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Integrated Pest Management for Major Date Palm Pests in Iraq

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This publication was made possible by the support of the American people through the United States Agency for International Development (USAID).

Acknowledgment

The authors thank HSAD under which this work was accomplished .Special thanks go to Dr. Paul Gasparini (HSAD COP) and Dr. Azhr Al- Haboby (ICARDA-HSAD Project Manager) for their contribution and support. Thanks to Dr. Hamid Ali Hadwan, General Director of the Plant Protection Directorate/MoA for his support to IPM activities. Thanks to all national teams for their excellent field work that allowed this manual to be produced. The authors are thankful to ICARDA and HSAD staff who contributed in different ways in the preparation and editing of this manual. Thanks are extended also to Dr. Mohammad Zedan Khalaf/Ministry of Science and Technology for his assistance in providing some of the photos used in this manual.

INTRODUCTION

In addition to their social, environmental, health and religious importance, palm groves formed over the decades a source of livelihood for an important segment of Iraqi farmers, especially after the orchards became shelter to another crop of high economic return (citrus), contributing to achieve self-sufficiency until the late nineties. of the last century. This agro-ecological combination was introduced by ancestors and maintained by subsequent generations with such high productivity to put Iraq at the top of the list of countries in terms of number of palm trees or date production until the mid-nineties of the last century. However, researchers have not made any significant contributions in the development of modern cultivation systems of date palm and improvement of palm groves. The cultivation of date palm is now facing numerous problems and serious constraints that could threaten this vital industry to a great extent. Data from the Ministry of Planning and Development Cooperation shows that the number of palm trees and their productivity were reduced drastically (from 33 million in the seventies to about16 million palm trees in 2012).Date production was greatly affected reaching to low of500.000 ton/year.

Palm groves are mainly found in central and southern Iraq, especially along the banks of the Tigris, Euphrates, Diyala and Shat El Arab rivers. The constraints that have led to the decline in date production include:

1. Main palm groves were located within military operation fields during the Gulf War
2. Negligence, including carelessness or inattention, to palm care procedures, including, pruning, removal of dry fronds, pollination and even harvesting;
3. Pests (insects, and perennial weeds);
4. Drought and inefficient irrigation methods, as well as lack of knowledge in best practices in fertilization;
5. Increased production costs and low market prices for dates.
6. Progressive age and height of trees can hinder agricultural operations (especially pruning and pollination) and can render the entire operation, costly and inefficient. Moreover, most palm groves are not well prepared to accommodate for mechanized palm care methods.
7.Urban expansion at the expense of palm groves.

The proliferation of date palm pests and the severity of infestation vary according to the pest species, age of the tree and the dominating environmental conditions.

The following pests are classified as key pests because of their wide presence and the severe economic damage they can cause to the date palms and fruits:

1. Dubas bug: Dubas bug is an endemic pest that has pervaded palm groves in Iraq, for over a century. Infestation varies between provinces and regions within the same province. Temporal variation has also recorded for this pest. Heavy infestation is mainly found in central Iraq, including the provinces of Karbala, Babel, Baghdad, Diyala and Wasit. Infestation in the provinces of the Middle Euphrates and the southern area (Najaf, Diwaniyah, Samawah) are categorized as moderate, whereas in the provinces of Salahuddin and Al-Anbar, they are still limited.
2. Humara (Lesser Date Moth - LDM): this pest is found in almost all date palm growing regions.
3. Date palm borers: Borers do not differ in their importance and severity from other serious date palm pests. Their significance- aside from the direct injuries they impose on plants -arises from the difficulty of their control as they lurk in hidden places with no efficient pesticides to reach them.

The development of a reliable IPM program against these pests is considered a big challenge. The following are the most important species of date palm borers in the country.

a. Long horn stem borer
b. Bunch borer
c. Frond borer

4. Dust mite: found in many areas, it affects the late fruit stages.5. Other pests: such as scale insects, insects of mature and stored fruits, as well as fungal diseases such as Almajnoona (black blight) and inflorescence rot are classified as secondary or less important pests. However, given appropriate environmental conditions, these pests may become principal pests that belong to the major pests category.

The following tables present major date palms or fruits pests .

Table.1.Number of major date palm pests

Number of date palm pests = 62 (insects and mites)	8 mites and spiders	
	54 insect pests	

Table.2. Major date palm pests and suggested control methods

Common name	The major pests	
	Scientific name	Suggested control method
Dubas bug	*Ommatissus lybicus*	**Cultural control (pruning, modern planting...),biological control, botanical insecticides, summer oils and safe chemical insecticides**
Alhummara (Lesser date moth)	*Batrachedra amydraula*	**Cultural practices, sanitation, bio-agents (pathogenic fungi, bacteria, parasitoids) bunch bagging**
Long horn date palm stem borer	*Jebusaeahammarschmiditi*	**Cultural practices, bio-gents, photoelectric trap powered by solar energy, pheromone traps**
Bunch borer	*Oryctes spp*	**Cultural practices (pruning, sanitation, removal of heavily infested trees) , mechanical (gathering and destroying larvae)bio-agents, photoelectric trap powered by solar energy, pheromone traps**
Frond borer	*Phonapate frontalis*	**Cultural practices, bioagents, photoelectric trap powered by solar energy s, pheromone traps**
Dust mite	*Oliginychus Afraciaticus*	**Sulfur,bioagents, spray at hibernating stage using selective acaricides, bio-agents, bunch bagging**
Oriental wasp	*Vespa orientalis*	**Poisoned bait traps, attracting screen traps**
Termite	*Microcerutermes diversus*	**Cultural practices (removal of dead trees to eliminate the source of infestation) chemical control (selective insecticides)**
Fig moth	*Ephestia cautella*	**Bio-agents,cultural practices, sanitation. bunch bagging**
Inflorescence rot	*Sporendonema* (*Maugeniella*) scaettae	**Cultural practices, selective fungicides (systemic)**
Almajnoonna (black blight)	*Clara* (*Thieslaviopsis*) *paradocsa*	**Cultural practices, selective fungicides**

Integrated pest management

Traditional control programs of main date palm pests (Dubas and Humera) relied on ground and aerial spraying of broad spectrum chemical pesticides which affected the natural balance between the palm pests and their natural enemies. Misuse of these pesticides for an extended period has caused many negative consequences such as the development of multiple resistances toward various groups of pesticides, adverse effects on natural enemies and other non-targeted organisms, resurgence of secondary pests to the level of principal pests, in addition to the effect on environment and human health. At present, the use of pesticides is not economically and environmentally commendable because of the low efficiency of most pesticides in use.

The best solution lies in the development and implementation of an integrated management program that addresses the entire range of date palm pests. In order for this program to succeed, farmers must be willing to accept the idea and to cooperate with specialists and Agricultural extension agents in the adoption and dissemination of safe and effective alternative control practices against the date palm pests.

Integrated Pest Management is a comprehensive approach to control pests, which includes the collection of information on the pest's biological traits and link them with the governing environmental factors in order to identify available control methods to manage the pest in a more economically efficient way that is more environmentally friendly and less risky to the human health. Based on this concept, the Iraqi agricultural policy started moving towards safe alternatives to control epidemic pests. Direct actions were taken to implement the integrated management programs in various agricultural systems in the country.

The Harmonized Support for Agricultural Development program (HSAD) in Iraq, funded by USAID and implemented jointly by ICARDA and the Ministry of Agriculture, has devoted much effort in the dissemination of the IPM concept and application in controlling date palm pests.

The key elements of the pest management system are as the follows:

1. Provide adequate information concerning the identification, biology, life cycle, ecology and natural enemies of the target pest.
2. The development of an effective monitoring system to track the population of the pests, the damage they do and the role of natural enemies in controlling them.
3. Development of a decision-making system using the economic threshold as a base to determine the date of control application.
4. Take suitable decisions on what is the best control system to be used.
5.Record the data on all activities implemented in the field, including: date of sampling, data obtained, the control method used and results of the treatment in terms of reducing pest population or the damages they cause
6. Evaluation should be repeated annually.

The success of the integrated management program depends mainly on the accuracy of the monitoring process in terms of population density of the pests and their damage. This would provide the necessary information on the most important pests in the intended dates and therefore provide information on the suitable timing of control application.

Components of applied IPM program against date palm pests

1.Identification of pests and their associated natural enemies;

2.Development of a monitoring program for the targeted pests and their natural enemies;

3.Data documentation and reporting;

4.Development of a decision making mechanism;

5.Application of suitable pest control tools;

6. Annual investigation and evaluation.

In order to make sampling a reliable process, samples should be collected at regular intervals, taking the time of day for collection, into consideration. Truly representative samples should be chosen randomly, using appropriate sampling techniques and methods. The square area of the orchard and growth stage of the trees should also be taken into consideration along with the distribution of infestation, climatic factors, topography of the region, type of soil, and the borders of the orchards. The sampling process should start with a preliminary survey of the orchard; samples are then taken and examined looking for pest stages, molting skins, and damages on parts of targeted plants. Insect activity could also be monitored by using light or pheromone traps when available. Colored sticky traps can be used as a monitoring device for several pests. Traps are used according to insect species which vary in behavior and attraction to light color and wave length.

In order to maintain the efficiency of pheromone and adhesive traps, pheromone capsules and adhesive screens should be regularly replaced. Monitoring tools and devices are usually varied according to the pest species and crop.
Adult insects collected from traps, or from rearing immature stages on host plant parts should be identified according to reliable scientific sources. Specimens could also be sent along with the required information on both, the pest and the host plant to international museums for identification. Accurate diagnosis of the pest is the main element needed for the development and application of the most efficient method to control it.

The continuous monitoring process should provide enough information on the following aspects:
1. An early warning of the dangerous pests.
2. The most important stage in the lifecycle of the pest.
3. Presence or absence of natural enemies.
4. the most suitable timing of control application.
5. The efficiency level and success of the control method used against the pest

The IPM program was successful when implemented against epidemic date palm pests, such as Dubas bug, lesser date moth, and date palm borers. Integrated Pest Management programs, especially for epidemic pests like Dubas, Lesser date moth, or borers, have been very effective and they were widely commended by date farmers in areas of application.

Dubas bug

Dubas bug is considered a key pest that infects palm trees in areas of central Iraq, which includes the provinces of Najaf, Karbala and Babel in the Middle Euphrates region to the south, and extends toward the north, east and west, including the provinces of Baghdad, Wasit, Diyala, Salahuddin and Al-Anbar.

The level of pest Infestation varies according to the region, variety, cultural practices, and trees service practices followed, as well as to the surrounding environmental factors, especially temperature, relative humidity and dust storms.

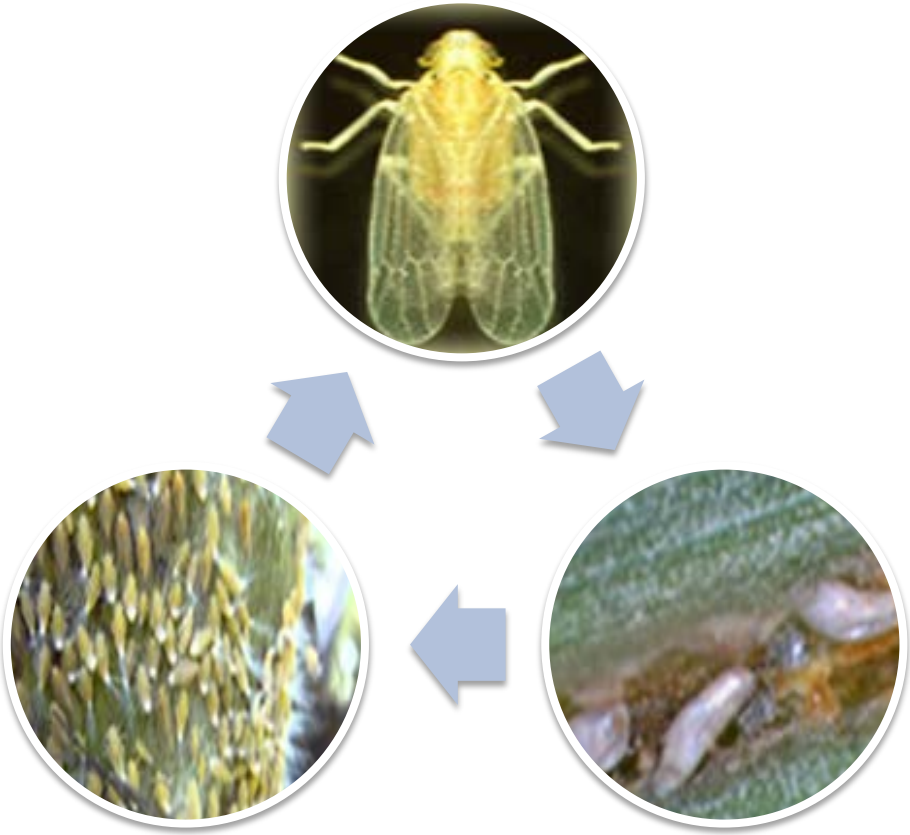
This insect has two generations per year, the spring (summer) generation and the fall (winter) generation. The starting date of each generation is influenced by the climatic factors. Nymphs of the spring generation usually start emergence in late March, reaching their peak in April, and may be extended to the beginning of the month of May. The insect stays alive till the end of June when females stop laying their eggs which undergo a dormant period that can last for two months. New nymphs of the fall generation start emerging by the end of August.

Field Surveys conducted by researchers at different scientific institutes indicated that the insect, during all the stages of its lifecycle, hides under different parts of the tree in those particular years when winter is relatively moderate, (no frost).

These stages can be seen on date palm leaves early in spring when females may start laying their eggs which indicates a nearly appearance of the pest and additional sources of infestation and other complications.

The lifecycle of Dubas consists of three stages; egg, nymph (five instars) and adult. Both nymphs and adult stages feed on plant sap and cause serious damage to the trees. Nymphs are considered more important than the adults because of their rapacity which increases as the nymphs develop.

Life cycle and description of stages



Nymphal instars

Age of the nymph	Wing buds	Description	Length of nymph (mm)	Number of setae	Number of thoracic lines	Nymphinstar
First	Not found	White in color, presence of three lateral dark spots on abdominal segments, compound eyes red, absence of the lateral intermittent line on thoracic and abdominal segments	1-1.25	6	Not found	
Second	Small and directed downward	Onset of two lateral and parallel dark lines on the dorsal side of abdomen	1.5-2	10	Not found	
Third	Covering the first and part of the second abdominal segments	Two parallel dark lines extended to the thoracic and abdominal segments	2-2.75	16	3	
Fourth	Covering first, second and a part of the third abdominal segments	Presence of three lateral lines on each side of the thoracic segments	3-3.5	20	3	
Fifth	Covering first, second, third, and a part of the fourth abdominal segments	The frontal wing buds are covering the posterior buds which also cover the third adnominal segment	3.5-4	24	3	

Damages caused by Dubas

Nymphs and adults feed on plant sap, causing direct and indirect damages. The repetition of infestation twice a year (spring and fall generations) for several subsequent seasons depletes the sap of the infected palm trees which weakens the tree and leads to significant reduction in yield quality and quantity. The infected leaves turn yellow in color and then dry out with the continuous and repeated infestation. The process of

laying eggs in different parts of the fronds causes another direct damage because of the destruction of plant tissue by ovipositor females. Pathogenic organisms may also be transmitted by Dubas through feeding or egg laying process.

The indirect damages are represented by the honey dew excreted by Dubas nymphs. Mold and dust are accumulated on the infected trees leading to weakened efficiency of plant parts to functions normally, especially in the process of photosynthesis and distribution of nutrients to the tree. Honey dew can also impede agricultural care processes, including bunch bagging and harvesting of dates because farmers can be affected by this sticky substance which can damage their skin or clothes. Moreover, honeydew that trickles off of the affected palm tree, can land on other trees or surrounding crops planted in the same grove, especially citrus trees

Direct damages

*** Secretion of massive amounts of honey dew**
*** Infected leaves become yellow in color, with blight-like symptoms**
***Damage on leaves and fruit tissue caused by the female ovipositor through the egg laying process.**

Indirect damages

*** The accumulation of honey dew affects the efficiency and performance of photosynthesis and food absorption**
*** accumulation of dust and mold on infected trees will reduce the quality of dates**
***Intervention with palm care operations.**
***Precipitation of honey dew affects fruit trees and other crops planted under date palm trees in the orchards.**

Honeydew symptoms on leaves of fruit trees

Management Methods used for controlling Dubas bug

The Dubas bug occupies the top of the worst epidemic pests list in terms of the areas it affects yearly (250000 donums/year) and in terms of the amount of pesticides used to control it. Over the decades, huge amounts of broad spectrum chemical pesticides have been sprayed through various air and ground spraying methods. However, depending fully on a specific group of pesticides over extended periods of time has weakened the efficiency of these pesticides. In addition, the bug's resistance to many of the chemical pesticides in use can also be a reason why these pesticides are no longer effective

One of the other disadvantages that accompany pesticides could be the transition of secondary pests into primary ones which doubles their damage to palm trees. Dust mites can also wreak havoc in other fruit trees that coexist with palms, sharing the same grove. An example of these pests includes mealy bugs, crustacean insects and fruit flies. Therefore, the disadvantages that accompany using conventional, broad spectrum chemical pesticides can be summarized as

Follows: The limitations associated with the use of broad spectrum insecticides can be summarized as follows:

1. The direct impact of these pesticides on natural enemies of targeted and non-targeted pests, . pollinators, honey bees and fish;

2. Reduced efficiency of pesticides due to continuous usage for long periods and the .development of insect resistance towards insecticides;

3. Toxic effect of pesticides on human health and livestock, as well as environmental pollution in terms of soil, water and air;

4.The high cost of pesticides adds an additional load on farmer's budget;

Based upon the above, the most effective pest control solutions to adopt the integrated management approach, which helps reduce the amount of chemical pesticides with **environmentally**-safe and efficient alternatives.

Integrated pest management of Dubas bug

Integrated management involves using all available control measures, including chemical insecticides–(these can be used as a last resort) -to control infestation and reduce the number and damage of pests. Integrated management techniques take into account all biological and ecological aspects of pest control and require the adoption of a reliable monitoring program as a basis for sound decision making. Pest Management is also a part of a comprehensive process of crop management. The basic elements for the management of Dubas, include the following:

1. Agricultural practices, which include removal of old leaves from the lower parts of the tree to eliminate a large percentage of Dubas eggs that are an important source of infestation. Regular irrigation and fertilization should include the use of organic fertilizers (compost) and manure instead of, or in addition to chemical fertilizers. New orchards should follow modern designs that allow an 8x8 meter space between planted trees.

2. The development and adoption of a monitoring and early warning program to detect Dubas and identify its natural enemies as a basis for decision making and scheduling of control application.

3. Monitoring and sampling techniques must take into account several important factors, such as the number and distribution of palms per unit area, the target level of leaves and the sample size (number of leaflets / Palm),as well as the adopted sample collecting mechanism.

To determine the level of pest infestation, it is recommended that samples are collected when the pests are in their egg stage because the rapid movement of nymphs or adults can influence the accuracy of population estimation. The process is implemented by taking one or two samples per geographical region/week in order to determine the percentage of egg hatching, developmental stage of the pest and the presence of natural enemies.

The applied Integrated Management for Dubas

1. Pruning and removal of the lower fronds to eliminate a large portion of Dubas eggs injected in these leaves

2. Using botanical and environmentally safe insecticides

A - Spraying Dubas eggs or Nymphs (phases 1-3), with 1% Neem (Azadirachtin)at a ratio of 2-3 ml./per liter of water, or by mixing 1.5 ml. of neem + 15 ml. summer oil, using ground sprayers.

B- Spraying Dubas eggs or Nymphs (phases 1-3), with the botanical pesticide, Oxymatrine, at a ratio of 2ml./per liter of water.

2. Agricultural soap at a ratio of 2-3%;

3. Application of biological insecticides such as the pathogenic fungi *Beauveria,*and *trichoderma* at a ratio of 5g/l;

4. Using biological control agents such as lace wing (it can be obtained from the mass rearing unit of the MoA or other specialized institutes).

Other groups of natural enemies associated with Dubas in the field, including the lace wing (Chrysopidae), coccinellid beetles and the egg parasitoid *Oligosita* sp, play an important role in the elimination of large proportions of Dubas stages. These natural enemies may be found in mass rearing laboratories, or they can be conserved by field protection and maintenance. Such practice should include the use of safe pesticides in timed applications and encourage planting crops that are known for attracting and harboring natural enemies.

INTEGRATED PEST MANAGEMENT ELEMENTS FOR DUBAS BUG

Type of Agrosystem,Agricultural practices,Green pesticides(Neem) and summer oil, Oxymetrin

Beauvaria

Lace wing

Farmer field school (FFS)

Oligosita

Monitoring and predicting system

Biological control agents

Procedure for the estimation of Dubas infestation (intensity) would provide:

^Predicting of pest emergence

^ Estimation size of infestation

^ Evaluation of control efficiency

Inaccuracy data would lead to the following:

^ Wrong timing of control application

^Difficulties in recognizing level of infestation within or in different regions. Therefore, application is made in all regions whether levels of infestations are low, medium or high

Rearing and releasing the local predator lace wing Chrysopidae) to control Dubas

Releasing process of lace wing

Mass rearing of lace wing

Lesser date moth (Alhumara)

The lesser date moth is considered as one of the key pests attacking almost all date palm varieties in Iraq and many other countries in the world. Larvae start attacking the florescence and continue after fruit setting, feeding on subsequent fruit stages. Infested fruits become dry red in color. Most dried fruits drop causing big losses in yield. The starting date of generation emergence and infestation intensity vary according to the region and mostly coincide with the developmental stages of fruits which usually mature earlier in the southern region than the northern sides of the date palm growing region, according to the surrounding environmental factors.

Life cycle and description

The periodical activity starts in spring when climatic factors become favorable. Females lay their eggs individually on the cap of fruits or on strands close to them. Newly laid eggs are yellowish green in color and turn yellow before hatching. Young larvae are white stars that turn pink as larvae develop and become older. Mature larvae spin a light whitish silky cocoon inside which they later transform into pupae. Duration for adult emergence varies according to climatic factors. especially daily temperature. The adult is a small slim moth, around 12 -15 mm in length, dark in color with a silver abdomen. It has compound brown eyes and

silver antennae with dark spots. The front wings of the moth are covered with white scales and very small dark spots. The dorsal wings are narrow and dark, with long, dark bristle edges. After mating, females start laying their eggs on fruits, or nest around them. This insect goes through three overlapped generations during the developmental stages of fruits in most date palm growing regions of the country. However, the beginning and duration of generations vary according to surrounding environmental factors.

1.Adult

2. Egg close to cap

3.Egg

8. Pupa inside Cocoon

9. Dried fruits infested by LDM

4. Larvae

7. Secondary infection after LDM infestation

6. Sign of larva feeding inside the fruit

5. Larva bore inside the fruit through thr cap

Symptoms of infestation

Larvae start attacking small fruits and bore through the cap inside the fruits to feed on contents leaving an empty outside wall. During the subsequent generations, larvae attack different sizes of fruits and feed mainly on the soft pith and nucleus during the chemri stage (a stage of maturation where the date fruits are green and inedible). Infested fruits wilt and turn red in color. Small dried fruits can be seen tied or hanging by silken threads produced by the larvae. Dropped fruits with insect penetration holes and silky remains close to fruit cap are considered identifying characteristics, or signs of infestation by lesser date moth.

Larva on cap before entering the fruit

Hole represent larvae entrance inside the fruit

Integrated management elements for lesser date moth

The components of date palm pest management may overlap, especially when dealing with dubas and lesser date moth. However, the main steps suggested for the control of lesser date moth are the following:

1. Installation of photoelectric traps at the rate of one trap per region for monitoring purposes in order to determine the periodic activity of the insect,the date of adult emergence,and the timing of control practices.Pheromone traps can be used for both monitoring and control measures against LDM, through male confusion and mating distrubtion.The trap would attract males and reduce the chance of mating which will certainly reduce the level of infestation during the next generations.

Location of light traps on the tree

2. Release of the egg parasitoid *Trichogramma evanescens* at the rate of300 individuals/tree, twice per season, the first is applied after two weeks of completion of pollination and the second release would be after two weeks from the first one. Capsules containing the parasitoids are inserted within the fruit bunches.

Location of capsule on the bunch

Parasitoid female

3. Release of the larvae parasitoid *Bracon hebetor* at a rate of 5 pairs /tree after two weeks of pollination. When used with another bio-agent, parasitoid is applied after two weeks of releasing the egg parasitoid or spraying the biological insecticide Bt (*Bacillus thuringiensis*) .

Larvae of theparasitoid Bracon

Adult female of *Bracon*

4. Application of the biological insecticide Bt. in spray form, at a ratio of 3g/l (6-7 l/tree) after two weeks of completion of pollination.
5. Agricultural and sanitation practices to remove the dropped fruits from the orchards because they are considered as a source of infestation for the next generation.

Date palm borers

Recently, date palm borers have been considerd as major pests that cause serious damages to palm trees.Heavy infestation of stem borers would lead to the rupture of stems and collapsing of trees.Infestion debilitates the trees and reduces their productivity and yield.The pest are most damaing when they are at their larvae or adult stage, depending on the feeding behavior of the different speceis.

Damages caused by borers

Major species of palm borers

There are several species of borers that cause direct damages to different parts of palm trees in Iraq. The distribution of species and intensity of infestation vary according to the region and surrounding environmental factors. However, the most important and familiar species include the following three:

1.Bunch borer

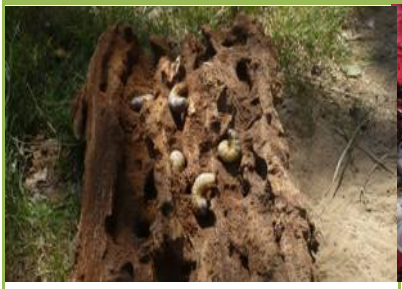
This species mainly infects the top of the tree and can be found in almost all stem parts of the aged trees. In middle age trees, larvae of this borer are found at the bases of the frond at the top of the tree

Life cycle and description

Adult bunch borers emerge in spring and the females start laying eggs after mating. Females prefer to lay their eggs at the base of the upper fronds, at the top of the tree. The white, ovoid-shaped eggs hatch to display arcuate, creamy larvae that have three thoracic legs and a well-developed head with strong mandibles. Larvae molt three times to become mature. During this period, larvae dig some cavities, using tissues and debris of the stem and fronds, where it then molts to pupa. Larvae molt to pupae which are dark brown in color with lateral brown spots on both sides representing the spiracle of larvae and pupae. Duration of pupa stage differs according to environmental factors. Newly emerged adults are brown and gradually turn into glossy black after few hours of emergence. Females can be differentiated from males by the dorso-frontal horn which is long in male and very short or absent in female.

4.Pupa

1.Adult



3. Larvae inside palm tissue

2. Larvae

Damages and symptoms of infestation

The life cycle of the bunch borer species is similar to that of the Arabian rhinoceros beetle; however, they differ in their feeding habits and the damage they cause. The rhinoceros beetle attacks most parts of palm tree creating a network of tunnels which lead to the weakness of the trees and breaking of the stem at any other additional stress such as wind storms. The bunch borer is found at the top of the tree and larvae are found at the base of fronds while adults feed on the stalk of the bunch, tunneling inside of it and leading to the rupture of the bunch or the destruction of its tissue. Fruits in such bunch are misshaped and small. Infestation of bunch borers is found in all date palm growing regions with increasing intensity towards the middle Euphrates and southern provinces.

Large larvae in the tissue of palm tree.

Larvae at the base of frond

Fruits of different sizes because of destruction of tissue by bunch borer

Small fruit in infested bunch compared to healthy one

2. Long horn stem borer

This species is considered as a serious palm stem pest. Infestation can be found on all lower and upper parts of the stem.

Symptoms of infestation

Infestation by this species is intensifying and, in the case of aging trees, it is becoming a more serious threat depending in its severity on the region and variety. Overlapping symptoms of this species with other borer species might occur with the dominance of one over the others. Infestation includes the gummy excretion found on the bases of the fronds at the top of tree. In the event of heavy infestation, the number of holes the pest bores in the stem may exceed 200/m of trunk. .

		
3. Holes made by borers on stem	2. Emergence holes of stem borers adults	1.Symptoms of infestation by borer on stem

Life cycle and description

Larvae make tunnels inside the trunk in which they spend the winter months. The mature larva is about 5cm in length, with a small head inserted on the thorax and Legless abdominal segments that are well developed. During spring and when conditions are favorable, the larvae start digging their holes close to the external surface and then molt to pupae inside these holes. Pupae are white in color and gradually turn into reddish brown. The duration of the pupa stage varies according to climatic conditions (especially daily temperature). The female insect is larger than the male and both are cylindrical in shape, reddish brown in color, with large, compound eyes and antennae that are longer than insect body. After mating, females start laying their eggs individually on stems and on the bases of fronds. Newly hatched larvae start boring in the stem and fronds to move inside and continue their feeding in the tunnel molting to pupae and then to adults. The duration of each stage varies according to climatic factors and the larval stage alone may last more than three months

4. Anterior part of larva appears from the hole

1.Adults

3. Pupa

2. different stages and large larva

3. Frond borer

This species is found in many countries in the region infesting grapes, pomogranate and other host plants inaddition to the fronds of date palm.

Symptoms of infestation and damage

Both larvae and adult life stagesare considered as harmful..Adults bore tunnels inside the middle rib of the green fronds.Symptoms of infestation are represented by the presence of the gummy materials excreted from the entrance holes.Infested fronds becomebristle and easy to break.This pest also attacks dried fronds which are used for handcrafts industries,and to build traditional roofs of homes in the villages.Symptoms in this case are charecterised by the presence of exit holes used by newly emerged adults.Debris in the tunnels are another sign of infestation.When the insect attacks the stalk of the bunch,fruits shrivle and dry out.

Description and life cycle

Adult frond borers are medium-sizebeetles that have elongated, dark brown or black bodies.The first thoracic segment of the insect covers the head, the anterior part of thedorsal plate is the first thoracic segment with thorns,while the posterior edge issmooth and shiny.Female frond borers lay eggs on green or soft fronds and bunches.The newly emerged larvae are creamy

3.Symptoms of infestation

2.Damages caused by frond borer

1.Adult

in color, legless, arcuate in shape and all stages may be found within the same frond at the same time.

Integrated management tools for date palm borers

1. Cultural practices

This is an effective practice to control the larvae of bunch borers which are found at the base of the fronds in middle aged palm trees and can be found in all parts of the trunk in old trees. Larvae duration is long and may extend to more than six months. The collection and destruction of larvae is done manually during the annual routine service of palm orchards (pruning and cutting of fronds) which starts in December and continues until March. This method has proven to be an effective method to control bunch borers and to population density, significantly.

2. Physical and mechanical measures

This method is directed against the adults through the use of photoelectric light traps with a wave length of 320-420 nm. Light traps proved to be effective against the adult stages of the three species of palm borers. Adults start their periodical activity during April and continue in summer and fall to disappear in December. The highest population is recorded in the months of June, July and August.

Field studies showed that the implementation of agricultural, physical and mechanical measures resulted in 82% and 90% reduction of borers' population during the first and second years of application. Yield increase exceeded 20% and this could be further improved if the application of the program continues during the subsequent seasons.

3. Other practices

The success of the management program against date palm borers should take into consideration the following essential applications:

1. Identifying neglected orchards which produce low yields and that are considered as a source of infestation. Infested trees should be removed and burned if there is no other effective mean to control the pest and rehabilitate the orchard is available. Moreover, there is a need to obtain the necessary supplies for the implementation of agricultural services of palm groves.
2. Using normal or photoelectric light traps to identify the infestation loci (since these traps are effective monitoring tools, in addition to their role as a control measure) to help reduce the population density of date palm pests. They can be used to determine the relation between the climatic factors and the distribution of intended pests in order to decide the ecological map for each pest and the associated natural enemies which would be used as a prediction tool for infestation level and suggested control practice.
3. Encouraging the owners of date palm orchards to do the annual service and removal of borers' larvae which are considered as a source of subsequent infestations.

The use of light traps in the control and monitoring program against bunch borer

The application of the suggested control methods against date palm pests can coincide among each other and one management tool may be efficient in controlling more than one pest at a time. Therefore, farmers are advised to contact the Directorates of Plant Protection in Baghdad or the Departments of Plant Protection and Agricultural Extension at the Agricultural and Extension Directorates in the Provinces in order to provide information concerning any problems in their orchard and to get the required recommendation to combat this problem