Food and Agriculture Organization of the United Nations

Red Palm Weevil

Guidelines on management practices

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Required citation:

Editors

Contributors

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8. **Guidelines on mechanical sanitization of infested palms and removal of severely infested palms**

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12. **Guidelines on good agronomic practices (including palm density in the field, irrigation, and crop and field sanitation)**

Preface

Abbreviations and acronyms

1 Red palm weevil biology

1.1 Classification of red palm weevil

1.2 Geographical distribution and primary host range

Table 1

Table 1. **The primary host species of RPW**

Family	Plant species	Common name
Agavaceae	*Agave americana*	American agave
Arecaceae	*Areca catechu*	Betel nut palm
	Arenga pinnata (synonym *A. saccharifera*)	Sugar palm
	Borassus flabellifer	Toddy palm
	Borassus sp.	Palmyra palm
	Calamus merrillii	Palasan palm
	Caryota cumingii	Fishtail palm
	Caryota maxima	Giant mountain fishtail palm
	Cocos nucifera	Coconut palm
	Corypha umbraculifera	Talipot palm
	Corypha utan (synonyms *C. gebanga*, *C. elata*)	Gebang palm
	Elaeis guineensis	African oil palm
	Livistonia decora (synonym *Livistonia decipiens*)	Ribbon fan palm
	Livistonia chinensis	Chinese fan palm
	Livistonia saribus	Serdang palm
	Metroxylon sagu	Sago palm
	Oncosperma horridum	Thorny palm
	Oncosperma tigillarium	Nibong palm
	Phoenix canariensis	Canary Island palm
	Phoenix dactylifera	Date palm
	Phoenix sylvestris	Silver date palm
	Roystonea regia	Royal Palm
	Sabal palmetto	Cabbage palm
	Trachycarpus fortunei	Windmill palm
	Washingtonia filifera	California fan Palm
	Washingtonia robusta	Washingtonia palm
Poaceae	*Saccharum officinarum*	Sugar cane

1.3 Life cycle

Figure 1. **Eggs**

1.3.1 Eggs

Figure 2. **Larva**

Figure 1

1.3.2 Larvae

Figure 3. **Pupae**

Figure 2

1.3.3 Pupae

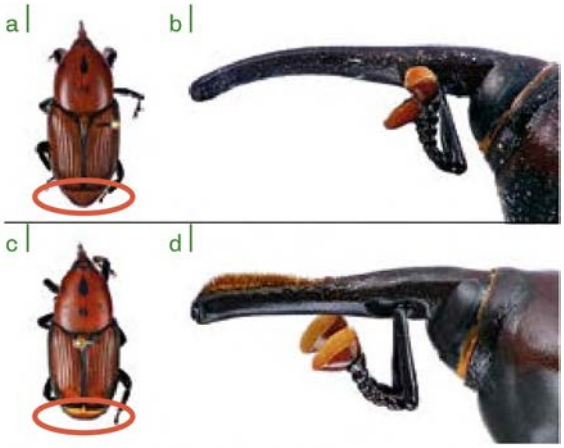

Figure 4. **Female (a, b) and male (c, d) adults are distinguished on the basis of soft hairs on the dorsal side of the snout and abdominal end**

Figure 3

1.3.4 Adults

Figure 4b Figure 4d

Figure 4a Figure 4c

2 Red palm weevil integrated pest management and surveillance

2.1 Red palm weevil management

2.2 Pest surveillance

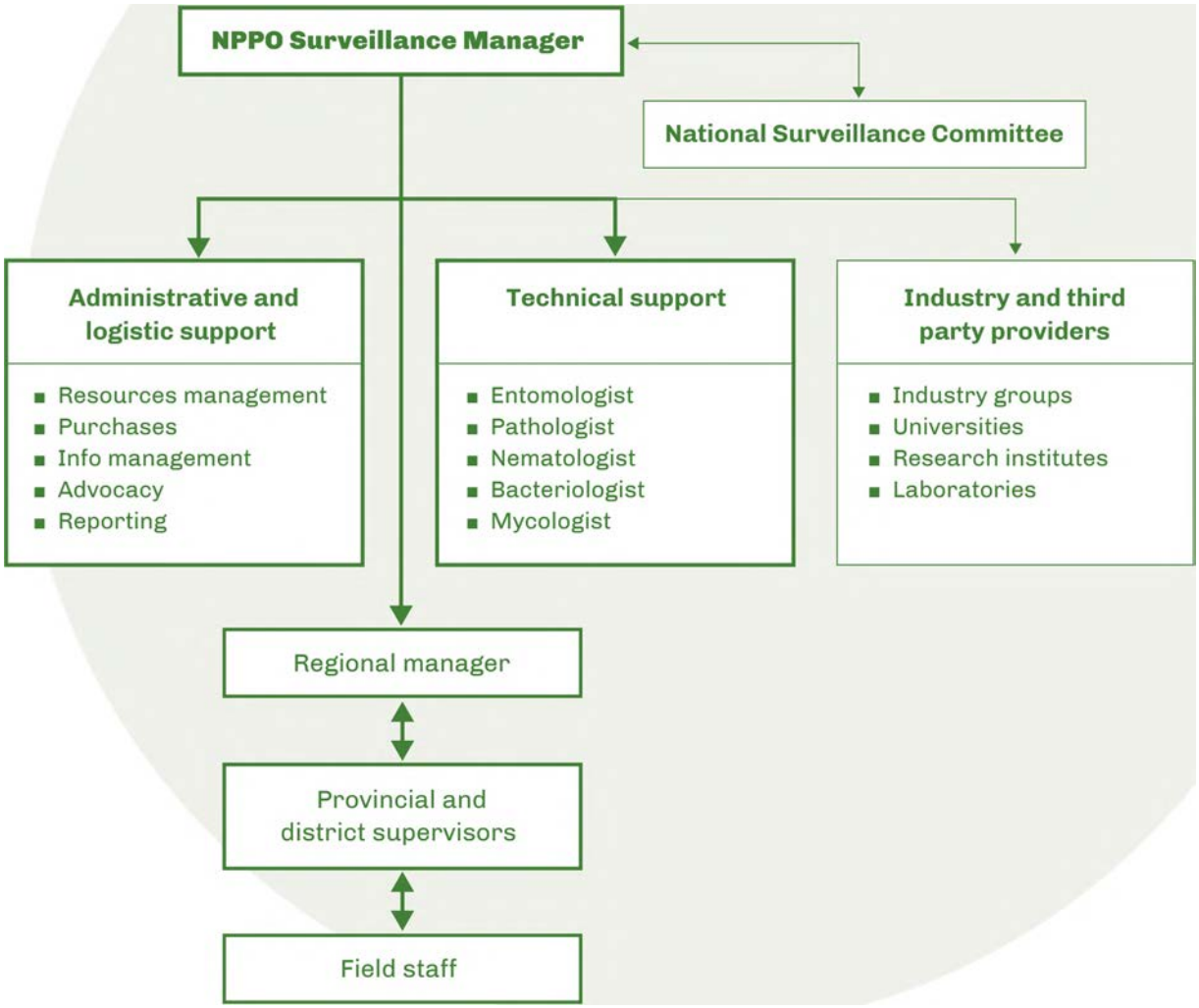

Figure 5. **Example of organizational and management structure for a national pest surveillance programme.**

Source: IPPC plant pest surveillance guide (FAO, 2016)

2.2.1 Organizational arrangements

Figure 5

2.2.2 Prior survey considerations

2.2.3 Survey action plan

Survey action plan	
Step 1. Choose a title for the survey and select survey team.	■ Record the title of your survey. ■ Record the names of all personnel involved in the survey (surveyors, survey supervisors, and administrative assistants).
Step 2. Determine the purpose of the survey.	■ Determine and record the purpose of your survey (early detection, delimiting, pest free areas, areas of low pest prevalence, pest management, etc.).
Step 3. Detail the target pest: names, life cycle, dispersal modes, diagnostic characteristics of all pest stages to identify the pest in the field.	■ Record the names of the pest. ■ Record the economic impact of the pest (low–moderate–high). ■ Record the life cycle of the pest and the diagnostic characteristics of each stage. ■ Create any pest information sheets you will use in the field.
Step 4. Detail the host: names, life cycle, distribution, etc.	■ Record the names of the host plant. ■ Record the economic importance of the host plant (low–moderate–high). ■ Record the growth habits of the host plant. ■ Record the likely accessibility of the host if considering a specific survey. ■ Record the regional distribution of the host plant.
Step 5. Detail alternative hosts.	■ Record alternative pest reservoirs.
Step 6. Review any results of surveys conducted in similar conditions, or any other relevant literature, etc.	■ Collect any accessible relevant survey or surveillance plans or reports.
Step 7. Identify the survey area.	■ Record the area for your survey. ■ Provide brief details on the climate, topography and geographical coordinates (Global Positioning System (GPS) coordinates). ■ (area = country, part of a country or parts of several countries).

Survey action plan	
Step 8. Identify the district.	■ Record the district(s) for your survey, clearly identifying each district and providing GPS coordinates.
Step 9. Identify type of survey place, field sites and sampling sites, and number of sampling points.	■ Record the characteristics of places, field sites and sampling sites: – places: e.g. farms, communities, villages, nurseries, ports or markets; – field sites: e.g. fields, plantation lots, private gardens, market stalls; – sampling sites within each place or field site: e.g. quadrats, individual plants, trees, trees with pheromone traps, or crop rows; – number of sampling points: e.g. number of points, offshoots or pheromone baiting traps on an individual tree.
Step 10. Select sites for survey.	■ Calculate and record the number of sites and samples needed, for the level of survey that you intend. ■ Decide the number of samples at each site.
Step 11. Determine sample size required.	■ Determine and record method for choosing places to survey, field sites to survey, sampling sites to survey. ■ Tabulate all possible places, field sites and sampling sites being considered, providing these with individual identifiers. ■ Decide which places, field sites and sampling sites to sample.
Step 12. Determine the timing for survey.	■ Decide on the best time for the survey, considering that this may depend on: – the life cycle of the pest; – the phenology of the pest and its hosts; – the timing of pest management programmes; – whether the pest is best detected on crops in active growth or other stages/conditions. ■ Record the best timing for the survey, detailing the reasons. ■ Record the frequency if the survey is to be performed more than once.
Step 13. Determine what data to collect.	■ Decide if and how you will mark the sites and record an example. ■ Design and include a form for recording data, if appropriate.
Step 14. Determine methods for collecting samples of pests (if required).	■ Determine and record what types of specimens you would collect if the pest is found. ■ Record how you will label the specimens. ■ Record how the specimens will be prepared, treated and identified. ■ Create a list of tools/supplies that you will need to take when surveying.
Step 15. Prepare survey guidance.	■ Prepare a clearly illustrated guide to inspection and sampling in the field, including as appropriate: – visual inspection of plants for different symptoms of damage, presence of different stages of pest, etc.; – use of pheromone trapping and other trapping methods; – collection of samples of the pest for identification/verification as needed.

Survey action plan	
Step 16. Create data storage.	■ Design a spreadsheet or database in which to electronically store the data. ■ Decide how you will create backup copies of the data and how often you will do so.
Step 17. Finalize the team of people involved.	■ Organize information and training for the team. ■ Ensure that personnel involved in surveys are adequately trained, and where appropriate audited, in sampling methods, preservation and transportation of samples for identification, and record keeping associated with samples. ■ Record other people who will be involved in the design, data analysis, pest identification or any other part of the survey.
Step 18. Obtain permission to visit sites and any permits required.	■ Record what sort of permits and permissions will be needed, and who is to seek them. ■ If you find it useful, note the time frames for permission to be obtained. ■ Begin seeking permissions when appropriate.
Step 19. Perform survey: collect data and samples in the field.	■ Conduct the survey using the pre-prepared guidance. ■ Record the site data in the form designed for data collection or electronically through a pre-designed app if available.
Step 20. Analyse data.	■ Store, tabulate and analyse the survey data. ■ Create a map of the pest distribution.
Step 21. Report results.	■ Report the survey results, including at least the following information: – survey title and team members, from step 1; – reason for surveying, from step 2; – background information on the pest, host and sites of interest, including data of any earlier, related surveys (steps 3–6); – survey design methods in detail, including site selection (steps 7–11); – timing of the survey (step 12); – type of data and specimens collected (steps 13 and 14); – how the data were analysed and interpreted (step 20); – conclusions that can be drawn about the survey findings, and how these relate back to the purpose of surveying; – geographical distribution of the pest (including a map, if appropriate) (step 19).

3 Guidelines on visual inspection for early detection of red palm weevil in date palm (*Phoenix dactylifera*)

3.1 Introduction

Figure 6a

Figure 6b

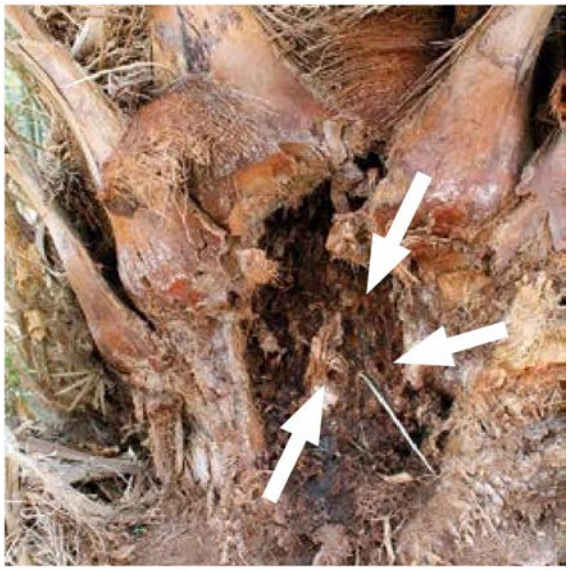

Figure 6a. **Damaged trunk showing tunnels made by RPW larvae**

Figure 6b. **Small and large larvae of RPW collected from an infested palm (one Oryctes larva can also be seen, indicated by arrow mark)**

3.2 Types of damage symptoms in date palm

3.2.1 Early infestation and damage

Figure 7

Figure 8

Figure 9

Early infestation and damage in date palm

Figure 7. **Fresh brown viscous liquid oozing from the base of a trunk indicating RPW early infestation**

Figure 8. **Early damage symptoms with dried brown ooze on a trunk showing dripping marks**

Figure 9. **Dried leaves in a crown, with some damage at the base, indicating RPW damage in the crown**

3.2.2 Medium infestation and damage

Figure 10

Figure 11

Figure 12

Figure 13

Figure 14

Figure 15

Figure 10. **Damage with holes (white arrows) and an adult near the holes trying to enter (yellow circle)**

Figure 11. **Young palm with dried frass and chewed fibres showing infestation**

Figure 12. **Soft tissues from trunk scooped out to show damage to fresh tissues**

Figure 13. **Small holes (white arrows) and chewed fibres indicating RPW infestation**

Figure 14. **Young palm with 15–25 cm deep damage caused by RPW**

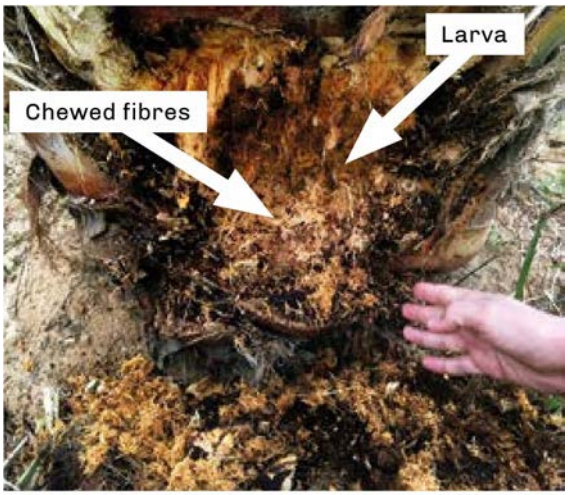

Figure 15. **Damaged tissues removed to show boreholes, chewed fibres, frass and larvae**

3.2.3 Severe or high infestation and damage

Figure 16

Figure 17

Figure 18

Figure 19

Figure 20

Figure 21

3.2.4 Offshoots

Figure 16. **Young palm showing a small 15 cm hole at the bottom with some chewed fibres**

Figure 17. **Fresh brown viscous liquid oozing from the base of a trunk indicating RPW early infestation**

Figure 18. **Young palm exhibiting a deep cavity at the base of the trunk caused by RPW infestation**

Figure 19. **Damage caused by RPW in a young palm with a big cavity and feeding holes**

Figure 20. **Damage by RPW extends on one side of the trunk and runs up to the crown indicating severe damage**

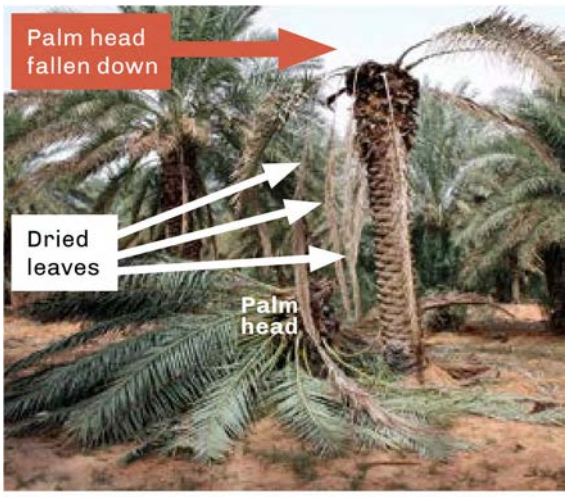

Figure 21. **Sometimes the infestation on theWcrown is very severe and results in a toppled crown**

3.3 Tools used for inspection

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Figure 22. **Screwdriver**

Figure 23a. **Telescopic probe, closed**

Figure 23b. **Telescopic probe, partly extended**

Figure 24. **Using a metal rod (skewer) in the field to check for infestation**

Figure 22)

nger (Figure 23a

Figure 23b

Figure 24

3.4 Inspection schedules

3.5 Marking and labelling of damaged palms

3.6 Assessing the degree of damage and indication of next action

3.7 Periodic review of the situation

3.8 Conclusions

4 Guidelines on visual inspection for early detection of red palm weevil in Canary Island palm (*Phoenix canariensis*)

Figure 25

Figure 25. **Late symptoms of RPW infestation: although the initial infestation may have started a minimum of three months before, early symptoms may remain undetected for the untrained observer; the final collapse of the palm can take as little as one week**

rvey (Figure 26
Figure 27a), wh

Figure 27b Figure 27c

Figure 28a

Figure 29 own (Figure 30

Figure 25 Figure 28b) and

Figure 26. **The cutting of an inspection window, comprising a triangular area extending from the top of the crown down to the base of the canopy (about 50 cm long) where fronds have been removed, may facilitate the observation of early symptoms of infestation**

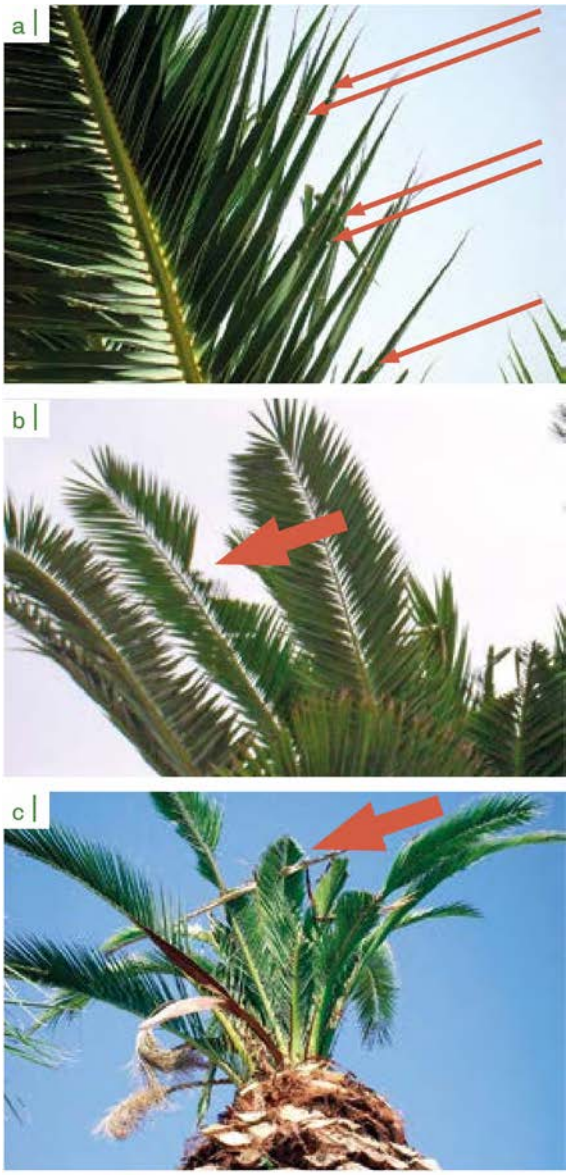

Figure 27. **Early symptoms of RPW infestation in Canary Island palm: damage inflicted by larvae on fronds developing in the crown result in the fronds becoming (a) perforated, (b) chewed, or (c) broken when unfolded**

Figure 28. **The tunnelling activities of RPW larvae may lead to the absence of new fronds in the canopy (a), and frass may be found on unfolded fronds (b)**

Figure 29. **Already developed fronds may wilt/die as a consequence of damage made by RPW larvae in the internal tissues of the crown, which may result in the crown looking asymmetrical**

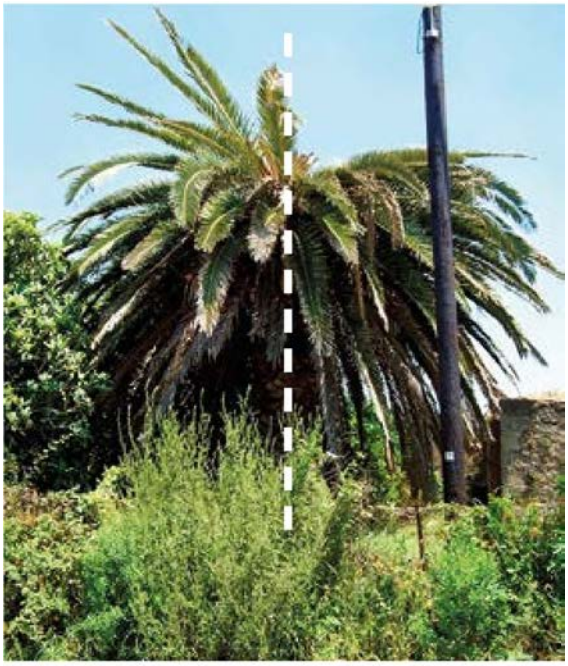

Figure 30. **The crown becomes asymmetrical because of continuous damage on the developing fronds, and once this stage is attained, the collapse of the palm may take only a matter of days**

5 Guidelines on phytosanitary inspections

5.1 Phytosanitary regulations/legislation

5.1.1 Phytosanitary import requirements

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Ornamental palms (Figure 31)

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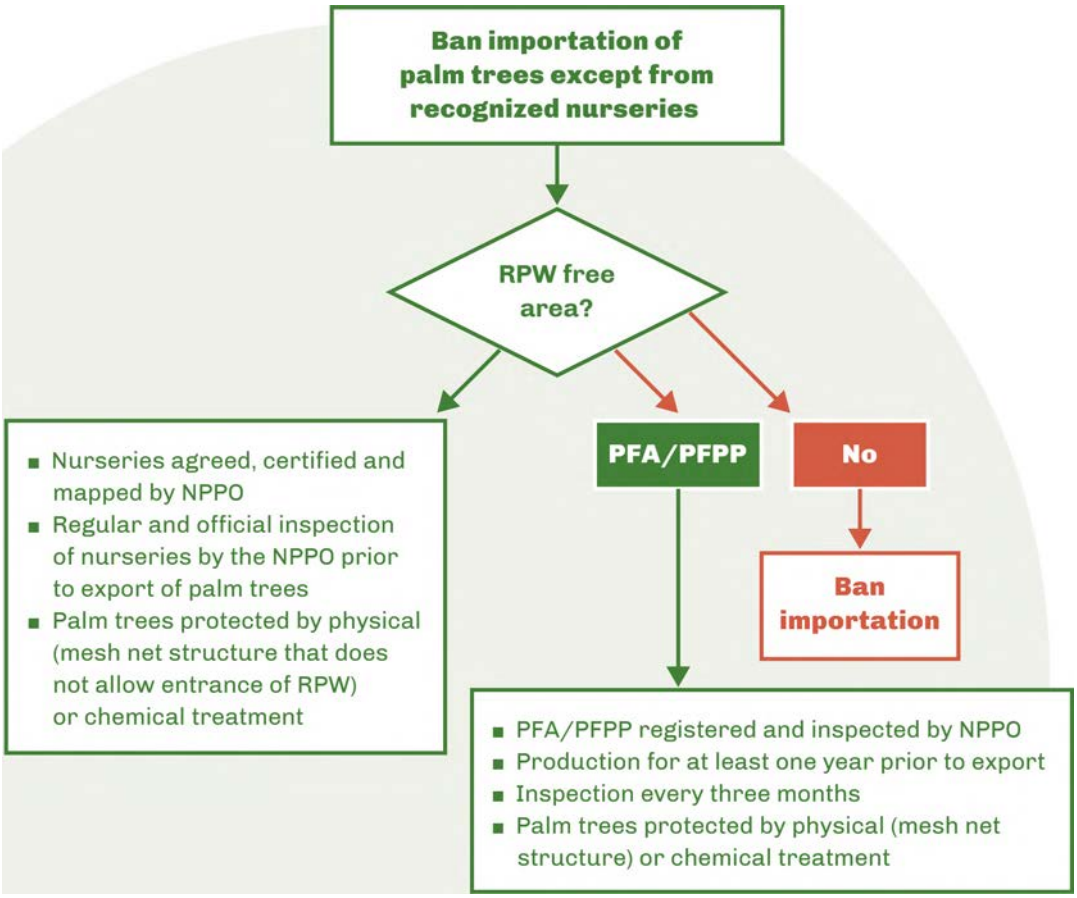

Figure 31. **Phytosanitary measures required for importation of palm trees**

Additional phytosanitary measures for infested areas

- **Figure 32**
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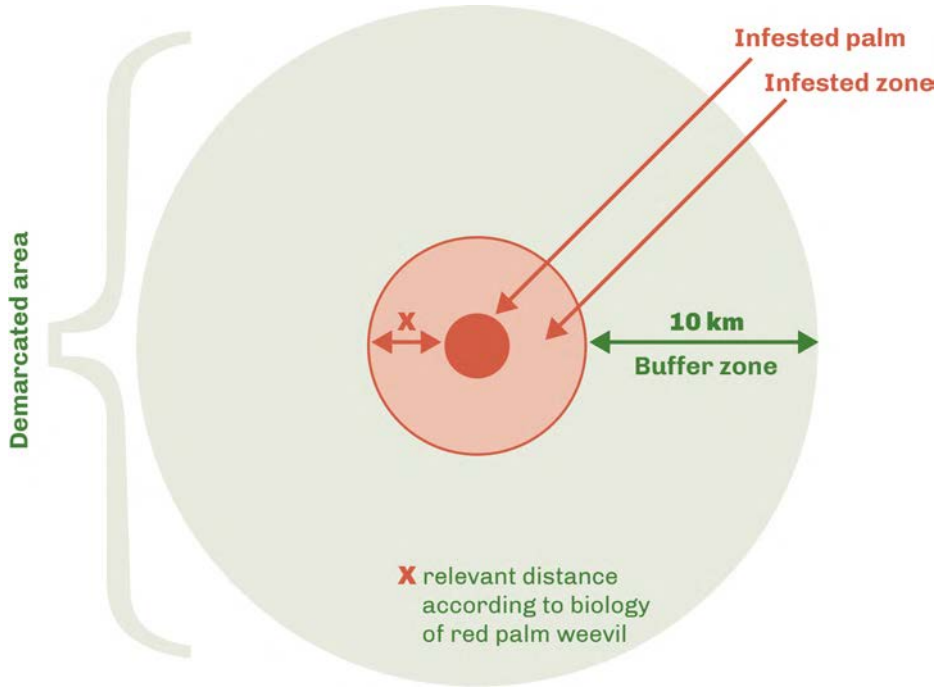

Figure 32. **Demarcated area with buffer zone and infested zone**

Date palms

Figure 33

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Localization (GIS, mapping)

a. **Identification of a healthy parent tree (registration by serial number, number of offshoots, area, year, etc.) (notification to NPPO)**

Treatment of offshoots (dipping in relevant chemical solution)

b. **Selection and removal of offshoots under supervision of NPPO**

Developing of offshoots in protected area in the authorized and certified nursery

c. **Rearing offshoots in a protected area in the nursery (regular inspection by NPPO)**

Figure 33. **Selection of offshoots (or starting material for propagation)**

5.1.2 Nurseries entitled to trade RPW free palms (Figure 34)

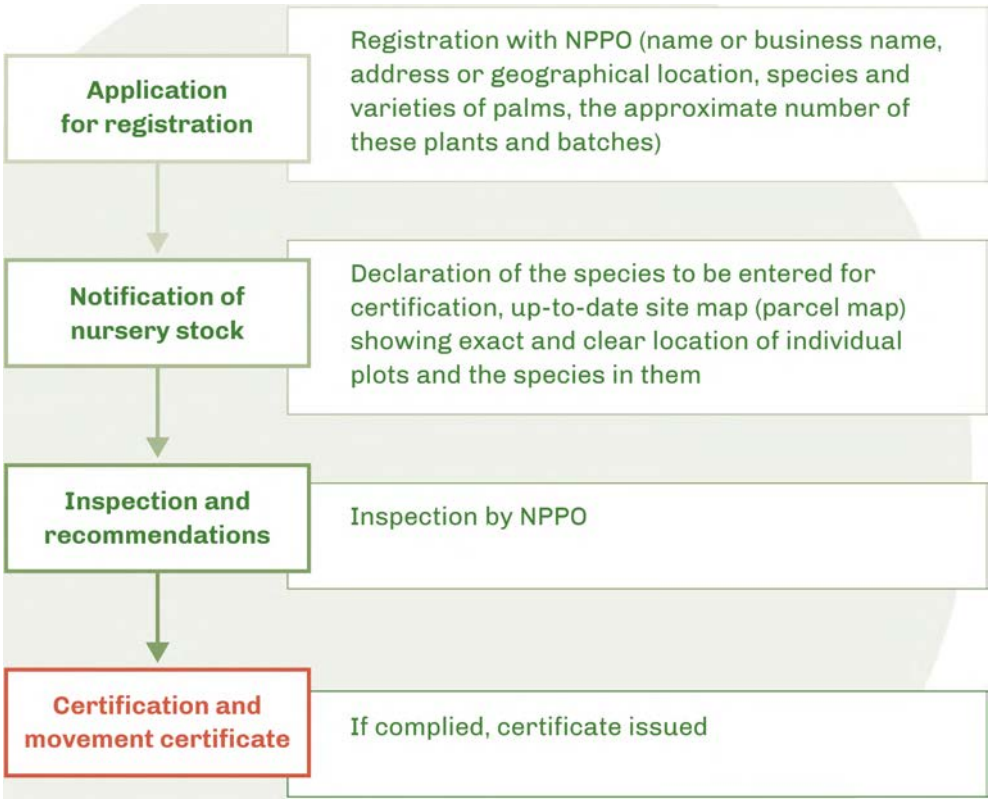

Figure 34. **Registration of nursery**

5.1.3 Movement of palms

5.2 Inspection

5.2.1 Inspection at borders (point of entry) (Figure 35)

Step 1: Documentation review

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Step 2: Preliminary visual examination (physical inspection)

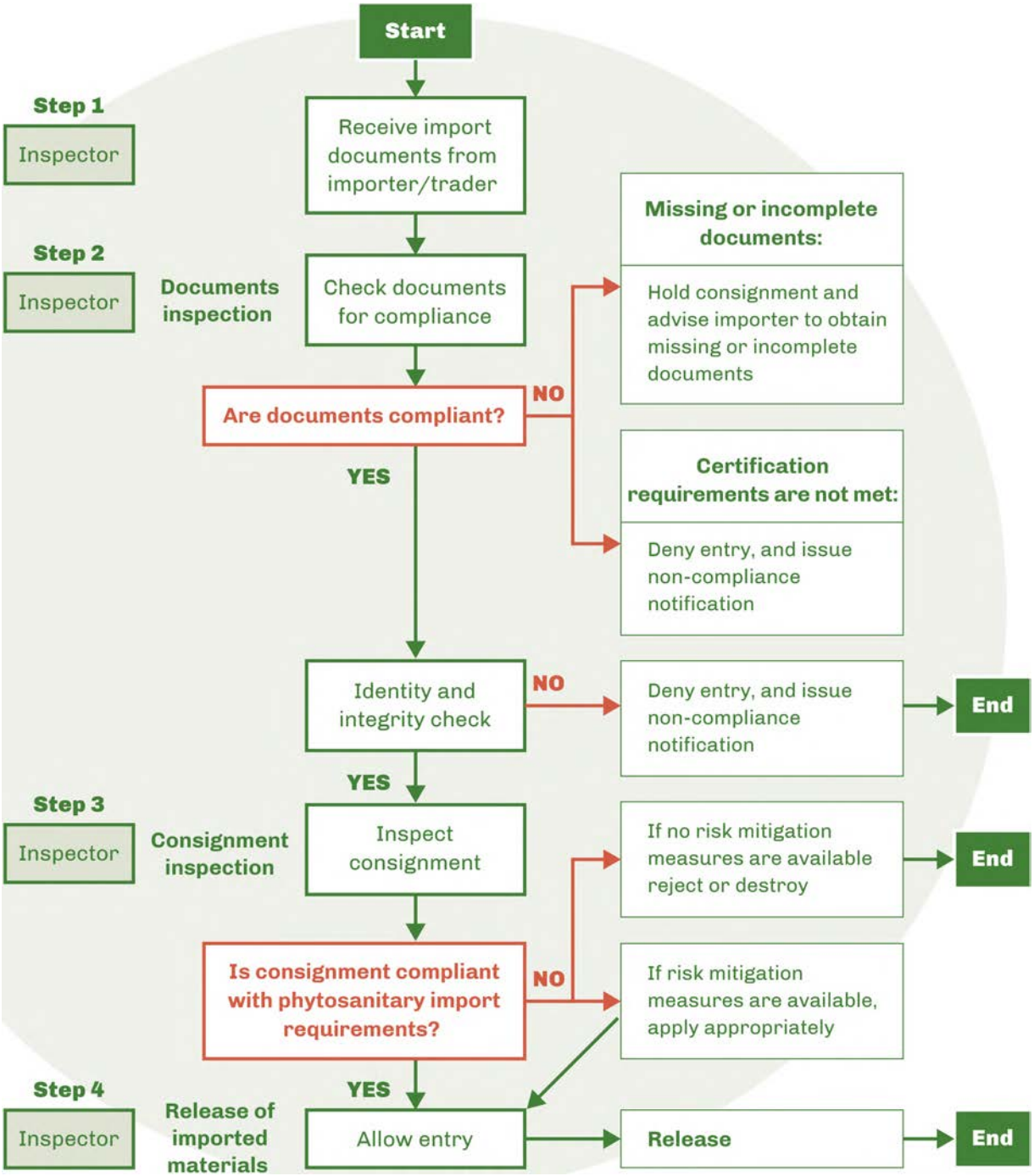

Figure 35. **Import verification chart**

Step 3: Detailed visual examination (physical inspection)

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5.2.2 Inspection of nurseries

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5.3 Control of movement of palms inside countries

6 Guidelines on offshoot inspection protocols: preventive methods for planting offshoots from other farms

Figure 36

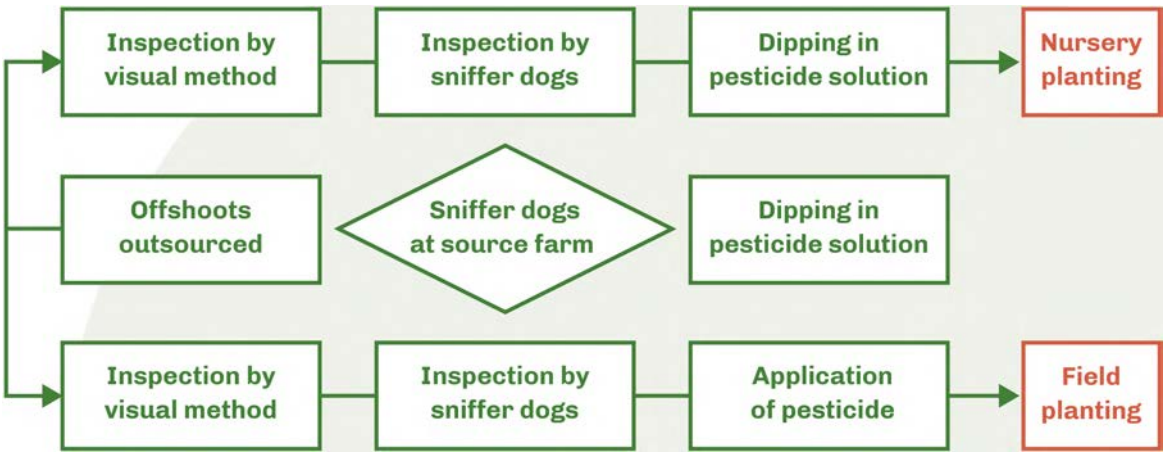

Figure 36. **Flow chart showing the process of offshoot treatments**

Figure 37. **Visual inspection at the source farm**

Figure 38. **Visual inspection of offshoots at the destination farm**

Figure 39. **Checking the offshoots with sniffer dogs for any hidden RPW infestation or stages**

Figure 40. **Dipping offshoots in pesticide solution before planting**

Figure 41. **Transplanting in the field after treatments**

6.1 Transplanting in farms

1.

Figure 37

Figure 38

2.

Figure 39

3.

4.

Figure 40

5.

Figure 41

6.

6.2 Nursery management

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Figure 39

4.

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Figure 40

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7.

8.

9.

6.3 Other general guidelines for transplanting offshoots

Figure 41

7 Guidelines on RPW pheromone trapping with respect to trap design, trap density and servicing

7.1 Introduction

7.2 Trapping protocols

7.2.1 Trap design

7.2.2 Food baits and kairomones

7.2.3 Water in the trap and trap servicing (renewal of food bait and water)

7.2.4 Insecticide in the trap

7.2.5 Lure and lure longevity

7.2.6 Trap placement and trap density

7.2.7 Service-free trapping options

7.2.8 Data collection, validation and decision making

Figures 42 to 49

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Figure 42. **Fermenting dates mixed in water in RPW pheromone traps: essential for good bait–lure synergy**

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Figure 43. **Poorly maintained RPW pheromone traps**

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Figure 44. **Recording weevil captures during trap servicing**

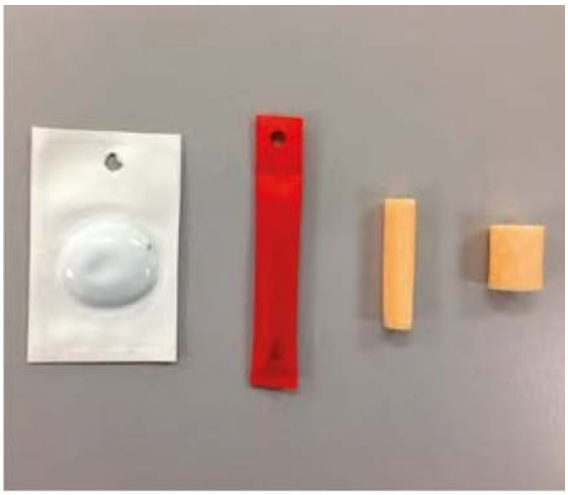

Figure 45. **Commercial RPW pheromone lures**

Figure 46. **Attract-and-kill (HOOK-RPW™) dollop on date palm**

Figure 47. **Attract-and-kill (Smart Ferrolure™) dollop on date palm**

Figure 48. **A dry RPW pheromone trap (Electrap™)**

Figure 49. **Dead weevils at the base of an Electrap™**

8 Guidelines on mechanical sanitization of infested palms and removal of severely infested palms

8.1 Objective and approach

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Figures 50–72

8.2 Step 1: preparation

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Figure 50. **Offshoot pruning for deep inspection**

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Figure 51. **Insecticide treatment by soaking targeted zones**

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8.3 Step 2: sanitation

8.3.1 First case: the infestation symptom is a drying offshoot

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8.3.2 Second case: the infestation symptom is not a drying offshoot but the larvae have passed from the offshoot to the mother palm

a)

b)

Figure 52. **Infested offshoot**

Figure 53. **Young infested offshoot**

Figure 54. **Cutting all the leaves of the infested offshoot as low as possible**

Figure 55. **Cocoon at the base of a petiole**

Figure 56. **Cocoon control**

Figure 57. **Cutting off the infested offshoot with a manual cutting tool**

Figure 58. **Cutting off the infested offshoot with a chainsaw**

Figure 59. **Cutting off to reach the base of the offshoot**

Figure 60. **Inspected the cutting area with knife to check the depth of the infestation**

Figure 61. **Non-infested tissue at the base of the offshoot**

Figure 62. **Sanitation of the infested zone detected by the presence of cocoon, petiole easy to pull, chewed fibres or oozing (linked with aerial roots when in high position)**

©FAO/Michel Ferry

Figure 63. **Progressive and careful elimination of the infested tissues**

Figure 64. **Sanitized palm**

Figure 65. **Too deeply infested palm, better to be eradicated**

8.3.3 Third case: palm detected too late with very advanced infestation

How to differentiate between the infested parts and the non-infested parts

Figure 66. **Possible limits of the infestation zone**

Figure 67. **Only the upper part of the trunk and the bases of part of the fronds are infested**

The sanitation process

1.

2.

Figure 68. **Fronds, after control of their bases, are placed aside and processed as normal green waste**

Figure 69. **Cutting the trunk of an infested palm into small blocks with a chain saw**

Figure 70. **Cutting an infested palm into small pieces until a non-infested area is reached**

8.4 Step 3: waste management

Figure 71a. **Drying waste arising from non-infested parts**

Figure 71b. **The females lay their eggs in live tissue that they reach after digging with their rostrum a hole of a few mm in depth; successful oviposition in drying tissue will never occur**

Figure 72a. **Waste arising from infested parts, cut into small pieces, is spread out to dry**

Figure 72b. **Larvae feed on sap that they extract from the palm fibrous tissue after chewing it; they cannot survive on drying tissue**

9 Guidelines on removal and safe disposal of highly infested and damaged palms

9.1 Introduction

1.

Figure 73

2.

3.

9.2 Small and marginal farms

1. ■

■

Figure 74, Figure 75 Figure 76

2.

Figure 77, Figure 78 Figure 79

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■

Figure 73. **Highly infested palm ready for removal**

Figure 74. **Using a chain saw, the palm is cut from the base**

Figure 75. **Using crowbars, the palm is moved for cutting into small pieces**

Figure 76. **Leaves are cut and then the trunk is cut into small pieces**

Figure 77. **Spraying the damaged tissues removed from the infested palm, before burning**

Figure 78. **Leaf bases and some tissues from a damaged palm, heaped together to be sprayed with insecticide and then burned**

Figure 79. **Spraying to sanitize the area near a treated palm**

Figure 80. **Trunk pieces are loaded into a covered truck with a pulley to facilitate easy transport**

Figure 81. **Dumping ground of damaged palm trunk pieces brought from different gardens**

Figure 82. **The trunk pieces are shredded into very small bits and dumped in a square**

9.3 Medium and large farms

Figure 74, Figure 75 Figure 76

Figure 80). These
scapes (Figure 81

Figure 82

10 Guidelines on preventive pesticide treatments (sprays/showers)

10.1 Introduction to preventative and curative pesticide applications

10.2 Preventive pesticide applications (chemical/natural)

a)

b)

10.3 The preventive chemical spray (shower)

10.3.1 Purpose

10.3.2 Scope

10.3.3 Reference documentation

10.3.4 Methodology

Area determination

Prior notice

Figure 83. **Preparing spray solution and carrying out preventive treatment of the Canary Island palm**

Solution preparation

Figure 83

Spraying process

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Figure 84

Figure 85

Figure 86

10.3.5 Supporting information resources

Figure 84. **Preventive chemical treatment against RPW in an urban area**

Figure 85. **Truck mounted elevator with platform to treat the crown of the Canary Island palm**

Figure 86. **Canary Island palm labelled after preventive chemical treatment**

11 Guidelines on curative pesticide treatments (chemical trunk injection)

11.1 Curative pesticide treatments (chemical/ natural)

11.2 Chemical trunk injection

11.2.1 Purpose

11.2.2 Responsibilities of personnel

Programme director

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Team leader technicians

Workers

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All personnel

11.2.3 Reference documentation

11.2.4 Methodology

Area determination

Prior notice

Work procedure

Figure 87

Figure 88

Solution preparation

Solution application

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1.

2.

Figure 89

3.

Figure 90 Figure 91

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Figure 87. **Visual detection method in action**

Figure 88. **Labelling with one clear strap indicating palm needs injection treatment**

Figure 89. **Starting injection method by drilling holes**

Figure 90. **Injection method in action**

Figure 91. **Post incection treatment of date palm**

11.3 Safe application of pesticides

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Table 2. **Chemical treatments equipment list**

Tool group	Tools	Use
Machinery and equipment	Transport vehicle	Transporting workers, tools and products
	Spraying pumps, hoses, products, injection equipment, drills hoses	Pesticide application
	Tools (repair kit)	Maintenance
	Chemical products	Control
	pH meter	
Individual equipment	Personal protection equipment	Individual safe protection
Others	Mobile data-input device	Registration of actions taken
	Labels	Follow-up actions
	Cameras	Documentation

12 Guidelines on good agronomic practices (including palm density in the field, irrigation, and crop and field sanitation)

12.1 Good agronomic practices

12.1.1 Palm density (spacing) in the field

12.1.2 Field sanitation

12.1.3 Offshoot management

Figure 92

12.1.4 Frond pruning

Figure 92. **Protect fresh wounds on the trunk with insecticide immediately after removing offshoots**

12.1.5 Irrigation method adopted

Figure 93

Figure 94

©FAO/J.R. Faleiro

Figure 93. **Open flood irrigation with fodder and weeds growing close to date palm facilitates RPW attack**

Figure 94. **Irrigation water in contact with the palm: predisposes the palm to RPW attack**

12.1.6 Role of fertilizers in the management of RPW

12.1.7 Varietal selection

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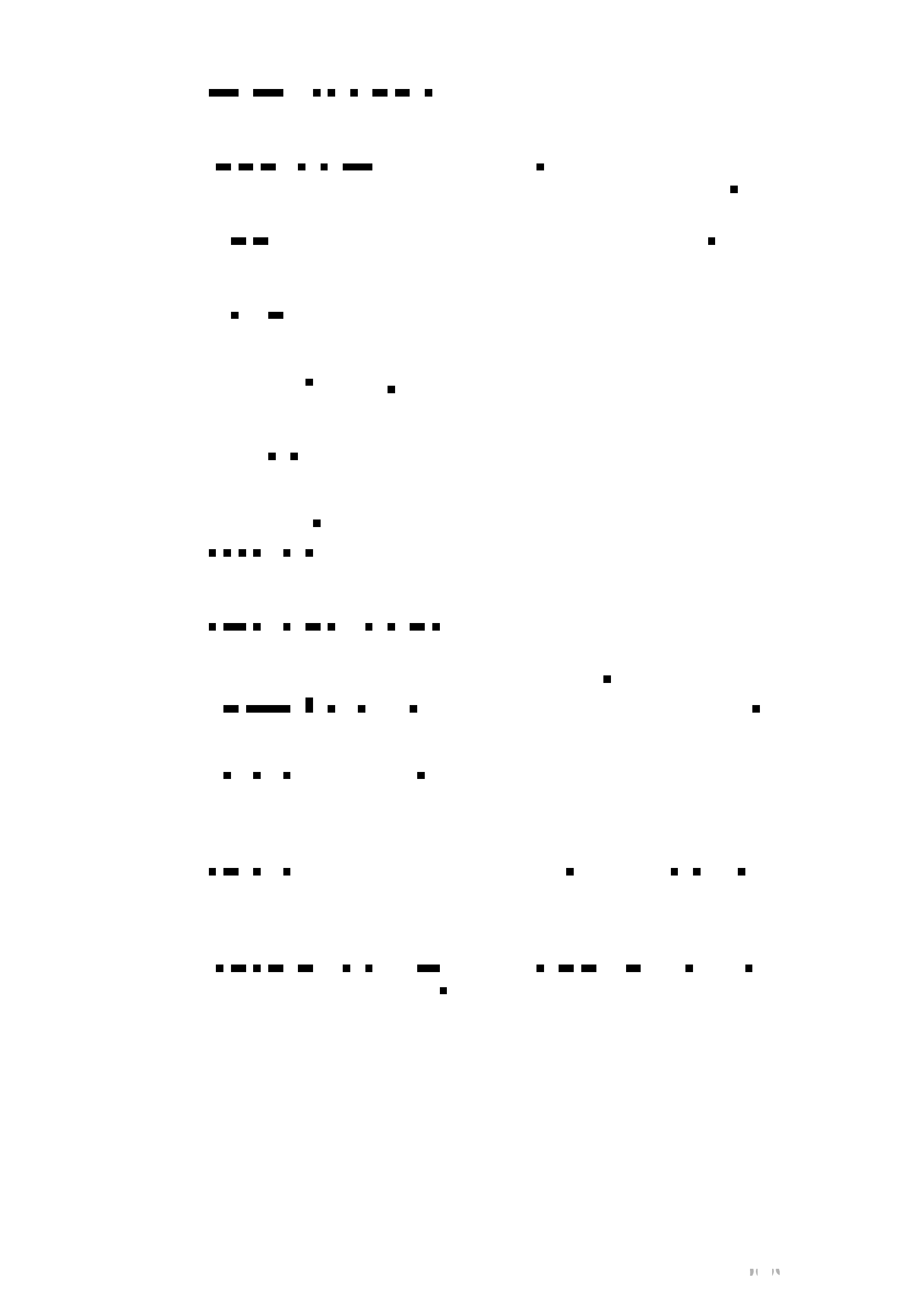
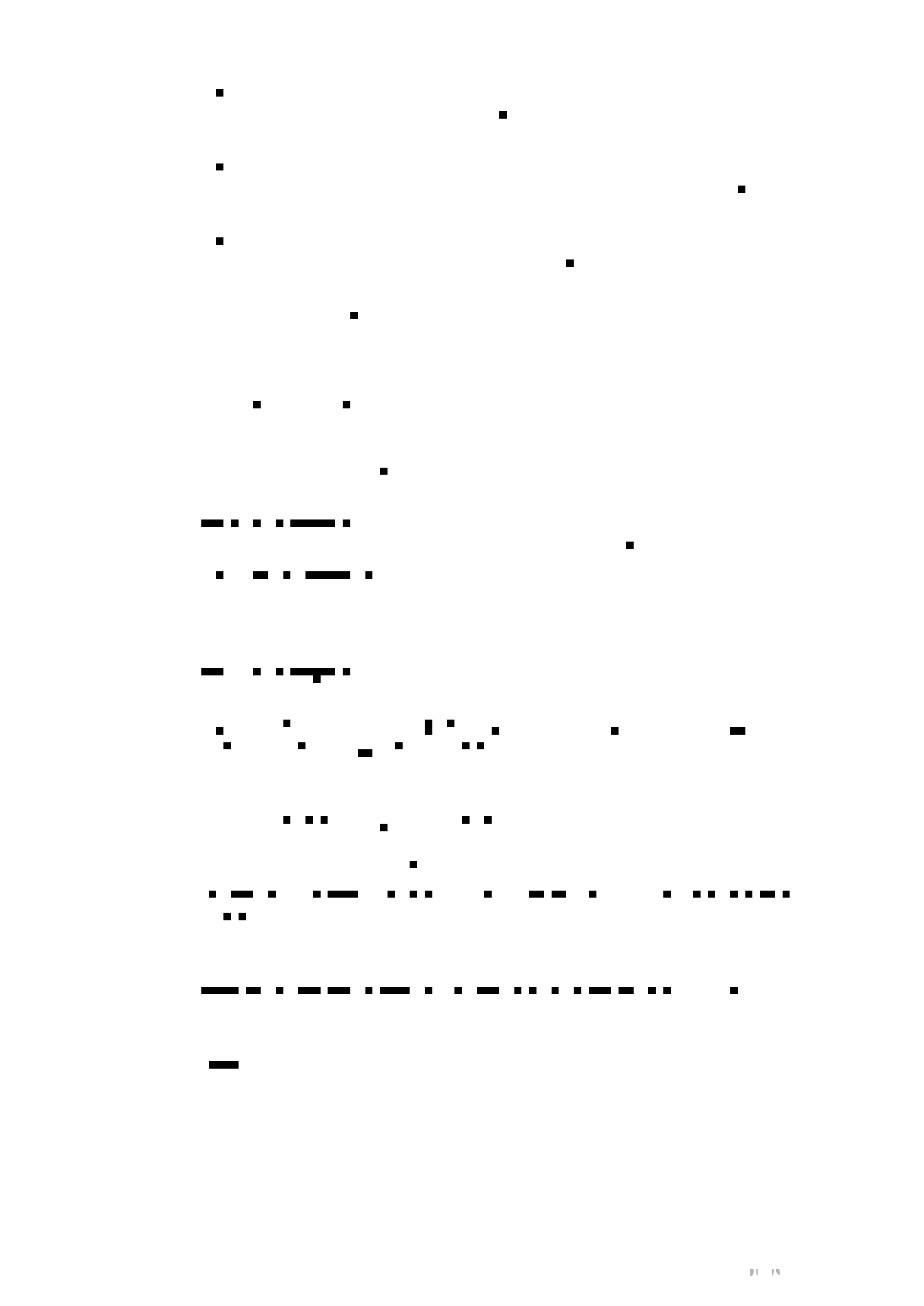
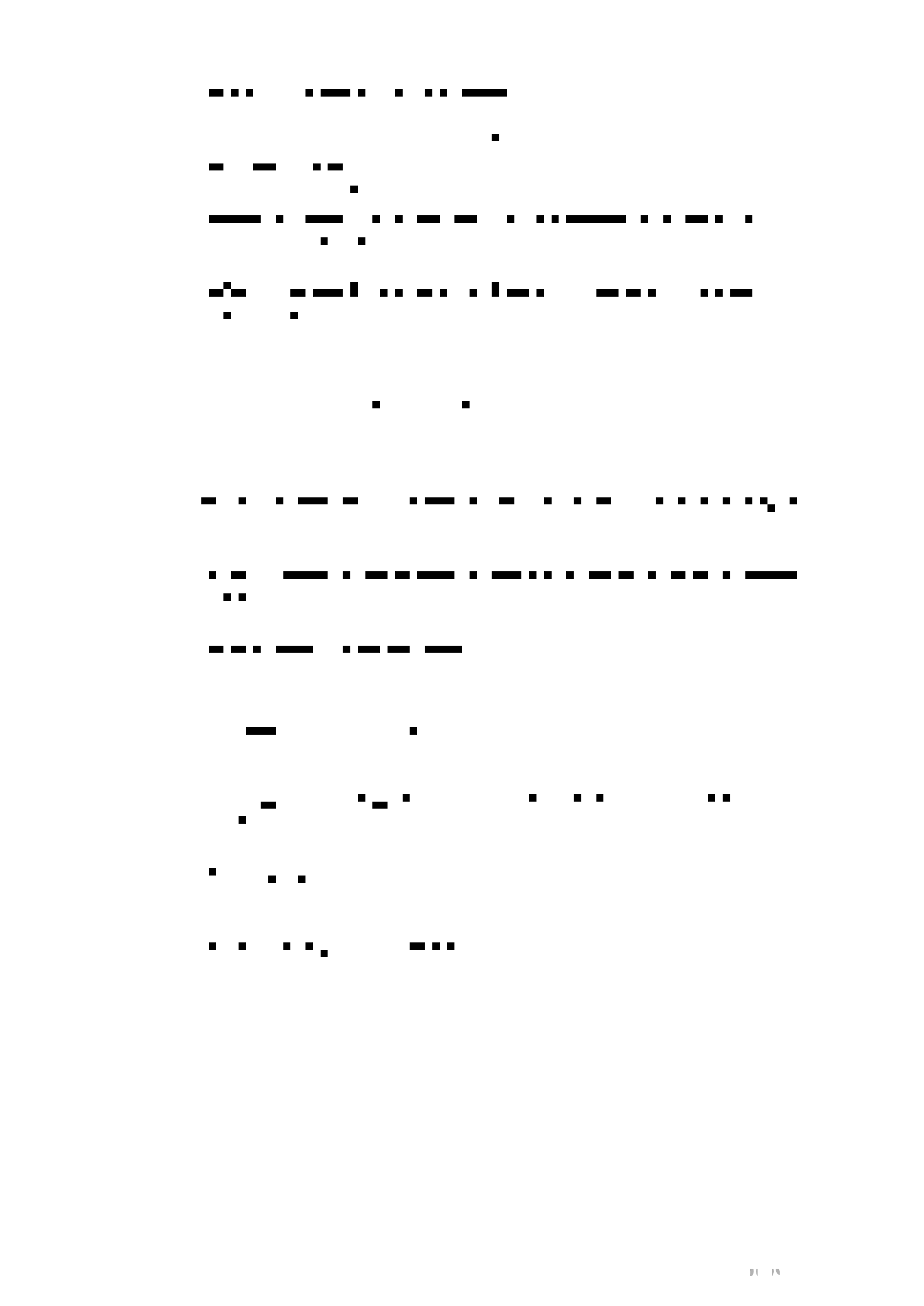
12.2 General management recommendations

Bibliography







Red Palm Weevil

Guidelines on management practices

Since gaining a foothold on date palm in the Near East during the mid-1980s, the red palm weevil (RPW) *Rhynchophorus ferrugineus* Olivier has spread rapidly over the last three decades and is now a major pest of palms in a diverse range of agro-ecosystems worldwide. In most of the countries affected, failure to manage RPW can be attributed to lack of awareness about this pest and to lack of systematic and coordinated control actions or management strategies that involve all stakeholders. These guidelines have been developed by FAO to support all those involved in the day-to-day management of RPW in the field (including farmers and pest-management professionals), researchers, and the decision makers and administrative stakeholders who support implementation of integrated pest management (IPM) strategies for RPW. Written by internationally recognized RPW experts, the guidelines describe the biology and host range of RPW and address all aspects of RPW-IPM, including surveillance, phytosanitary measures, early detection, pheromone trapping protocols, preventive and curative chemical treatments, removal and safe disposal of severely infested palms, and best agricultural practices to mitigate attacks by this lethal pest of palms.

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