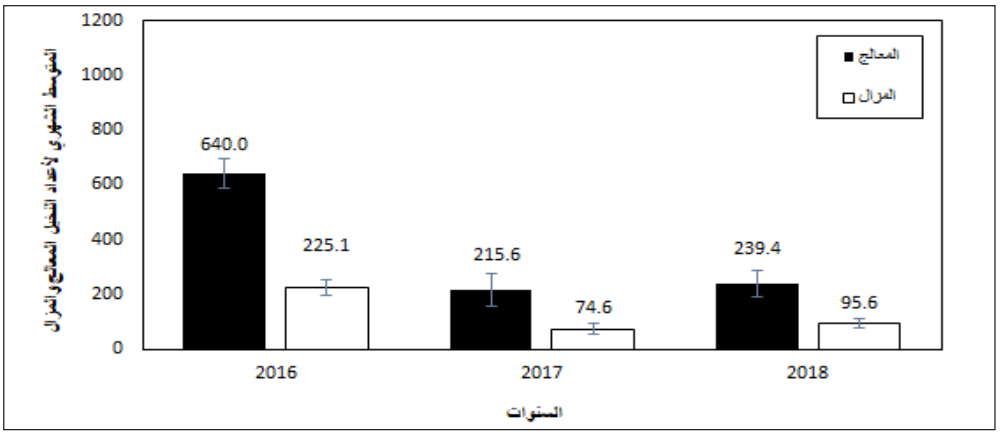
شكل رقم (4) أعداد النخيل المفحوص خلال الفترة 2016-2018

وقدرت الأعداد الكلية للنخيل والفسائل المصابة خلال فترة المشروع (2016–2018)، حيث بلغت أعداد النخيل والفسائل المصاب 10,381، 3,482، 4,040 على التوالي (شكل5). أما مجموع ما تم علاجه من النخيل خلال الثلاثة أعوام نحو 7,680، 2,587، 2,873 على التوالي.



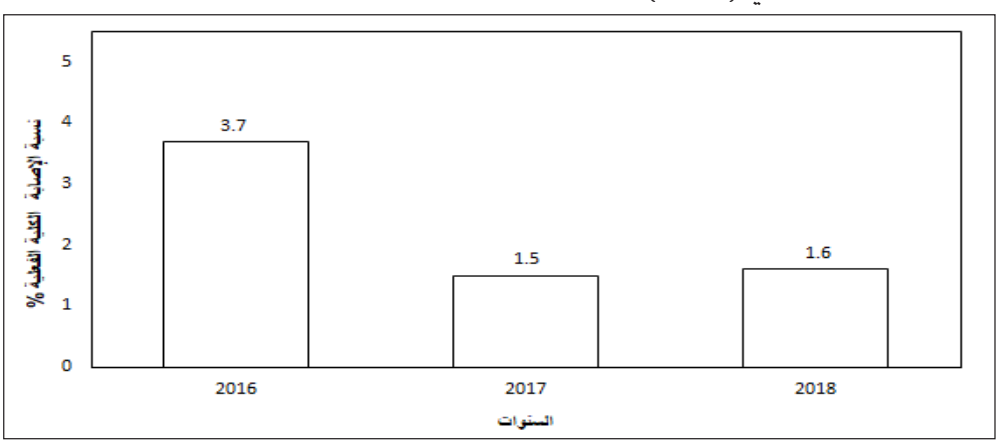
شكل رقم (5) أعداد النخيل المزال والمعالج والمجموع الكلي للإصابات خلال الفترة 2016-2018

بينما بلغ عدد النخيل والفسائل المزال نحو 2,701، 895، 1,147 على التوالي (شكل 5). أما المتوسط الشهري لأعداد النخيل المعالج خلال الثلاثة أعوام بلغ نحو 0, 640، 6, 216، 4, 239 على التوالي (شكل6). في حين بلغ المتوسط الشهري لأعداد النخيل المزال خلال ذات الفترة 1, 225، 6, 74، و6, 95 على التوالي (شكل 6).

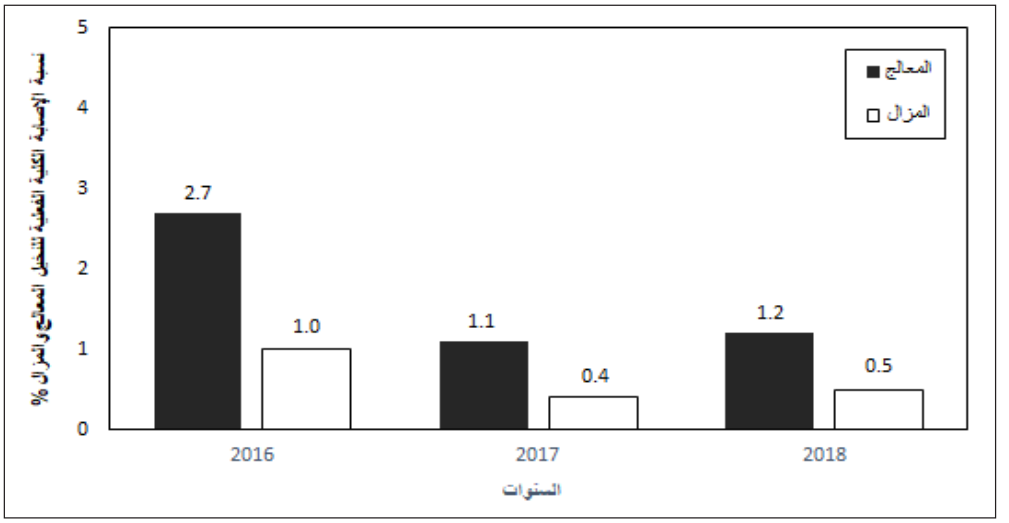


شكل رقم (6) المتوسط الشهري لأعداد النخيل المزال والمعالج خلال الفترة 2016-2018

أما النسبة الفعلية للإصابة بحشرة سوسة النخيل الحمراء خلال الثلاثة أعوام كانت 3, 7 %، و1, 5 %، و1, 6 %. وتمثل هذه النسبة المجموع الكلي الواقعي للنخيل المصاب إلى المجموع الكلي الواقعي للنخيل في كل منطقة (شكل7). أما النسبة المئوية الفعلية للنخيل المعالج خلال فترة المشروع (2016-2018) كانت 2, 7 %، و1, 1 %، و1, 2 %، على التوالي (شكل 8). بينما كانت نسبة النخيل والفسائل المزال خلال ذات الفترة 1, 0 %، و0, 4 %، و0, 5 %، على التوالي (شكل8).



شكل رقم (7) النسبة الكلية الفعلية للإصابة بحشرة سوسة النخيل الحمراء خلال الفترة 2016-2018



شكل رقم (8) متوسط النسبة الكلية الفعلية للإصابة بحشرة سوسة النخيل الحمراء: المزال والمعالج خلال الفترة 2016-2018

برنامج رصد الطور الكامل لحشرة سوسة النخيل الحمراء

برنامج الحصر لحشرة سوسة النخيل الحمراء يهدف إلى تتبع نشاط الطور الكامل للسوسة في بساتين النخيل لتحديد مناطق نشاط وانتشار الحشرة ولتكثيف الجهود في الحد من مخاطرها؛ وكذلك التوقعات المستقبلية لانتشار الحشرة.

هناك عدة وسائل يتم الاستعانة بها في رصد حشرة سوسة النخيل الحمراء. من أهم تلك الوسائل استخدام المصائد الفرمونية التجميعية ذات الطعم الغذائي والتي تعد من الطرق الفعالة في الاستدلال على نشاط الطور الكامل للسوسة في المزارع، عوضاً عن الطور اليرقي الذي يتواجد داخل جذع النخلة الأمر الذي يصعب من اكتشاف الإصابة بسهولة. وعادة ما يستفاد من نتائج رصد حشرة سوسة النخيل الحمراء في اتخاذ القرار السريع نحو تطبيق وسائل المكافحة المناسبة بصورة حازمة للحد من أضرارها على النخيل، وللتقليل من نشاطها (شكل9).

شكل رقم (9) المصيدة الفرمونية الكايرومونية المستخدمة في مشروع سوسة النخيل الحمراء

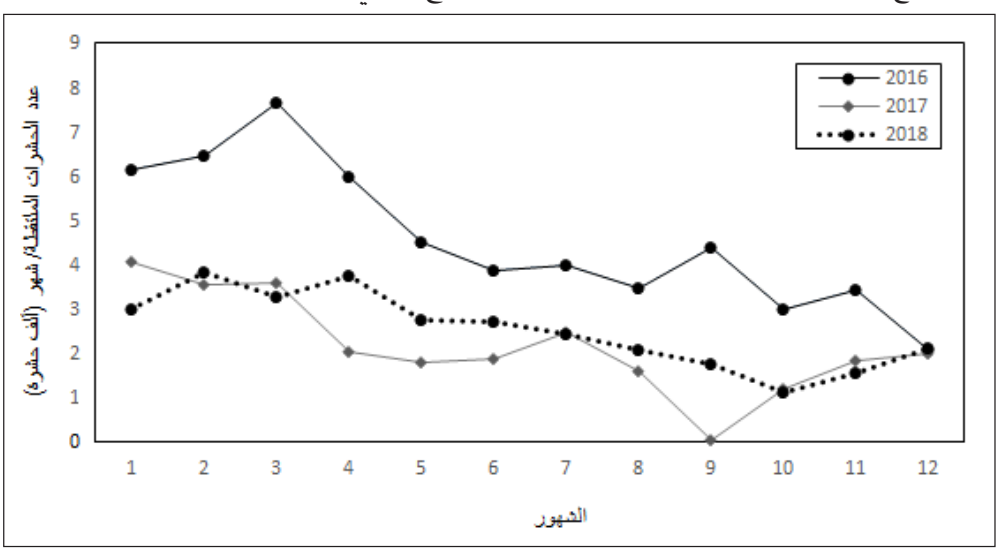
اختيار المواقع الدائمة في برنامج رصد حشرة سوسة النخيل الحمراء

الأساس في تثبيت نظام الرصد الدائم للمصائد هو من أجل تجميع البيانات عام بعد آخر للمواقع ذاتها، ومع الزمن البيانات السنوية يمكن تحليلها لتحديد التغيرات في الأعداد المجمعة للسوسة والتي يمكن الاستدلال بها في تحديد المناطق ودرجات الإصابة المستقبلية. كما ويمكن الاستفادة من البيانات في تحديد ما إذا كان التغير في مجاميع الحشرات هو نتيجة الظروف البيئية، أو الموقع أو أثر هذه الظروف على تطوير المجاميع العددية للسوسة، وكذلك لتقييم فعالية برنامج المكافحة.

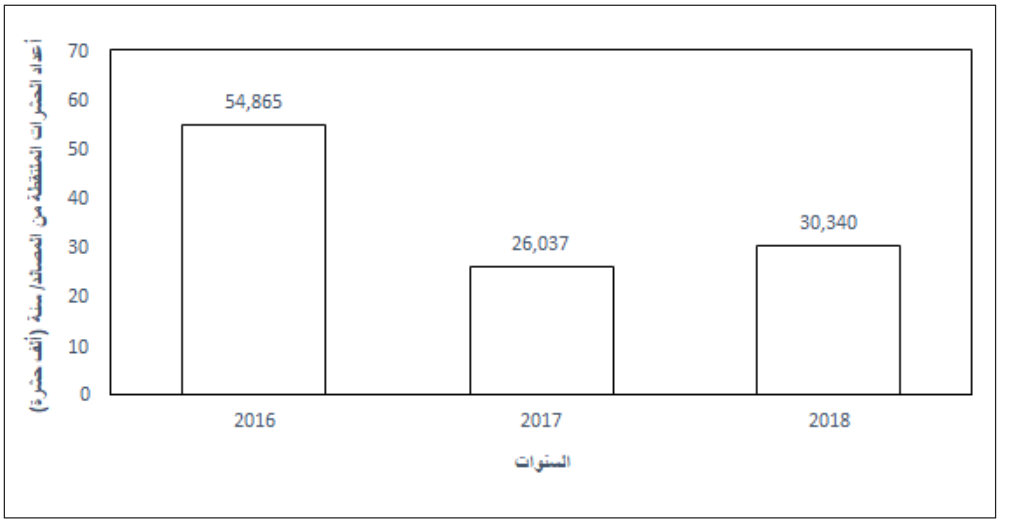
تم تحديد المواقع الدائمة بناءً على إتاحتها وتعاون والمزارعين مع فريق العمل والجهود المبذولة في إدارة المصائد الفرمونية التجميعية الموزعة على المزارع. تم نشر نحو (2,713) مصيدة في 2016 موزعة على (365) مزرعة في (55) منطقة. أما عام 2017 فقد تم نشر نحو (1,073) موزعة على (239) مزرعة في (57) منطقة. بينما في عام 2018 فقد تم نشر نحو (2,453) مصيدة في 2018 موزعة على عدد (361) مزرعة في (57) منطقة.

إنجازات رصد الطور الكامل لحشرة سوسة النخيل الحمراء 2016-2018

رصدت مجاميع الطور الكامل لحشرة سوسة النخيل الحمراء الملتقطة من المصائد الفرمونية التجميعية بشكل أسبوعي ودون المجموع الكلي، كما رصدت مجاميع السوسة لكل شهر. يبين شكل (10) توزيع أعداد الحشرات الملتقطة خلال أشهر السنة للفترة (2018–2016). يتضح من نتائج عملية الرصد المتحصل عليها أن المجموع الكلي للحشرات الملتقطة من المصائد



شكل رقم (10) الأعداد الشهرية الملتقطة للطور الكامل لحشرة سوسة النخيل الحمراء من المصائد الفرمونية التجمعية خلال الفترة 2016-2018



شكل رقم (11) الأعداد الكلية الملتقطة للطور الكامل لحشرة سوسة النخيل الحمراء من المصائد الفرمونية التجميعية خلال الفترة 2016-2018

والتي تم إعدامها خلال ثلاث سنوات من الرصد بلغت 54,865، و26,037، 30,340 على التوالي (شكل11). ويتضح من البيانات السابقة أن حشرة سوسة النخيل الحمراء نشطة على مدار السنة، حيث لوحظ أن أعدادها تزداد خلال الفترة من شهر يناير حتى شهر أبريل، ومن ثم يبدأ نشاط السوسة في الانخفاض بعد ذلك. أما فيما يتعلق بالهبوط في أعداد السوسة خلال شهر سبتمبر عام 2017، يعود ذلك بسبب التوقف في أخذ القراءات لأسباب خارجة عن الإرادة.

يبين الجدول (1) القراءات المتعلقة بأعداد السوسة الملتقطة من المصائد الفرمونية في المواقع المثبتة الدائمة حسب توزيعها على بعض القرى خلال 2018–2016. يمثل العمود الأول أسماء القرى؛ العمود الثاني أعداد المصائد الفرمونية؛ العمود الثالث يشمل على متوسط أعداد السوسة الملتقطة للمصيدة لعام 2016؛ العمودين التاليين يعرضان نفس القراءات لعام 2018. العمودين الأخيرين (السادس والسابع) هما للمقارنة بين السنتين، العمود السادس يعبر عن التغير في النسبة ما بين المتوسطات الكلية لأعداد السوسة الملتقطة من المصائد في عام 2016 و2018. تمثل القراءات السالبة التناقص في أعداد السوسة الملتقطة خلال السنتين في (20) منطقة، في حين أن (6) من المناطق أبدت زيادة في أعداد السوسة. وأعلى معدل تناقص في أعداد السوس الملتقط ظهر كان في منطقتي داركليب والسهلة الجنوبية، 78,2%، 73,8% على التوالي. ومن النتائج أيضاً لوحظ الزيادة في النسبة المئوية التي فاقت 50% التي ظهرت في منطقتين (بوري وباربار). العمود الأخير يمثل الفروق الفعلية في متوسط أعداد السوسة الملتقطة في كل مصيدة بكل موقع من مناطق الرصد.

ويمكن الاستدلال من البيانات المتحصل عليها من المصائد الفرمونية في تحديد مواقع انتشار

السوسة بالمملكة. كما أنه بات بالإمكان أيضاً المقارنة ما بين القراءات المتحصل عليها من عام لآخر ضمن برنامج الرصد للسوسة في تقدير التغيرات في نشاط الحشرة من خلال الأعداد الملتقطة، وكذلك في تقييم كفاءة برنامج المكافحة بكل منطقة.

أهمية الرصد الدوري لنشاط الحشرة من خلال المصائد الفرمونية تأتي كخطوة نحو تجميع أعداد كبيرة من الحشرات الكاملة (تشمل كلا الجنسين ذكوراً وإناث) ومن ثم قتلها مما يسهم في التقليل من فرص التزاوج بين الجنسين، وفي منع وضع البيض، وزيادة مجاميعها، ونشر الإصابة أو زيادتها في أماكن وجودها. ولا تزال هناك حاجة إلى بذل المزيد من الجهد في رفع كفاءة برنامج الرصد لحشرة سوسة النخيل الحمراء وذلك من خلال توفير الدعم لتكثيف نشر المصائد، والكفاءة في أخذ القراءات لتبسيط عرض النتائج مع الالتزام بالدقة في العمل.

جدول رقم (1) تحليل بيانات المصائد الفرمونية التجميعية خلال الفترة 2016-2018

المنطقة	عدد المصائد لعام 2016	متوسط عدد الحشرات الشهري/ مصيدة لعام 2016	عدد المصائد لعام 2018	متوسط عدد الحشرات الشهري/ مصيدة لعام 2018	نسبة التغير في متوسط أعداد الحشرات بين عامي 2016-2018	التغير الفعلي بين عامي 2016-2018
أبوصيبع	9	36,3	8	33,4	-8,1	-3,0
البديع	13	26,2	13	17,3	-33,8	-8,8
البرهامة	37	22,1	22	30,2	36,5	8,1
البلاد القديم	27	19,0	21	27,4	44,4	8,4
الجسرة	155	18,6	121	20,2	8,7	1,6
الجنبية	562	7,5	520	4,8	-35,8	-2,7
الدراز	13	21,8	13	20,8	-4,2	-0,9
الزلاق	304	10,1	359	9,7	-4,0	-0,4
السهلة الجنوبية	32	32,7	30	8,6	-73,8	-24,2

القرية	27	20,3	20	18,2	−10,7	−2,2
القلعة	21	29,1	21	24,1	−17,2	−5,0
الهملة	95	29,5	90	30,8	4,4	1,3
باربار	114	24,7	79	37,9	53,6	13,2
بوري	469	10,7	70	17,6	63,7	6,8
توبلي	38	53,7	37	24,6	−54,1	−29,0
جنوسان	18	22,9	9	20,0	−12,6	−2,9
داركليب	20	37,5	68	8,2	−78,2	−29,3
دمستان	46	35,6	40	26,2	−26,4	−9,4
سار	22	26,6	22	20,8	−21,9	−5,8
صدد	61	33,4	47	14,1	−57,8	−19,3
عالي	24	21,7	18	16,1	−25,9	−5,6
كرانة	39	31,5	38	25,8	−17,9	−5,6
كرباباد	44	20,9	36	14,0	−33,2	−7,0
كرزكان	138	24,4	112	15,2	−37,6	−9,2
مقابة	16	37,5	16	32,8	−12,5	−4,7
هورة عالي	14	38,1	14	22,4	−41,1	−15,6

الخاتمة

يشكل مشروع حصر ومكافحة حشرة سوسة النخيل الحمراء في مملكة البحرين خطوة انتقالية مهمة بوكالة الزراعة والثروة البحرية في إطار مسئولياتها في مكافحة السوسة، ونشر المعلومات الفنية حتى تكون في متناول الأخصائيين والفنيين للاستدلال في تقييم كفاءة تطبيق برامج المشروع، ولتحديد نقاط القوة والضعف وذلك لتفعيل أفضل له والاستغلال الأمثل للموارد خلال سنوات التنفيذ.

شكر وتقدير

نتوجه بخالص الشكر وعظيم الامتنان للحكومة الموقرة على دعم المشروع باعتماد الميزانية اللازمة بتخصيص مبلغ مليون دينار لتنفيذ مشروع حصر ومكافحة السوسة تنفذ على مدى خمسة أعوام (2020-2015). والشكر موصول لصاحب السعادة وزير الأشغال وشئون البلديات والتخطيط العمراني على توجهاته السديدة، ومتابعة سعادة وكيل الزراعة والثروة البحرية الدائمة. كما نتقدم بالشكر العميق لجميع العاملين في المشروع لما بذلوه من جهد كبير وتعاون وتفاني مثمر في سبيل الحد من انتشار وتوسع الآفة.

المراجع

1- زايد، عبدالوهاب وجيمنز.إي.جي.أ (2005). زراعة نخيل التمر، منظمة الأغذية والزراعة. ص 349.

2- عبدالكريم، عبد العزيز محمد (2010). حشرة سوسة النخيل الحمراء الدروس المستفادة والفرص المتاحة لتحسين استئصال وإدارة نظم التحكم في الآفة. ندوة النخلة حياة وحضارة، 23-24 نوفمبر، 2009. مركز عيسى الثقافي، مملكة البحرين.

3- منظمة الأغذية والزراعة FAO (2005). زراعة نخيل التمر. منظمة الأغذية والزراعة. ص 349.

4- Cabello,T. (2002) RPW in spain. Retieved June 22th 2009, from:http;//www.redpalm.com/RPWReport/Spain.htm.

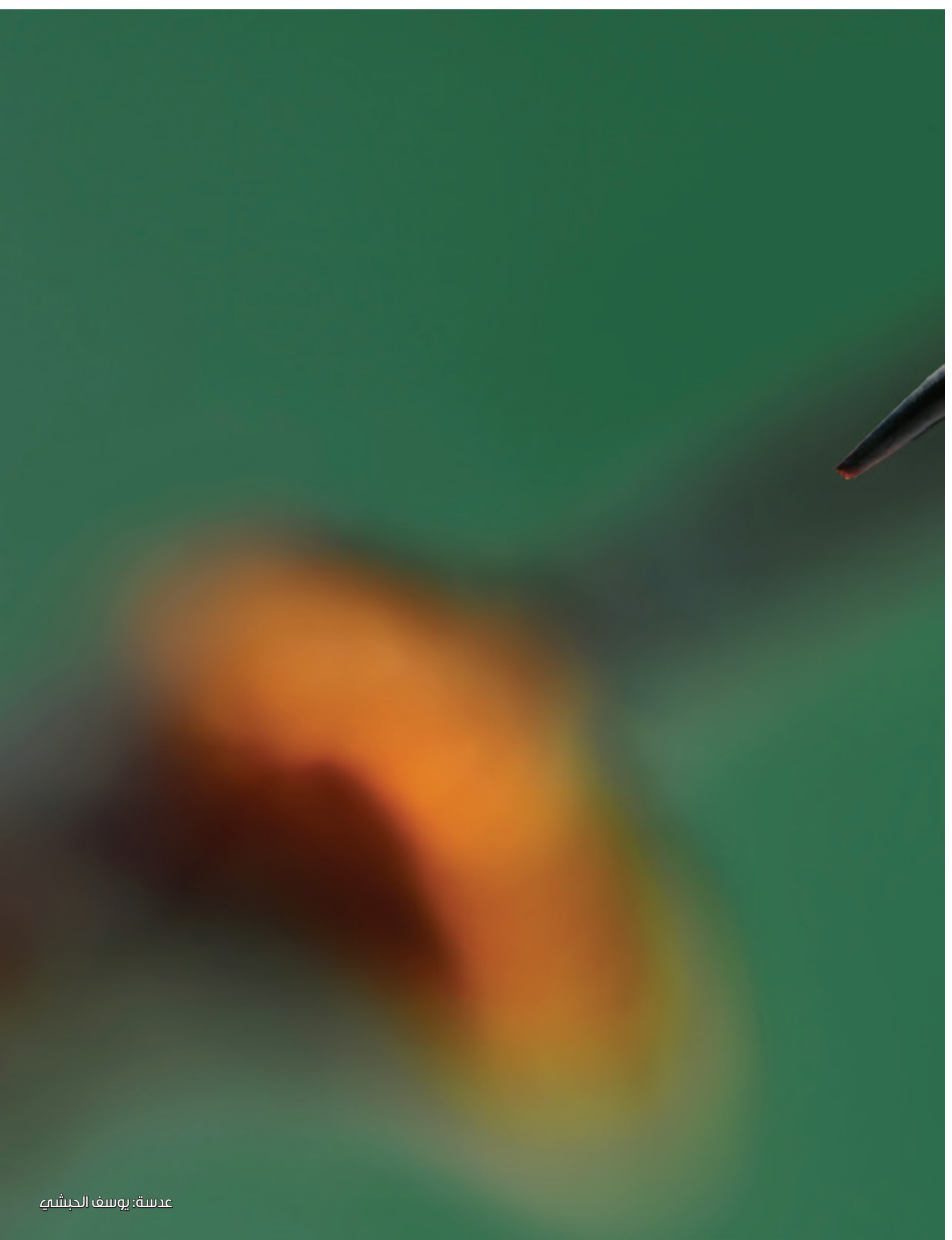
5- Faghih, A. A. (1996). The biology red Palm weevil, Rhynchophorus ferrugines oliver (Curculionidae: Coeloptera) in Sarvaan region. Appl. Ent. Phytopath.1618-.

6- Faleiroa, J. R. (2006). A review of the issues and management of the red palm weevil Rhynchophorus ferrugineus (Coleoptera: Rhynchophoridae) in coconut and date palm during the last one hundred years. International Journal of Tropical Insect Science, 26: 135154-

7- Kontodimaas, D. (2006). RPW in Greece. Relieved June 22th 2009 from; www.redpalm.com/RPWReportlGreecce1.htm.

8- Thuraya A. Almansoori, Mohammed A. Al-Khalifa and AbdulAziz M. A. Mohamed. 2015. Date palm status and perspective in the Kingdom of Bahrain. In J.M. Al-Khayri, S.M. Jain and D.V. Johnson (eds.), Date Palm Genetic Resources, Cultivar Assessment, Cultivation Practices and Novel Products. Springer, The Netherland.

9- United States Department of Agriculture (USDA) (2010). New pest response guidelines red palm weevil Rhynchophorus ferrugineus. Animal and Plant Health Inspection Service Cooperating State Departments of Agriculture. First Edition Issued 2010.



عدسة: يوسف الحبشي

استراتيجية وزارة الزراعة

في المملكة الاردنية الهاشمية

في مكافحة
سوسة النخيل الهندية الحمراء

المهندس صيتان السرحان
مدير مديرية الوقاية والصحة النباتية

استراتيجية وزارة الزراعة في المملكة الاردنية الهاشمية في مكافحة سوسة النخيل الهندية الحمراء

محصول النخيل في المملكة:

تقدر المساحات المزروعة من النخيل المثمر (صنفي البرحي والمدجول) في الأردن حالياً بحوالي 40 ألف دونماً موزعة على امتداد وادي الأردن وحتى منطقة العقبة في أقصى الجنوب الأردني وفي منطقة الازرق شرقاً ويقدر عدد الأشجار منها ما يقارب من نصف مليون شجرة ومن المتوقع أن ترتفع حصة الإنتاج الأردني من هذه التمور في السوق العالمية خلال السنوات القادمة نتيجة لدخول مساحات جديدة مزروعة حديثاً في الإنتاج ونتيجة زيادة الطلب العالمي على تمور المدجول ونتيجة لاستمرار زخم التوسع بزراعته وإنتاجه مما يساهم في الحد من الاختناقات التسويقية في الخضار والفواكه الأخرى بالإضافة إلى ارتفاع العوائد من الإنتاجية على المتر المكعب من المياه بعدة أضعاف مقارنة مع باقي أنواع المزروعات الأخرى هذا بالإضافة إلى امكانيات قطاع التمور من تشغيل الأيدي العاملة المدربة والماهرة على مدار السنة حيث يمكن للقطاع بوضعه الحالي من تشغيل ما يقارب من 5000 فرصة عمل ويتمتع هذا القطاع أيضاً بالقدرة على استخدام التقنيات والميكنة الحديثة بالإنتاج وعمليات ما بعد الحصاد وهنالك عدد من المزارع الحاصلة على شهادة الممارسات الزراعية الحسنة(Global Gap) و الـ HACCP والايزو 22000 وغيرها من شهادات الجودة العالمية وهنالك تطوير و تحديث مستمر من قبل مزارعي هذا القطاع لتقنيات ما قبل وما بعد الحصاد.

ويواجه هذا القطاع مجموعة من التحديات أهمها سوسة النخيل الحمراء الهندية التي تهدد ديمومة هذة الثروة الوطنية وذلك لسرعة انتشارها و تكاثرها وقدرتها على الطيران والانتقال من منطقة إلى أخرى.

ظهور سوسة النخيل الهندية الحمراء في المملكة:

تم إكتشاف سوسة النخيل الهندية الحمراء في الأردن عام 1999 حيث تم التعامل معها من قبل وزارة الزراعة والمركز الوطني منذ البداية كآفة خطرة فتم الحد من انتشار الحشرة في منطقة الغور الأوسط وهي المنطقة التي ظهرت بها الإصابة حتى عام 2005 إلى مستويات منخفضة جداً، وذلك بسبب النجاح في تطبيق استراتيجية الإستئصال للآفة من خلال تنفيذ المسح الكامل للإصابة بإستخدام برامج الرصد الحسي (البحث المباشر عن الاشجار المصابة داخل الحقل من خلال الاعراض الظاهرية) والرصد بالمصائد الفرمونية الجاذبة ثم الإعدام للاشجار المصابة مهما كانت شدتها.

المعوقات التي تواجه اجراءات السيطرة على آفة سوسة النخيل الهندية الحمراء.

1. عدم القدرة عل الكشف المبكر للإصابة نظراً لطبيعة الحشرة البيولوجية الخفية حيث تقضي معظم فترة حياتها داخل الشجرة.
2. النقل غير القانوني لأشجار النخيل (التهريب) وخاصة للأشجار والفسائل المصابة بالرغم من الرقابة الشديدة.
3. الإمكانيات المادية لشراء مستلزمات عمليات المراقبة والمكافحة .
4. المزارع المهملة.

إستراتيجية السيطرة على آفة سوسة النخيل الحمراء في الأردن:

1. تطبيق إجراءات الحجر الزراعي الخارجي وذلك من خلال منع إستيراد اشجار وفسائل النخيل من البلدان التي سجل فيها إصابة واستيراد الفسائل والأشجار المنتجة من خلال الأنسجة فقط.

2. تطبيق إجراءات الحجر الزراعي الداخلي وذلك من خلال تطبيق مايلي:

أ) تعليمات رقم (ز/ 21) مكافحة سوسة النخيل الهندية الحمراءالصادرة بموجب المادة (22) من قانون الزراعة رقم (13) لسنة 2015 وتعديلاته والتي تنص على مايلي:

- على جميع أصحاب مزارع النخيل السماح لكوادر وزارة الزراعة المختصين بالدخول لجميع مزارع النخيل الموجودة في المملكة وتسهيل مهمتهم بالكشف ومراقبة حالة الأشجار فيها.
- يتوجب على المزارع التي تثبت إصابة مزرعته بآفة سوسة النخيل الهندية الحمراء اتخاذ الإجراءات التالية فوراً:

* نشر المصائد الخاصة بجذب هذه الآفة ومتابعتها ومعالجتها بشكل دائم حسب الأصول وبالتعاون مع مديرية الزراعة المعنية ومديرية وقاية النبات.

* التخلص من الأشجار المصابة إصابة شديدة بهذه الآفة بإستئصالها من جذورها وتقطيعها وحرقها حتى الرماد وطمرها وبالتعاون مع مديرية الزراعة المعنية ومديرية وقاية النبات وبخلاف ذلك تقوم الوزارة بإتلاف الاشجار المصابة وعلى نفقة صاحب العلاقة دون تعويض.

- منع نقل أشجار وفسائل النخيل من المزارع والتي سجلت فيها إصابات شجرية سابقة بحشرة سوسة النخيل إلى منطقة أخرى ويستثنى من ذلك المزارع التي خضعت لرقابة كوادر وزارة الزراعة وتم التأكد من سلامة الأشجار فيها وخلوها من تواجد حشرة سوسة النخيل فيها خلال السنوات السابقة.

ب) تطبيق إجراءات الحجر الزراعي الداخلي وذلك من خلال تطبيق القرارات الصادره والخاصه بنقل فسائل وأشجار النخيل وتشمل:

- منع النقل من والى المناطق المصابة.
- منع النقل بين المحافظات.
- منع النقل خارج أوقات الدوام الرسمي والعطل الرسمية.

3. القيام بجولات ميدانية بشكل مستمر على مزارع النخيل للقيام بالمهام التالية.

- توعية المزارعين باهمية خدمة شجرة النخيل والمحافظه عليها من الآفات الزراعية.
- تعريف المزارعين بآفة سوسة وأضـــرارها الاقتصادية وخطورة انتقالها من مكان لأخر.
- توعية المزارع وإرشاده الى تنفيذ عمليات المراقبة من خلال إستخدام المصائد التقليدية والجافة.
- توعية المزارع بعمليات المكافحة التي تتم للسيطره على الآفة
- توعية المزارع بالاجراءات الحجرية الخاصة بسوسة النخيل الحمراء

4. توزيع مصائد متخصصة في جميع المناطق والعمل على إدامتها من خلال الزيارات الدورية وتزويدها بالاحتياجات اللازمة.

5. معالجة الأشجار ذات الإصابة الخفيفه عن طريق الحقن والسقاية

6. القيام بعمليات الرش الوقائي للتخلص من الأطوار الكاملة للحشرة

7. التخلص من الأشجار المصابة إصابة شديدة في بؤر الإصابة.

8. التعاون مع جمعية التمور الأردنية حيث تم توقيع مذكرة تفاهم للتشارك والتعاون في مجال عمليات المسح والمكافحة.

9. التعاون مع المنظمات الدولية والإقليمية ومنها منظمة الأغذية والزراعة (الفاو) والمنظمة العربية للتنمية الزراعية في مجال مراقبة ومكافحة سوسة النخيل الهندية الحمراء.

10. الاجراءات التي ستتم خلال العام 2019:

- حصر المزارع وتصنيفها ضمن مزارع كبيرة إقتصادية وصغيرة ومزارع مهملة حيث تم إجراء عمليات الحصر خلال شهر يناير /2019 وذلك للقيام بما يلي:

* متابعة المزارع الصغيرة من خلال الوزارة.

* متابعة المزارع الكبيرة من خلال جمعية التمور

* تطبيق الأنظمة والقوانين على المزارع ا لمهملة

- تنفيذ يوم تعريفي لأصحاب مزارع النخيل حول أهمية مشاركتهم لوزارة الزراعة في جهودها للسيطره على الآفة والدور المناط بهم في هذا المجال.

- تنفيذ دورة تدريبية مدربين (TOT) للمهندسين العاملين في مناطق زراعات النخيل من خلال خبراء من منظمة الاغذية والزراعة على عمليات المسح والمكافحة وكذلك مهارات التدريب اللازمة.

- تنفيذ يوم حقلي للفنيين العاملين في مزارع النخيل يشمل جميع العاملين في المزارع وذلك لتعريفهم بما يلي:

* حشرة سوسة النخيل الهندية الحمراء.

* عمليات الفحص الدقيق عن الاصابة من خلال الاعراض الظاهرية على الاشجار.
* التدريب على استخدام المصائد التقليدية والمصائد الجافة في عمليات المراقبة
* عمليات المعالجة للاشجار ذات الاصابة الخفيفة والمتوسطة والتي تشمل الحقن والسقاية.
* استخدام النماذج والسجلات الخاصة بالمزرعة لتوثيق عمليات المراقبة والمكافحة.

– قيام الفني بتطبيق آلية المراقبة والمتابعة داخل المزرعة وكتابة تقارير بجميع الإجراءات في السجل الخاص بالمزرعة.

– قيام المرشد الزراعي بالزيارات الدورية للمزرعة والإطلاع على تقرير الفني الزراعي وكتابة تقرير بالملاحظات الإرشادية والتوصيات للفني الزراعي وتسليم نسخة من هذه التوصيات لصاحب المزرعة

– الإجتماع الدوري بين وزارة الزراعة وجمعية التمور لعرض ما تم إنجازه من أعمال لتعزيز نقاط القوة ومعالجة نقاط الضعف.

– الإستمرار في إجراء التجارب على التقنيات الحديثة في مجال الحقن والمراقبة والفحص المبكر.

– التعاون مع المركز الوطني للبحوث الزراعية في مجال متبقيات المبيدات المستخدمة في مكافحة سوسة النخيل الهندية الحمراء.

– التعاون المستمر مع الإعلام فيما يتعلق بالنشرات التوعوية الخاصة لمكافحة سوسة النخيل الهندية الحمراء.

– التعاون مع المؤسسات الحكومية والبلديات من خلال توفير الآليات والتوعية وتطبيق تعليمات وزارة الزراعة الخاصه بمراقبة ومكافحة سوسة النخيل الهندية الحمراء.

****

عدسة: يوسف الحبشي

استراتيجية وزارة التنمية الريفية

في الجمهورية الإسلامية الموريتانية

قصة نجاح مكافحة سوسة النخيل في موريتانيا

إعداد: محمد أكنيت

المشرف الوطني على برنامج مكافحة سوسة النخيل

وزارة التنمية الريفية في الجمهورية الإسلامية الموريتانية

استراتيجية وزارة التنمية الريفية في الجمهورية الإسلامية الموريتانية

قصة نجاح مكافحة سوسة النخيل في موريتانيا

مقدمة عن النخيل في موريتانيا

تعود أول زراعة للنخيل في موريتانيا إلى الهجرات من شبه الجزيرة العربية نحو شمال إفريقيا. وقد شهدت هذه الزراعة ازدهاراً في القرنين السابع والعاشر ميلادي في مناطق آزوكي، وادان وشنقيط في ولاية آدرار، التي تم منها نقل زراعة النخيل إلى وسط وجنوب البلاد (تجكجة، لعصابة، والحوضين الشرقي والغربي).

إلا أن امتداد وتوسع زراعة النخيل في موريتانيا خصوصاً في منطقة الوسط (تكانت) ومناطق الشرق (الحوضين) تميزت فيما بعد باستخدامها الواسع للنوى كطريقة للتكثير، مما انعكس إيجاباً على التنوع البيولوجي الكبير الذي ساهم في تنوع وتحسين أصناف

رئيس الجمهورية السيد محمد ولد عبد العزيز يتلقى شروحا حول سوسة النخيل الحمراء
خلال زياراته لبؤرة سوسة النخيل بتجكجة نوفمبر 2016

النخيل الموريتانية عبر الزمن. ويقدر عدد النخيل في موريتانيا بعد سنوات الجفاف بحوالي 2,9 مليون نخلة موزعة على 352 واحة في خمس ولايات من الوطن، وتغطي مساحة قدرها 19000 هكتاراً.

وفي الوقت الذي تسعى فيه الحكومة الموريتانية جاهدة، بتوجيهات سامية من فخامة رئيس الجمهورية السيد محمد ولد عبد العزيز، للرفع من إنتاجية ومردودية هذا النمط من الزراعة عن طريق خلق البنية التحتية البحثية اللازمة، من مخابر لإكثار النخيل عن طريق الزراعة النسيجية لزيادة المساحة المزروعة به على المستوى الوطني ومكافحة الأمراض والآفات المستوطنة، ومصانع لتكييف وحفظ التمور والخضروات وتوفير مياه الري للمزارعين عن طريق المضخات التي تعمل بالطاقة الشمسية، فضلاً عن التأطير الضروري، ووضع آلية للقروض الميسرة وفتح الباب لإنشاء الرابطات التشاركية للواحات والاتحادات الجهوية الواحاتية المنبثقة عنها.

وعلى الرغم من هذه الاجراءات المتخذة وبصورة غير متوقعة، ظهرت في أواخر شهر ديسمبر سنة 2015، آفة جديدة وافدة (مستوردة)، تم تسريبها عن طريق استيراد خصوصيين لفسائل من إحدى دول الخارج إلى واحة تجكجة. وكانت هذه الآفة هي سوسة النخيل الحمراء التي لم تكن معروفة في البلاد.

معالي السيدة لمينة منت القطب ولد أمم وزيرة التنمية الريفية
خلال إحدى زياراتها الأولى لبؤرة سوسة النخيل بتجكجة شهر يناير سنة 2016

دخول سوسة النخيل الحمراء إلى موريتانيا:

تعتبر سوسة النخيل الحمراء من أخطر الآفات الحشرية التي تهاجم النخيل في الوطن العربي وكثير من دول العالم، وأصبحت أخطر آفة تهدد النخيل في منطقة المغرب العربي منذ دخولها إلى ليبيا سنة 2008 والمغرب في 2009 وتونس في 2012 وموريتانيا نهاية 2015.

وشكل ظهور هذه الآفة في موريتانيا بواحة تجكجة تهديداً حقيقياً لموروثها الواحاتي، مما دفع السلطات العمومية، بالتعاون مع منظمة الأغذية والزراعة للأمم المتحدة (الفاو)، إلى اتخاذ جملة من الإجراءات الاستعجالية لمحاصرتها ووأدها في البؤرة التي ظهرت فيها لتفادي انتشارها في بقية الوادي، الذي إن حدث سيشكل خطراً بالغاً على عموم المناطق الواحاتية في البلاد. حيث شملت هذه الإجراءات النقاط التالية:

- إنشاء لجنة وطنية، مكلفة بالسهر على المتابعة اليومية لوضعية هذه الآفة.
- ابتعاث فريق فني إلى عين المكان للإشراف المباشر على وضع ومتابعة تنفيذ البرتوكول الوطني لمكافحة هذه الآفة والذي تمحور حول النقاط التالية:

منطقة عازلة طولها 7كلم	منطقة وسطية على طول 5 كلم	منطقة موبوءة على طول 3 كلم	منطقة وسطية طولها 5 كلم	منطقة عازلة طولها 7كلم

1- تقطيع الوادي إلى ثلاث مناطق كما في الشكل أدناه (منطقة موبوءة، منطقة محاذية للمنطقة الموبوءة، منطقة عازلة)، تكون لكل منطقة معاملة فنية خاصة، من حيث الاستكشاف اليومي لنخيلها ووضع المصائد فيها والمعاملة الكيميائية الوقائية.

2- القضاء الكلي على كل نخلة مصابة بالسوسة، مهما كانت درجة الإصابة، وذلك عن طريق تقطيعها إلى أجزاء صغيرة، وذلك بحضور الملاك، مع الحرص على ألا يسقط أي شيء منها خارج بساط بلاستيكي يتم بسطه تحت النخلة. بعد ذلك، يوضع كل ما هو موجود فوق البساط داخل خنشة يتم ربطها بإحكام وتنقل خارج الوادي وتحرق في محارق حديدية خاصة.

3- إنشاء فرق استكشاف يومية للكشف المبكر عن النخيل المصاب.

4- اعتماد الحديقة كوحدة قياس، بحيث تعتبر حديقة مصابة كل واحدة تظهر فيها نخلة مصابة وتخضع لنظام محدد من حيث الاستكشاف ونصب المصايد والمعاملة الكيميائية الوقاية.

5- أخذ عينات من النخيل على مستوى الحدائق التي تكثر فيها الإصابة، والتي لا تظهر عمليات الفحص إصابتها لمعرفة إن كانت الإصابة قد لا تظهر إلا بعد شق جذع النخلة.

وصول بعثة الفاو إلى بؤرة السوسة نهاية يناير 2016

6- حقن جميع نخيل البساتين المصابة سنة 2016 بمبيد جهازي.

7- القيام بتنظيف وفحص ورش (الغمر) بمبيد جهازي كيميائي لمجموع نخيل الوادي عند نهاية كل فترة حصاد.

8- نصب شبكة من المصائد الفرمونية لمكافحة الحشرة على مستوى الحدائق المصابة في المنطقة الموبوءة، وعدم وضعها في المنطقة الوسطية، وذلك لتجنب خلق ظروف تساعد في انتشار الآفة، بينما يتم نصبها للمراقبة في المنطقة العازلة.

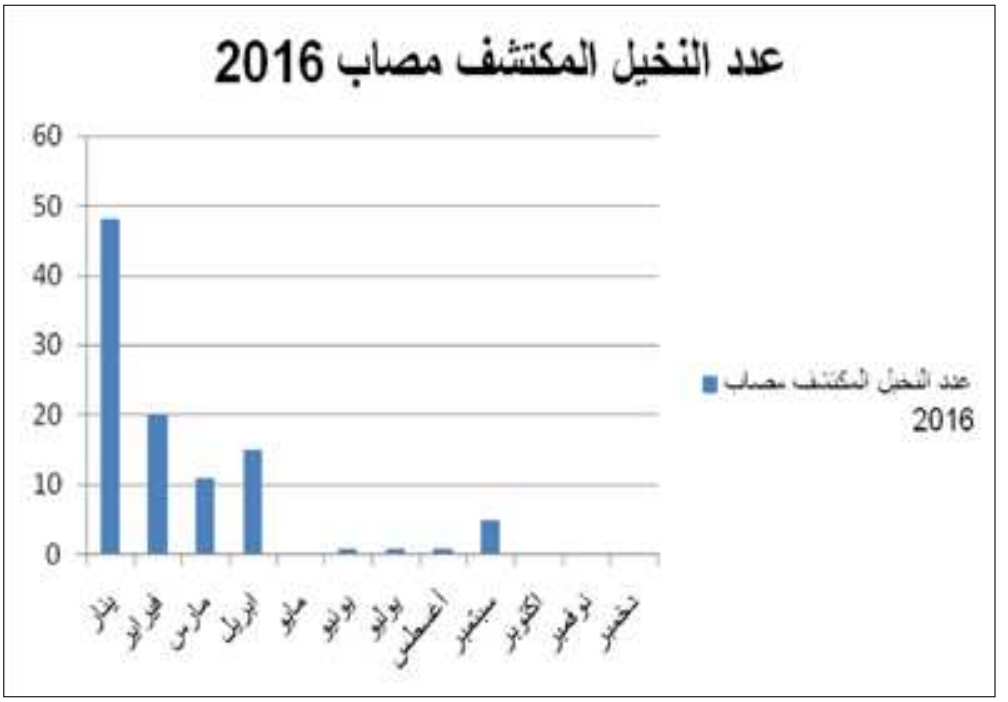
9- تطبيق، بصفة صارمة، حجر زراعي يحرم حركة فسائل النخيل من وإلى وادي تجكجة ويحظر تبادل الفسائل بين الولايات الواحاتية.

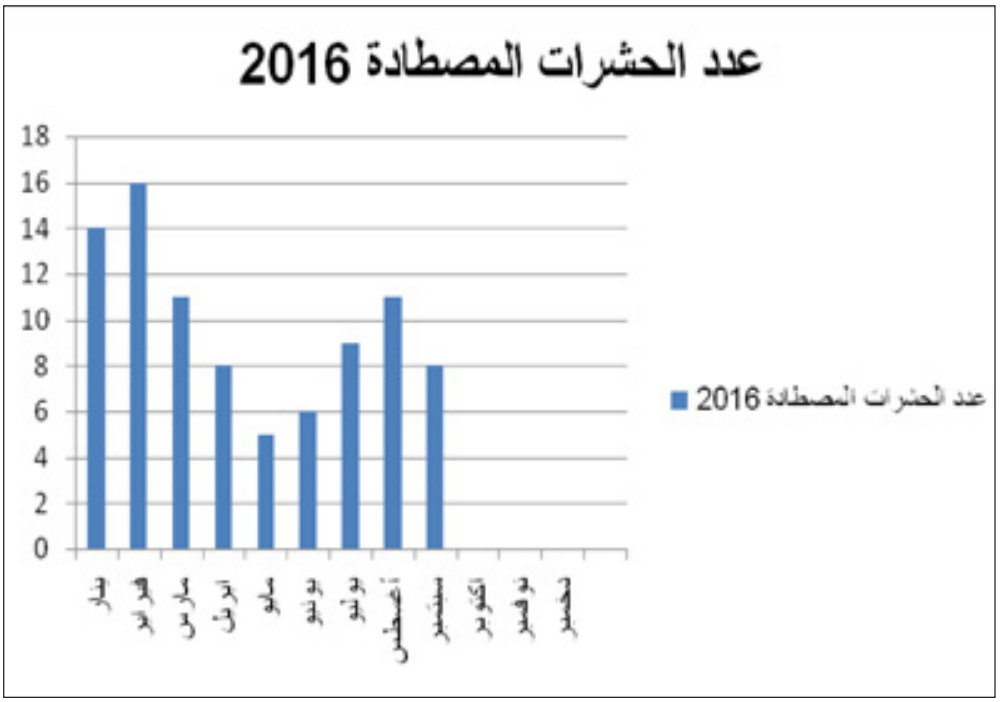
10- تحسيس وتوعية مختلف الفاعلين من كل المستويات (السلطات الإدارية، المنتخبون، ملاك النخيل، مجتمع مدني...إلخ) حول أهمية تطبيق هذا البرتوكول.

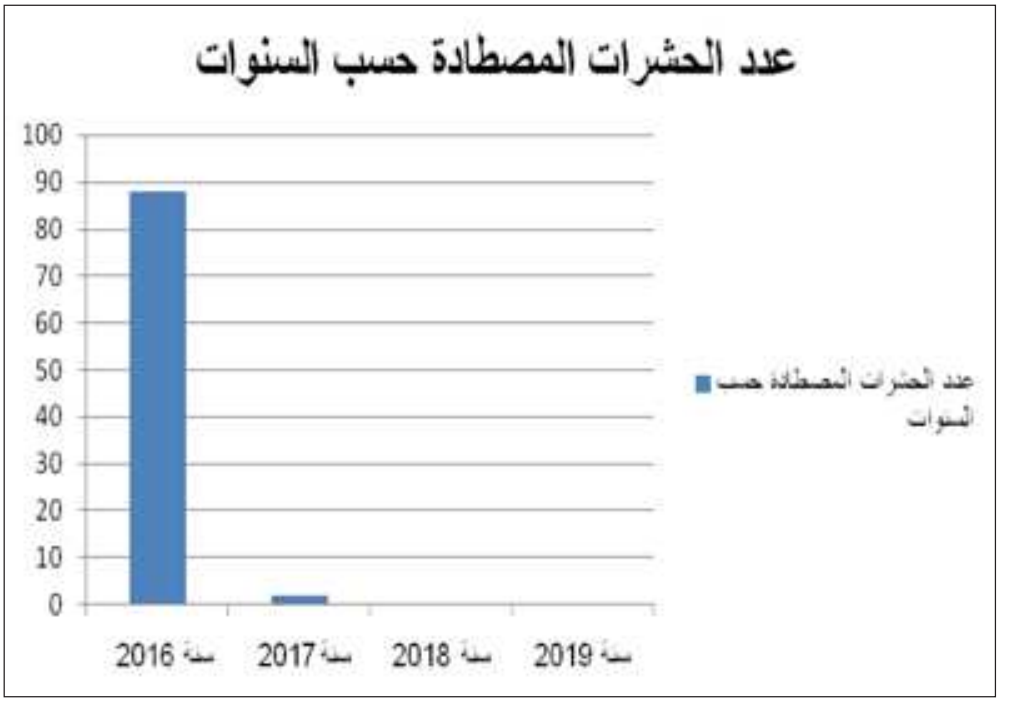
11- تكوين الفنيين والمزارعين على المستوى المحلي والجهوي والوطني.

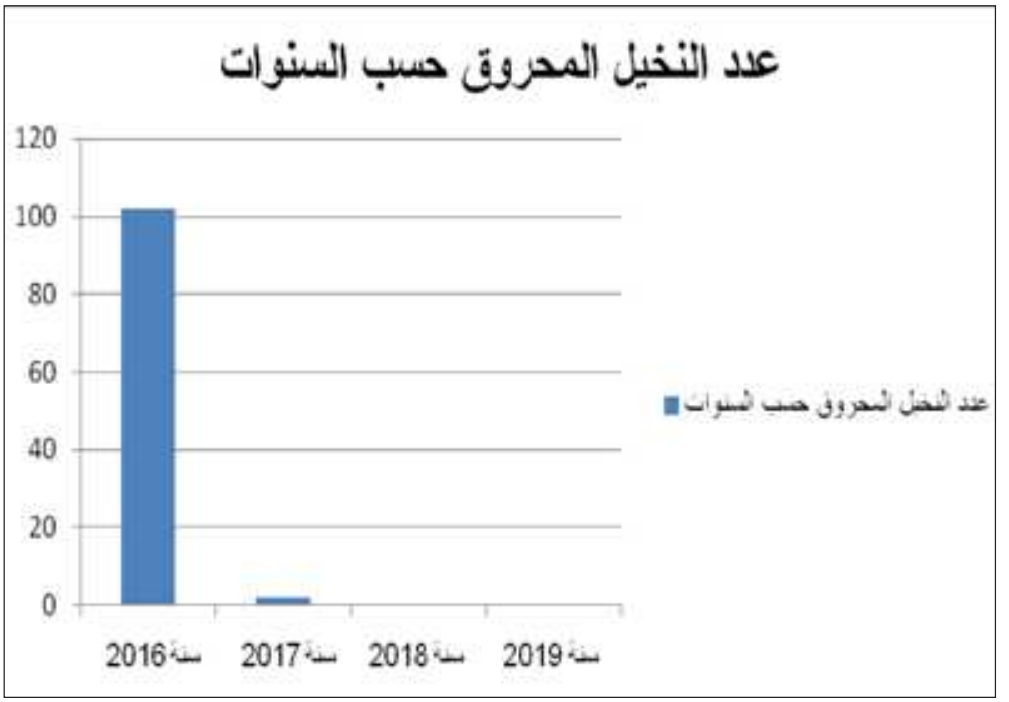
وقد مكن تطبيق هذه الإجراءات من الوصول الى النتائج التالية:

- تحديد الحدائق المصابة، والتي بلغت 22.
- محاصرة الآفة في المنطقة الموبوءة.
- إمكانية وجود نخلة مصابة داخل حديقة يوجد فيها العديد من النخيل المصاب، ولا يمكن العثور على إصابتها في مراحلها الأولى إلا بقطعها.
- قطع وحرق 102 نخلة تأكدت إصابتها سنة 2016 ونخلتين 2017 واصطياد 88 حشرة سنة 2016 وحشرتين سنة 2017، كما هو موضح في الرسوم البيانية التالية:


عدد النخيل المكتشف مصاب 2016
60
50
40
30
20
10
0
يناير
فبراير
مارس
أبريل
مايو
يونيو
يوليو
أغسطس
سبتمبر
أكتوبر
نوفمبر
ديسمبر
عدد النخيل المكتشف مصاب 2016


عدد الحشرات المصطادة 2016
18
16
14
12
10
8
6
4
2
0
يناير
فبراير
مارس
أبريل
مايو
يونيو
يوليو
أغسطس
سبتمبر
أكتوبر
نوفمبر
ديسمبر
عدد الحشرات المصطادة 2016


عدد الحشرات المصطادة حسب السنوات
100
90
80
70
60
50
40
30
20
10
0
2016 سنة
2017 سنة
2018 سنة
2019 سنة
عدد الحشرات المصطادة حسب السنوات


عدد النخيل المحروق حسب السنوات
120
100
80
60
40
20
0
2016 سنة
2017 سنة
2018 سنة
2019 سنة
عدد النخيل المحروق حسب السنوات

– تظهر البيانات أعلاه، بأنه على الرغم من مواصلة العمل بنفس الوتيرة في سنتي 2017 و2018، لم يتم اكتشاف سوى نخلتين مصابتين سنة 2017، مقابل 102 سنة 2016، ولم تكتشف أي إصابة أو حشرة سنة 2018، وذلك دليل على تسجيل نجاح فريد من نوعه في مجال مكافحة السوسة الحمراء، عن طريق وضع وتنفيذ خطة علمية دقيقة تتم مراقبتها من طرف السلطات العليا التي حرصت على الصرامة في تنفيذها لتفادي استيطان هذه الآفة، الذي إن حدث يكون من الصعب إن لم يكن من المستحيل القضاء عليها، وذلك حسب ما حصل في العديد من البلدان. ويتواصل العمل بهذه الخطة مع تحيينها لتتلاءم والمرحلة التي وصلت إليها الوضعية، إلى أن يتم التأكد، حسب النظم المعمول بها دولياً، من القضاء وبصفة نهائية على آفة السوسة الحمراء في البلاد (مضي عامين كاملين على آخر اكتشاف لنخلة مصابة والذي سيكون يوم 25 يونيو القادم).

****

عدسة: يوسف الحبشي