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The Current Status of the Date Palm Tree (*Phoenix dactylifera L.*) and its Uses in the Gaza Strip, Palestine

الوضع الحالي لشجرة النخيل واستخداماتها في قطاع غزة

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إقرار

أنا الموقع أدناه مقدم الرسالة التي تحمل العنوان:

The Current Status of the Date Palm Tree (*Phoenix dactylifera L.*) and its Uses in the Gaza Strip, Palestine

الوضع الحالي لشجرة النخيل واستخداماتها في قطاع غزة

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الوضع الحالي لشجرة النخيل واستخداماتها في قطاع غزة

The Current Status of the Date Palm (Phoenix dactylifera L.) Tree and its Uses in the Gaza Strip, Palestine

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واللجنة إذ تمنحها هذه الدرجة فإنها توصيها بتقوى الله ولزوم طاعته وأن يسخر علمها في خدمة دينها ووطنها.

والله ولي التوفيق،،،



نائب الرئيس لشئون البحث العلمي والدراسات العليا

أ.د. عبدالرؤوف علي المناعمة

Abstract

Date Palm (*Phoenix dactylifera L.*) is considered one of the most important fruit crops in Palestine. Its cultivation has been known for thousands of years. It has a major socio-economic importance due to its commercial, nutritional, environmental, social, health and religious values. It possesses a minimum water demand and tolerates high levels of salinity and harsh weather. Due to its importance as a resistant and strategic crop facing serious threats, the current study comes to investigate the current status of the Date Palm tree and its uses in the Gaza Strip. Field surveys and questionnaire interviews (N=150) were applied to fulfill the purpose of the study.

The current study revealed a total number of 250,000 trees of Date Palm in the whole Gaza Strip. Its cultivation is more concentrated in the Middle Governorate. At least, 19 cultivars have been recorded locally with the Hayani, Barhee and Bentaisha are the most common. The average of balah production in the last years was 12,000 – 15,000 ton per year. The Red Palm Weevil (RPW) is a major serious pest threatening the sustainable production of the Date Palm sector in the Gaza Strip. The introduction of infected offshoots from Egypt and ability of adult weevils to fly long distance seem to be main causes of the local infections discovered in late 2011. Different control techniques have been adopted by the responsible parties to combat the insect. More than 40 industries have been found to be associated with Date Palm trees in the Gaza Strip. Handicraft production and food industries are the main creative uses of the Date Palm by the Palestinian community.

The results of the questionnaire survey in the Middle Governorate pointed out that the Hayani cultivar was grown by all respondents. About 59% of the respondents suffered from the decrease of the number of Date Palm trees in their orchards due to different causes including Israeli procedures and pest attacks. The average production of the Date Palm tree reaches 130 kg per year. As far as wildlife is concerned, 55.3% of the respondents ensured the occurrence of tens of vertebrate faunistic species in their Date Palm orchards. All respondents were aware of the environmental values and the popular uses and industries achieved by Date Palm trees and this is a good sign of consideration. 70.7% of respondents were found to produce household products such as Ajwa, Eid cakes, molasses, etc.

With regard to the threats facing the Date Palm sector in the Gaza Strip, 90.0% confirmed such risks and problems. The Israeli occupation with its military operations and the outbreak of RPW are main crucial threats. About 77% used a variety of chemical pesticides to combat and eliminate Date Palm pests. 84.0% believed that the local projects of Date Palm cultivation have several advantages such as the provision of self-sufficiency and food security, improvement of productivity and national income and reduction of unemployment rate. Finally, the study recommends the improvement of the processes of Date Palm cultivation, production and marketing, and the cooperation of the different parties to ensure good sustainable development of this sector in the Gaza Strip.

Key words: Date Palm, cultivars, Red Palm Weevil, public uses, Gaza Strip.

ملخص الدراسة

تعتبر شجرة النخيل من المحاصيل الأكثر أهمية في فلسطين. عرفت زراعة النخيل في قطاع غزة منذ آلاف السنين. لشجرة النخيل أهمية اجتماعية اقتصادية نظراً لقيمتها التجارية والغذائية والبيئية والاجتماعية والصحية والدينية. وتتميز بأنها تتطلب الحد الأدنى من المياه وتحمل مستويات عالية من الملوحة ومن الظروف القاسية. بالرغم من أهمية النخيل كمحصول استراتيجي مقاوم، إلا أنه يواجه مهددات خطيرة. وبالتالي هدفت الدراسة الحالية لتقصي الحالة الراهنة لأشجار النخيل واستخداماتها في قطاع غزة. تم عمل مسوحات ميدانية ومقابلات استيعابية (N = 150) لتحقيق هدف الدراسة.

كشفت الدراسة الحالية أن العدد الكلي لأشجار النخيل في قطاع غزة حوالي 250 ألف شجرة، 67% منها هي أشجار مثمرة. تتركز زراعة النخيل بشكل كبير في المحافظة الوسطى. تم تسجيل تسعة عشر صنفاً على الأقل من أصناف النخيل والأصناف الأكثر شيوعاً هي الحياتي والبرحي وبنيت العيش. بلغ متوسط إنتاج البلح في السنوات الأخيرة 12,000-15,000 طن في السنة. تعتبر آفة سوسة النخيل الحمراء من الآفات الأكثر خطورة والتي تهدد الانتاج المستدام للنخيل في قطاع غزة. ويبدو أن ادخال الفسائل المصابة من مصر وقدرة الحشرة على الطيران لمسافات طويلة هو السبب الرئيسي في انتشار العدوى بهذه الآفة والتي اكتشفت في أواخر عام 2011. تم استخدام تقنيات مختلفة لمكافحة هذه الآفة من قبل الجهات المختصة. يوجد أكثر من 40 صناعة واستخداماً عاماً تعتمد على أشجار النخيل في قطاع غزة. وتعتبر المشغولات اليدوية والصناعات الغذائية من أهم الاستخدامات في المجتمع الفلسطيني.

أظهرت نتائج الاستبانة في المحافظة الوسطى أن صنف الحياتي يزرع من قبل جميع المستجيبين. ويعاني 59% من المستجيبين من تناقص أعداد أشجار النخيل في بساتينهم لأسباب مختلفة من أهمها الممارسات الإسرائيلية ومهاجمة الآفات. يبلغ متوسط إنتاج شجرة النخيل 130 كغم. وفيما يتعلق بالحياة البرية، أكد 55.3% من المستجيبين بوجود العشرات من الحيوانات الفقارية في بساتينهم. جميع المستجيبين كانوا واعين للقيم البيئية وللاستخدامات الشعبية والصناعات المرتبطة بشجرة النخيل وهذا مؤشر جيد يجب أن يؤخذ بعين الاعتبار. أكد جميع المستطلعين على وجود استخدامات شعبية وصناعات مرتبطة بشجرة النخيل. أشارت نتائج الدراسة إلى أن 70.7% من المستجيبين يقومون بإنتاج منتجات منزلية مثل العجوة، وكعك العيد، والدبس وغيرها.

أما فيما يتعلق بالتهديدات والمخاطر التي تواجه قطاع النخيل في قطاع غزة. أكد 90.0% من المستجيبين على وجود مثل هذه المشاكل والمهددات ويعتبر الاحتلال الإسرائيلي وانتشار آفة سوسة النخيل الحمراء الأكثر تهديداً وخطورة. حوالي 77.3% من المستجيبين يستخدمون أنواع مختلفة من المبيدات الكيميائية لمكافحة الآفات التي تصيب أشجار النخيل. يعتقد 84.0% من المستجيبين أن مشاريع زراعة النخيل لها أهمية بيئية واقتصادية مثل ضمان الاكتفاء الذاتي والأمن الغذائي، زيادة الإنتاجية والدخل القومي، والحد من نسبة البطالة في المجتمع الفلسطيني. وأخيراً توصي الدراسة بتحسين عمليات زراعة وانتاج وتسويق النخيل، وعلى تعاون الجهات المختلفة لضمان التنمية المستدامة لهذا القطاع الزراعي البالغ الأهمية في قطاع غزة.

كلمات مفتاحية: نخيل البلح، أصناف، سوسة النخيل الحمراء، الاستخدامات العامة، قطاع غزة.

Dedication

To my lovely family ...

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List of Abbreviation

Abbreviation	Full Name
ARIJ	Applied Research Institute – Jerusalem
ASDPD	Al-Ahlyah Association for the Development of Date Palm
B.C.	Before Christ
BCU	Biological Control Unit
EQA	Environmental Quality Authority
EHCRS	Earth and Human Center for Research and Study
EPF	Entomopathogenic Fungi
FAO	Food and Agriculture Organization
FAOSTAT	Food and Agriculture Organization Statistical Database
GEF	Global Environment Facility
GIS	Geographic Information System
Ha	Hectare
ICARDA	International Center for Agricultural Research in the Dry Areas
IPM	Integrated Pest Management
ISSR	Inter Simple Sequence Repeats
IUG	Islamic University of Gaza
Kg	Kilogram
MENA	Middle East and North Africa
MT	Metric Ton
MMT	Million Metric Tons
MOA	Ministry of Agriculture
MSRD	Al-Mosadder Society for Rural Development
PCBS	Palestinian Central Bureau of Statistics
PNAPD	Palestinian Al-Nakheel Association for Progress and Development
PNGOs	Palestinian Non-Governmental Organizations
PPE	Personal Protective Equipment
RAPD	Random Amplification of Polymorphic DNA
RPW	Red Palm Weevil
SGP	Small Grants Programme
SPSS	Statistical Package for Social Sciences
UNEP	United Nations Environmental Programme
USA	United States of America
UAE	United Arab Emirate

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Chapter 1

Introduction

Chapter 1

Introduction

1.1. Overview

Date Palm has long been one of the most important fruit crops in the arid regions of the Arabian, Middle East and North Africa (MENA) (Chao and Krueger, 2007). It is one of the oldest trees from which man has derived benefit, and it has been cultivated since ancient times (El-Juhany, 2010). Today the Date Palm is found in both the old world (Near East and North Africa) and the new world (American continent) where dates are grown commercially in large quantities (Zabar and Borowy, 2012).

The world total number of Date Palms is about 120 million, distributed in 30 countries and producing between 7.51 million tons of fruit per year (FAO, 2013). Asia is the first position with 60 million Date Palms ; while Africa is in the second position with 32.5 million Date Palms . Mexico and the USA have 600,000 palms followed by Europe (Spain) with 320,000 and Australia with 30,000 (Zaid, 2001). Date Palm trees spread throughout the Arab world from Mauritania to Arabian Gulf. Arab countries possess 70% of the 120 million world's Date Palms and are responsible for 67% of the global date production (El-Juhany, 2010).

Date Palm has a major socio-economic importance not only for its fruit but also as an ornamental plant. Because of its high nutritional value, great yields and its long life span, the Date Palm has been mentioned as the “tree of life”. Dates are a main income source and staple food for local populations in many countries in which they are cultivated, and have played significant roles in the economy, society, and environment of those countries (Saafi et al., 2008; Chao and Krueger, 2007). In addition to its commercial and nutritional value, the Date Palm tree has a minimum water demand, tolerates harsh weather, and tolerates high levels of salinity; in fact, it is more salt tolerant than any other fruit crops (FAO, 1982; Alhammadi and kurup, 2012). Date Palms are afflicted with many diseases and pests. The RPW has recently become one of the major Date Palm pests and causes severe losses to farmers (Vidyasagar and Aldosari, 2011).

Cultivated Date Palm have existed in Palestine for 5,000 years. The Mediterranean climate conditions dominant in the area provide optimal conditions for growth and development of certain cultivars of Date Palm (Abu-Qaoud, 2015).

Date Palm cultivation in the Palestinian Territories exists in the regions of Jericho and the Jordan Valley in the West Bank, and in the Gaza Strip (Figure 1.1). The total harvested area of dates in both the West Bank and Gaza was 873 hectare (ha) (hectare =10.000 m²) in 2011. In the West Bank, there were 85,000 Date Palms spread over 600 ha, with a production capacity of 2,300 metric ton (MT) in 2012. However, the total date fruit production in Gaza was about 3,000 MT, with Hayani as a major cultivar in Gaza and Medjool in the West Bank (Abu-Qaoud, 2015).

Many local, national or even regional food industries are dependent on dates of the Gaza Strip. In medicine, the plant is known to be used to cure many illnesses such as fevers, cystitis and edema. The ripen fruits enhance the contraction of the uterus during delivery. The long leaves are used as cleaning tools or in roofing recreational places. The trunks are usually used in building purposes or industry (Abd Rabou et al., 2008).

The main problems facing the Date Palm are lack of water, Israeli incursions and bombardments dredging, Israel's control of vaccine trees and pesticides, high production costs, weak marketing services and limited support policies for the cultivation of Date Palm (Wafa, 2014).

The Gaza Strip is a penne region of Palestine on the eastern coast of the Mediterranean Sea that borders Egypt on the southwest for 11 km and West Bank on the east and north along a 51 km border. Gaza has an annual population growth rate of 2.91%, the 13th highest in the world, and is overcrowded. The territory is 41 km long, and from 6 to 12 km wide, with a total area of 365 km². In 2016, the Palestinians of the Gaza Strip numbered around 1.88 million people (PCBS, 2016). The Gaza Strip is a densely populated and impoverished region inhabited primarily by Muslim Palestinian refugees; the majority live in large, overcrowded refugee camps.

The city of Gaza is the principal city and administrative center. Other cities include Beit Lahia in the north and Khan Younis and Rafah in the south (see Table 1.1).

Table (1.1): Governorates of Gaza Strip and West Bank

Governorate	Area (km ²)	Population
North Gaza	61	377,126
Gaza	74	645,204
Middle Governorate	58	273,381
Khan Younis	108	351,934
Rafah	64	233,490
Jenin	583	318,958
Tubas	402	66,854
Tulkarm	246	185,314
Nablus	605	389,329
Qalqilya	166	113,574
Salfit	204	72,279
Ramallah and Al-Bireh	855	357,969
Jericho	593	53,562
Jerusalem	345	426,533
Bethlehem	659	221,802
Hebron	997	729,194
Total	6020	4,816,503

(Source: PCBS, 2016).

The study area has a typical semi-arid Mediterranean climate; hot in summer and cold in winter. The average daily mean temperature ranges from 25°C in summer to 13°C in winter, with the average daily maximum temperature range from 29°C to 17°C and the minimum temperature range from 21°C to 9°C, in summer and winter respectively. The daily relative humidity fluctuates between 65% in daytime and 85% at night in summer and between 60% and 80% respectively in winter (UNEP, 2003).

The Gaza Strip has small construction and handicrafts industries, and some farming, including citrus fruits, Date Palm, olives, and livestock. However, Gaza depends on Israel for nearly 90% of its imports (largely food, consumer goods, and construction materials) and exports (mainly citrus fruit and other agricultural products), as well as employment.

Date Palm cultivation in the Palestinian Territories exists in the regions of Jericho and the Jordan Valley in the West Bank (Figure 1.1). In the Gaza Strip, the Date Palm cultivation is mainly concentrated in the Middle and southern Governorate (Figure 1.2). Deir Al-Balah is situated in the Middle Governorate of the Gaza Strip, along the coastline of the eastern Mediterranean Sea. Deir Al-Balah is well known for growing Date Palms. An estimated 20,000 of which covered the landscape south and west of the city. However, thousands of date trees have been uprooted or bulldozed by the Israeli Army since the beginning of the Second Intifada in 2000. In addition to being a local delicacy, date cultivation constitutes one of the principal sources of income for many of Deir Al-Balah's residents. The particular type of date that is cultivated in the area is known as "Hayani". Other leading agricultural products cultivated in Deir Al-Balah include citrus, almonds and grapes.



Figure (1.1): The geographic distribution of cultivation of the Date Palm in Palestine.



Figure (1.2): The geographic distribution of cultivation of the Date Palm in the Gaza Strip.

Studies concerning the Date Palm in the Gaza Strip seem to be very limited and not neither comprehensive nor specific. Therefore this study aims to investigate on the status of the Date Palm and its uses in the Gaza Strip.

1.2. Problem

1. The local studies of Date Palm sector seem to be very limited.
2. The outbreak of RPW, which has recently become one of the most threats facing the Date Palm sector.
3. The sustainable use of Date Palm trees can contribute to job creation opportunities for poorer families.
4. There is a weak awareness of people toward the various issues and topics related to the Date Palm sector.

1.3. Objectives

1.3.1. Main Objective

The objective of this study is to investigate the current status of the Date Palm (*Phoenix dactylifera L.*) and its uses in the Gaza Strip.

1.3.2. Specific Objectives

1. To display the geographic distribution and main cultivars of Date Palm through field surveys.
2. To investigate the industrial uses of Date Palm.
3. To study the main threats and diseases facing the Date Palm. Particular emphasis will be paid to the Red Palm Weevil and its control techniques.
4. To investigate the public awareness and attitudes toward the Date Palm through questionnaire application.

1.4. Significance

The present study can be considered the first of its kind in the sense that it will provide useful information about the reality of the Date Palm in the Gaza Strip to both responsible authorities and the public as follows:

- The geographic distribution, main cultivars and industrial uses of Date Palm.
- Threats and diseases facing the Date Palm.
- The current status of Red Palm Weevil and its control techniques.
- Also the study will enhance the responsible and public parties toward the cultivation and protection of Date Palm.

Chapter 2

Literature Review

Chapter 2

Literature Review

2.1. History of Date Palm

Date Palm is one of the oldest trees from which man has derived benefit and it has been cultivated in North Africa and the Middle East for at least 5000 years (Zohary and Hopf, 2000; Jaradat, 2011; Chao and Krueger, 2007). It was certainly domesticated by 3000 B.C. in Mesopotamia, and may even have been cultivated as early as 5000 B.C. (Mahmoudi et al., 2008). During the past three centuries, dates were also introduced to new production areas in Australia, India/Pakistan, Mexico, southern Africa, South America, and the United States (Chao and Krueger, 2007). Date Palm trees have played significant roles in agriculture and represents a significant part in the reclamation program. Besides the nutritional values and health benefits of the fruits, the Date Palm by-products are daily used by local population in many countries in which they are cultivated (Bekheet, 2013).

Historically the tropical appearance of palm trees was noted in ancient documents, and on stone inscriptions uncovered by archaeological excavations and from multiple references in the Bible Scriptures. Ancient civilizations revered palm trees as symbols of fertility, peace, and victory. Palm tree images were struck and minted on ageless coins of the Greeks and Romans (Malcolm, 2006).

From its center of origin, date cultivation spread throughout the Arabian Peninsula, North Africa, and the Middle East. The spread of date cultivation later accompanied the expansion of Islam and reached southern Spain and Pakistan. The Spanish were the first to introduce Date Palms outside the Arabian Peninsula, North Africa, and the Middle East/South Asia, carrying them to America (Chao and Krueger, 2007; Ateeq et al., 2013).

The Date Palm, mentioned more than any other fruit-bearing plant in the Holy Quran, is a symbol often associated with Islam and Muslims. Throughout the month of Ramadan, dates are a common ingredient in the Muslim diet (Nalamkandy, 2011).

Moreover, it is believed to be of benefit to pregnant women. In Surat Maryam, Allah provided Maryam (peace be upon her), the mother of Prophet Eesa (peace be upon him), with dates when she was experiencing discomfort and pain during the final stages of her pregnancy. "And shake towards thyself the trunk of the palm-tree It will let fall fresh ripe dates upon thee" (Surat Maryam:25). The Date Palm tree was mentioned in the Holy Quran twenty times as following in Table 2.1.

Table (2.1): Date Palm statements that mentioned in the Holy Quran

Surat	No. of statement	Statement
Al-Baqarah (البقرة)	2.266	(أَيُّودٌ أَخَذْتُمْ أَنْ تُكُونَ لَهُ جَنَّةٌ مِّنْ نَّخِيلٍ وَأَعْنَابٍ تَجْرِي مِنْ تَحْتِهَا الْأَنْهَارُ لَهُ فِيهَا مِنْ كُلِّ الثَّمَرَاتِ). "Would one of you like to have a garden of palm trees and grapevines underneath which rivers flow in which he has from every fruit?..".
Al-Anam (الأنعام)	6.99	(وَهُوَ الَّذِي أَنْزَلَ مِنَ السَّمَاءِ مَاءً فَأَخْرَجْنَا بِهِ نَبَاتٍ كُلِّ شَيْءٍ فَأَخْرَجْنَا مِنْهُ خَضِرًا نُخْرِجُ مِنْهُ حَبًّا مُتَرَاكِبًا وَمِنَ النَّخْلِ مِنَ النَّخْلِ مِنْ طَلْعِهَا قِنْوَانٌ دَانِيَةٌ وَجَنَّاتٍ مِنْ أَعْنَابٍ وَالزَّيْتُونَ وَالرُّمَّانَ مُشْتَبِهًا وَغَيْرَ مُتَشَابِهٍ). "...We produce from it greenery from which We produce grains arranged in layers. And from the palm trees - of its emerging fruit are clusters hanging low. And [We produce] gardens of grapevines and olives"
Al-Anam (الأنعام)	6.141	(وَهُوَ الَّذِي أَنْشَأَ جَنَّاتٍ مَعْرُوشَاتٍ وَغَيْرَ مَعْرُوشَاتٍ وَالنَّخْلَ وَالزَّرْعَ).. "And He it is who causes gardens to grow, [both] trellised and untrellised, and palm trees and crops of different [kinds of] food and olives and pomegranates, similar and dissimilar....".
Ar-Rad (الرعد)	13.4	(وَفِي الْأَرْضِ قِطْعٌ مُتجاوِزَاتٌ وَجَنَّاتٌ مِنْ أَعْنَابٍ وَزَّرْعٌ وَنَخِيلٌ صِنْوَانٌ وَغَيْرُ صِنْوَانٍ). "And within the land are neighboring plots and gardens of grapevines and crops and palm trees, [growing] several from a root or otherwise, watered with one water; but We make some of them exceed others in [quality of] fruit".
An-Nahl (النحل)	16.67	(وَمِنْ ثَمَرَاتِ النَّخِيلِ وَالْأَعْنَابِ تَتَّخِذُونَ مِنْهُ سَكَرًا وَرِزْقًا حَسَنًا). "And from the fruits of the palm trees and grapevines you take intoxicant and good provision. Indeed in that is a sign for a people who reason".
Al-Isra (الإسراء)	17.91	(أَوْ تَكُونَ لَكَ جَنَّةٌ مِّنْ نَّخِيلٍ وَعِنَبٍ فَتُفَجَّرَ الْأَنْهَارُ خِلَالَهَا تَفْجِيرًا). "Or [until] you have a garden of palm trees and grapes and make rivers gush forth within them in force [and abundance]".

Surat	No. of statement	Statement
Al-Kahf (الكهف)	18.32	﴿وَاضْرِبْ لَهُم مَّثَلًا رَجُلَيْنِ جَعَلْنَا لِأَحَدِهِمَا جَنَّتَيْنِ مِنْ أَعْنَابٍ وَحَفَفْنَاهُمَا بِنَخْلٍ وَجَعَلْنَا بَيْنَهُمَا زُرْعًا﴾ "And present to them an example of two men: We granted to one of them two gardens of grapevines, and We bordered them with palm trees and placed between them [fields of] crops".
Maryam (مريم)	19.23	﴿فَأَجَاءَهَا الْمَخَاضُ إِلَى جِذْعِ النَّخْلَةِ قَالَتْ يَا لَيْتَنِي مِتُّ قَبْلَ هَذَا وَكُنْتُ نَسِيًّا مَنْسِيًّا﴾ "And the pains of childbirth drove her to the trunk of a palm tree. She said, Oh I wish I had died before this and was in oblivion, forgotten."
Maryam (مريم)	19.25	﴿وَهَرِي إِلَيْكَ بِجِذْعِ النَّخْلَةِ تُسَاقِطُ عَلَيْكَ رُطْبًا حَلِيًّا﴾ "And shake toward you the trunk of the palm tree; it will drop uspon you ripe, fresh dates".
Ta-Ha (طه)	20.71	﴿قَالَ أَمَنْتُمْ لَهُ قَبْلَ أَنْ آذَنَ لَكُمْ إِنَّهُ لَكَبِيرِكُمْ الَّذِي عَلَّمَكُمُ السِّحْرَ فَلَا قِطْعَانَ أَيْدِيكُمُ وَأَرْجُلِكُمْ مِنْ خِلَافٍ وَلَا صَلْبَيْكُمُ فِي جُذُوعِ النَّخْلِ وَلَتَعْلَمُنَّ أَيُّنَا أَشَدُّ عَذَابًا وَأَبْقَى﴾ "You believed him before I gave you permission. Indeed, he is your leader who has taught you magic. So I will surely cut off your hands and your feet on opposite sides, and I will crucify you on the trunks of palm trees, and you will surely know which of us is more severe in [giving] punishment and more enduring"
Al-Muminun (المؤمنون)	23.19	﴿فَأَنْشَأْنَا لَكُمْ بِهِ جَنَّاتٍ مِّنْ نَّخِيلٍ وَأَعْنَابٍ لَّكُمْ فِيهَا فَوَاكِهُ كَثِيرَةٌ وَمِنْهَا تَأْكُلُونَ﴾ "And We brought forth for you thereby gardens of palm trees and grapevines in which for you are abundant fruits and from which you eat".
Ash-Shuara (الشعراء)	26.148	﴿وَزُرُوعٍ وَنَخْلٍ طَلَعُهَا هَضِيمٌ﴾ "And fields of crops and palm trees with softened fruit?".
Ya-Sin (ياسين)	36.34	﴿وَجَعَلْنَا فِيهَا جَنَّاتٍ مِّنْ نَّخِيلٍ وَأَعْنَابٍ وَفَجَّرْنَا فِيهَا مِنَ الْعُيُونِ﴾ "And We placed therein gardens of palm trees and grapevines and caused to burst forth there from some springs".
Qaf (قاف)	50.10	﴿وَالنَّخْلُ بَاسِقَاتٍ لِّهَا طَلْعٌ نُّصِيدٌ﴾ "And lofty palm trees having fruit arranged in layers".
Al-Qamar (القمر)	54.20	﴿تَنْزِعُ النَّاسَ كَأَنَّهُمْ أَعْجَازُ نَخْلٍ مُنْقَعِرٍ﴾ "Extracting the people as if they were trunks of palm trees uprooted".
Ar-Rahman (الرحمن)	55.11	﴿فِيهَا فَاكِهَةٌ وَالنَّخْلُ ذَاتُ الْأَكْمَامِ﴾ "Therein is fruit and palm trees having sheaths [of dates]".

Surat	No. of statement	Statement
Ar-Rahman (الرحمن)	55.68	﴿فِيهِمَا فَاكِهَةٌ وَنَخْلٌ وَرُمَّانٌ﴾ "In both of them are fruit and palm trees and pomegranates".
Al-Hashr (الحشر)	59.5	﴿مَا قَطَعْتُمْ مِنْ لَبَنَةٍ أَوْ نَضَعْتُمْهَا قَائِمَةً عَلَى أَوَّلِهَا ..﴾ "Whatever you have cut down of [their] palm trees or left standing on their trunks - it was by permission of Allah and so He would disgrace the defiantly disobedient".
Al-Haqqa (الحاقة)	69.7	﴿سَخَّرَهَا عَلَيْهِمْ سَبْعَ لَيَالٍ وَتَمَازِيَةَ أَيَّامٍ حُسُومًا فَفَرَى الْقَوْمُ فِيهَا صَرْعَى كَأَنَّهُمْ أَعْجَازُ نَخْلٍ خَاوِيَةٍ﴾ "Which Allah imposed upon them for seven nights and eight days in succession, so you would see the people therein fallen as if they were hollow trunks of palm trees".
Abasa (عبس)	80.29	﴿وَزَيْتُونًا وَنَخْلًا﴾ "And olive and palm trees".

2.2. Geographic Distribution of Date Palm

Phoenix dactylifera is a widely distributed species occurring in diverse geographic, soil and climatic areas (El-Hadrami et al., 2011). Date Palms grow in hot, arid regions of the world (encompasses the dry desert region of the world between 10°N and 39°N in the Northern hemisphere and between 7° S to 33 °51' S in the Southern hemisphere) and in nearly rainless regions at 9-39° North latitude, which are represented by the Sahara and Southern fringe of the Near East (Arabia Peninsula, Southern Iraq and Jordan) (Al-Khalifa et al., 2013).

Date Palms are marketed worldwide as a high-value sweet fruit crop. It is considered as an important subsistence crop in most of the world's desert areas (Mahmoudi et al., 2008). The Date Palm has traveled remarkably well as civilization moved out of the Middle East and reached places such as Spain and the United States, with the Coachella Valley (California) later becoming the primary commercial region of date production in the USA (Sauer, 1993).

Beyond the arid climates, Date Palm can also be grown in many other countries for food or as an ornamental plant including the continents of Americas, southern Europe, Asia, Africa, and Australia. The majority of Date Palm-growing areas are located in developing or underdeveloped countries where date fruit is considered the primary food crop, thus playing a major role in the nutritional status of these communities (Siddiq and Greiby, 2013).

The common requirement among all Date Palm growing areas is the high temperature (35°C) necessary for an optimal development of pollen and the low relative humidity for fruit setting and ripening. Such desert-adapted tree require large quantities of water drawn from deep in the soil through a well-established root system or from surface irrigation. Dates are widely grown in the arid regions between 15°N and 35°N, from Morocco in the west to India in the east (El-Hadrami and Al-Khayri, 2012; Dayang et al., 2014; Nwanekezi et al., 2015).

2.3. Worldwide Production of Date Palm

The area under Date Palm cultivation almost doubled from 1990 to 2007 (0.63 to 1.23 million hectares), however, there has been some decrease in years 2008 to 2010 (Figure 2.1). The 2011 area figures stood at 1.20 million hectares (FAO, 2012), which represented an increase of 90.5% as compared to 1990's. It is noted the increases in area under date cultivation were more rapid from 1990 to 2001- about 70% increase to 1.07 million hectares - whereas only 11% increase was observed from 2001 to 2011.

The total world production of dates was 7.51 million metric tons (MMT) in 2011 (FAO, 2013), which represented an almost 120% increase as compared to the 1990 production of 3.43 MMT (Figure 2.1). World date production increased consistently between years 1990 and 2001, for a total of 97% increase to 6.76 MMT. The production from 2001 to 2011 showed mixed trends, with about 11% increase. Overall, it is noteworthy to mention that date cultivation and production have shown positive growth trends (Siddiq and Greiby, 2013).

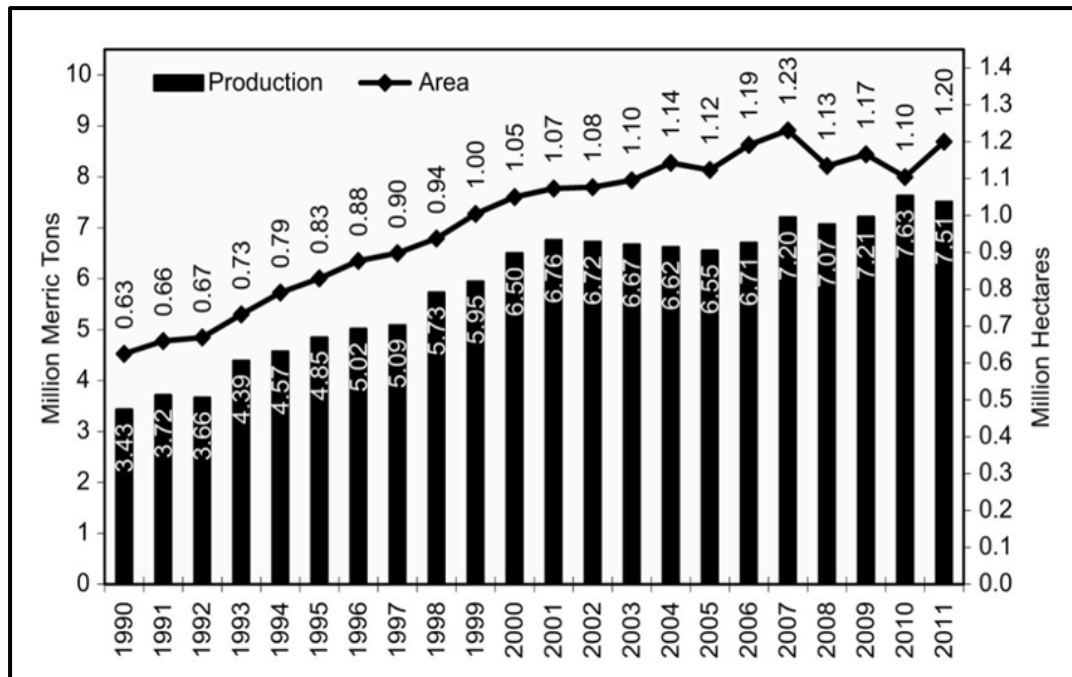


Figure (2.1): World date production and area under cultivation (1990–2011).
Source: Adapted from FAO (2012).

Table 2.2 represents data on the area under date cultivation and production for leading countries. Egypt was the top-most producer of dates with 1.37 MMT of total world production followed by Saudi Arabia (1.12 MMT), Iran (1.02 MMT), United Arab Emirates (0.90 MMT) and Algeria (0.69 MMT). Combined, these top five countries contributed a 68% share of total world production. Other countries, not shown in Table 2.2, with noticeable production (in thousand metric tons) were: Palestinian occupied territories (37.0), Kuwait (33.6), USA (30.0) and Turkey (28.3).

Table (2.2): Leading date-producing countries in the world in 2011 (with over 50,000 MT)

Country	Area (hectares)	Production (metric tons)	Share of World Production (%)
Egypt	41,652	1,373,570	18.30
Saudi Arabia	172,297	1,122,820	14.96
Iran	154,274	1,016,610	13.55
UAE	200,000	900,000	11.99
Algeria	17,2500	690,000	9.19
Pakistan	93,088	557,279	7.43
Oman	31,148	268,011	3.57
Tunisia	51,000	180,000	2.40
Libya	30,056	165,948	2.21
China	10,500	150,000	2.00

Country	Area (hectares)	Production (metric tons)	Share of World Production (%)
Morocco	43,982	119,473	1.59
Yemen	14,983	59,627	0.79
Palestine*	2,700	10,000	0.13
World Total ¹	1,202,706	7,514,984	-

(Source: Siddiq & Greiby, 2013), ¹Including all other countries not listed, * Added by the researcher.

As per FAO's 2011 data, dates are produced in 37 countries (FAO, 2012), however, it is noted that countries listed in Table 2.2 accounted for 95.4% of the total production while the remaining 25 countries contributed less than 5%. A regional distribution of date-producing countries is given below (Sidiqq and Greiby, 2013):

- **Asia:** Saudi Arabia, Iran, UAE, Iraq, Pakistan, Oman, China, Yemen, Kuwait, Turkey, Qatar, Bahrain, Jordan, Occupied Palestinian Territory, and Syria.
- **Africa:** Egypt, Algeria, Tunisia, Libya, Morocco, Mauritania, Chad, Niger, Somalia, Benin*, Kenya, Cameroon, Namibia, Swaziland, and Djibouti.
- **Americas:** USA, Mexico, Peru, and Colombia.
- **Europe:** Albania and Spain.

The average economic life of a Date Palm is 40 to 50 years, but some are still productive up to 150 years. There are a few Date Palms that are probably several hundred years old. The average Date Palm produces 40 kg fruit annually, with yields of more than 100 kg possible with intensive management. When farmed with low levels of inputs and management, dates may produce 20 kg fruit or less annually (Hodel and Pittenger, 2003).

2.4. Botanical Description of the Date Palm

Date Palm is a perennial, and monocotyledonous plant belonging to Palmaceae (Barrow, 1998). The name of Date Palm originates from its fruit; "phoenix" from the Greek means purple or red (fruit), and "dactylifera" refers to the finger-like appearance of the fruit bunch. Date Palm is dioecious, meaning it has separate female and male trees (Chao and Krueger, 2007).

Tree: The Date Palm is an impressive tree producing a slender trunk that can grow on an average from 15-20 meters in height. The trunk is covered from ground level to the top with the overlapping persistent woody leaf base, or boot, from old leaves that have died (Figure 2.2) (Robinson and William, 2012).

Leaves: The leaves of the Date Palm are pinnate, resembling a large feather. They can be as long as 6m. They are composed of a long midrib and slender gray-green or bluish-green leaflets 20 to 40 cm long. Many Date Palm leaves have a bluish cast. A healthy Date Palm should have at least 20 to 30 live green leaves, forming a loose crown with the base leaves recurved (Robinson and William, 2012).

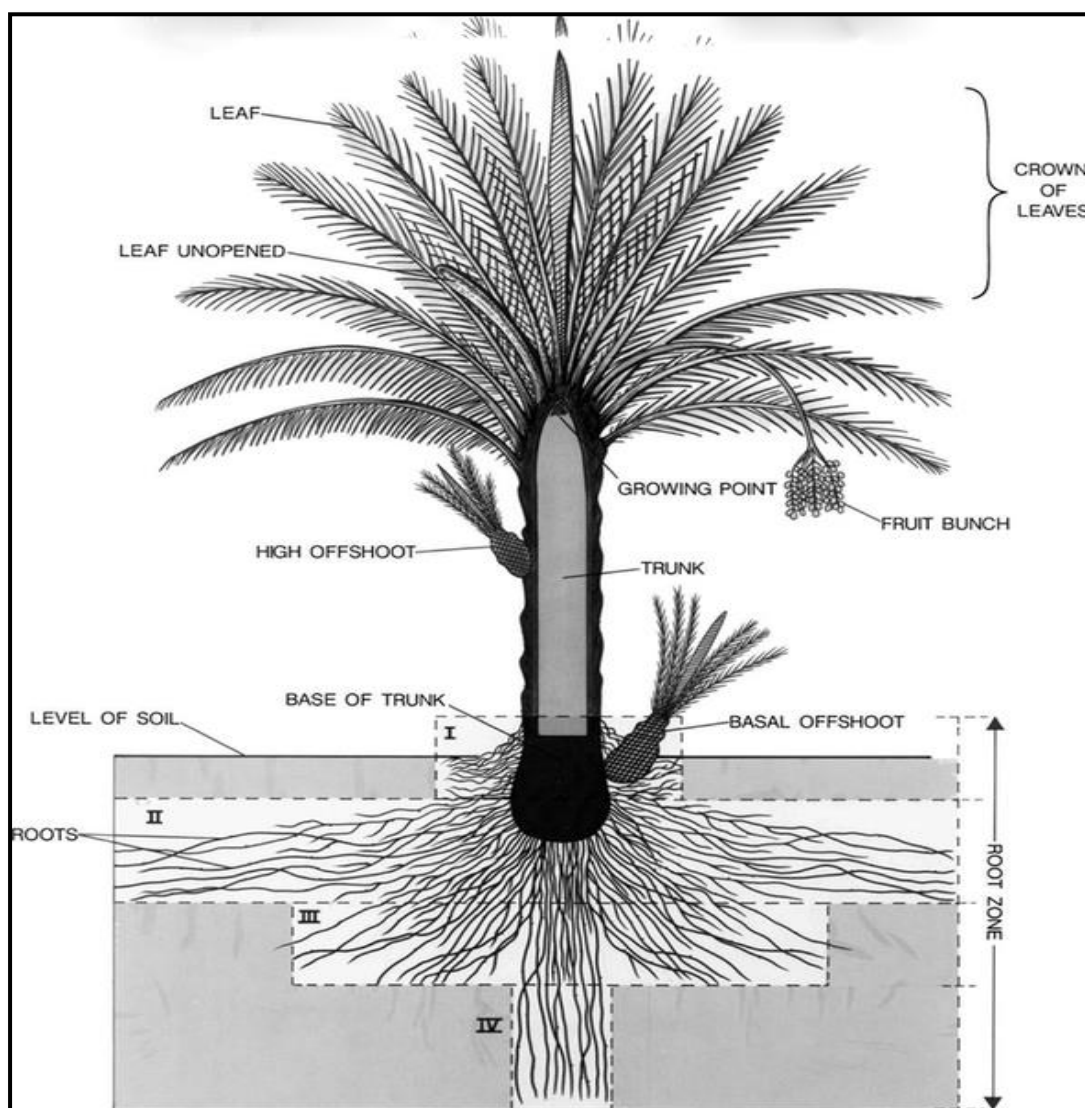


Figure (2.2): Schematic diagram of the Date Palm, source: (Chao and Krueger, 2007).

Fruit: Only female trees produce fruit, and for the fruit to be fully developed and edible, pollination must take place. Pollinated berries are oblong, dark-orange or brown-black when ripe, and have one woody seed. Unpollinated dates do not develop viable seeds or sugar, and their poor taste is much like chewy cardboard. Trees produce five to ten bunches of fruit each year. A mature tree produces up to 150 pounds annually (El-Hadrami and Al-Khayri, 2012).

Flowers: Male and female flowers are borne on different trees and are unlike in appearance. Male flowers are waxy and cream colored, and are borne on a branched spadix 15 to 22.5cm in length. A large inflorescence can have 6,000 to 10,000 flowers. Female flowers are fragrant and whitish colored, and are borne on a spadix 30-75 cm long. Both female and male flowers usually have three sepals and three petals. Date Palms begin to flower between 3 to 5 years. Pollen from the male flower must be collected by hand and transported to the females mechanically (Robinson and William, 2012; El-Hadrami and Al-Khayri, 2012; Zabar and Borowy, 2012).

2.5. Reproductive Biology of the Date Palm

Dates flower when the shade temperature increases to more than 18°C, and form fruit when it is more than 25°C (Zaid and de Wet, 2002). The flowers (and later the fruit on female trees) are borne on a flat, tapering peduncle or rachis, commonly known as the "fruit stalk" in the female trees. The fruit normally develops after fertilization from one of the three carpels within each pistillate flower. Date fruit vary in size and shape depending on cultivar, culture, and environment (Chao and Krueger, 2007).

Dates ripen in five stages which can be described as follows:

- 1. Hababouk stage:** earliest stage of fruit development; it begins from fruits set and continues 4–5 weeks, in this time the content of moisture in the fruit is 85 to 90% (Zabar and Borowy, 2012).
- 2. Kimri stage:** it is characterized by rapid increase in fruit size, weight, content of reducing sugars and highest acid activity; the content of moisture in the fruit is 80 to 85%. This stage finish when the fruits start to turn yellow or red, according to cultivar (Biglari, 2009).

3. Khalal stage: fruit starts to turn from green to yellow (or red, according to cultivar). weight gain is slow but sucrose content increases, moisture content goes down to 50–55%, and tannins start to precipitate. In some cultivars this latter process evolves rapidly, what makes them already palatable; ‘Barhee’ and ‘Hayani’ are harvested at this stage (Zabar and Borowy, 2012).

4. Rutab stage: dates become half-ripe, soft, and turn to a light brown color, and the sucrose turns to invert sugars, they contain less tannin than in the Khalal stage and fruit moisture is about 35 to 40% (Chao and Krueger, 2007).

5. Tamar stage: dates become soft and sugar becomes mostly invert; at this stage of development semi-dry and dry dates contain about 50% sucrose and invert sugar and the fruit moisture is 20–25% (Zabar and Borowy, 2012).

Water content is 75% to 80% in young fruit, decreasing to 40% to 60% at the beginning of ripening, and decreasing rapidly later (Chao and Krueger, 2007). The sugar content is about 20% dry matter during early Kimri, increasing steadily to 50% dry matter at the beginning of Khalal, and then accumulating at a faster rate until reaching 72% to 88% of dry matter at maturation (Reuveni, 1986). The average Date Palm produces 40 kg fruit annually, with yields of more than 100 kg possible with intensive management (Chandrasekaran and Bahkali, 2013). When farmed with low levels of inputs and management, dates may produce 20 kg fruit or less annually. Female plants start producing dates at 4 to 6 years of age and reach full production within 15 to 20 years (Chao and Krueger, 2007).

2.6. Cultivation of Date Palm

Date Palm cultivation is one of the most important agricultural activities in some countries, especially Arab countries, and is considered as the first important crop in these countries with perspective to number, widespread, integrated ecological and agricultural system.

Because of the biology of the Date Palm, its cultivation has a number of unusual features that are not common in other perennial crops. There are a number of cultural practices that require access to the crown of the tree, this can be challenging and

sometimes dangerous. The crown of the tree needs to be accessed for pollination, bunch tie-down, covering, harvesting, and pruning (Chao and Krueger, 2007).

Date is wind pollinated in nature, but insect pollination is possible. After pollination, bunches are often tied to the leaf stalks to support the weight of the fruit. Fruit thinning is sometimes practiced in date cultivation. Fruit thinning is used to decrease alternate bearing, increase fruit size, improve fruit quality, advance fruit ripening, and facilitate bunch management (Robinson and William, 2012). Fruit thinning can be carried out three ways: removal of entire bunches, reduction in the number of strands per bunch, and reduction in the number of fruit per strand.

Date Palms are propagated by four different methods as follows:

1. **Seeds propagation:** propagation by seed is not desirable as it usually produces a differentiated population with no two palm seedlings are alike, and so decreasing the chances of producing quality fruit (Zabar and Borowy, 2012; Al-Khalifah et al., 2013).
2. **Offshoots propagation:** this is the method most used in Date Palm propagation; palms whether male or female can be propagated using the offshoots which develops from axillary buds on the trunk; cutting Date Palm offshoots from the mother palm requires a skilled and trained laborer; the offshoots are then replanted in a new plantation orchard (Chao and Krueger, 2007; Zaid and De wet, 2002; Al-Khalifah et al., 2013).
3. **High offshoots propagation:** box or plastic bag filled with soil or peat moss material is wrapped and fastened around the base of the high offshoot; the soil should be moist until rooting occurs; rooted high offshoot can be removed and replanted in the nursery or in the orchard (Zabar and Borowy, 2012).
4. **Tissue culture propagation:** a new technique applied for rapid propagation of Date Palm; three following methods of tissue culture are used: shoot tips and buds culture (organogenesis), embryo culture (embryogenesis), and highly differentiated somatic tissues culture which includes leaf, stem, inflorescence and root sections (Al-Khalifah et al., 2013).

2.7. Harvest and Postharvest Handling of Date

2.7.1. Maturity Indices

Maturity stages of dates include Hababouk (earliest stage of development), kimri, khalal, rutab, and tamar (Zabar and Borowy, 2012). Most dates are harvested at the fully-ripe "Rutab" (light-brown and soft) and "Tamar" (dark brown and soft, semidry, or dry) stages, when they have much greater levels of sugars, lower contents of moisture and tannins, and are softer than the "Khalal" stage dates (Shamim et al., 2013). Increased sweetness with ripening of dates results from the increase in total sugars and in soft cultivars the conversion of sucrose to fructose and glucose (Kader and Hussein, 2009; Shamim et al., 2013).

2.7.2. Quality Indices

Pre-harvest practices that influence date quality at harvest include covering fruit bunches with paper bags to shelter them from dust, pests, and rain; and fruit thinning to reduce compactness of the bunches and increase fruit size and quality. Quality indices include fruit size, shape, color, texture and cleanliness (Kader and Hussein, 2009; Yahia and Kader, 2011).

2.7.3. Harvesting

Time of harvest is based on date fruit's appearance and texture (related to moisture and sugar content). Proper timing of harvest reduces incidence and severity of cracking or splitting of dates, insect infestation, and attack by microorganisms (Yahia et al., 2013). Dates are harvested in August at the khalal stage or in September to December at the rutab and tamar stages. The whole bunches are harvested and lowered to ground level, then hung on a carrier for transportation to the packinghouse (Zabar and Borowy, 2012; Yahia et al., 2013; Kader and Hussein, 2009).

Green to greenish-yellow and ripe (rutab) fruits are removed from the branches before packing in 5kg-fiberboard boxes for shipment to markets. These dates should be cooled to 0°C and transported under refrigeration (0-2°C and 90-95% relative humidity) to maintain their quality (Kader and Hussein, 2009).

Hydrocooling can be used to cool khalal dates to near 0°C in 10 to 20 minutes, depending on initial temperature, but requires effective disinfection of the water and removal of excess surface moisture from the cooled dates before packing in the shipping containers. Use of a perforated plastic liner within the box can reduce water loss during transportation and marketing (Elansary, 2008).

Date bunches are usually covered with net covers to collect the fallen ripe fruits. As the palm tree grows taller, harvesting the dates becomes more difficult and more costly. Ladders may be mounted on the palm tree to facilitate harvesting (Zabar and Borowy, 2012; Kader and Hussein, 2009).

2.7.4. Insect Disinfestation

Insect infestation and damage caused by insect feeding on the dates is one of the primary causes of postharvest losses in quality and quantity. Dates can be infested with some of the stored-products insects (such as *Oryzaephilus surinamensis*, *Oryzaephilus mercator*, *Tribolium confusum*, *Plodia interpunctella*, *Cryptolestes ferrugineus*, and *Cadra* spp.) and must be fumigated with an approved fumigant for disinfestation followed by packaging in insectproof containers (Kader and Hussein, 2009). Methyl bromide for 12 to 24 hours at temperatures above 16°C is very effective in insect disinfestation. Heated air at 50 to 55°C for 2 to 4 hours is effective in insect disinfestation. Freezing at -18°C or lower for at least 48 hours (from the time when the fruit temperature reaches -18°C or lower) is enough to kill all life stages of stored products insects (Kader and Hussein, 2009).

2.7.5. Preparation for Market

This stage include:

- Cleaning dates to remove dust, dirt, and other foreign materials using air pressure and water followed by air drying to remove surface moisture.
- Packaging to protect the dates from physical damage Use of insect-proof packaging to prevent reinfestation of the dates with insects during their subsequent storage and handling steps.

- Cooling to below 10°C (preferably to 0°C) before transportation or storage under the same temperatures (0 to 10°C) and 65-75% relative humidity. Forced-air cooling is the most appropriate cooling method for dates (Kader and Hussein, 2009).

2.7.6. Storage Conditions

Storage and transport at low temperatures is the most important tool for maintaining quality of dates because it minimizes loss of color, flavor, and textural quality; delays development of sugar spotting, incidence of molds and yeasts, and insect infestation; prevents development of syrupiness and souring of excessively moist dates (Mahmoudi et al., 2008).

Dates should not be mixed with onions, garlic, potatoes, apples, or other commodities with strong odors that can be absorbed by the dates. Exposure to ammonia or sulfur dioxide can be detrimental to quality of dates (Kader and Hussein, 2009).

2.8. Uses of Dates and Date Palm

Date Palms produce many products that are useful to humans. The primary product is the date fruit, which can be eaten fresh, dried, or in various processed forms (Chao and Krueger, 2007). Dates can be used in cereal, pudding, bread, pressed cakes, cookies, candy bars, ice cream, and date shakes. Date fruit also can be made into juice, vinegar, wine, beer, sugar, syrup, honey, chutney, pickle, paste, dip, and food flavoring (Chao and Krueger, 2007; El-Hadrami et al., 2011; Al-Khalifah and Shanavaskhan, 2012).

Date fruit are high-energy food sources with 72% to 88% sugar content at maturity. During the Khalal stage, nearly all (80% to 85%) of the sugar is sucrose (Chao and Krueger, 2007). As ripening progresses, the sucrose is hydrolyzed into reduced sugars such as glucose and fructose (Zabar and Borowy, 2012).

Date fruit are good sources of iron and potassium; a fair source of calcium, chlorine, copper, magnesium, and sulfur; and a minor source of phosphorus (El-Hadrami and Al-Khayri, 2012). In addition, dates are a source of 16 amino acids and vitamins A, B1, and B2 (Ismail and Radzi, 2013). The trunk and wood of Date Palms can be used as timber, wood, or fuel. Fiber from the trunk and leaves can be made into bags, baskets, camel saddles, cords, crates, fans, food covers, furniture, mats, paper, ropes, trays, and twine (El-Hadrami and Al-Khayri, 2012). Dried bundles of leaves can be made into shades, roofs, separating walls, and enclosures. Ribs of the leaves can be used to build boats or fishing traps (Chao and Krueger, 2007).

Oil from date seeds can be manufactured into soap (Nehdi et al., 2010). Date fruit also have many medicinal uses (Ismail and Radzi, 2013). They can be used as an astringent for treating intestinal problems; treatment for sore throat and colds; relief of fever (Al-Qarawi et al., 2005), cystitis, edema, liver, and abdominal problems; to counteract hangovers; and many more uses (Al-Gboori and Krepl, 2010).

Groves of Date Palms are important environmental niches for local wildlife and play a central role in the desert ecological system (Jain et al., 2011). Date Palms have been effective for the control of desertification and land reclamation in the Arabian Peninsula, especially in UAE (Gotch et al., 2006).

Production of dates provides jobs for a manpower population estimated at 50 million people, 35% of which are located in the southern Mediterranean countries (El-Hadrami and El-Hadrami, 2009).

2.9. Date Palm Cultivars Grown in the MENA

There is a controversy over the total number of Date Palm cultivars available across the world. Zaid (2002) estimated 3,000 varieties around the world. A large number of date cultivars are grown in the MENA. The most important are: Amhat, Barhee, Bent Aisha, Zaghloul, Hayani, Ameri, Kuboshy and Samany. All major Date Palm growing countries have their own favorite cultivars such as Ajwah in Saudi Arabia, Khalas in UAE, Amir Hajj in Iraq, Saigy and Hayani in Egypt, Deglet Noor and Thoory in Algeria (Sanderson, 2001).

There are many of date cultivars are cultivated in the MENA. The main important cultivars are:

Medjool: The Medjool trunk is medium in size, leaves are short with average curvature and of medium width, the number of spines on each leaf range between 30 and 38. Fruit size varies from small to large; shape is mostly oval (Figure 2.3 a), ranging between orange and yellow, topped with fine reddish-to-brown stripes that develop during the khalal stage (Zabar and Borowy, 2012; Abu-Qaoud, 2015).

Barhee: One of the most famous date cultivars, Barhee is characterized by its sweet taste and high per tree productivity, making its cultivation highly attractive. It is mainly consumed as khalal when still crisp in texture (Figure 2.3 b). The palm has a spreading crown, green leaves and an aesthetically-pleasing shape (Zabar and Borowy, 2012).

Hayani: Hayani is a large palm with large leaves of average curvature, long thorns, medium-sized fruit, with a length of 4–5 cm, and a diameter of 2.5–3 cm. The color is dark red at the completion of growth. Shape is cylindrical with a conical. The fruit turns black at rutab end (Figure 2.3 c) (Abu-Qaoud, 2015).

Zahidi: This date is known for its high invert sugar level and is widely used to make diced dates and date sugar products. It features a crunchy and fibrous flesh (Figure 2.3 d). Distinguished by its large seed in proportion to the fruit itself (Zabar and Borowy, 2012).

Halawi: Semi-dry, extremely sweet, small to medium in size. Thick flesh, caramel taste, and sweet, is somewhat wrinkled in appearance, with a yellow color ripening to a light amber and then to a golden brown (Figure 2.3 e) (Zabar and Borowy, 2012).

Khadrawy: A cultivar favored by many Arabs, it is a soft, very dark date. Originally from Iraq, it has many desirable qualities. It cures well, it ripens to amber, then cured to a reddish brown, with a caramel like texture and a sweet flavor (Figure 2.3 f) (Zabar and Borowy, 2012).

There are many of date cultivars are cultivated in Palestine. They can be identified by their characteristic fruit appearance and texture and fall into three types: soft, semi-dry, and dry. Main cultivars are Medjool, Barhee, Hayani, Ameri, Halawy, Zahidi, and Bentaisha (El Kichaoui et al., 2013; Abu-Qaoud, 2015). According to the estimates Ministry of Agriculture (MOA) for the year 2013 can be classified palm trees in the Gaza Strip, according to Table 2.3.

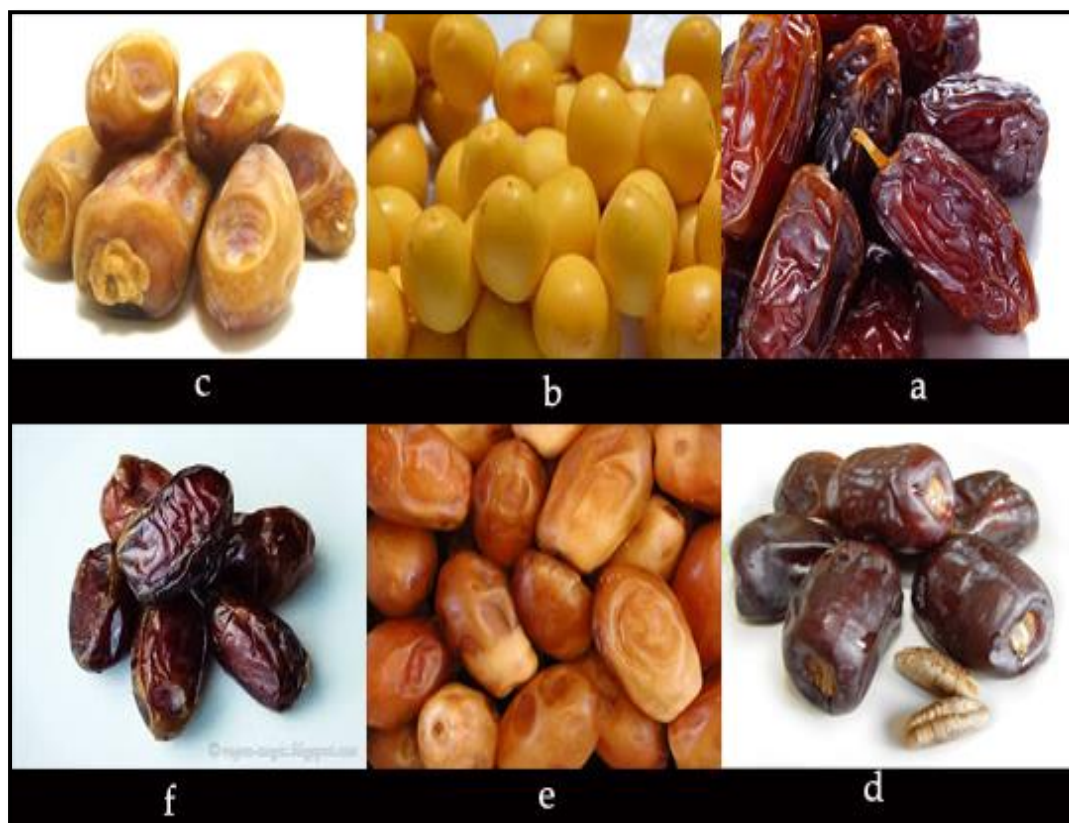


Figure (2.3): The main cultivars of the Date Palm in MENA region. (a) Medjool (b) Barhee (c) Hayani (d) Zahidi (e) Halawy (f) Khadrawy.

Table (2.3): Main Date Palm cultivars grown in the Gaza Strip

Cultivars	Number	Percentage
Hayani (حياني)	143250	95.5%
Bentaisha (بنت عيشة)	2250	1.5%
Ameri (عمري)	750	0.5%
Barhee (برحي)	3000	2%
Others*	750	0.5%
Total	150,000	100%

(Source: Qofa, 2014), *Other cultivars are: Zahidi, Halawy and Medjool.

2.10. Pests and Diseases of Date Palm

2.10.1. Major Vertebrate Pests

Fruit Bats: The Egyptian fruit-bat (*Rousettus aegyptiaus*) is the most common bat and may be found in cities, national park and nature reserves. In Israel this bat is considered as an agricultural pest and large colonies were persecuted and exterminated by authorities in the early 1950s (Moran and Keidar, 1993).

Fruit-bats caused great economic losses because they feed mainly on fruits (87%) while leaves and pollen constitute the remaining 13% (Korine et al., 1999). The local farmer had covered some fruiting trees such as Date Palm with fishing nets or had hung pieces of plastic materials from tree branches. These precautions are useful methods of protecting fruit from attack of both bats and birds (Zohoori et al., 2007).

Rodents: Various types of rodents as Roof Rat (*Rattus rattus*), Norway Rat (*Rattus norvegicus*), Polynesian Rat (*Rattus exulans*), House Mouse (*Mus musculus*) and Spiny Mouse (*Acomys cahirinus*) are considered a major threat to the Date Palm trees where a significant shortfall in crop quality and quantity also cause severe deterioration in the age of the trees because it facilitates injury Date Palm tree with red palm weevil, which eventually lead to the death of the tree (Brookas and Fiedler, 1999; Sullivan, 2002).

Pest Birds: Birds rarely have the opportunity to damage or consume date fruit. The destruction of the Date Palm tree due to bird activities are small as compared to those caused by rodents. The several species of pest birds that are found in post-harvest situations in South and Southeast Asia are House and Tree sparrows (*Passer domesticus*, *P. montanus*), common pigeons (*Columba livia*), Doves (*Streptopelia species*), Asiatic House Crows (*Corvus splendens*), and common mynas (*Acridotheres tristis*) (Brookas and Fiedler, 1999).

2.10.2. Major Invertebrate Pests

The Date Palm and its fruits are subject to attacks by several pests that are, in most cases, well adapted to the oasis environment. Damage caused by pests is considerable and leads to heavy economic losses. The major invertebrate pests that infect Date Palm are shown in Table 2.4.

Table (2.4): Major invertebrate pests that infect Date Palm

Common Name	Scientific Name	Impact On Date Palm
Red Palm Weevil سوسة النخيل الحمراء	<i>Rhynchophorus ferrugineus Olivier</i>	Yellowing and wilting of palms, that may lead to the death of the affected plant. The crown wilts first, and lower leaves will follow, due to damage to vascular tissue.
Mealy Bugs البق الدقيقي	<i>Maconellicoccus hirsutus Green</i>	It infects modern fronds and fruits in the wet and dark areas. It absorbs the succulent, causing wrinkling and dry fruits. Sugary secretion of substances leads to the growth of the black fungus, mold and thus prevent the arrival of light affected areas.
Termites النمل الأبيض	<i>Microcerotermes diversus (Silv)</i> <i>Miceotermes najdensis Harris</i>	These insects are attacking palm stalks, where severe injury lead to the destruction of the tree and inferred its existence mediated mud tunnels built by the worker bees on the affected parts.
Date Palm Dubas دوباس النخيل	<i>Ommatissus binotatus de Berg</i>	They cause direct harm on palm stalks by sucking the sap of dates, they excrete falls on the fronds capturing dust and promoting fungus that block light and prevents the plant from getting enough sunlight.
Date seed Beetle خنفساء نواة التمر	<i>Coccotrypes datyliperda Fab</i>	Beetles lay their eggs in the nucleus and we note the presence of small holes on the outside of the fruit is scatter and stools larvae exist within the nucleus.
Pomegranate Fruit Butterfly أبو دقيق الرمان	<i>Virachola livia Klug</i>	The larvae feed on fruit; lead to the fallen, and is characterized by the appearance of holes on the fruit surrounded by a black caterpillar secretions and feces.
Date Palm Frond Borer حفار سعف (جريد) النخيل	<i>Phonapate Frontalis</i>	Larvae and insects dig tunnels slanted inside veins fronds leading to break when exposed to the winds. It is one of the few pests damage to the palm and these insects are active at night and avoid light.

Common Name	Scientific Name	Impact On Date Palm
Date Palm Stem Borer حفار ساق النخيل ذو القرون الطويلة	<i>Jebuses hammerschmidtii Reiche</i>	Their larvae attack the weak palm trunks and dig the tunnels leading to the destruction of vascular bundles and thus the weakness of the trunk and death in the end.
Date Palm Fruit stalk borer حفار عذوق النخيل (القارضة)	<i>Oryctes elegans prell O. Agamemnon Arabicus O. Boas fab</i>	It is a pest of Date Palm crops responsible for economically damage throughout the Middle East. The larvae feed on the green leaves or roots of the palm tree. At the end, it causing a weakness and breaking of palm fronds. The Specialists advised farmers to use optical traps or phosphorous compounds to combat this insect.
Parlatoria Date Scale حشرة النخيل القشرية (بارلتوريا)	<i>Parlatoria blanchardii Targ</i>	Spread in appropriate circumstances on the roofs of all vegetative parts and fruits. Injury appear in humid areas distant from the sun and cause dryness in the Palm because of the absorption of succulents.
Lesser Date Moth دودة التمر الصغرى (الحميرة)	<i>Batrachedra amydraula Meyr</i>	Lead to the loss of 50-60% of the productivity of palm if neglected control. Small larvae attack the fruit and feed on the internal contents and become reddish-brown in color. Injury to lead to the loss of fruits.
Greater Date Moth دودة التمر الكبرى الطلع	<i>Arenipses sabella Hampsm</i>	Small larvae feed on pollen, flowers and fruits. It can be inferred injury this insect pollen from the existence of tunnels filled with feces of insects and other plant materials.

(Source: Al-Jaghoub et al., 2003).

2.10.3. Date Palm Diseases

Plant diseases are either non-infectious or infectious. Non-infectious diseases are caused by very low temperatures, mineral excesses and deficiencies (Mahmoudi et al., 2008). Infectious diseases are caused by parasitic organisms like fungi, bacteria or virus pathogen. Diseases caused by fungi are easier to control than the bacterial and viral diseases.

Fungal diseases: Rust, black spots , powdery mildew, seedling damping off, Coconut crown rot are some of the fungus diseases (Abdullah et al., 2010).

Bacterial diseases : Canker disease is caused by bacterial infection. The affected parts form corky outgrowth. Stems tend to crack open. Rose plants and citrus plants are quite susceptible to this disease. In lemon plants leaves, stems and even the fruits get the smallpox-like corky outgrowth (Abdullah et al., 2010).

Viral diseases : Most viral diseases are incurable. Seasonal plants and short life plants like Banana and Papaya affected with viral diseases need to be destroyed. Aphids are vectors of many viral diseases. By controlling aphids, viral diseases can be prevented to some extent. Bunchy top of Banana, leaf curl of Tomato and brinjal, Chilli and Papaya, yellow mosaic leaf of Bhendi are some of the virus diseases (Geering and Randles, 2012).

2.10.4. Red Palm Weevil (RPW)

The Red Palm Weevil (*Rhynchophorus ferrugineus*, Olivier) is a serious pest of Date Palm and causing significant ecological and economic damage to farmers (Hoddel et al., 2015). It belongs to Curculionidae family under the order Coleoptera (Vidyasagar and Aldosari, 2011; Hoddel et al., 2015; Hajjar et al., 2015; Al-Dosary et al., 2016). It is a hidden pest and remains inside the palm during the larval development and makes tunnels and pupates. The female weevil after mating deposits eggs into soft tissues of the palm or any fresh wounds caused mechanically.

In its life-cycle a female may lay about 200 to 260 eggs. The eggs hatch in 3 to 5 days into larvae which tunnel into stem and remain hidden inside the trunk. The larvae will grow up to 5 cm and reach pre-pupal stage after several instars in about 60 to 90 days. Pupation occurs in a cocoon spun with chewed fibers and lasts for about 20 days. The adult on emergence may remain inside the stem or may disperse and spread the infestations to other palms (Vidyasagar and Aldosari, 2011; Giblin-Davis et al., 2013; Al-Dosary et al., 2016).

The existing methods for managing and controlling the RPW involve detecting their existence/origination and then applying insecticides if the attack is in early stage otherwise burning the infested plants or infested part of the plants. The remedial actions depend on the stage of attack of RPW (Al-Saqer and Hassan, 2011).

Currently, there is no standardized technique for eliminating RPW without damaging the palm tree. The only possibility to save palm tree with minimum damage is to detect the existence of RPW in early stages (Al-Saqer and Hassan, 2011). The most successful way of controlling and managing RPW is reported from India by using Integrated Pest Management (IPM) program . It includes monitoring and taking care of palm trees regularly, trapping adult RPW, treating cuts and infections in palm trees, detecting RPW at early stage, treating plant in early stages if infected with RPW, eradicating infested plants, proper cutting of fronds and training and educating farmers and agriculture officers (Al-Saqer and Hassan, 2011; Faleiro et al., 2012).

2.11. Date Palm in Palestine

The Palestinian Territories cover 602,0 km², distributed between the West Bank (566,5 km², 94% of the total area) and Gaza Strip (365 km², 6% of the total area). The total area of cultivated agricultural land currently used by Palestinians covers 15.5% (931.5 km²) of the Palestinian land area, of which 90.6% is in the West Bank and 9.4% is in Gaza (PCBS, 2016).

Date Palm cultivation has been known in Palestine for thousands of years. The Jordan Valley has been cultivated by Palestinian farmers for 5,000 years, especially surrounding the city of Jericho, which is considered the oldest city in the world. Greeks and Romans named the northern part of Palestine the Land of the Date. It is known that the historic city of Jericho was dubbed Palm City; Arab travelers from Jericho stated that the basic problem which faced the Arab cavalry was traversing Date Palm forests, which covered the region (Abu-Qaoud, 2015).

Most of the date cultivation in the West Bank is now concentrated in Jericho and the Jordan River. The extremely high temperatures and low relative humidity that prevail in those areas provide optimal conditions for growth and development of Date Palm.

Being a tree of great economic, nutritional and religious value and with its ability to grow in various climatic conditions, including saline soils, Date Palm is of great interest for Palestinian farmers (Kalbouneh, 2011). Nowadays, the cultivation of Date Palm is located in regions of Jericho and the Jordan Valley in the West Bank, and the Gaza Strip, especially in Deir Al-Balah and Khan Younis. After 1967, considerable areas of the Jordan Valley were cultivated by Israeli farmers and new quality Date Palm cultivars were introduced (Daiq, 2007). The adaptability of the new cultivars and the use of advanced techniques for propagation and cultivation produced fruits of excellent quality and yield to supply both local and global markets (EQA, 2006).

The cultivated area of Date Palms in the West Bank increased from 76 ha in 1993/1994 to 130 ha in 2001/2002, with an increase in production from 880 to 1,700 MT. Production also increased between 2006 and 2012. There are 85,000 Date Palms of good cultivars spread over 600 ha. The production capacity had increased from only 60 MT in 2000 to 2,300 MT in 2012. This number was doubled by 2015 with a projected production level of 5,000 MT (Abu-Qaoud, 2015).

In the Gaza Strip, production of Date Palm reached about 2,000–3,000 MT during the 1970–1980 decade, this amount increased to 5,000–6,000 MT in the period 1995–2002, and declined to 3,000 MT in the 2003–2008 period (Abu-Qaoud, 2015). The total harvested area of dates in both the West Bank and Gaza was 873 ha in 2011 (FAOSTAT, 2011), this area increased to 2700 ha in 2014 representing only 0.2 % of to the total harvested area in the world (Al-Fares, 2014). In comparison with Middle Eastern countries this is a very small contribution. However, there has been a significant increase in the harvested area of dates in the West Bank and Gaza in the last 10 years.

There are many of date cultivars are cultivated in Palestine. These main important cultivars are Medjool, Hayani, and Barhee. The successful cultivation of the Date Palm has a positive impact on Palestinian agriculture. It has great importance in creating job opportunities for families, finding an alternative for the products of Israeli settlements, and providing food security to poor families, especially during

political crises, border closures and curfews related to the Israeli occupation.

The local demand for dates in Palestine is relatively stable. During the late twentieth century, the average per-capita consumption was 0.6 kg, which is close to the average domestic consumption globally of 0.9 kg per capita per year, but much lower than that of Saudi Arabia (38 kg) (El-Jafari and Lafi, 2004). The total amount consumed in 1994 was 1,466 MT; this amount increased in 2000 by 28.4%. Moreover, in 2010, this amount increased to 3,019 MT. About 85% of the Palestinian Date Palm production goes to the domestic market and only 15% of production is exported (PCBS, 2011). The date fruit consumption of a Palestinian family is no more than 0.17% of the total food consumption. This low percentage is mainly due to the consumption habit, the high price of dates and the presence of several alternative fruits. The development of the local date market requires a change in consumption habit, developing processes to promote this product, emphasizing health and nutritional benefits and providing adequate marketing infrastructure (Daiq, 2007).

Several constraints face the cultivation and production of Date Palm in Palestine, among them: poor farm management, pest and disease control, harvesting, processing and marketing; shortage of qualified and trained national staff and laborers, and insufficient research and development (Erskine et al., 2011; Abu-Qaoud, 2015).

2.12. Previous Studies on Date Palm

Multi-purpose Date Palm surveys were carried out in different countries worldwide. Special focus was paid on the importance of Date Palm (environmental, medical, socioeconomic, traditional, etc.), uses, cultivation, pests, diseases, genotyping and identification of different cultivars of the Date Palm. Australia was one of these countries where intensive Date Palm surveys were carried out. For example Reilly and Reilly (2014) studied the industrial uses of Date Palm and he mentioned that there are a broad range of industry practices.

In the U.S.A, Siddiq and Greiby (2013) studied the date fruit production, postharvest handling, processing, and nutrition. They mentioned that dates are an important fruit, especially in many African, Middle-Eastern, and Asian countries.

In Pakistan, Abul-Soad (2011) studied the current status and prospective of Date Palm. He studied Date Palms in Balochistan from different aspects: How did the flood affect Date Palms, establishment and management of the Date Palm nursery, tissue culture, and the constraints facing the development of Date Palm in Pakistan.

Work on Date Palm seems to be intensive and extensive in Saudi Arabia. Most studies concentrated on highlighting the socioeconomic and traditional importance of Date Palm. El-Juhany (2010) studied the degradation of Date Palm trees and date production in Arab Countries: causes and potential rehabilitation. Massoud et al. (2011) studied the geographic information system (GIS) used for assessing the activity of the Red Palm Weevil in the Date Palm. More recently Nasser (2014) studied the use of midribs of Date Palm cultivars grown in Saudi Arabia for energy production and he mentioned that the relatively high heating values found for the Date Palm midribs indicate that they are promising as an energy source. El-Hadrami and Al-Khayri (2012) studied the socioeconomic and traditional importance of Date Palm. Aleid et al. (2015) carried out a comprehensive work aiming at studying the status of the Date Palm in Saudi Arabia. They studied the importance of Date Palms to Saudi Arabia agriculture, production statistics and economics, and the current agricultural problems facing the various cultivars.

In Egypt, Mahmoud and Elbana (2013) conducted a study about the evaluation of olive and palm byproducts on feeding camels, and they mentioned that date stone showed better nutritive values than olive cake. Abdalla and El-Kawy (2010) studied karyotype analysis for Date Palm. Bekheet (2013) described the best methods of micropropagation of Date Palm in Egypt. Ibrahim et al. (2014) studied germination of Date Palm pollen grains (*in vitro*) and its impact on fruit quality and they mentioned that the germination of pollen grains *in vitro* is very important and useful to determine the best pollinators for pollination process. Moreover, Ismail (2014) studied the germination of Date Palm pollen grains affected by different sugar types

in the medium. More recently, Abed El-Azim et al. (2015) carried out a comprehensive work aiming at studying the hydrocarbons, fatty acids and biological activity of Date Palm pollen growing in Egypt.

In Iraq, there are a lot of research on Date Palm. For example, Al-Rawi and Al-Mohemdy (2001) studied the effect of water quality on the growth and yield of Date Palm. Their results showed that irrigation with saline water caused salt accumulation in soil, which caused a reduction in tree growth and give low yield as well as low quality of fruits. Zabar and Borowy (2012) studied the cultivation of Date Palm in Iraq and they pointed out that the Date Palm cultivation in Iraq has a long history. Hameed (2012) described the inflorescence rot disease of Date Palm caused by *Fusarium proliferatum* in Southern Iraq. Finally, Khierallah et al. (2014) described the molecular characterization of some Iraq Date Palm cultivars using RAPD and ISSR markers.

In Tunisia, Saafi et al. (2008) studied the common Date Palm cultivars and they mentioned that these cultivars are a potential source of valuable nutrients. They also showed that the pulp of the common varieties could be used in food industries as an important and inexpensive source of sugars which may possess nutritional and technological values. Bouaziz et al. (2008) studied protein and amino acid profiles of Tunisian Date Palm fruit seeds and they mentioned that these seeds are rich in many nutritional compounds, which would justify their use as a possible valuable source for human nutrition. Hamza et al. (2012) conducted an extensive study about genetic variation in Tunisian Date Palm cultivars using ISSR marker and their relation with fruit characteristics. Recently, Ziadi et al., (2014) described a physico-chemical characteristics and total quality of Date Palm varieties grown in the southern Tunisia.

In Sudan, Sulieman et al. (2012) conducted a comparative study on five Sudanese date fruit cultivars and they mentioned that the physical characteristics like fruit weight, length, flesh thickness, seed weight differed significantly between the various cultivars. Ezebilo et al. (2013) studied the diversity of Date Palm cultivars in northern Sudan. They pointed out that the Date Palm farms in Sudan can serve as sites for conserving genetic resources along with fulfilling the primary aim of food

production. Khairi et al. (2010) conducted an extensive work on the status of Date Palm cultivation and date production in Sudan. They mentioned that Sudan ranks number 8 in the list of top date producing countries of the world. The prospects for establishment of an advanced date industry in Sudan are promising.

In the UAE, Zaid (2001) study the world date production, and he mentioned several problems and obstacles are hindering the development of the date industry around the world. Al Hammadi (2006) and Alhammadi and Kurup (2012) studied the impact of salinity stress on Date Palm and they mentioned that the salinity can reduce plant growth through osmotic effects, toxicity of ions, nutrient uptake imbalance, or a combination of these factors. Results of these studies indicated that there are differences in salt tolerance between Date Palm cultivars.

In Palestine, many surveys have been carried out to highlight the status and perspective of Date Palm. Abu-Qaoud (1993 and 2015) conducted a survey in the West Bank and Gaza Strip and he revealed that in spite of the feasibility of date-palm production, cultivation in the Palestine is still below expectations. He added that several constraints have been found to impede the Date Palm progress. These included the high investment costs and the underdeveloped marketing structures. Ali-Shtayeh et al. (2000) conducted an ethnobotanical survey in the West Bank of Palestine and they revealed that as many as 63 plant species including Date Palm had medical importance in relieving and treating several diseases including skin, gastric and urinary disorders, respiratory problems, arthritis and cancer and prostate disorders. Said et al. (2002) and Ali-Shtayeh and Jamous (2006) conducted extensive ethnopharmacological surveys in order to evaluate the potential of the Palestinian plants including Date Palm in treating different diseases and illnesses. Moreover, Abu-Rabia (2005) described some floristic species including Date Palm that are commonly used as a food and medicine source in Palestine. The Applied Research Institute – Jerusalem (ARIJ) (2002) described plants occurring in Palestine including the Date Palm with their nutritional, economic, medicinal and fodder values. Ali-Shtayeh and Jamous (2002) mentioned the Date Palm was one of 334 plant species that have been recorded to be threatened in the West Bank and the Gaza Strip. To conserve the Palestinian floristic and agricultural plants, Azaizeh et al. (2003)

suggested a multilevel program involving the training of local practitioners, an establishment of a medicinal plant botanical garden and a field gene bank.

In the Gaza Strip, work and research on flora including the Date Palm is restricted to few studies. Bolous (1959) studied the flora of the Gaza Strip since decades. He described as many as 251 floristic species including the Date Palm and highlighted some aspects of their uses. Abd Rabou et al. (2008) studied the common flora and its uses in Wadi Gaza. They described 70 plant species and highlighted some aspects of their uses. They revealed that the Date Palm has been used as a food source. It is also used in herbal medicine and as a fodder for grazing animals and timber and fuel production. Abou Auda (2010, 2011 and 2012) studied the plant ecology in the Gaza Strip and denoted to the local potential uses of Date Palm. Madi (2001 and 2005) and Madi et al. (2002) described the various wild plants species prevailing in the coastal sand dunes of Gaza Strip with the Date Palm was included.

Studies specialized in handling the Date Palm are few. Albanna and Eid (2007), MOA (2010) and Qofa (2014) focused on the industries, local uses and the ecological importance of the Date Palm in the Gaza Strip. The MOA (2012) demonstrated the magnitude of the RPW infection to the Date Palm sector in the Gaza Strip and suggested the possible methods of control and prevention. More recently, the Biological Control Unit (BCU) at the Islamic University of Gaza (IUG) carried out an extensive study about the evaluation, isolation and molecular identification of the Entomopathogenic Fungi (EPF) *Metarhizium anisopliae* and *Beauveria bassiana* against the RPW in the Gaza Strip. This study aims to identify indigenous strains potentially suitable for the biological control of the RPW. The findings showed that the *B. bassiana* and *M. anisopliae* exhibited a good biological control agent against larvae and adults of the RPW. The pathogenicity of the two most virulent isolates and the toxicity assay on larvae showed a highest mortality percentage nearly to 100% and 90% by 6 days after spraying the larvae with 3.4×10^8 spores/ml of *B. bassiana* and 3.6×10^8 spores/ml of *M. anisopliae* respectively. The use of *B. bassiana* and *M. anisopliae* can be considered to be useful as a preventive and curative tool for protection of Date Palm trees (El Kichaoui et al., 2017).

Chapter 3

Methodology

Chapter 3

Methodology

3.1. Materials and Methods

3.1.1. Study Area

The total area of the historic Palestine is 27,009 km². The area of the West Bank is 5844 km², and constitute 21.6% of the total area of the land of the historic Palestine. The Gaza Strip, an area of 365 km², and constitutes 1.35% of the total area of the historic Palestine. Deir Al-Balah is situated in the Middle Governorate of the Gaza Strip, along the coastline of the eastern Mediterranean Sea. Deir Al-Balah is well known for growing Date Palms. The particular type of date that is cultivated in the area is known as "Hayani" (see Figure 1.2).

3.1.2. Site and Institutional Visits

During the course of the current study, visits to Date Palm fields were carried out to the five governorates of the Gaza Strip in order to investigate the current status of the Date Palm. Meetings and discussions with farmers, date orchards owners and normal people are of utmost priority to fill the gaps needed in data collection regarding Date Palms in the Gaza Strip. Moreover, vital visits were carried out to the MOA and other association that interest of the Date Palm sector.

3.1.2.1. Ministry of Agriculture

The MOA was founded in 1994 in the Gaza Strip. It's a government organization dealing with all respect to the agriculture sector, where working hard to keep up with scientific developments in the field of agriculture. This Ministry work to increase agricultural production and private strategic crops with a view to developing the agricultural sector and to improve a minimum of food security through the implementation of various projects, as well as the application of technological methods to increase production and improving the quality that contribute to the sustainability of food security in the Gaza Strip and to improve the livelihoods of farmers.

The vision of the MOA is creating an agricultural system to achieve excellence, perfection, quality and support the economy through investment of natural and human resources and opportunities, and enhance the ability to search, particularly in the areas of manufacturing, development, innovation and development.

The Ministry has set up several projects to support the Date Palm cultivation such as Bahja Gardens and Bayroha'a project, in addition to giving farmers a training and awareness courses and contribute effectively in the fight against the RPW.

3.1.2.2. Palestinian Al-Nakheel Association for Progress and Development

The Palestinian Al-Nakheel Association for Progress and Development (PNAPD) is non-governmental, non-profitable organization that works in agricultural sector . It has established in Khan Younis in 1998. The association works at many sectors including agricultural, social, relief, environmental, educational and developmental fields. Whereas it works on supporting and developing the farmers capabilities, and preserving the agricultural environment in Gaza governorates through providing the training , consultation , guidance and other related needs of farmers. Besides that, the association provide assistance for the Palestinian farmers in financial and social sides, and working on raising the income for the rural families . It's ideal sign is that no good in society that eats what didn't plant. The organization also support the development of agricultural national production, and dependence on local production to avoid the siege problems, and the closure of cross boards. The association mission is to be pioneer association in Gaza Strip on developing the agricultural sector to reach the agricultural development in all fields, support and develop the farmers generally by cooperation with governmental and non-governmental organizations that work in the same field.

Association Goals:

- Development and improvement of cultivated land productivity.
- Qualifying the workers in agriculture, and giving them the required skills in and after production.
- Bringing and planting new spices of palms in addition to the current ones.

- The development of vaccination, gathering, manufacturing, storage procedures and utilization of palm waste in handicrafts.
- Developing the agricultural infrastructural services and other fields.
- Take care of social, cultural and health sides of the farmers.
- Strengthening of rural women skills to increase their production and enhance their income.
- Highlight the vital role of rural women, the rights and status of rural women in the social, economic and political views, for comprehensive sustainable development in Palestinian rural areas.
- Strengthening civil society concepts, sustainable rural development, and public services.
- Hosting experts, counselors, sessions and training workshops in all agricultural areas.

3.1.2.3 Al-Ahlyah Association for the Development of Date Palm

Al-Ahlyah Association for the Development of Date Palm (ASDPD) was founded in 2004 in the Deir Al-Balah and consist from a group of engineers, farmers and specialists. This Foundation works through various programs and activities on the development of the Date Palm sector and preparing rehabilitation and training programs for farmers and engineers as well as for the rehabilitation a number of them as a specialists in this area. It contributes effectively to achieve leadership and work with high quality to improve this important sector to contribute to the improvement of the economic, environmental and social situation in the region.

3.1.2.4. Earth and Human Center for Research and Study

Earth and Human Center for Research and Study (EHCRS) is a center located in Gaza Governorate and consist from multidisciplinary and highly qualified team. Team members are graduated from different countries. The center is interested in Human and Environment. EHCRS seeks to support scientific research and produce high quality studies and research to enhance the progress and advancement efforts in Palestine. EHCRS condenses the efforts to finalize reliable and applicable proposals to serve the Palestinian society.

EHCRS goals:

- To contribute to enrich the research and in particular the environmental and humanitarian studies.
- To participate in improving capacity building skills of potential researchers to help them excel in scientific research and relevant studies.
- To strengthen the role of research, especially in the environmental and humanitarian studies in Palestine.
- To work on underpinning and reinforcement of the importance of research and its applications for decision makers.
- To promote the concepts of partnership, constructive discussion, and consultation to come up with ideal solutions for relevant matters in the fields.
- To look for possible logical and practical solutions for daily life issues in the Palestinian society.

3.1.3. Outbreak and Control of RPW

The PRW is considered one of the most damaging pests that have caused losses in Date Palm cultivation. The study investigated the number of Date Palm trees infected by the insect, nature of the injury, place of infection and ways of its control.

3.1.4. Structured and semi-structured interviews

Conversations, meetings, discussions and interviews were carried out with farmers, workers in addition to the staff of MOA, EHCRS, PNAPD and ASDPD who relate to Date Palms. The researcher developed and used a set of close and open ended questions during the structured and semi-structured interviews conducted. Very important meetings and interviews were fulfilled with Saleh Bekheet (Undersecretary of MOA), Wael Thabet (Director of the Plant Protection and Inspection Department, MOA), Mohammed Abu Auda (Director of Horticulture Department, MOA), Mohammed Hussein (Director of EHCRS), Abdallah Al-Farra (Director of PNAPD) and Islam Shuaib (Director of ASDPD).

3.1.5. Questionnaire Design and Application

A questionnaire (Appendix 1) was designed and applied in Jun and July 2016 in the Deir Al-Balah region, which is situated in the Middle Governorate of the Gaza Strip. This region is chosen because it is the richest in the Gaza Strip in terms of Date Palm cultivation and production. The target group are agricultural farmers. One hundred and fifty farmers were included in this survey. The farmers were individually interviewed and their responses recorded in questionnaires specially designed to conduct this work. The validity of the questionnaire was tested by five specialists in agricultural, plant and environmental sciences. The questionnaire was piloted and further modified to capture the concerns raised by the farmers during the pre-test survey. The questionnaire included yes/no and multiple choice questions.

During the survey, interviewer explained to the farmers any of the questions not clear to them. The questionnaire included relevant information on personal profile of farmers, education, income from Date Palm, household and farmland size, production of Date Palm, general uses and industries based on the Date Palm, pests that face their trees and development and management of Date Palm.

3.1.6. Photography

A professional digital camera was used to take photos regarding the different aspects of field visits. These photos covered the cultivars of Date Palm grown in the Gaza Strip, pests facing Date Palms in addition to the public and industrial uses of the Date Palm tree.

3.1.7. Data Analysis

Data were statistically analyzed using SPSS computer program version 18.0 for windows (Statistical Package for Social Sciences Inc, Chicago, Illinois). Graphs were plotted using Microsoft Excel program 2010.

Chapter 4

Results

Chapter 4

Results

4.1. Distribution of the Date Palm in the Gaza Strip

The Date Palm cultivation is historic in Palestine including the Gaza Strip. According to current estimates of MOA, a total number of 250,000 Date Palm trees are found in the Gaza Strip (Table 4.1), of which about two-thirds (67%) are fruit trees. Although it is cultivated in the whole Gaza Strip, it is more concentrated in the middle Governorate (100,000 = 40.0%) as well as in Khan Younis (85,000 = 34.0%). The Gaza Governorate harbors the least Date Palm trees.

Table (4.1): The number of the Date Palm trees in the Gaza Strip

Governorate	No. of the Date Palm Tree	Percentage (%)
Rafah	28,000	11.2
Khan Younis	85,000	34.0
Middle Governorate	100,000	40.0
Gaza	17,000	6.8
North Gaza	20,000	8.0
Total	250,000	100

Source: (MOA, 2016).

With regard to the age of the Date Palm trees, PNAPD pointed out that 20,000 trees are of less than ten years old including 15,000 palm trees have been planted in the Bayroha 'a El-Nakheel - Kuwait, and the rest 230,000 had ages exceeding 10 years old, though thousands of the trees were stated to exceed 100 year old.

4.2. Date Palm Cultivars Grown in the Gaza Strip

At least, nineteen Date Palm cultivars are recorded in the Gaza Strip. These cultivars can be identified by their fruit appearance and texture. They fall within three types: soft, semi-dry, and dry. The recorded cultivars are Hayani, Barhee, Bentaisha, Ameri, Dairy, Degani, Hilali, Halawy, Hatmi, Jabri, Khanaizi, Khalas, Khasab, Lulu, Mukтоми, Medjool, Sukkari, Zahidi and Zaghlood (Figure 4.1, 4.2). The numbers and percentages of these cultivars are illustrated in Table 4.2.

Table (4.2): The number of tree for each cultivar

Cultivars	Number of tree	Percentage (%)
Hayani	210,000	84
Bentaisha	25,000	10
Barhee	10,000	4
Other cultivars	5,000	2
Total	250,000	100

Source: (MOA, 2016).



Figure (4.1): Main cultivars of the Date Palm: (A) and (B) Barhee, (C) and (D) Hayani.



Figure (4.2): Minor cultivars of the Date Palm: (A) and (C) Ameri, (B) and (D) Halawy, (E) Medjool.

4.3. Production of the Date Palm in the Gaza Strip

The total harvested area of the Date Palm in the Gaza Strip is 8500 acres (acre = 10,000 m²). The average of Balah production in the last few years was estimated as 12,000-15,000 tons per year. In 2015, the total production was estimated to be 11,710 ton (Table 4.3 and 4.4). The average production per tree is 100-150 kg, which means the possibility of self-sufficiency and to build a stable industry for palm products. According to personal communications with the MOA, ASDPD, PNAPD and EHCRS, the average production per tree was said to reach 400-450 kg depending on certain physical conditions such as irrigation, lighting amounts, temperature, humidity, wind, etc.

Table (4.3): Quantity of production of Date Palm in the Gaza Strip

Governorate	Quantity of Production (ton)	Percentage (%)
Rafah	1,680	11.2
Khan Younis	5,100	34.0
Middle Governorate	6,000	40.0
Gaza	1,020	6.80
North Gaza	1,200	8.00
Total	15,000	100

Source: (MOA, 2016).

Table (4.4): The number of productive tree and quantity of production of Date Palm cultivars in the Gaza Strip

Cultivars	Number of Productive Trees	Percentage (%)	Quantity of Production (ton)	Percentage (%)
Hayani	147,000	86.7	10,290	87.9
Bentaisha	17,500	10.3	1,260	10.7
Barhee	4,000	2.4	100	0.85
Other cultivars	1,000	0.60	60	0.51
Total	169,500	100	11,710	100

Source: (MOA, 2016).

4.4. The Current Status of the Red Palm Weevil in the Gaza Strip

4.4.1. Nature of RPW

RPW is a serious pest of Date Palm and causes severe losses to farmers. It belongs to Curculionidae family under the order Coleoptera. It is a hidden pest and remains inside the palm during the larval development and makes tunnels and pupates. The female weevil after mating deposits eggs into soft tissues of the palm or any fresh wounds caused mechanically.

4.4.1.1. The different stages of RPW noted in the field

All stages of the RPW could be monitored inside the palm itself and the life cycle cannot be completed elsewhere. The different stages of RPW noted in the field are:

- 1. Egg stage:** The eggs are usually found hidden inside the palm. Specialists confirmed that the female deposits about 200-400 eggs in separate holes they produced while searching for fodder within injuries found on the palm. The eggs are whitish yellow, smooth, shiny (Figure 4.3 A), cylindrical with rounded ends, slightly narrower at the anterior end, and about 3mm long and 1mm wide. These hatch in two to five days, and larvae bore into the interior of the palms, feeding on the soft succulent tissues, discarding all fibrous material (ASDPD, 2012; MOA, 2012).
- 2. Larval stage:** The larva is a destructive stage to the palm tree when it feeds on the moist tissues. It bores inside the palm tree making abnormal holes. Subsequently, the palm tree falls down during 6-12 months. This stage takes 36-78 days. The larva has a creamy color and reddish head as it also has 13 segments (Figure 4.3 B). When feeding by boring inside the trunk, it eliminates stinking excrements or residues that get mixed with a thick slimy liquid (Al-Dosary et al., 2016; ASDPD, 2012; MOA, 2012).

3. Pupal stage (Cocoon): The pupa is at first cream colored but later turns brown (Figure 4.3 C). The average length of the pupa is 6 cm and the width is 3 cm. It prefers the cocoon to be surrounded by high humidity to prevent drying out and death. The cocoon can be found inside the trunks of the palm tree or inside the leafstalk. Pupal stage ranges from 11-45 days on the average (ASDPD, 2012; Faleiro et al., 2012).

4. Adult weevil: The adult is large, being up to 42mm and 16mm wide, with a long rostrum, characteristic for the weevil (Figure 4.3 D). It is ridden brown in color with variable dark markings on the pronotum. This cycle takes approximately 2-3 months for the adult female to lay about 350 eggs in its life time. During the first three weeks, when it emerges from cocoon, 80% of eggs are laid inside the wounds of the leaves and trunks, cavities, or the roots of offshoots (Al-Dosary et al., 2016; MOA, 2011).

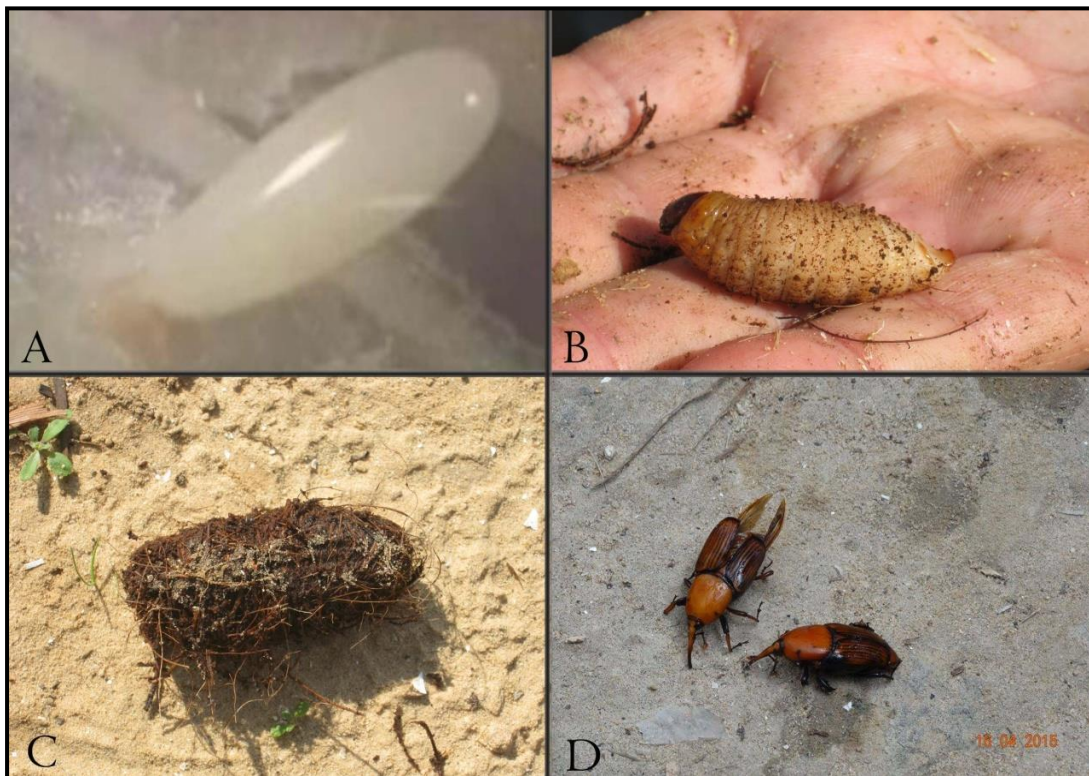


Figure (4.3): Life cycle of the Red Palm Weevil: (A) egg stage (B) larval stage (C) pupal stage (D) adult weevil.

4.4.1.2. Methods of infection with RPW

The incidence with RPW link with many factors that helps the insect to penetrate plant tissue such as the incidence with Fruit Stalk Borer (Figure 4.4) which provides the appropriate places for the RPW to lay eggs in the gaps or wounds resulting from pruning or holes made by female proboscis. Usually the places infected with RPW are: zone of aerial offshoots and apical meristem, offshoot near to the soil surface (Figure 4.5), zone infected with palm stalk borer and modern wounds, holes and tunnels caused by rodents and borers.



Figure (4.4): Fruit Stalk Borer (*Oryctes elgans*).



Figure (4.5): Examination of infested offshoots.

4.4.1.3. Reasons standing behind the infection with RPW

There are a lots of reasons that lead to the injury of the Date Palm trees with RPW, the most important of this are: removal of offshoots in periods of insect activity, over-pruning and ignorance of wound treatment, prior infection with Date Palm borers and the use of flood irrigation system (Figure 4.6).



Figure (4.6): Flood irrigation system of the Palm tree.

4.4.1.4. Symptoms of infection

1. The presence of tunnels on the trunk and the base of leaf petiole (Figure 4.7 A).
2. Hearing of gnawing sounds due to feeding by grubs
3. Oozing out of thick brown fluid from the tunnels (Figure 4.7 B).
4. The presence of chewed plant tissues in and around opening of tunnels with a typical fermented odor (Figure 4.7 C and D).
5. Breaking of the trunk or toppling of the crown in case of severe and prolonged infestation (Figure 4.7 E).
6. Drying and/or death of offshoots in case of severe injuries (Figure 4.7 F).
7. Drying of fruits (Figure 4.7 G).
8. The presence of any of RPW phases (Figure 4.7 H).



Figure (4.7): Symptoms of infection with RPW: (A) Presence of tunnels on the trunk, (B) Oozing out of thick brown fluid from the tunnels, (C) and (D) Presence of chewed plant tissues, (E) Breaking of the trunk, (F) Drying and/or death of offshoots, (G) Drying of fruits, (H) Presence of any of RPW phases.

4.4.2. Assessment of RPW Infestation in the Gaza Strip

4.4.2.1. Discovery and origin of the pest

Infested Date Palm trees with the RPW were officially discovered in September 2011 in a nursery of the Middle Governorate. It has been assumed that the origin of RPW was the infested palms of the Egyptian area bordering Gaza Strip. The introduction of infested offshoots of the commercial cultivars of Barhee or Medjool from Egypt could be a reason of the brutal discovery of this crucial pest in 2011.

4.4.2.2. The magnitude of infested Date Palms

The number of infested Date Palms is increasing year by year. Table 4.5 shows that the magnitude of infested Date Palms in the Gaza Strip during 2011 and 2015.

Table (4.5): The magnitude of infested Date Palms in the Gaza Strip (2011-2015)

Year	Infested	Treated		Eliminated	
		No.	Percentage (%)	No.	Percentage (%)
2011	4330	0	0	4330	100
2012	2,178	518	23.8	1,660	76.2
2013	6,971	5,935	85.1	1,036	14.9
2014	20,950	17,606	84.0	3,344	1.59
2015	903	830	91.91	73	8.08

(Source: MOA, 2016).

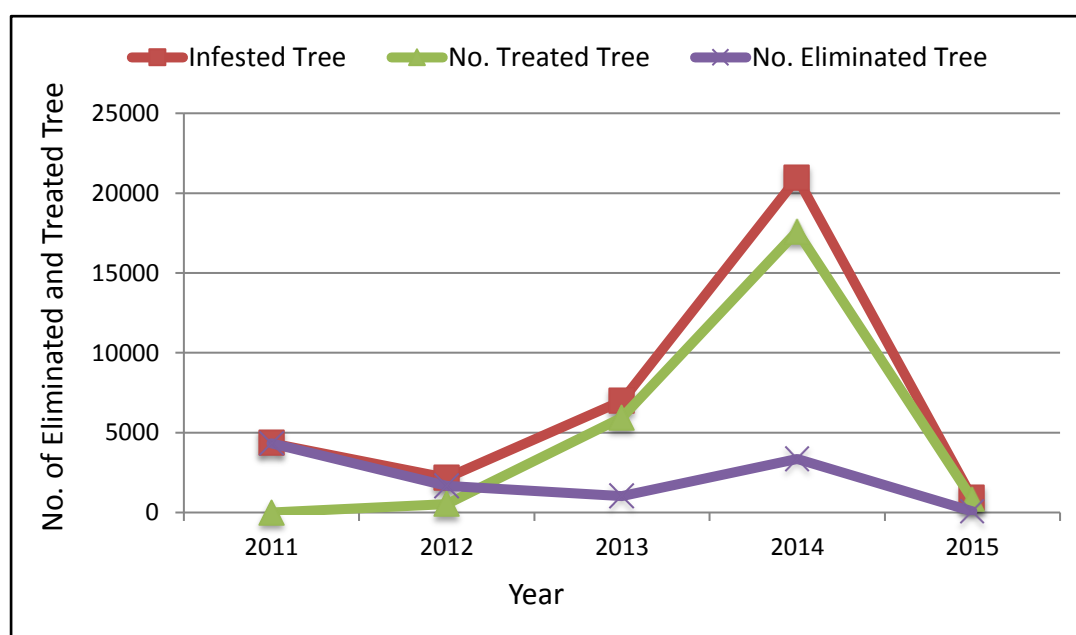


Figure (4.8): The magnitude of infested Date Palms in the Gaza Strip (2011-2015).

The MOA team is giving preference to save the infested palms instead of eliminating them. Curative treatment is mainly based on an injection treatment. Treatments applied are essentially curative although palms around infested ones are treated by spraying of pesticides.

With regard to the trapping of the RPW, Table 4.6 and Figure 4.9 show that there is a direct proportional concerning the number of traps employed and the number of adult weevils caught (2012–2015). It is worth mentioning that the trapping of the RPW was mostly occurred in the southern Gaza Strip. The young Date Palms (Hayani, Barhee or other cultivars) that have been planted during the last 10-15 years are very attractive to and easily infested by the RPW as they have a lot of offshoots and their leaf bases are not dry enough to prevent egg laying of the adult insects. The aim of the deployment of traps, one trap per 50 tree, in 2012 till 2015 is given to indicate the source of infection and its distribution as well as to combat the insect.

Table (4.6): Trapping of RPW (2012-2015)

Year	No. of Traps	No. of caught adult weevils
2012	80	2,389
2013	170	30,643
2014	604	50,651
2015	1,251	317,364

Source: (MOA, 2016).

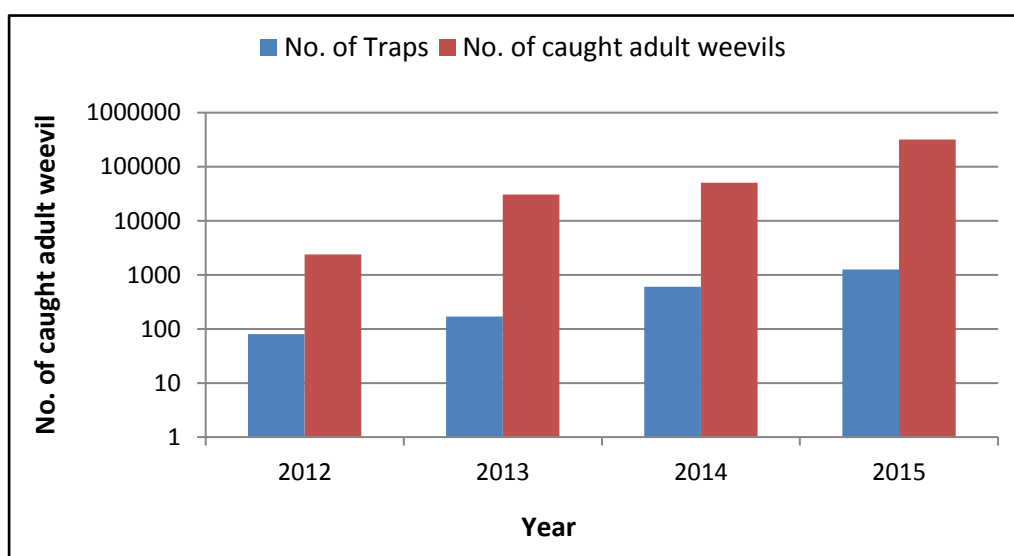


Figure (4.9): The number of traps and caught weevil.

Table (4.7): The number of caught weevil during 2014-2015

Item	Governorate	North Gaza	Gaza	Middle Governorate	Khan Younis	Rafah	Total
	No. of Traps	79	84	244	614	230	1251
Nov.	2014	261	1,265	729	7,693	6,978	16,926
Dec.	2014	565	1,115	2,554	11,677	10,403	26,314
Jan.	2015	800	692	962	7,300	1,290	11,044
Feb.	2015	928	2,198	2,039	16,812	4,290	26,267
Mar.	2015	879	2,248	1,872	14,333	2,108	21,440
Apr.	2015	656	3,219	2,368	8,285	1,767	16,295
May	2015	794	1,107	2,290	8,589	1,198	13,978
Jun	2015	803	570	1,283	6,596	703	9,955
July	2015	1,024	1,735	6,091	26,790	2,434	38,074
Aug.	2015	1,398	2,353	5,135	23,952	2,304	35,142
Sep.	2015	978	2,284	7,363	20,761	2,891	34,277
Oct.	2015	548	2,710	5,002	16,863	2,786	27,909
Nov.	2015	1,546	4,169	7,651	22,979	2,973	39,318
Dec.	2015	1,150	4,205	7,555	22,191	2,700	37,781
Total	2014-2015	12,330	29,870	52,894	214,821	44,825	354,720

Source: (MOA, 2016).

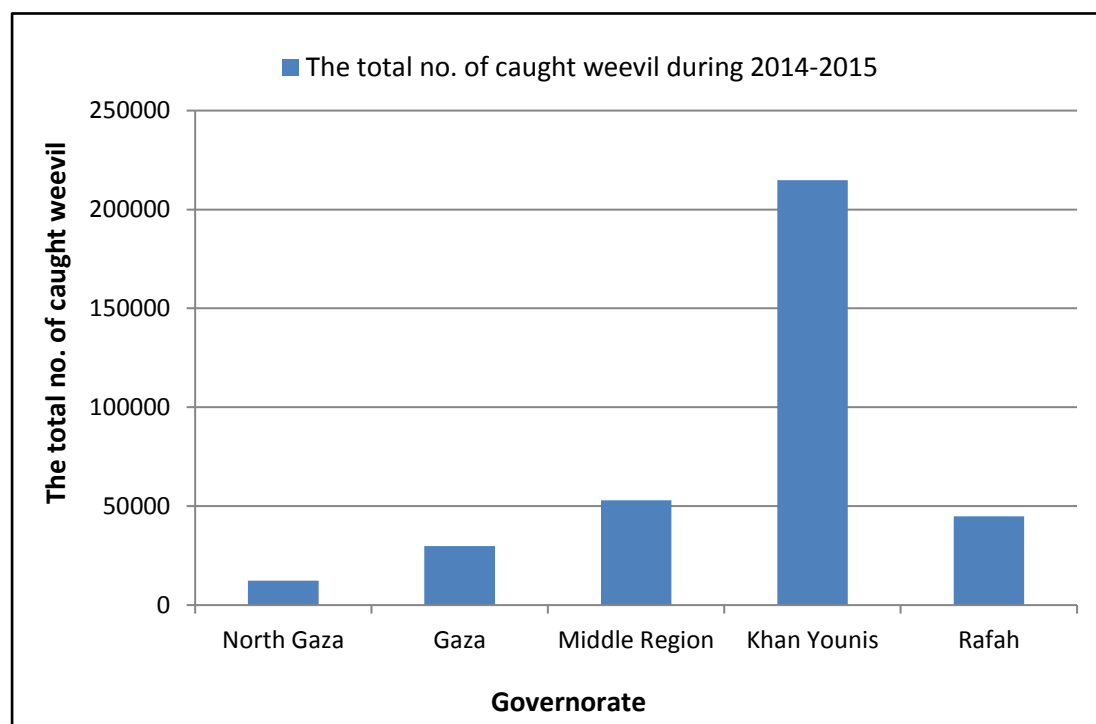


Figure (4.10): The number of weevil that were caught during 2014-2015.

4.4.3. Control Levels of the RPW

4.4.3.1. Regulation level

It includes enacted laws and decisions by the responsible authorities to protect Date Palm tree from pest infestation and prevent the spread within the borders of Gaza Strip. When the first infested palms were discovered in 2011, the MOA has enacted a law that establishes the RPW as a quarantine pest, and as a result, the transport of Date Palm trees and offshoots has been prohibited. This point is crucial due to the failure of the control methods against the RPW pest. Both farmers and responsible associations have been informed not to transport such tree till the RPW is to be eradicated.

4.4.3.2. Organization level

At the beginning of infestation in 2011, the MOA cooperated with the FAO and other associations including ASDPD, PNAPD, ICRC and Palestinian Non-Governmental Organizations Network (PNGOs) to establish the RPW committee in order to fight against the RPW pest. A team from the MOA has realized an important work of detection, sanitation and monitoring of the RPW. The team distributed pesticides and other tools to the farmers and brought a bulldozer to eliminate the infested palms. In the Gaza Strip, farmers have been involved in the control process of the RPW pest. They are also able to detect early symptoms of infestation.

Many activities held by the related associations and institutions on the seriousness of the RPW have been organized as follows:

1. Workshops to train the local farmers on the suitable control methods of the RPW pest have been organized by the RPW committee.
2. A total number of 1500 brochures prepared by FAO and ASDPD have been edited and distributed by MOA.
3. A technical booklet on the RPW has been edited by ASDPD with the assistance of GEF/SGP.
4. A leaflet on the RPW has been prepared and distributed by the EHCRS.

4.4.3.3. Technical level

For the successful control of the RPW, it is mandatory to judiciously mix various methods of control such as cultural control, chemical control, mass pheromone trapping, biological control, mechanical control, quarantine control, etc.

4.4.3.3.1. Agricultural control

The farming practices adopted by farmers play an important role in the health of the palms and the infestation levels. Local farmers have been found to apply various agricultural control methods including the use the right irrigation, proper fertilization, cleaning and pruning of palms and their offshoots. By this operation any potential sources of infestation are removed and destroyed making the farm clean. It is necessary to do this task as and when needed or on a scheduled basis.

4.4.3.3.2. Mechanical control

This method depends on the use of manual or mechanical means to eliminate the insect. The most important means noticed in the field were:

- Removal of dead trees in neglected farms and pruning products (Figure 4.11).
- Closing of all holes on the trunk resulting from offshoot removal by mud.
- Removal of Date Palm tree in neglected farms.
- Covering the roots of small trees with soil to a height of 20 cm to prevent insect attack.
- Burning of old fronds and infected offshoots to prevent the spread of infection to healthy tree.
- When severely damaged and dead palms are noticed, it is necessary to remove them and dispose of properly. Here, palms are cut to smaller bits and treated with pesticide and then burned.

Palms removed in large scale by heavy machinery like bulldozers are transported to a dumping area and burnt completely to kill any residual populations of the weevil.



Figure (4.11): Removal of Palm trees infected with RPW.

4.4.3.3.3. Biological control

Although of its importance as an ingredient of IPM, the biological control means has not been used in the Gaza Strip.

4.4.3.3.4. Behavioral control using the aggregation pheromone traps

The aggregation pheromone traps used locally are of the classic model as demonstrated in Figure 4.12 and 4.13. This model is efficient and presents the great advantage to be cheap, usually put one trap per 50 tree. Traps that are used in the field either homemade or imported from abroad. EHCRS work experience on local-made traps with different colors, these colors are red, white, black and yellow. Preliminary results and indications have shown a greater number of RPW are attracts to the traps with black color better than anyone else.



Figure (4.12): The classical model of RPW traps.

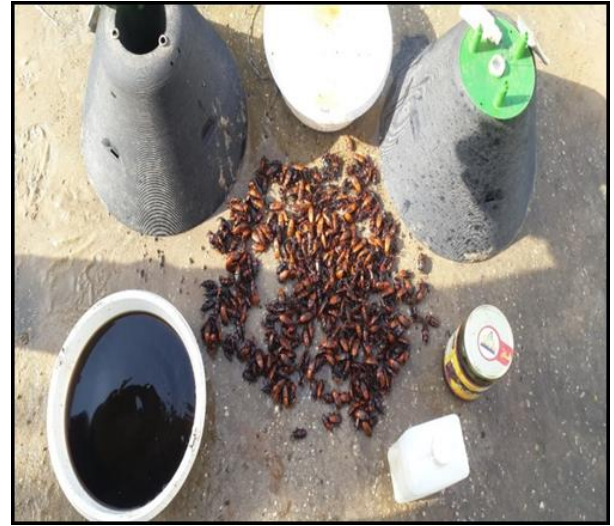


Figure (4.13): The components of RPW traps.

4.4.3.3.5. Chemical control

This method depends on both preventive and therapeutic programs as follows:

4.4.3.3.5.1. Preventive control

It includes spraying or dusting of pesticides on the trunks and leaves of the intact trees. Dursban, Rogor and Confidor are commonly used for this purpose in Gaza Strip (Figure 4.14).

4.4.3.3.5.2. Therapeutic control

It includes spraying or dusting of pesticides on the trunks and leaves of the infected trees by using of injection devices and fumigation.

1. Injection

Methods of treatment is determined by the rate of infection. If the infection is early, treatment can be applied by removing the affected parts. Then, the infected parts are cleaned and injected by appropriate pesticides. Cottonion, Diazinon, Metasystox, Marshal, Sybrein, Dursban, Rogor and Confidor are commonly used pesticides for this purpose (Figure 4.15). The injection is taken place through making three holes rising 20 cm from the place of injury. Injection devices (Figure 4.16) are commonly used to inject the appropriate pesticides into the infected tree. It is worth mentioning that the injection treatment may raise a serious problem by dinimuating the tree and allowing other pests to invade the tree itself.

2. Fumigation

This method is used to treat severe infections which yield tunnels in the trunk. This process is done using fumigation tablets (Phostoxin) against RPW infestation (Figure 4.17). In this case three holes were drilled into the tree: one at the point of infestation, the second 20cm above and the third 20cm below the first hole. The part of the trunk that oozes is to be cleaned and then, the decaying tissues and grubs are to be removed as much as possible. One tablet of Phostoxin is usually placed in the drilled hole. Sealing with moistened clay is then followed in order to prevent the leak of evaporated gas which results from Phostoxin.



Figure (4.14): Dursban pesticide which used to spraying palm trees.



Figure (4.15): Chemical pesticides used in the injection of infected trees.



Figure (4.16): Injection device used to inject pesticides inside date palm trees.







Figure (4.17): Fumigation tablets which used to treat infested palm trees with RPW.



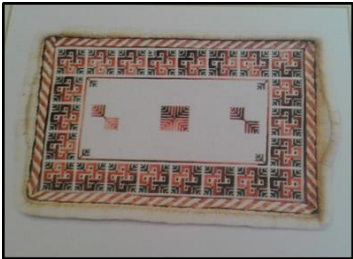


4.5. Industries Associated with Date Palm


There are 42 industries based on Date Palm products about 16 are food industries and remainder represent other industries (Table 4.8). Most of these industries are handicrafts. It is a traditional main sector of craft, and applies to a wide range of creative and design activities such as work with textiles, moldable and rigid materials, plant fibers, etc.

Table (4.8): Public uses and industries based on the Date Palm tree

Industries associated with Date Palm	Photo
<p>cultivation of Date Palm tree in public parks and green spaces</p> <p>(زراعة النخيل في المتنزهات العامة و المسطحات الخضراء)</p> <p>Date Palm trees have a geometric and beautiful landscape appearance. As a result, they are commonly planted in public parks and green spaces. From an ecological point of view, palms are known to act as windbreaks, accommodate temperature, raise relative humidity, stabilize soils and dunes and combat desertification.</p>	
<p>Use of fronds as a signal of grave or consolation presence</p> <p>(وضع جريد النخيل على قبر الميت و مقابل بيوت العزاء)</p> <p>Most Gazans place the fronds of palm tree on the top of graves. It is a common inherited practice in the Palestinian society. Besides, the fronds are commonly used in the Gaza Strip to indicate to the presence of consolation.</p>	
<p>Picture frames</p> <p>(صناعة البراويز)</p> <p>It is made from various parts of the palm tree especially the fronds. In some cases, these fronds are pigmented with different colors to give an aesthetically pleasing sight.</p>	



Industries associated with Date Palm	Photo
<p style="text-align: center;">Mat industry (صناعة الحصير)</p> <p>This craft work has a great history in Palestine. Many people inherited it from their parents and grandparents. Mats are manufactured in large quantities due to high demand especially in the winter. People use mats to cover the floor, where they give a beautiful sight to furnished rooms.</p>	
<p style="text-align: center;">Vases industry (صناعة المزهريات)</p> <p>Vases are decorative pieces designed to make everyday life more happy and creative. It is characterized by kindness and elegance. It is placed on the dining tables or on shelves to give a beautiful sight. Sometimes, vases are placed without roses to show their beauty.</p>	
<p style="text-align: center;">Chandelier industry (صناعة النجف والثريا)</p> <p>A lot of people love to see nature in their homes. They use the fronds of palm in chandelier preparation and they sometimes package it with a piece of braided fronds to give it a beautiful sight.</p>	
<p style="text-align: center;">Furniture industry (صناعة الأثاث)</p> <p>The manufacture of beds, cabinets, chairs, tables and shelves is common in the Gaza Strip. These tools are characterized by their cheapness, resistance to weather conditions, beauty, relation to the Palestinian heritage and attractiveness to Arab and foreign tourists.</p>	






Industries associated with Date Palm	Photo
<p align="center">Baskets and bowls industry (صناعة السلال والأطباق)</p> <p>It is one of the most famous traditional industries. It is easy to prepare, where women braiding fronds to make baskets, dishes and large vessels in order to keep clothes, bread, vegetables, fruits ...etc.</p>	
<p align="center">Bibelots industry (صناعة التحف الفنية)</p> <p>An art pieces that has historic, aesthetic and artistic value. It is one of the rare and precious things for the community and used to decorate rooms.</p>	
<p align="center">Salver industry (صناعة صواني الطعام)</p> <p>Such a salver is used to offer foods and drinks. It is characterized by resistance to damage, durability, cheap, attractive and give evidence to hold with the heritage of the community.</p>	
<p align="center">Tissues can industry (صناعة علب المناديل الورقية)</p> <p>These cans that have different shapes, sizes and colors are characterized by their durability and long-lasting.</p>	
<p align="center">Bags industry (صناعة الحقائب)</p> <p>The bags are made with different shapes, sizes, colors and decorations. Many women are attracted to buy these bags because of their lower prices and durability.</p>	

Industries associated with Date Palm	Photo
<p style="text-align: center;">Cans industry (صناعة العلب)</p> <p>These cans are commonly used by the Palestinians to keep special papers, needles and threads, accessories, cosmetics or decorations. They are sometimes used to harbor sweets and chocolates in special occasions such as holidays and feasts.</p>	
<p style="text-align: center;">Broom industry (صناعة المكاس)</p> <p>Brooms are made of fronds or fibers of palm to be used by women to clean walls, houses, rooms and gardens especially in rural areas. Small brushes are sometime produced from fibers to be used in cleaning small things such as stairs and shoes.</p>	
<p style="text-align: center;">Hats industry (صناعة القبعات)</p> <p>It is a common industry in the Palestinian society. They are available year round with low prices and different sizes, shapes and colors. Some women wear it in many occasions such as weddings.</p>	
<p style="text-align: center;">Border of parks and fields (عمل سياج للبيساتين)</p> <p>Some agricultural fields and orchards in the Gaza Strip are fenced using palm fronds. Fronds are commonly arranged in orderly lines around the fields. They are favored because of their lower price and beauty characteristics.</p>	

Industries associated with Date Palm	Photo
<p style="text-align: center;">Bird and fruit cages industry (صناعة أقفاص الطيور والفاكهة)</p> <p>This industry is often located near commercial fruit, vegetable and bird markets in order to be used in packaging and export. It is an eco-friendly profession trying to preserve the environment from the accumulation of palm wastes. This industry contribute to improving the standard of living of individuals.</p>	
<p style="text-align: center;">Pergola industry (صناعة المعرشات)</p> <p>Seashore pergola are common in the Gaza Strip. They are often made of leaves and trunks of palm trees. The internal environment inside these pergola is accommodated to be cooler than the outside.</p>	
<p style="text-align: center;">Decors made of palm trunks in resorts and restaurants (ديكورات من جذوع النخيل في بعض المنتجعات والمطاعم)</p> <p>Some people uses the trunks of palm tree to decorate their homes, resorts and restaurants, where it placed as ornamenting columns rather than the concrete columns.</p>	
<p style="text-align: center;">Luffa industry (صناعة ليف الاستحمام)</p> <p>The fibers of palm trunks are rarely used to produce luffa. Doctors sometimes recommend patients and people to use these fibers because they are good cleaner of human body as they protect it from skin diseases.</p>	



Industries associated with Date Palm	Photo
<p>Tables made from palm trunks (إعداد طاولات التقديم من جذوع النخيل)</p> <p>Pieces of trunks of palm have been found to be used by locals as tables in some shore parks and chalets.</p>	
<p>Ceilings industry (صناعة الأسقف)</p> <p>Since long times, palm trunks have been used as columns to bearing ceilings made of palm fronds.</p>	
<p>Mattress and pillow industry (حشو الفرشات والمساند)</p> <p>This industry depends on filling of cloth bags with fibers of palm tree. They are sometimes found in heritage parks and restaurants.</p>	
<p>Fresh date or balah consumption (الاستهلاك المباشر للتتمر أو البلح)</p> <p>Dates are considered one of the most important fruits in Palestinian society; especially in the fasting month of Ramadan. It is very delicious and it is commonly eaten with hot or cold drinks such as tea, coffee, cola and juice.</p>	
<p>Date packing and processing (تعبئة وتجهيز التمر)</p> <p>Here, dates are washed of, dried then packaged in bags made of nylon, carton bottles or transparent plastic containers. Finally, these bags are compressed and stored in suitable places.</p>	

Industries associated with Date Palm	Photo
<p style="text-align: center;">Balah pickle (البلح المخلل)</p> <p>This product is similar to the olive, egg-white and cucumber pickles. It has a pungent acid taste. The aim of the balah or date pickle production is to search an alternative use of dates.</p>	
<p style="text-align: center;">Ajwa industry (صناعة العجوة)</p> <p>Ajwa is a very common industry in the Gaza Strip; particularly Deir Al-Balah. It is made from the rutab phase of fruits. Sometimes, the Ajwa may contain seeds or blended with sesame, anise, hazelnuts and walnuts. One ton of Ajwa needs at least 3 tons of rutab.</p>	
<p style="text-align: center;">Dates pone (رغيف التمر)</p> <p>In spite of its rarity, this type of pone is commonly eaten by people who want to reduce their weight. The pone helps in slimming health because of its high nutritional value. Some people consider it a substitute for ordinary bread. It can be offered for guests with tea or coffee.</p>	
<p style="text-align: center;">Biscuits, pies and pastries production (صناعة البسكويت والفظائر والمعجنات المحشوة بالتمر)</p> <p>Some Palestinian women are fond in preparing some types of biscuits and pastries filled with dates or Ajwa instead of using chocolate. These home or sometimes factory products are very delicious and they are commonly eaten with hot or cold drinks such as tea, coffee, cola and juice. The Palestinians often offer these foods in special occasions such as holidays, birthday party, feasts, engagement and weddings.</p>	

Industries associated with Date Palm	Photo
<p style="text-align: center;">Dates powder (مسحوق التمر)</p> <p>This powder is used for both medicinal and nutritional purposes. Some women have been found mixing dates powder with oil in order to paint their hair.</p>	
<p style="text-align: center;">Dates salad (سلطة التمر)</p> <p>It is sometimes prepared in Ramadan. It very delicious especially when some vegetables and fruits such as lettuce, watercress, mushroom and apples are added.</p>	
<p style="text-align: center;">Date chocolate and tamreya industry صناعة شوكولاتة التمر و التمرية</p> <p>Many women prefer eating date chocolates with hot drinks such as coffee. Recently, it becomes one of the most hospitality sweet that are offered to visitors and guests.</p>	
<p style="text-align: center;">Balah jam (مربى البلح)</p> <p>The production of the balah jam depends on using fresh dates rather than rutab. It is a tasty food commonly consumed by the Palestinians year round; especially in the fasting month of Ramadan.</p>	
<p style="text-align: center;">Eid cakes (كعك العيد)</p> <p>During the two Eids (feasts) of Muslims, the Palestinians; especially women used to make the Eid cake, which mostly depends on the use of Ajwa as a filling material.</p>	

Industries associated with Date Palm	Photo
<p style="text-align: center;">Date cake (كعكة التمر)</p> <p>This is very delicious and rich in calories. The cake consists of flour, sugar, dates, walnuts, almonds and chocolate pieces commonly offered with several sauces such as toffee sauce in many occasions.</p>	
<p style="text-align: center;">Beverages industry (صناعة المشروبات)</p> <p>These drinks are easy to prepare. Doctors often advise women to prepare it for children due to its importance in strengthening the body, treating anemia and preventing nerve disorders.</p>	
<p style="text-align: center;">Qatayif production (إنتاج القطايف)</p> <p>The Qatayif is a very common traditional industry in the Palestinian society, especially during the fasting month of Ramadan. Sometimes, instead of nuts and other filling material, qatayif is filled with dates or Ajwa.</p>	
<p style="text-align: center;">Molasses (دبس البلح)</p> <p>It is a thick sugar liquid produced from certain varieties of dates. It consists of sugary material which constitute 85% of the dry weight. Molasses is produced by using old, primitive and manual modes.</p>	

Industries associated with Date Palm	Photo
<p style="text-align: center;">Coffee industry (صناعة القهوة)</p> <p>This type of coffee is commonly prepared by grinding the date seeds after being washed and dried. It contains no caffeine, does not cause acidity and helps to get rid of excess weight.</p>	
<p style="text-align: center;">Ropes and strings industry (صناعة الحبال والدوبار)</p> <p>The fibers of palm tree may be used in strings and ropes production.</p>	
<p style="text-align: center;">Eyeliner and coal industry from seeds (صناعة كحل العين و الفحم من النوى)</p> <p>The seeds of dates are collected and exposed to sun, washed well, crushed and finally used as eyeliner. The seeds are sometimes used in the production of coal.</p>	
<p style="text-align: center;">Use pollen in folk medicine (استخدام اللقاح في الطب الشعبي)</p> <p>The pollen of the palm tree is used by some Palestinians for therapeutic purposes. It strengthens bones and protects against fragility, aids digestion, helps in the treatment of inflammatory bowel and stomach ulcers, and helps stop blood bleeding.</p>	

Industries associated with Date Palm	Photo
<p style="text-align: center;">Organic fertilizer production (إنتاج السماد العضوي)</p> <p>Some palm residues could be used locally in fertilizer industry (humus) in order to be added to agricultural plants. It is considered a safe and a good alternative to chemical fertilizers that may pose harmful impacts on plants and environment.</p>	
<p style="text-align: center;">Animal fodder production (إنتاج علف الحيوانات)</p> <p>Some palm residues, e.g. fibers, seeds, fronds, ... etc. are sometimes involved in the production of the animal fodder or feed. A machine has been designed especially to chop, grind and turn palm residues into animal fodder.</p>	

4.6. The questionnaire application

The present data were collected using questionnaire applied on 150 inhabitants living in the Middle Governorate. The tables of the data are illustrated in Appendix 2.

4.6.1. Personal Profile of the Research Sample

Table 1 (Appendix 2) illustrates the characteristics of the research sample (N=150) in the Middle Governorate. The sex showed that 95.33% of the interviewed people were males and 4.7% were females (Figure 4.18). Distribution of this ratio was due to random selection of samples and does not mean that women's rights are robbed or prohibited from working in the agricultural sector, but there is a good proportion of them sharing their husbands and families in agricultural works such as harvesting, irrigation, fertilization, transportation, shipping and marketing of various products of Date Palm.

The age frequency showed that 26.0% of the interviewed population were more than 50 years, 24.7% from 41 to 50 years, 24.0% from 31 to 40 years, 23.3% from 21 to 30 years, and 2.0% were less than 20 years (Figure 4.19).

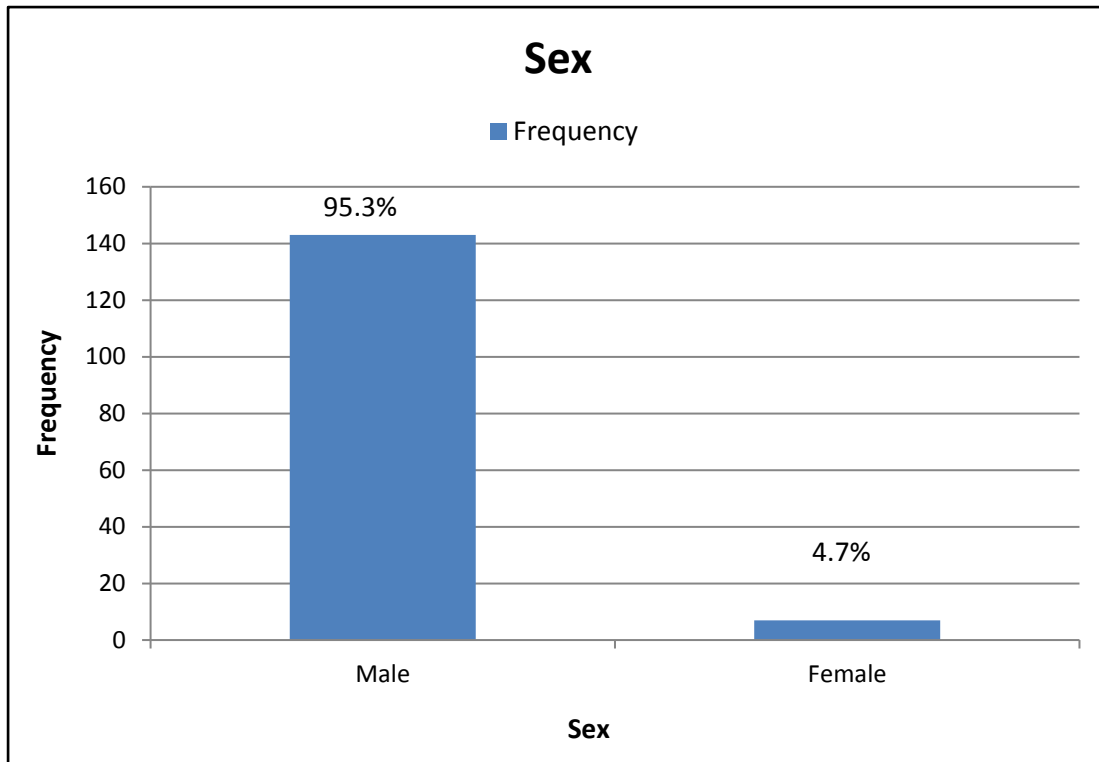


Figure (4.18): Sex of the surveyed population (N=150).

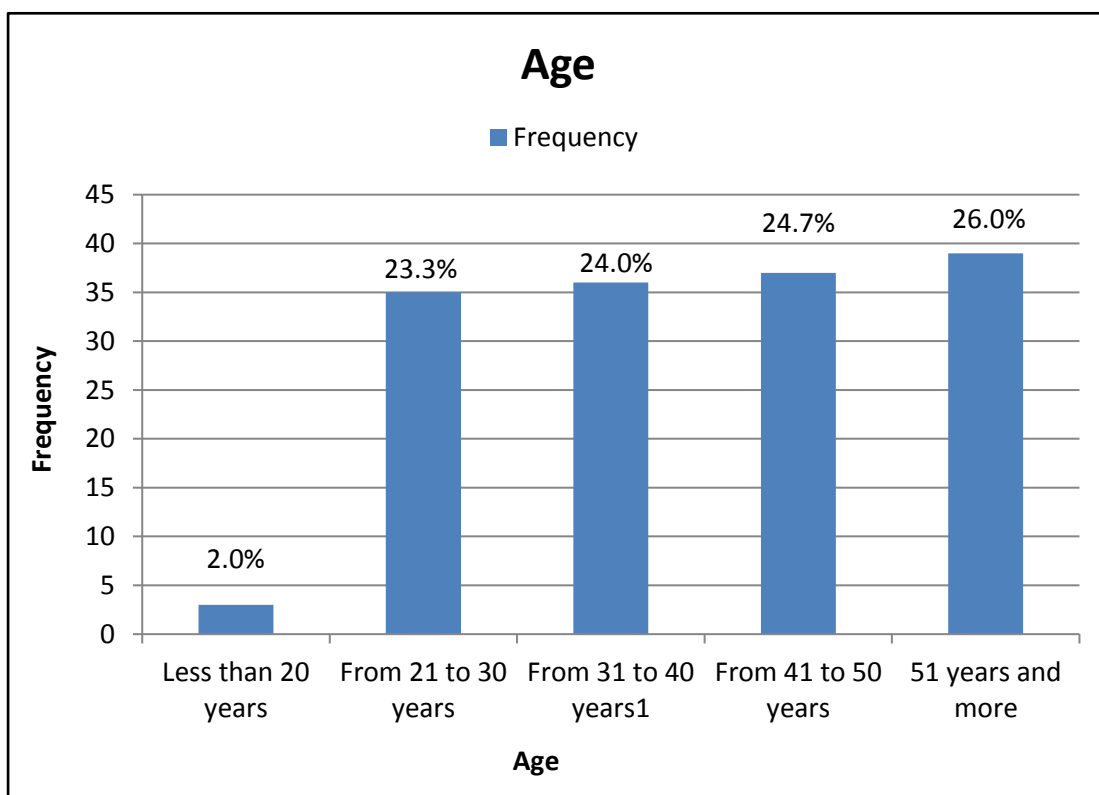


Figure (4.19): Age of the surveyed population (N=150).

For marital status, the majority of the interviewed people (84.0%) were married, while 13.3% were single and the rest 2.7% were widow (Figure 4.20). In general, 82.0% of the interviewed people have children.

The analysis of the educational level showed that 52.7% of the interviewed people had university or Diploma degree, 28.0% had finished secondary school and 17.3% had finished preparatory or primary school and only 2% had master degree (Figure 4.21). With regard to occupation, 46.7% were employees, 25.3% were unemployed. The rest were either practitioners or workers (Figure 4.22).

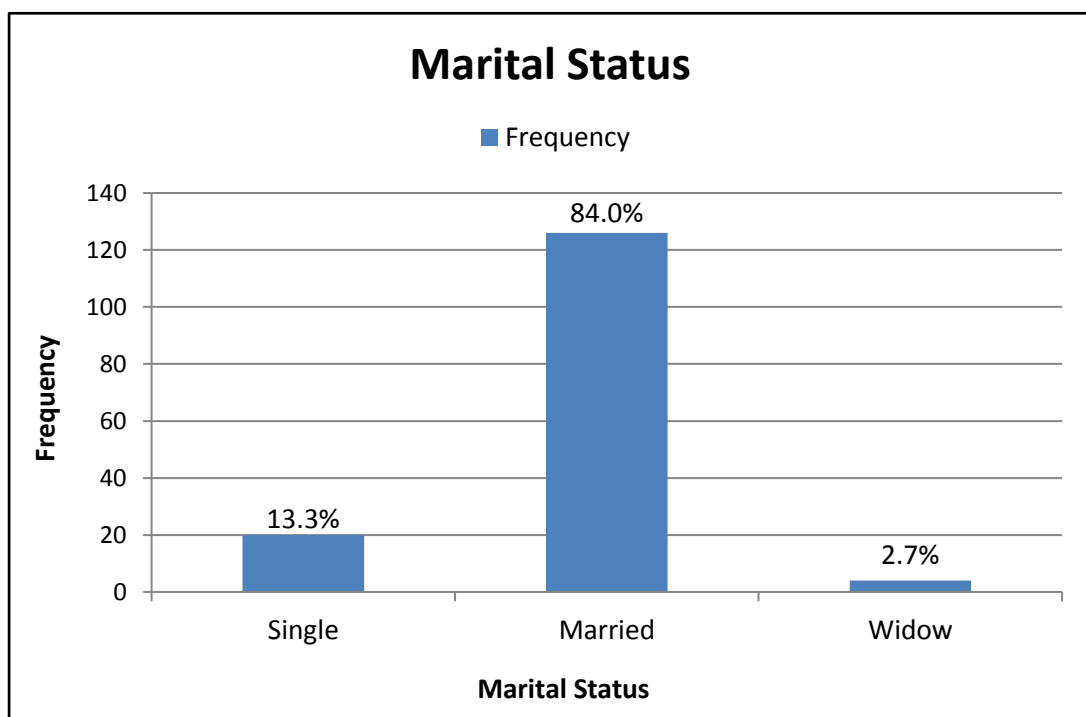


Figure (4.20): Marital status of the surveyed population (N=150).

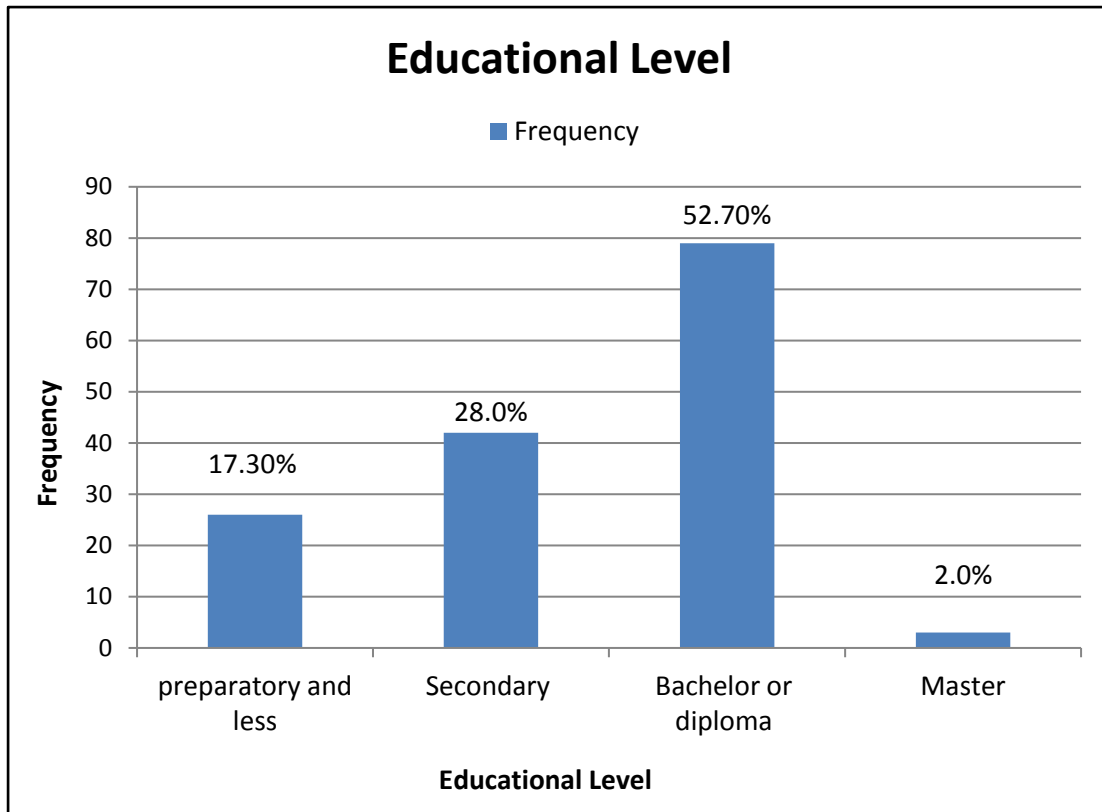


Figure (4.21): Educational status of the surveyed population (N=150).

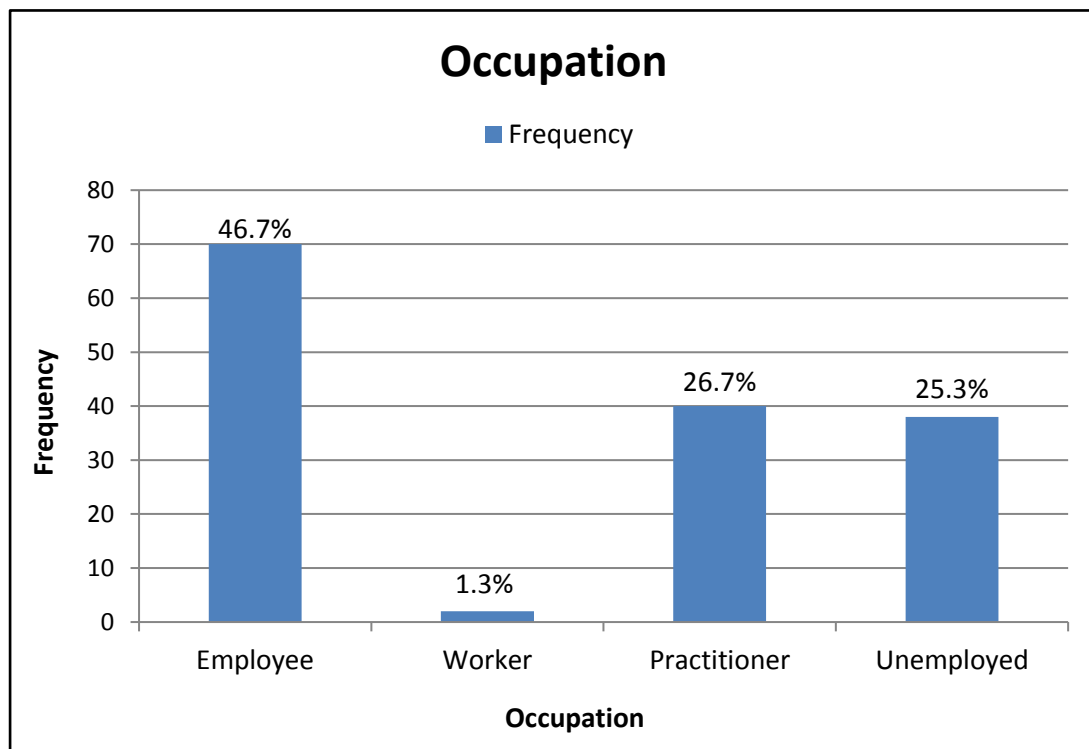


Figure (4.22): Occupation of the surveyed population (N=150).

4.6.2. Date Palm Orchards in the Middle Governorate

Table 2 (Appendix 2) illustrates an overview about the Date Palm in the Middle Governorate (N=150).

4.6.2.1. Area of the Date Palm orchards

The results showed that 42.7% of the interviewed people had from 1 to 3 dunum, 28.7% were less than 1 dunum, 17.3% had more than 6 dunum and 11.3% had from 4 to 6 dunum (Figure 4.23).

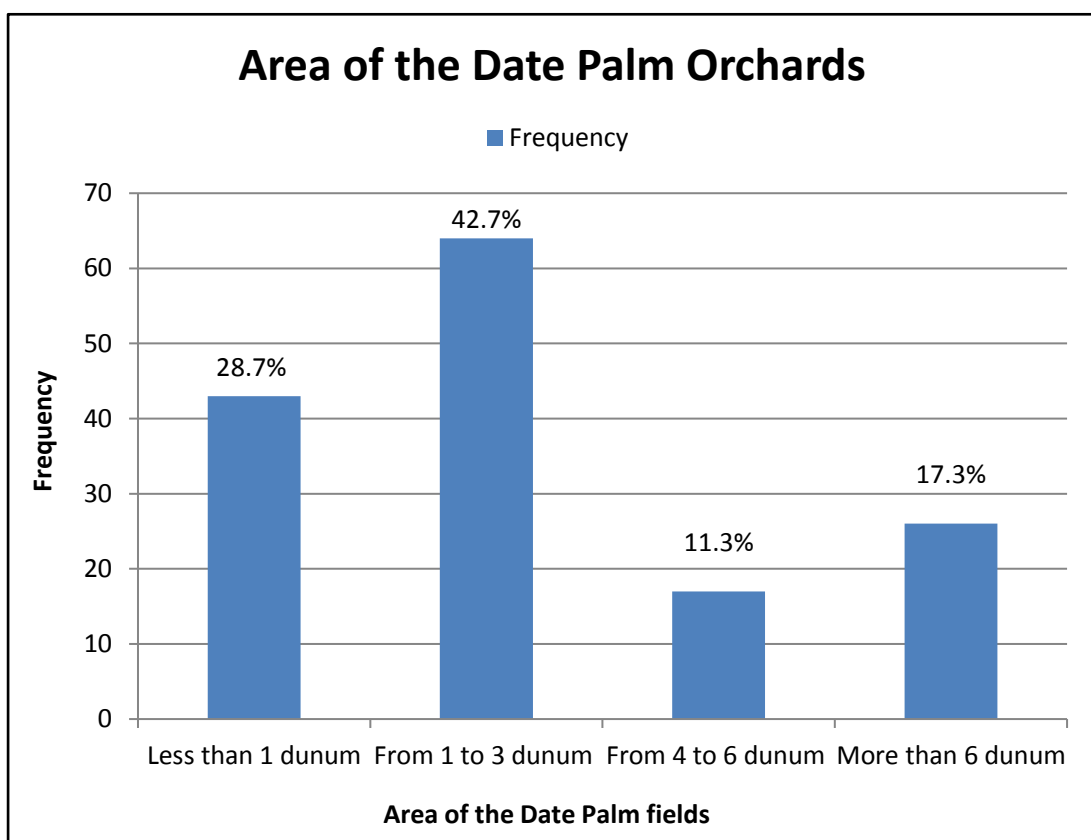


Figure (4.23): Area of the Date Palm orchards.

4.6.2.2. The total number of the Date Palm tree per orchard

Table 2 (Appendix 2) showed that 44% of the interviewed people had less than or equal 20 Date Palm trees per orchard, 21.3% had more than 60 trees, 20.0% had from 20 to 40 trees and 14.7% had from 41-60 tree (Figure 4.24).

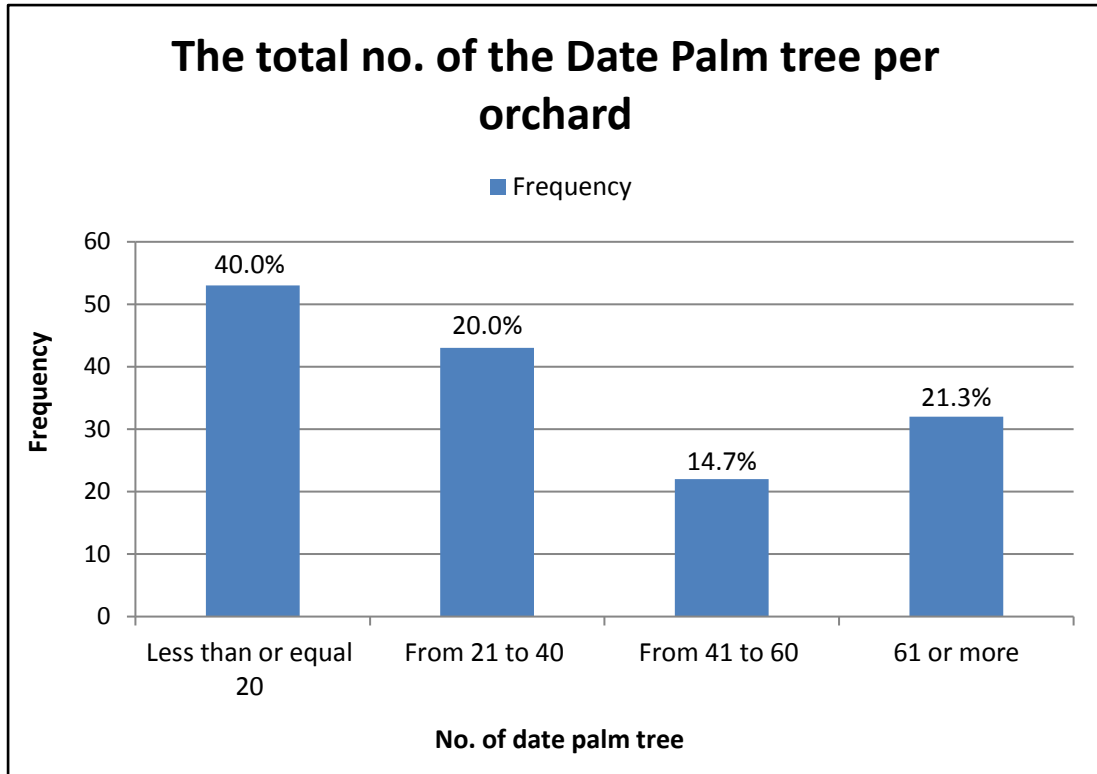


Figure (4.24): The total number of the Date Palm tree per orchard.

4.6.2.3. Age of the Date Palm trees

Table 2 (Appendix 2) showed that 46.0% of the interviewed people have Date Palm trees of ages from 11 to 30 years, 41.3% of less than or equal 10 years, 8.0% from 31 to 60 years, and 4.7% more than 60 years (Figure 4.25).

4.6.2.4. Number of Date Palm cultivars grown by the respondents

Figure 4.26 shows that cultivars grown by the respondents vary widely. Of all the Date Palm cultivars, the Hayani cultivar was the most common and preferred. 41.3% of the respondents reported that they grew only one cultivar (especially the Hayani cultivar), 26.7% grew two cultivars. Finally 32% of interviewed population grew four or more. The respondents mentioned the benefits associated with the growing of diverse cultivars as following:

1. The diversity of Date Palm cultivar serves as site for conserving genetic resources along with fulfilling the primary aim of food production.
2. They maximize yield, revenue and income.

- Having different cultivars on a farm can help lower the risk of total crop failure in the event of natural disasters such as biotic and abiotic stresses.

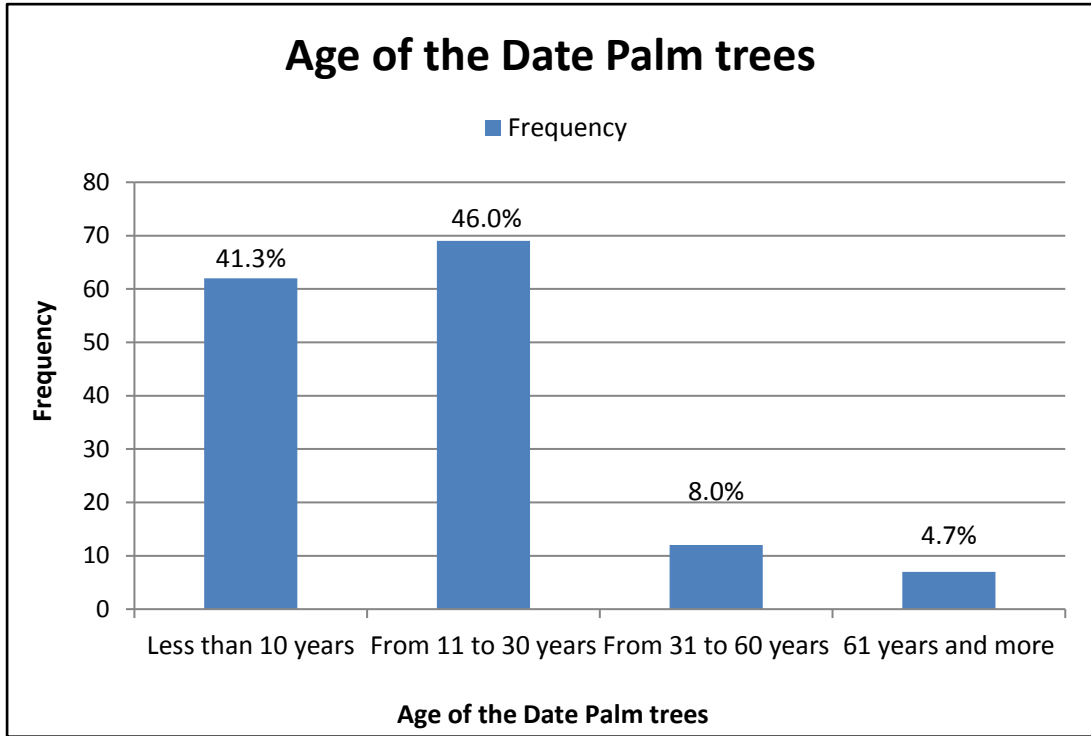


Figure (4.25): Age of the Date Palm trees.

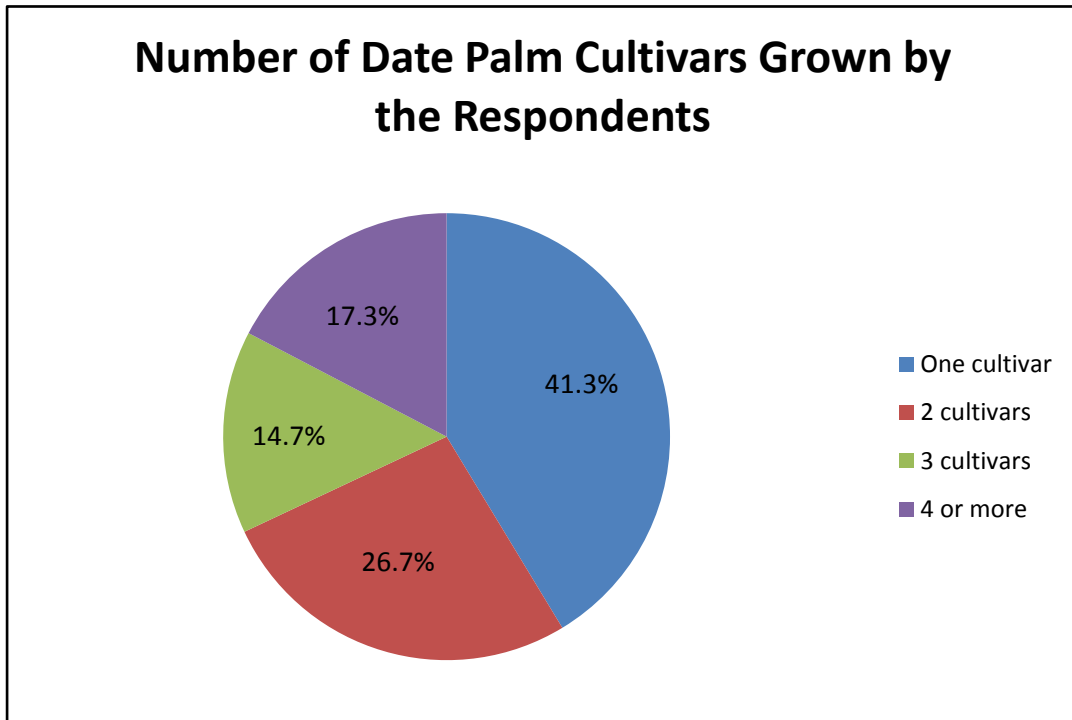


Figure (4.26): Number of Date Palm cultivars grown by the Respondents.

4.6.2.5. Factors standing behind the deterioration of Date Palm trees

The results of the current study showed that 58.7% of the interviewed population believed on the decrease of Date Palm trees in their orchards, while 41.3% did not believe (Figure 4.27). They mentioned such causes for this decrease as follows:

1. High production costs: date production is labor intensive and requires workers with sufficient experience.
2. Water shortage due to local as well as Israeli political considerations. This reason is the most significant obstacle to expanding Date Palm cultivation. Although the Date Palm is able to survive under arid conditions, they require sufficient water of acceptable quality to reach their potential yield; water requirements in such climates are higher when the water quality is low. Saline soils are a problem in this area because of insufficient annual rainfall to flush accumulated salts from the crop root zone.
3. The frequent interruptions of electricity and shortage of fuel and refrigeration cause significant damage due to improper storage of Date Palm fruits and their products.
4. Shortage of qualified and trained staff in various Date Palm activities.
5. High shipping and transportation costs: generally the cost of shipping and transportation for exports and imports in Palestine is more than 30 % above the norms.
6. Exposure of Date Palm trees to several diseases and pests including the RPW. In this regard, the lack of control and treatment of infected trees with RPW expands to the transmission of pests to other trees.
7. Some palms are in danger of dying out because of human activity.
8. Poor care made by farmers till achieving post-harvest.
9. Lack of interest in applied research related to manufacturing dates and their products.
10. Israeli procedures such as incursions, bombardments shoveling and bulldozing agricultural land in the Gaza Strip.

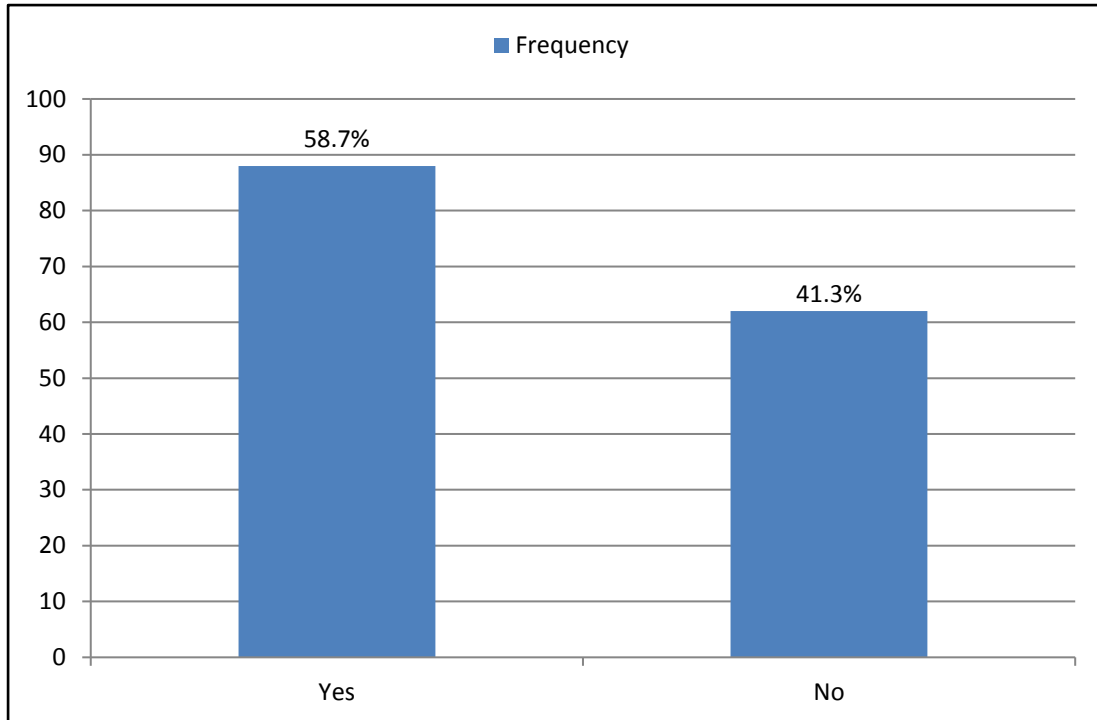


Figure (4.27): Response of the surveyed population (N=150) on the decreasing number of the Date Palm trees.

4.6.2.6. Methods of selling the products

The results of the current study showed that 35.3% of the interviewed population were found to sell their products (balah) directly to the market, 22.0% convert it to Ajwa, 12.0% store the products in special container until it turns into rutab, 18.7% of them sell balah in the field, 10.7% keep it for home consumption or present it as a gift to relatives and 1.3% sent products to the factories (Figure 4.28).

4.6.2.7. Source of irrigation water

Table 2 (Appendix 2) showed that 61.3% of the interviewed people use groundwater in irrigation, 28.7% depends on the rain water, 8.0% use reclaimed wastewater and finally 2.0% depends on other sources (Figure 4.29).

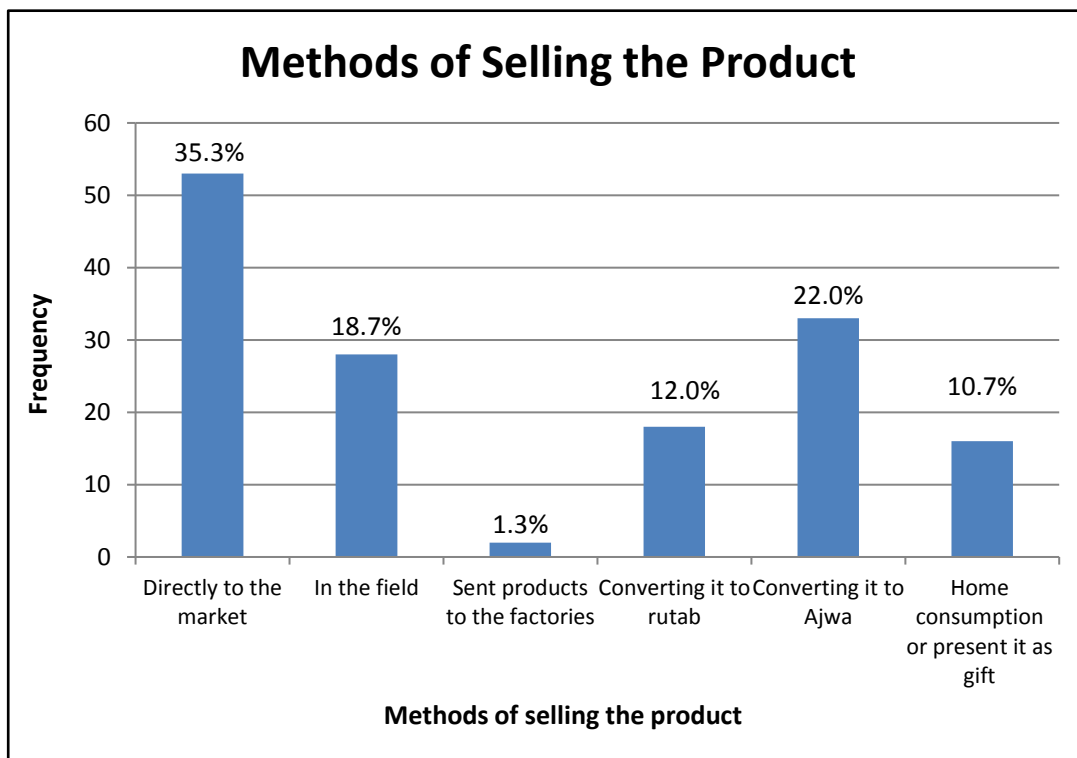


Figure (4.28): Response of the surveyed population (N=150) on the methods of selling the product.

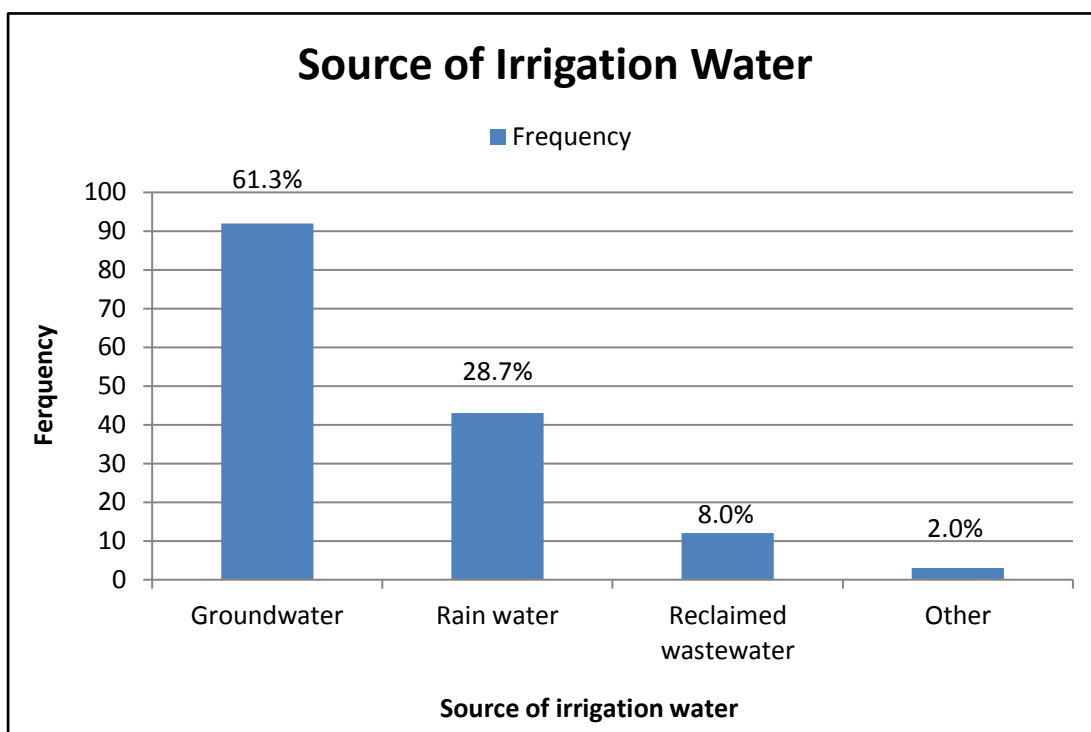


Figure (4.29): Response of the surveyed population (N=150) on the source of irrigation water.

4.6.2.8. Wildlife prevailing in Date Palm orchards

Table 2 (Appendix 2) showed that 55.3% of the interviewed population watch wild animals in their palm orchards (Figure 4.30), while 44.7% of them did not. Table 4.9, 4.10, 4.11, 4.12 and 4.13 illustrate these animals.

Table (4.9): Wild mammals mentioned by the sample population (N=150) that occur in Palm orchards

Family	Scientific Name	Common Name	Arabic or Local Name
Order Insectiveora			
Erinaceidae	<i>Hemiechinus auritus</i>	Long- Eared Hedgehog	قنفذ طويل الأذن
	<i>Paraechinus aethiopicus</i>	Ethiopian Hedgehog	القنفذ الأثيوبي
Order Chiroptera			
Pteropodidae	<i>Rousettus aegyptiacus</i>	Egyptian Fruit Bat	خفاش الثمار المصري
Order Carnivora			
Felidae	<i>Felis silvestris</i>	Wild Cat	قط بري
Order Rodentia			
Muridae	<i>Mus musculus</i>	House Mouse	فأر منزلي
	<i>Rattus spp.</i>	Rat	عرسة- فأر كبير
Spalacidae	<i>Spalax leucodon ehrenbergi</i>	Palestine Mole-Rat	الخد الفلسطيني
Order Lagomorpha			
Leporidae	<i>Lepus capensis</i>	Cape Hare	أرنب بري

Table (4.10): Birds mentioned by the sample population (N=150) that occur in Palm orchards.

Family	Scientific Name	Common Name	Arabic or Local Name
Order Accipitriformes			
Accipitridae	<i>Buteo buteo</i>	Common Buzzard	صقر حوام
Accipitridae	<i>Aquila chrysaetos</i>	Golden Eagle	نسر
Order Columbiformes			
Columbidae	<i>Columba livia</i>	Rock Dove	حمام بري
	<i>Streptopelia senegalensis</i>	Laughing Dove	حمام
Order Bucerotiformes			
Upupidae	<i>Upupa epops</i>	Hoopoe	هدهد
Order Piciformes			
Picidae	<i>Dendrocopos syriacus</i>	Syrian Woodpecker	نقار الخشب السوري

Family	Scientific Name	Common Name	Arabic or Local Name
Order Passeriformes			
Pycnonotidae	<i>Pycnonotus xanthopygos</i>	Yellow- Vented Bulbul	بلبل أصفر العجز
Passeridae	<i>Passer domesticus</i>	House Sparrow	عصفور دوري
Corvidae	<i>Corvus corone</i>	Hooded Crow	غراب بلدي رمادي
Order Galliformes			
Phasianidae	<i>Alectoris chukar</i>	Chukar Partridge	الشنار

Table (4.11): Reptiles mentioned by the sample population (N=150) that occur in Palm orchards

Family	Scientific Name	Common Name	Arabic or Local Name
Order Testudines			
Testudinidae	<i>Testudo graeca</i>	Spur- Thighed Turtle	السلحفاة الأرضية
Order Squamata			
Agamidae	<i>Agama stellio</i>	Agama	الحدرون
Chamaeleonidae	<i>Chamaeleo chameleon</i>	Mediterranean Chameleon	الحرباء
Gekonidae	<i>Hemidactylus turcicus</i>	Turkish Gecko	أم بريس
Lacertidae	<i>Acanthodactylus boskianus</i>	Boscs Lizard	السحلية الشائعة
Colubridae	<i>Coluber jagularis asianus</i>	Syrian Black Snake	العرييد
	<i>Coluber nummifer</i>	Coined Snake	الثعبان النقدي
	<i>Coluber ravergieri</i>	Ravergiers Whip Snake	ثعبان
	<i>Coluber rhodorhachis</i>	Jans Deserts Racer	ثعبان
	<i>Coluber rubriceps</i>	Red Whip Snake	ثعبان أحمر الرأس
Viperidae	<i>Vipera palaestina</i>	Palestine Viper	الحية الفلسطينية
	<i>Echis coloratus</i>	Carpet Viper	حياة السجادة

Table (4.12): Amphibia mentioned by the sample population (N=150) that occur in Palm orchards

Family	Scientific Name	Common Name	Arabic or Local Name
Order Anura			
Bufo	<i>Bufo viridis</i>	Common Toad	العجلوم الشائع
Hyla	<i>Hyla arborea</i>	Tree Frog	ضفدع الأشجار

Table (4.13): Invertebrate mentioned by the sample population (N=150) that occur in Palm orchards

Family	Scientific Name	Common Name	Arabic or Local Name
Order Coleoptera			
Curculionidae	<i>Rhynchophorus ferrugineus Olivier</i>	Red Palm Weevil	سوسة النخيل الحمراء
	<i>Coccotrypes dactyliperda</i>	Date Stone Beetle	خنفساء نواة التمر
Scarabaeidae	<i>Oryctes elegans, O. Agamemnon, Arabicus and O. boas Fab.</i>	Fruit Stalk Borer	حفار عنق النخيل
Cerambycidaes	<i>Pseudophilus testaceus Gah.</i>	longhorn Date Palm Stem Borer	حفار ساق النخيل ذو القرون الطويلة
Order Blattodea			
Termitidae	<i>Microcerotermis diversus and Microcerotermis diversus (Silv)</i>	Termites	النمل الأبيض
Order Hemiptera			
Pseudococcidae	<i>Maconellicoccus hirsutus Green</i>	Mealy Bugs	البق الدقيقي
Order Orthoptera			
Acrididae	<i>Locusta migratoria</i>	Migratory Locust	الجراد
Order Hymenoptera			
Formicidae	<i>Solenopsis invicta</i>	Red Imported Fire Ant	النمل
Helicidae	<i>Cornu aspersum</i>	Garden Snail	حلزون الحدائق
Order Araneae			
Liphistiidae	<i>Ryuthela secundaria</i>	??	العناكب

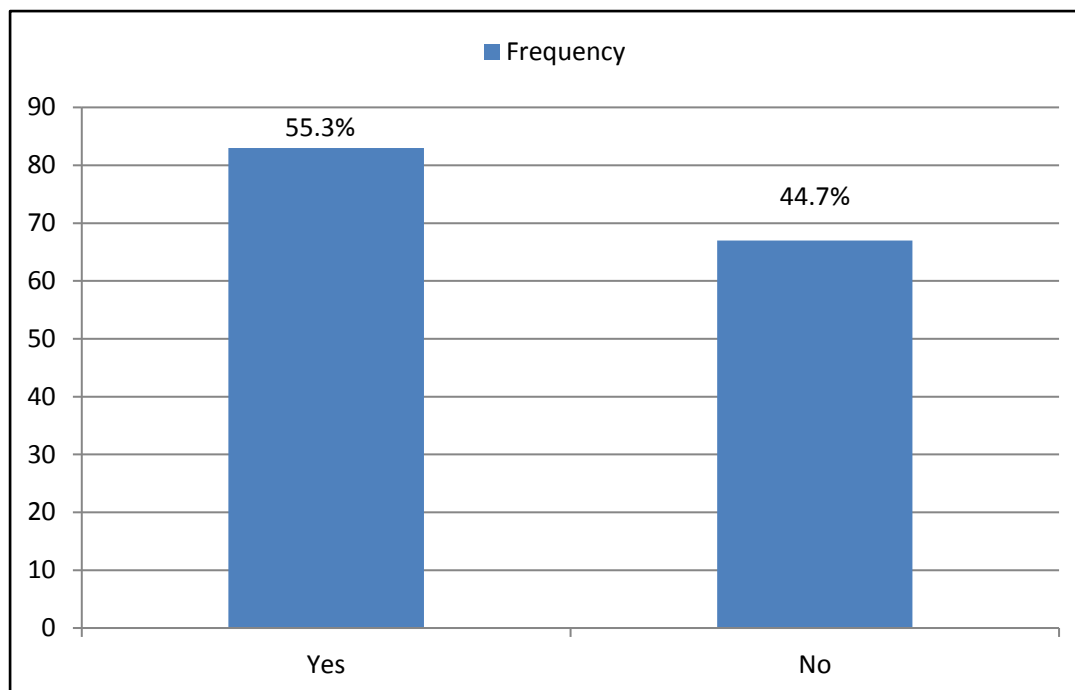


Figure (4.30): Response of the surveyed population (N=150) on the presence of wild animals prevailing in Date Palm orchards.

4.6.2.9. Plants prevailing in Date Palm orchards

Like the faunistic diversity, some fields harbours a diversity of wild plant species and domesticated plants including trees, shrubs and herbs. Table 2 (Appendix 2) and Figure 4.33 showed that 86.0% of the interviewed people cultivate trees other than the Date Palm tree (Figure 4.31 and 4.32)., while 14.0% of them their orchards containing only the Date Palm tree. Table 4.14 illustrate these plants.

Table (4.14): Plants mentioned by the sample population (N=150) that occur in Palm orchards

Family	Scientific Name	Common Name	Arabic or Local Name
Order Lamiales			
Oleaceae	<i>Olea europaea</i>	Olive	زيتون
Lamiaceae	<i>Mentha piperita</i>	Peppermint	نعناع
	<i>Ocimum basilicum</i>	Basil	ريحان
	<i>Salvia sp.</i>	Common Sage	مرمية
Order Sapindales			
Rutaceae	<i>Citrus sinensis</i>	Orange	برتقال
	<i>Citrus limon</i>	lemon	ليمون
	<i>Citrus clementina</i>	Clementina	كليمونتين

Family	Scientific Name	Common Name	Arabic or Local Name
	<i>Citrus paradisi</i>	Grapefruit	جريب فروت
Anacardiaceae	<i>Mangifera indica</i>	Mango	مانجا
Order Myrtales			
Myrtaceae	<i>Psidium Guava</i>	Guava	جوافة
Lythraceae	<i>Punica granatum</i>	Pomegranate	رمان
Order Vitales			
Vitaceae	<i>Vitis vinifera</i>	Graps	عنب
Order Rosales			
Rosaceae	<i>Prunus domestica</i>	Peaches	خوخ
	<i>Malus pumila</i>	Apple	تفاح
	<i>Prunus dulcis</i>	Almonds	لوز
	<i>Prunus armeniaca</i>	Apricot	مشمش
	<i>Rosa damascene</i>	Damask rose	ورد جوري
Moraceae	<i>Ficus carica</i>	Figs	تين
	<i>Morus nigra</i>	blackberry	توت أسود
Order Fagales			
Juglandaceae	<i>Juglans Regia</i>	Walnuts	جوز
Order Fabales			
Fabaceae	<i>Ceratonia siliqua</i>	Carob	خروب
Order Poales			
Poaceae	<i>Triticum spp.</i>	Wheat	قمح
Order Solanales			
Solanaceae	<i>Solanum spp.</i>	Potatoes	بطاطا
	<i>Capsicum annuum</i>	Green Pepper	الفلفل الحلو أو الرومي
	<i>Solanum melongena</i>	Eggplant or Aubergine	باذنجان
Order Magnoliales			
Annonaceae	<i>Annona muricata</i>	Annona	قشطة
Order Pinales			
Cupressaceae	<i>Cupressus sempervirens</i>	Evergreen Cypress	سرو المتوسط
Order Geraniales			
Geraniaceae	<i>Pelargonium graveolens</i>	Sweet Scented Geranium	جويسنة عطرية
Order Cucurbitales			
Cucurbitaceae	<i>Cucurbita pepo</i>	Field Pumpkin	قرع أو يقطين الحقل
	<i>Cucurbita maxima</i>	Winter Squash or Qara Sudani	قرع سوداني
Order Caryophyllales			
Cactaceae	<i>Opuntia ficus-indica</i>	Tuna Cactus	تين شوكي
Order Apiales			
Apiaceae	<i>Petroselinum crispum</i>	Garden Parsley	بقونس



Figure (4.31): Plants mentioned by the sample population (N=150) that occur in Palm orchards: (A) Lemon (B) Guava (C) Orange.



Figure (4.32): Plants mentioned by the sample population (N=150) that occur in Palm orchards: (A) Olives (B) figs (C) Pomegranate (D) blackberry.

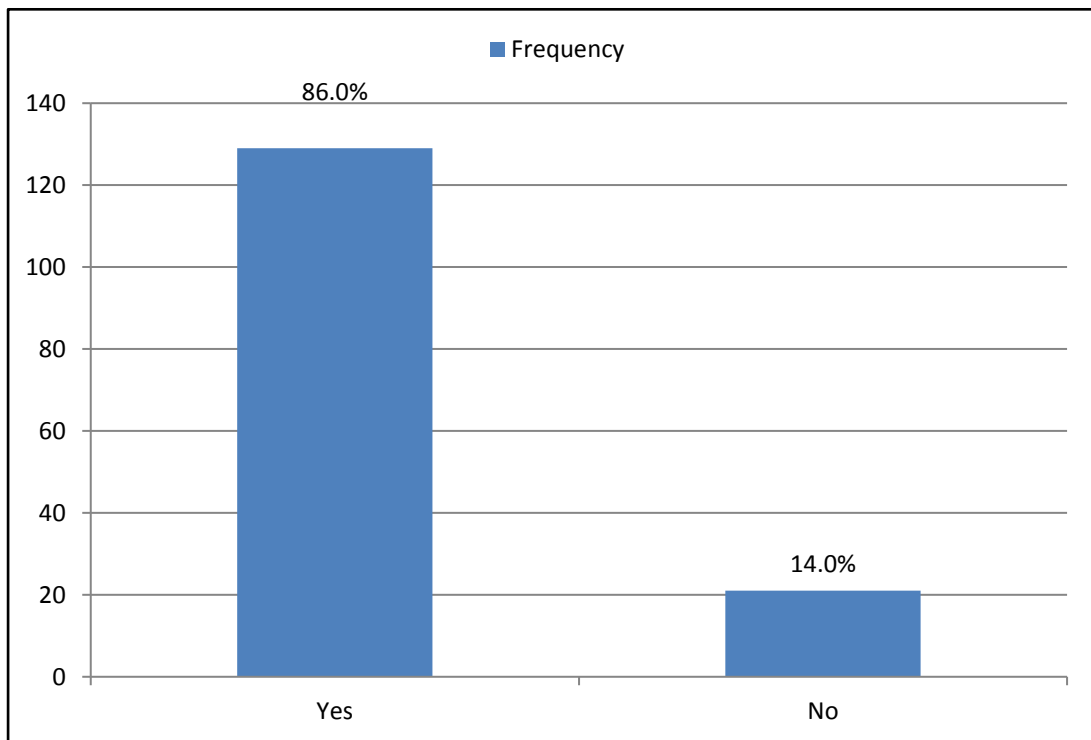


Figure (4.33): Response of the surveyed population (N=150) on the presence of plants prevailing in Date Palm orchards.

4.6.3. Production of Date Palm in the Middle Governorate

Table 3 (Appendix2) illustrates the production of Date Palm in Deir Al-Balah.

4.6.3.1. The average production of Date Palm per year

The results showed that the average production of the Date Palm tree equals 130kg per year. Table 3 (Appendix 2) and Figure 4.34 showed that 32.7% and 29.3% of the interviewed people confirmed that the average production per tree was from 70 to 100kg and from 101 to 200kg per annum respectively.

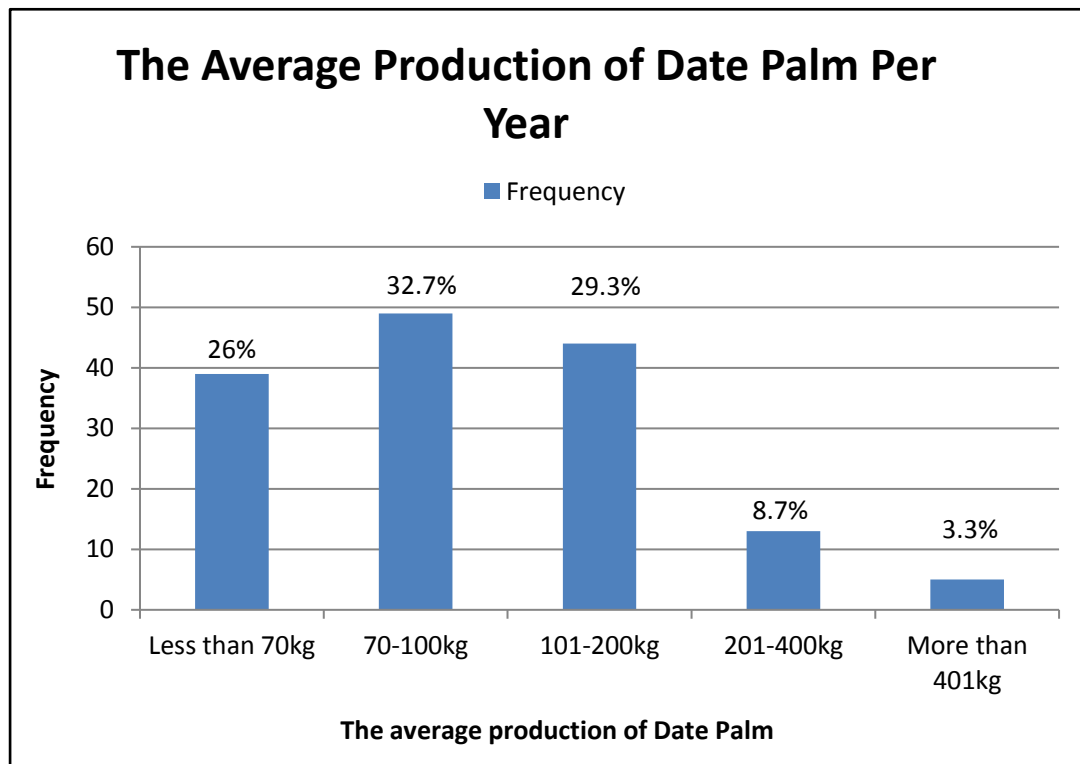


Figure (4.34): Response of the surveyed population (N=150) on the average production of Date Palm per year.

4.6.3.2. Assessment productivity of Date Palm

Table 3 (Appendix 2) showed that 61.3% of the interviewed people believed that the production of Date Palm was good, 24% very good, 10.0% poor and finally 4.7% believed that the production was excellent (Figure 4.35).

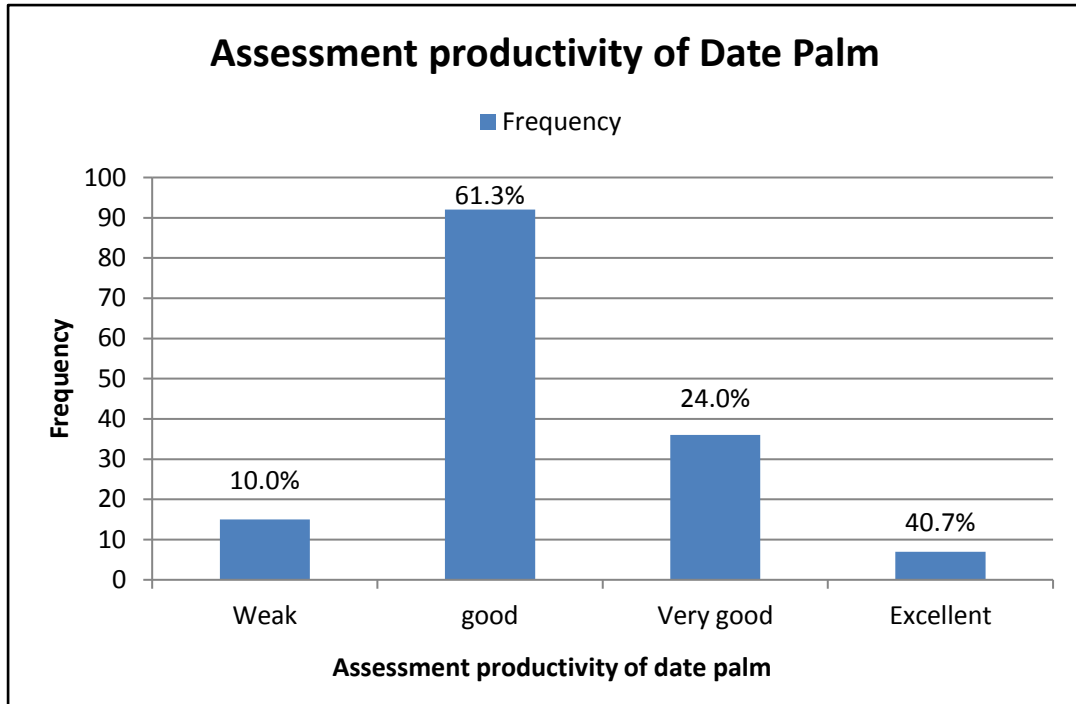


Figure (4.35): Response of the surveyed population (N=150) on the assessment of Date Palm production.

4.6.3.3. Deficiency in the production of Date Palm

Table 3 (Appendix 2) and Figure 4.36 showed that about two-thirds (66.0%) of the interviewed people believed in that there is a reduction in the production of Date Palm in the Gaza Strip, while 34.0% did not believe. The respondents who believed mentioned such causes for this deficiency as follows:

1. Israeli procedures such as incursions, bombardments shoveling and bulldozing agricultural lands in the Gaza Strip, which destroy Date Palm trees and lower their production.
2. The high cost of production due to the exploitation of manual labor.
3. An increase in the costs of storage means for fresh dates.
4. Weakness of marketing services.
5. There was an insufficient replacement of low-quality varieties with those of good quality.
6. Increased losses in dates due to increased infestation of pests and diseases, improper transporting, handling, and storage.
7. Lack of applied research related to manufacturing dates and their products.

8. The atmosphere may be not suitable for cultivation of new cultivars of Palm.
9. Destruction of Date Palms due to human encroachment and building activities.
10. Shortage of agricultural lands needed for planting new Date Palm trees.

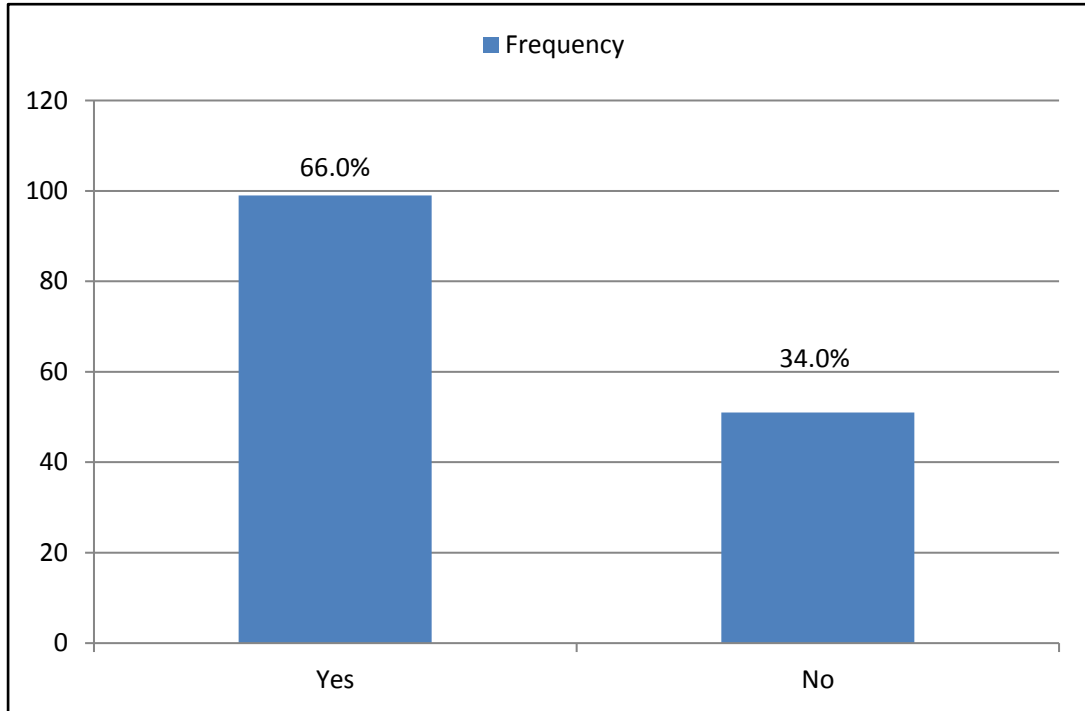


Figure (4.36): Response of the surveyed population (N=150) on the deficiency in the production of Date Palm.

4.6.3.4. Role of the Israeli occupation in deterioration of Date Palm sector

The results showed that 68.7% of the interviewed people believed that the Israeli occupation has a significant role in deterioration of palm sector in the Gaza Strip (Figure 4.37). They mentioned such causes for this deterioration as follows:

1. Israeli procedures such as incursions, bombardments shoveling and bulldozing agricultural lands in the Gaza Strip.
2. Closure of the borders usually leads to the prevention of export of products and import of chemicals, pesticides and vaccines from abroad.
3. Dumping of hazardous and toxic chemicals in the agricultural lands during the wars on the Gaza Strip in 2008, 2012, and 2014.

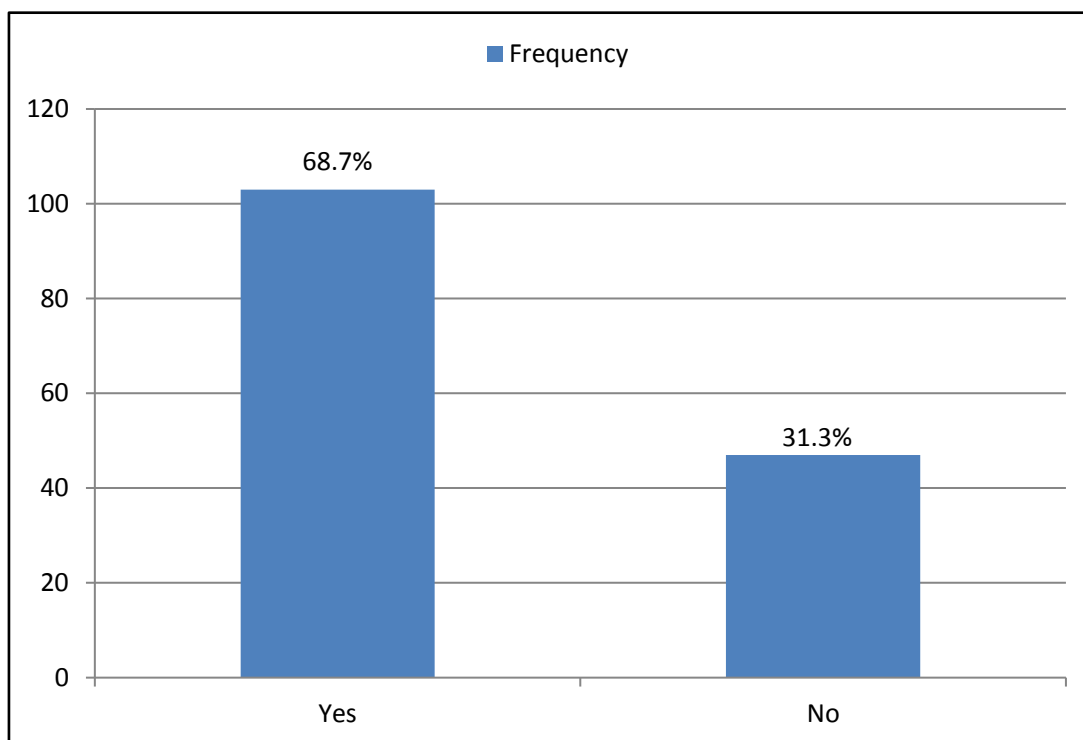


Figure (4.37): Response of the surveyed population (N=150) on the role of the Israeli occupation in the deterioration of palm sector.

4.6.4. General Uses and Industries Based on the Date Palm Tree

4.6.4.1. Role of the Date Palm tree in environmental improvement

All respondents of the current study confirmed the environmental importance of the Date Palm trees as follows:

1. The Date Palm trees maintain soil fertility; insects, bacteria and fungi. These organisms have a vital role in decomposing wastes and retaining the resulting elements to the soil.
2. Roots of the Date Palm trees have a vital function in fixing the soil and preventing soil erosion.
3. They purify air from toxic gases by absorbing them on leaf surface e.g. carbon dioxide, sulfur dioxide and nitrogen oxides.
4. They can capture particulate matter and dust from the air.
5. They can increase the proportion of oxygen in atmosphere.
6. They can control the climate by their cooling characteristics through shade and reflection of sun light.

7. They increase the biodiversity level of the urban environment by providing food, nesting and resting sites and shelter for many insects, birds and other animal categories.
8. The Date Palm trees reduce noise pollution.

4.6.4.2. Public uses based on the Date Palm tree

All respondents confirmed such popular and public uses based on the Date Palm trees as follows:

1. Cultivation of Date Palm trees in public parks, roads, streets and green spaces.
2. Use of fronds as a signal of grave or consolation presence.
3. Production of picture frames, vases, chandelier and bibelots.
4. Production of mats, baskets, bowls, salvers, cans, bags, hats, pillow, tissues cans, broom, bird and fruit cages, pergola and ceilings.
5. Manufacturing of decors from palm trunks in resorts and restaurants.
6. The use of fronds of Palm tree in borders and sieges of parks and fields.

4.6.4.3. Industries based on the Date Palm fruit

According to the results obtained, many industries based on the Date Palm trees have been stated by respondents as follows:

1. Production of molasses and Balah jam from certain varieties of dates especially in the fasting month of Ramadan.
2. Production of Ajwa and Eid cakes, especially during the two Eids (feasts) of Muslims.
3. Production of biscuits, pies, date cake and pastries.
4. Production of coffee from date seeds.
5. Production of qatayif, especially during the fasting month of Ramadan. Sometimes, instead of nuts and other filling material, qatayif is filled with dates or Ajwa.
6. Production of ropes and strings from fibers of palm tree.
7. Production of organic fertilizer and animal fodder from palm residues such as fibers, seeds, fronds, etc.

4.6.4.4. Production of industrial products from Date Palm tree

Table 4 (Appendix 2) showed that the majority of the respondents (70.7%) produced household products (Figure 4.38). These products include production of Ajwa, Eid cakes, molasses, balah jam, coffee, biscuits, pies, pastries and luffa.

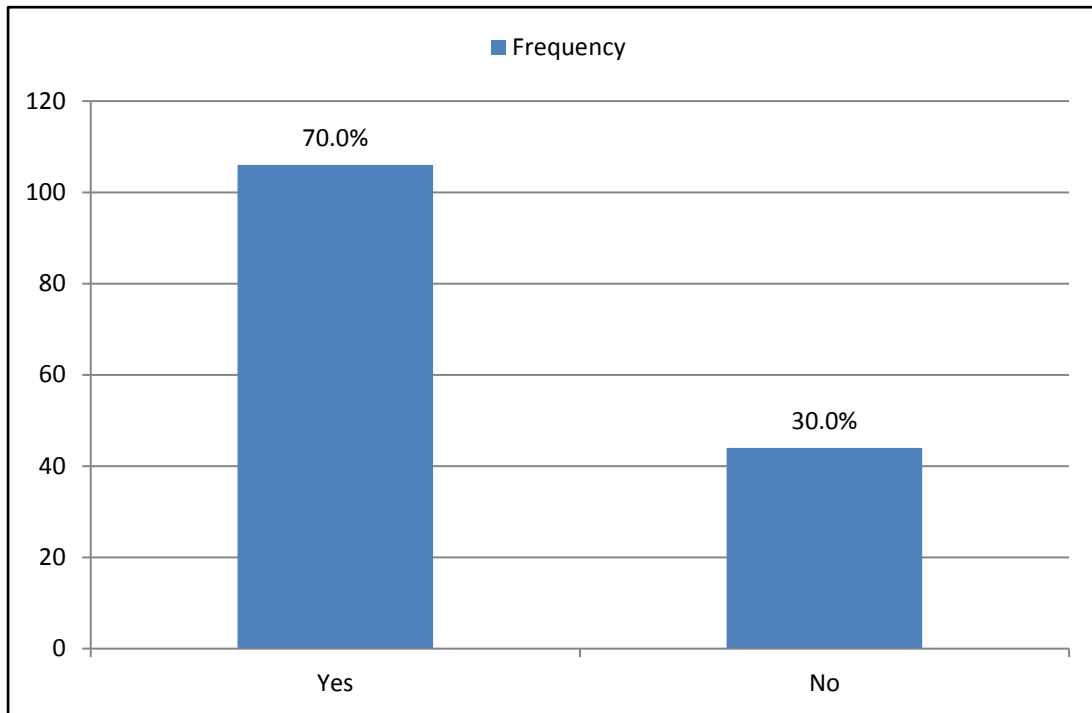


Figure (4.38): Response of the surveyed population (N=150) on the production of industrial household products from the Date Palm tree.

4.6.4.5. Encouragement and support of household products

The results showed that the majority of the interviewed population (84.7%) confirmed that their products did not receive any encouragement or support from the local responsible authorities (Figure 4.39). The rest received some sort of encouragement from responsible authorities and association such as MOA, ASDPD and PNAPD. This encouragement including marketing of products, implementation of advertising campaign and promote consumer to purchase these products.

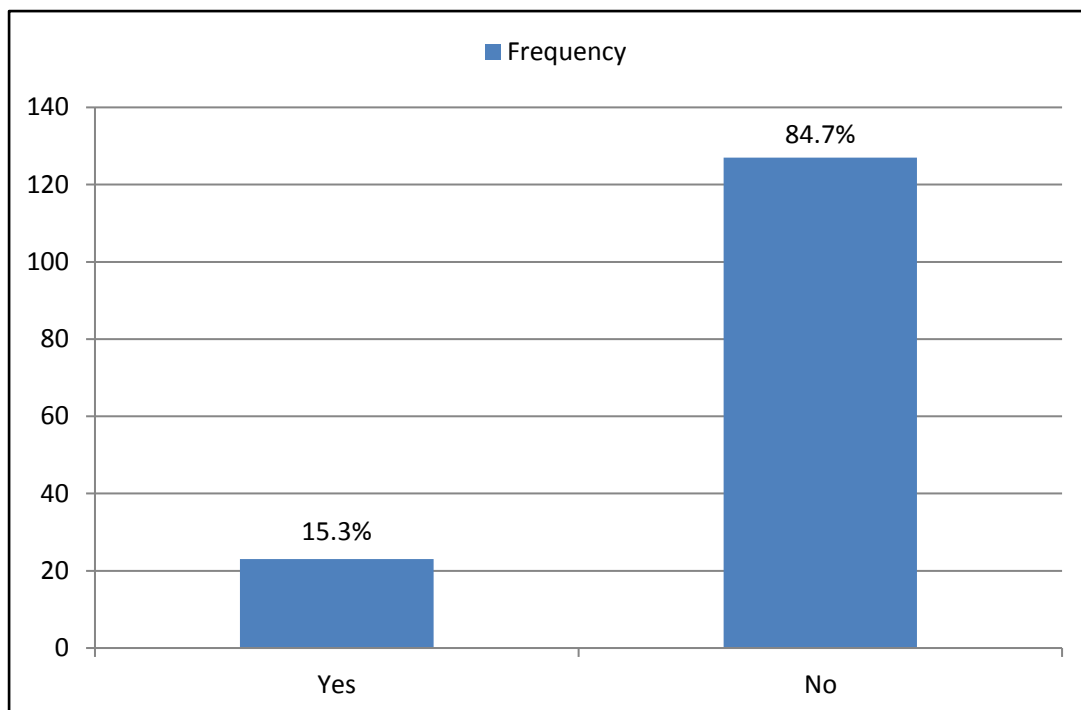


Figure (4.39): Response of the surveyed population (N=150) on the receiving any encouragement or support from the responsible authorities.

4.6.5. Threats Facing Date Palm Trees

4.6.5.1. Threats facing the cultivation of Date Palm

Table 5 (Appendix 2) and Figure 4.40 showed that 90.0% of the interviewed population believed on the threats that face the cultivation of Date Palm in the Gaza Strip. They mentioned the numerous threats as follows:

1. Israeli aggressions towards agricultural land in the Gaza Strip. Thousands of Date Palms trees were uprooted during the last era by the Israeli army.
2. Probable dumping of hazardous and toxic chemicals in agricultural lands during the wars on the Gaza Strip in 2008, 2012, and 2014.
3. Water shortage due to local as well as Israeli political considerations. This reason is the most significant obstacle to expanding Date Palm cultivation.
4. The export of dates and import of chemicals, pesticides, and vaccine has declined to a minimum due to closure of the borders.
5. Field and postharvest losses are high, and methods for measuring product quality and the use of date products and byproducts need improvement.

6. Exposure of Date Palm trees to several diseases and pests including the RPW. In this regard, the lack of control and treatment of infected trees with RPW expands to the transmission of pests to other trees.
7. The costs of date production, shipping and transportation are surpassing revenues.
8. Decrease in the productive capacity of Date Palms and the degradation of the quality of production.
9. Destruction of Date Palms due to human encroachment and building activities.
10. Poor care made by some farmers.
11. Shortage of qualified and trained staff in various Date Palm activities.
12. Shortage of interest in applied research related to manufacturing dates and their products.
13. Height of trees can hinder agricultural operations (especially pruning and pollination) and can render the entire operation, costly and inefficient.

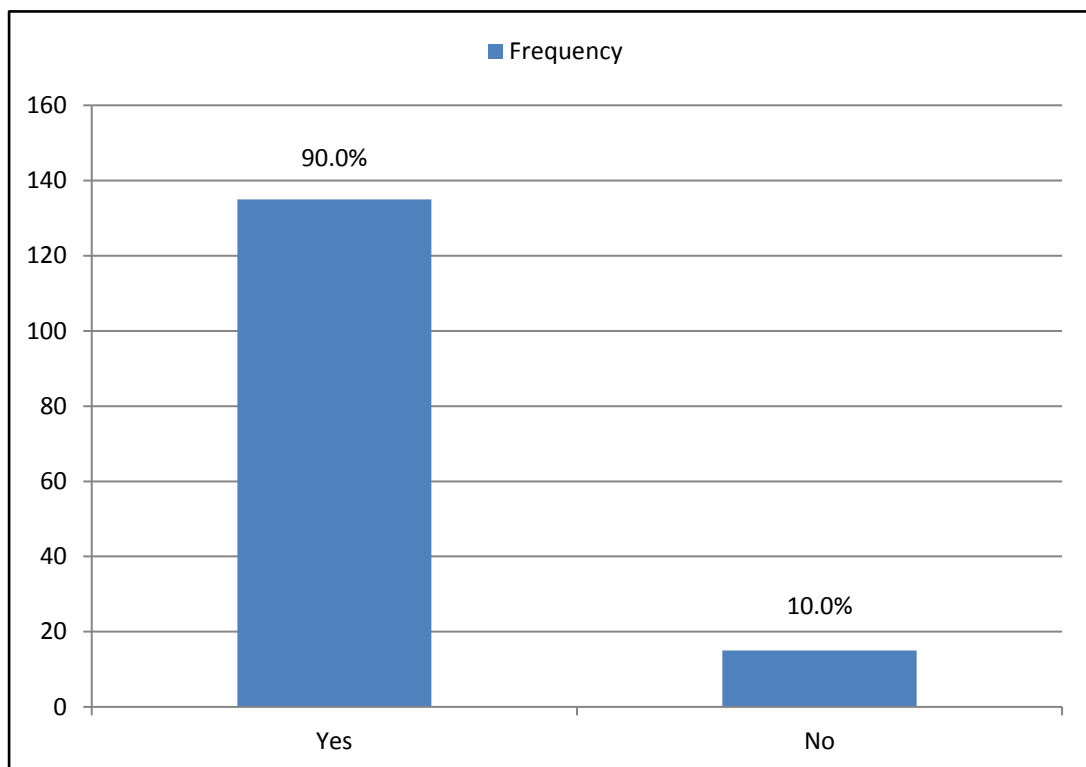


Figure (4.40): Response of the surveyed population (N=150) on the risks that faces the Date Palm cultivation.

4.6.5.2. Pests infecting Date Palm trees

The results showed that 76.0% of the interviewed population confirmed that their palm orchards were infected by several pests that cause big losses (Figure 4.41). The main pests mentioned by respondents included the RPW, fruit stalk borer and termites. Farmers uses several methods to combat these pests as follow:

1. Using the right irrigation, proper fertilization, cleaning, removal and pruning of infected palms and their offshoots to prevent the spread of infection to intact trees.
2. Closing of all holes on the trunk resulting from offshoot removal by mud.
3. Spraying or dusting of pesticides on the trunks and leaves of the non-infested trees. This pesticides are Dursban, Confidor and Rogor.
4. Using of pheromone traps, fumigation tablets and injection devices.
5. Plowing and turning the soil around the roots of trees to prevent the formation of tunnels and holes caused by termites.
6. Cleaning trees from the bottom to prevent the proliferation of ants and get rid of the weeds that proliferate inside it.

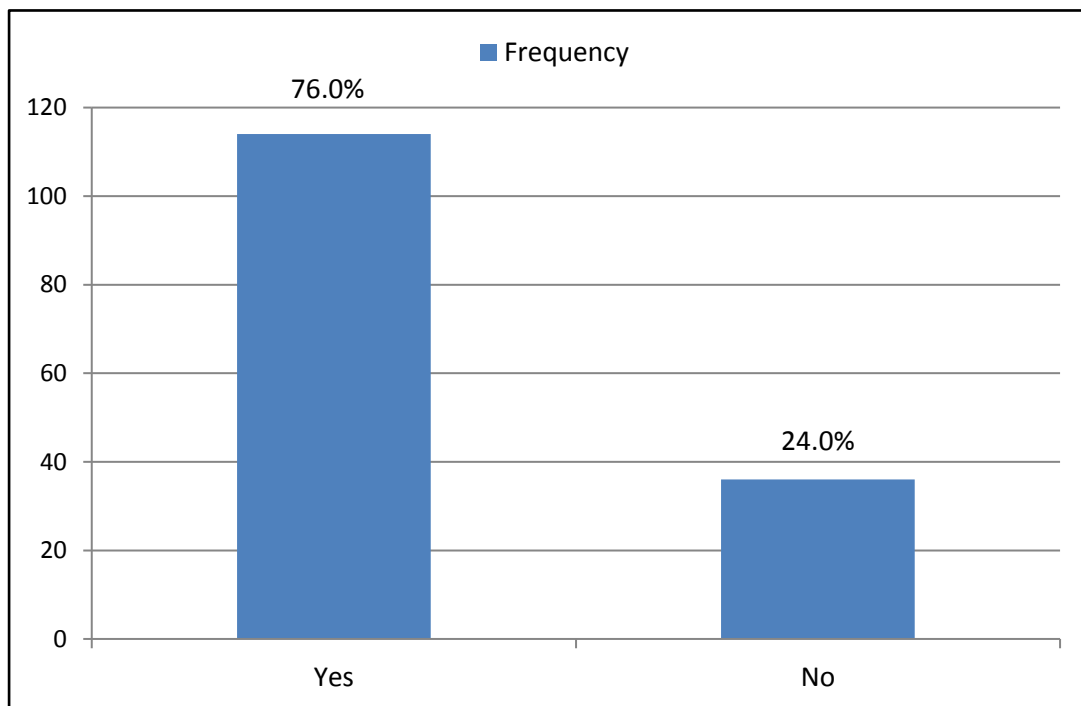


Figure (4.41): Response of the surveyed population (N=150) on the injury of their palm tree with pests.

4.6.5.3. Application of pesticides to combat pests

Table 5 (Appendix 2) and Figure 4.42 showed that 77.3% of the interviewed population used several types of chemical pesticide to combat and eliminate palm pests. The pesticides applied were Dursban, Confidor, fumigation tablets (Phostoxin), Rogor, etc. 22.7% did not use pesticides for the following reasons:

1. The high costs of these pesticides impede their usage.
2. The unavailability of pesticides in specific times.
3. The poor effectiveness and inefficiency of the pesticides used due to fraud made by traders.

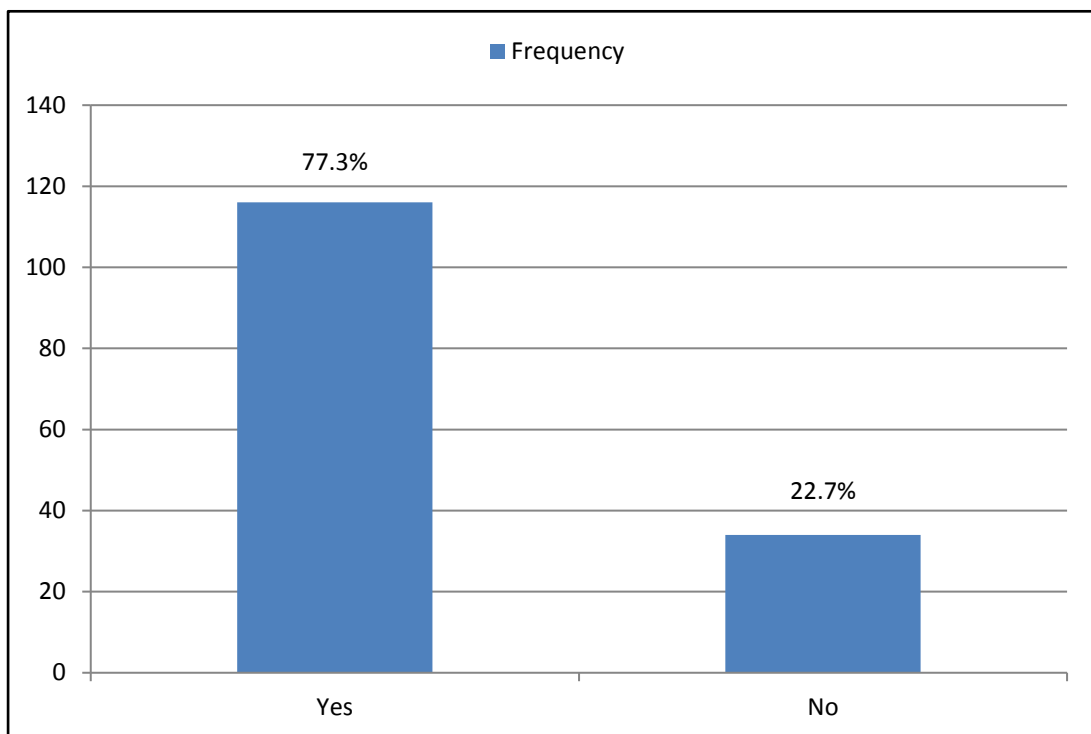


Figure (4.42): Response of the surveyed population (N=150) on application of pesticides to combat pests.

4.6.5.4. Sources of chemical pesticides

Table 5 (Appendix 2) and Figure 4.43 showed that 50.7% and 33.3% of the interviewed population confirmed that they obtain the pesticides from private companies and the available shops respectively. The rest obtain pesticides from MOA or other agricultural extension institutions.

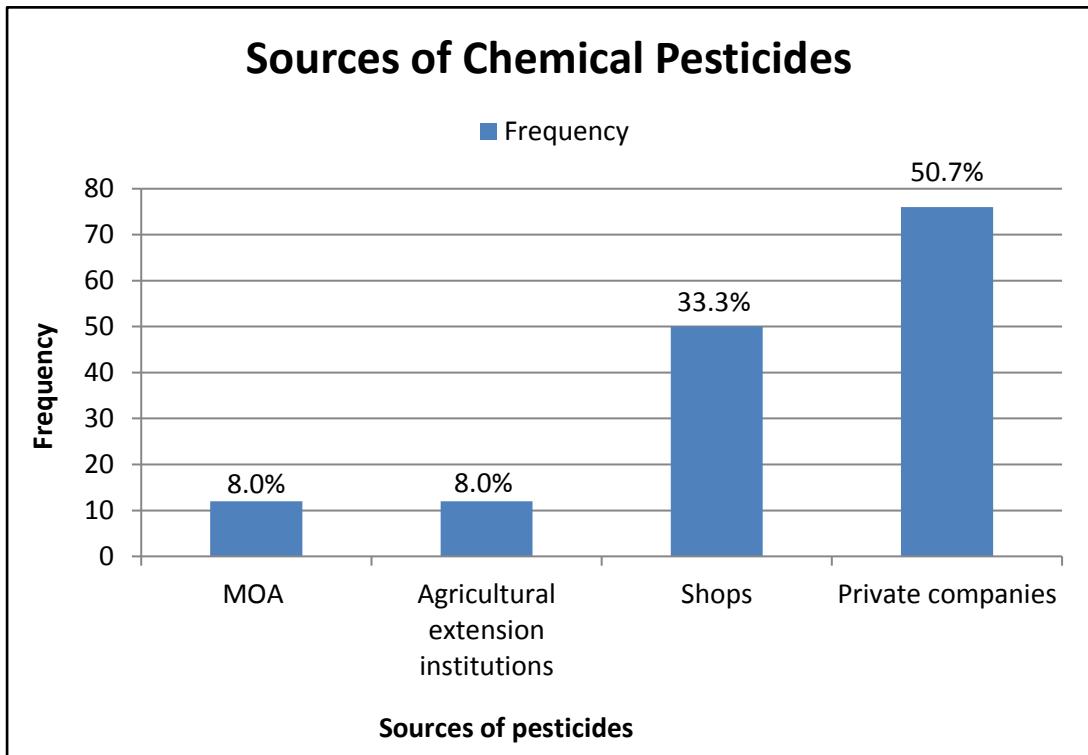


Figure (4.43): Response of the surveyed population (N=150) on the source of chemical pesticides.

4.6.5.5. Use of personal protective equipment during pesticide application

The results of the present work showed that about three-quarters (76.0%) of the interviewed population were not care on using personal protective equipment (PPE) during application of chemical pesticides (Figure 4.44). They claimed that their use to pesticides is not extensive. Many respondents confirmed that they had low awareness concerning the hazards of pesticides on the public health.

The rest quarter (24.0%) claimed that they use some sort of PPE during application of chemical pesticides. The protective equipment engaged included helmets, goggles, boots, gloves, gas masks and respirators.

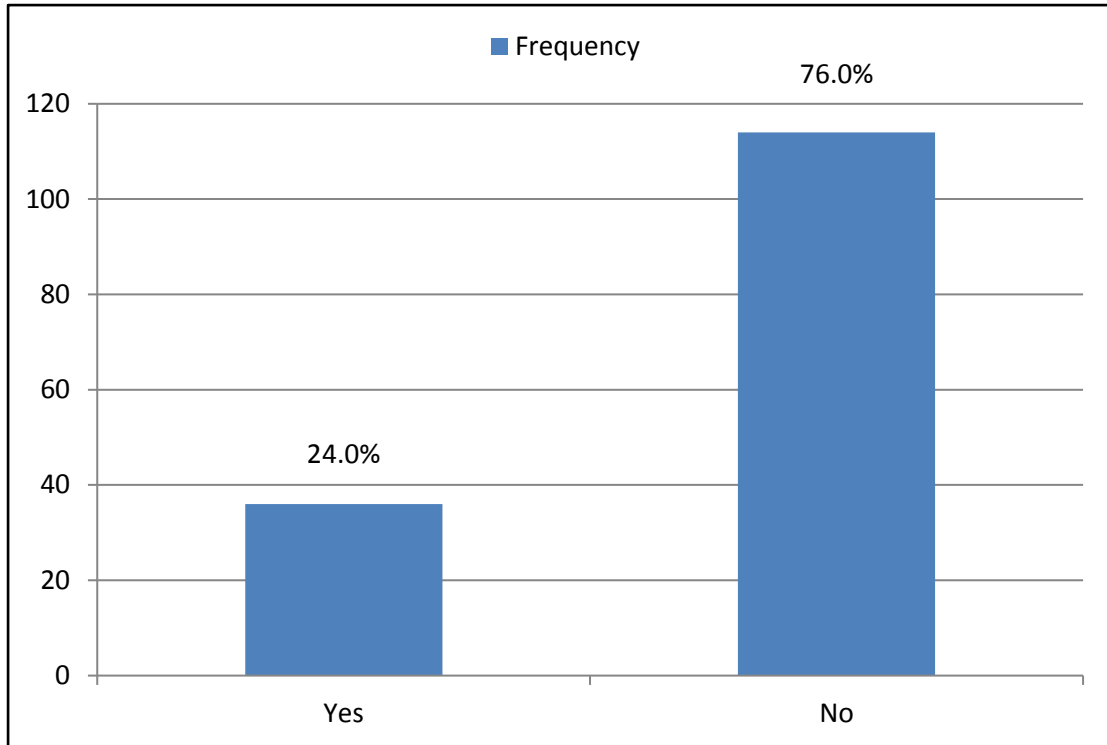


Figure (4.44): Response of the surveyed population (N=150) on use of personal protective equipment (PPE) during pesticide application.

4.6.6. The reality of RPW in Date Palm Orchards

4.6.6.1. Injury of Date Palm tree with RPW

The results of the current work showed that the majority of the interviewed population (74.7%) confirmed that the Date Palm trees were infected with RPW in various times from 2011 to 2016 (Figure 4.45). Farmers used several methods to combat this pest as follow:

1. Spraying or dusting of chemical pesticides on the trunks and leaves of the intact trees.
2. Using aggregation pheromone traps, injection devices and fumigation tablets.
3. Burning of old fronds and infected offshoots to prevent the spread of infection to intact tree.
4. Covering the roots with soil to a height of 20 cm to prevent insect attack.

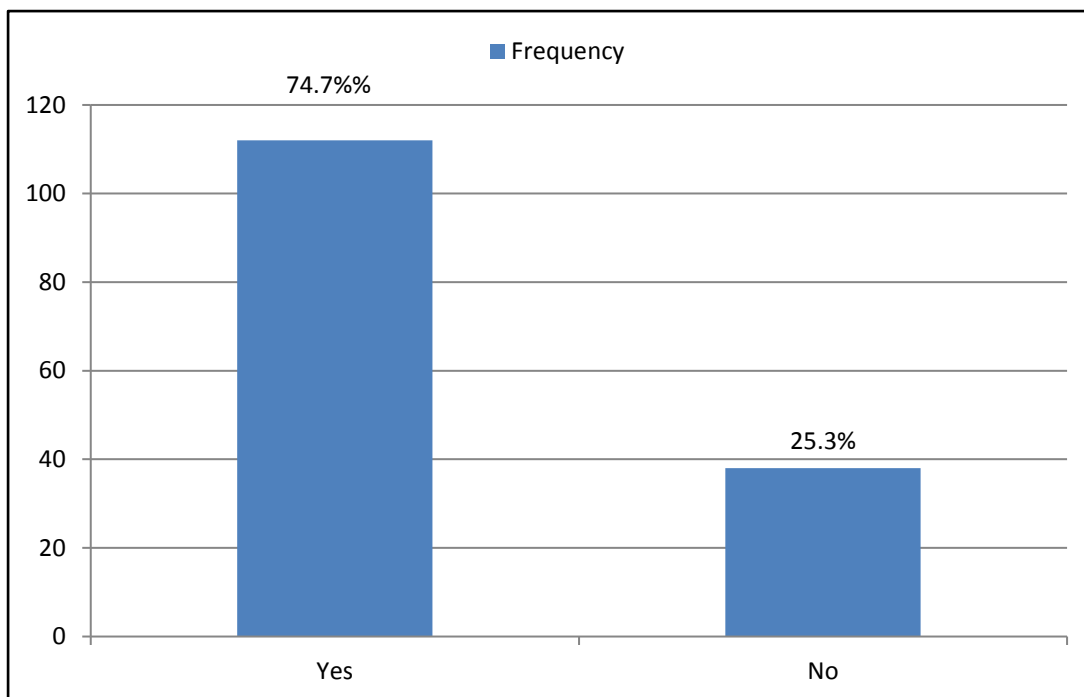


Figure (4.45): Response of the surveyed population (N=150) on the infection of their Palm tree with RPW.

4.6.6.3. RPW as a main threat facing Date Palm cultivation

The results of present work showed that 87.3% of the respondents considered the RPW is as the most threat facing the cultivation of Date Palm in the Gaza Strip (Figure 4.46). The reasons standing behind this consideration were as follows:

1. The symptoms appear after a long period of infection, and as a result, this requires a great effort to combat the pest.
2. It is a hidden pest that remains inside the palm during its larval development. During this period, it makes tunnels and pupates, then it weakens the tree until reaching its death.
3. It has a rapid reproduction rate and ease transmission of infection to intact trees.
4. It causes an economic loss for fruits, which become inappropriate for marketing or consumption.
5. There is no actual efficient treatment. The only efficient solution is to destroy and burn the infested palm.

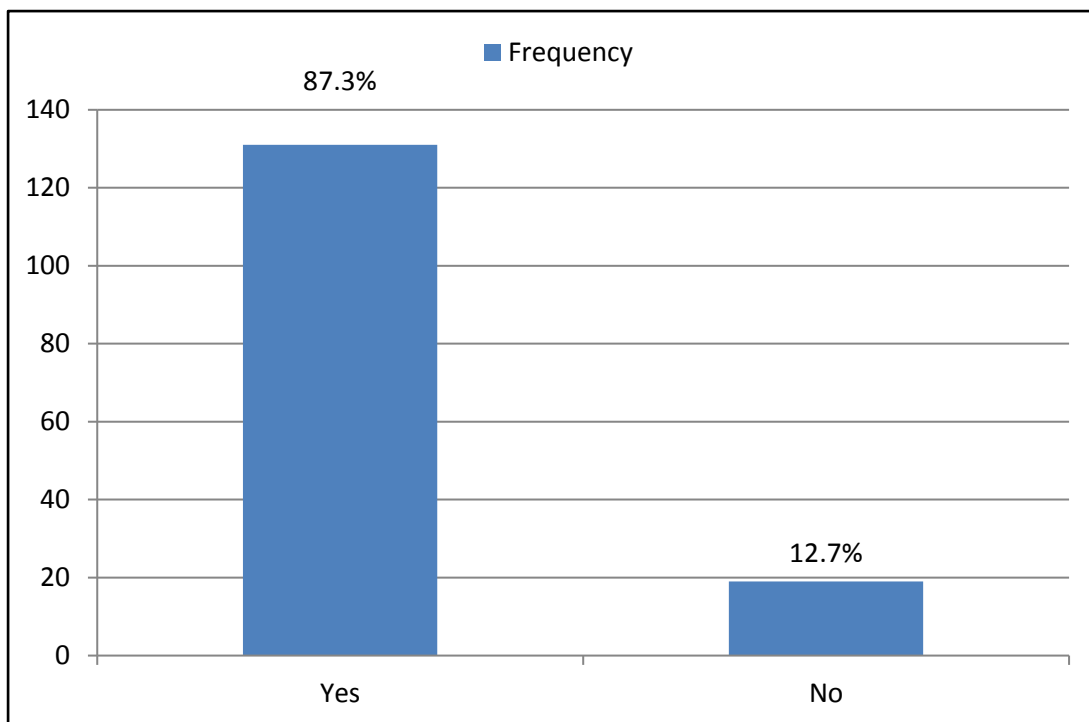


Figure (4.46): Response of the surveyed population (N=150) on considering RPW as a main threat that facing cultivation of Palm.

4.6.6.2. Assessment of losses caused by RPW

Table 6 (Appendix 2) and Figure 4.47 showed that 42.7% of the interviewed population considered that the losses caused by RPW were great, 32.0% moderate, 17.3% severe and finally 8.0% mild. The great losses were due to the extensive and intensive use of pesticides, fruit damages and weak marketing.

4.6.6.4. Role of the MOA in solving the RPW disaster

The results showed that 58.7% of the respondents believed that the MOA has no role in solving the RPW problem. The rest percentage considered that the MOA has an important role in solving this problem. According to many respondents, the role of the MOA is confined to providing guidance and advice. Others considered the role of MOA as great. They pointed out the responsibilities and tasks of MOA as follow:

1. It provides the farmers with pesticides, pheromone traps and injection devices. In addition it supervises the distribution of traps in farms.
2. MOA monitors, inspects palm fields and provides extension to farmers.
3. It conducts different meetings and training courses to farmers regarding RPW.

- It prepares and distributes leaflets and brochures related to the nature of RPW and its hazards as well as its control.

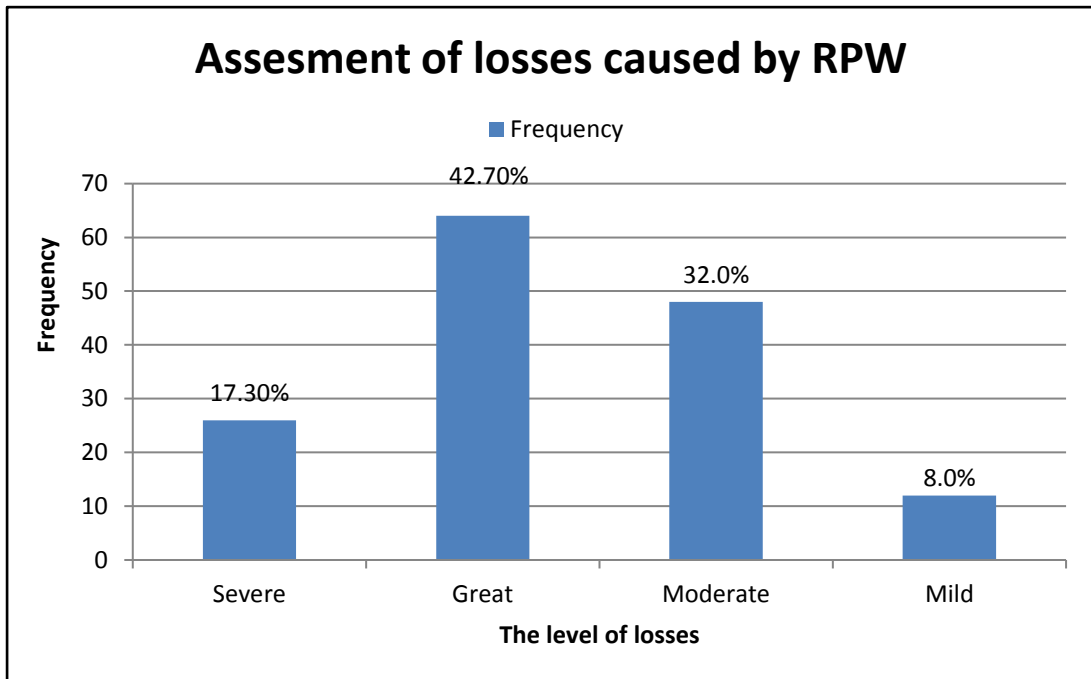


Figure (4.47): Response of the surveyed population (N=150) on the level of losses caused by injury their Palm trees with RPW.

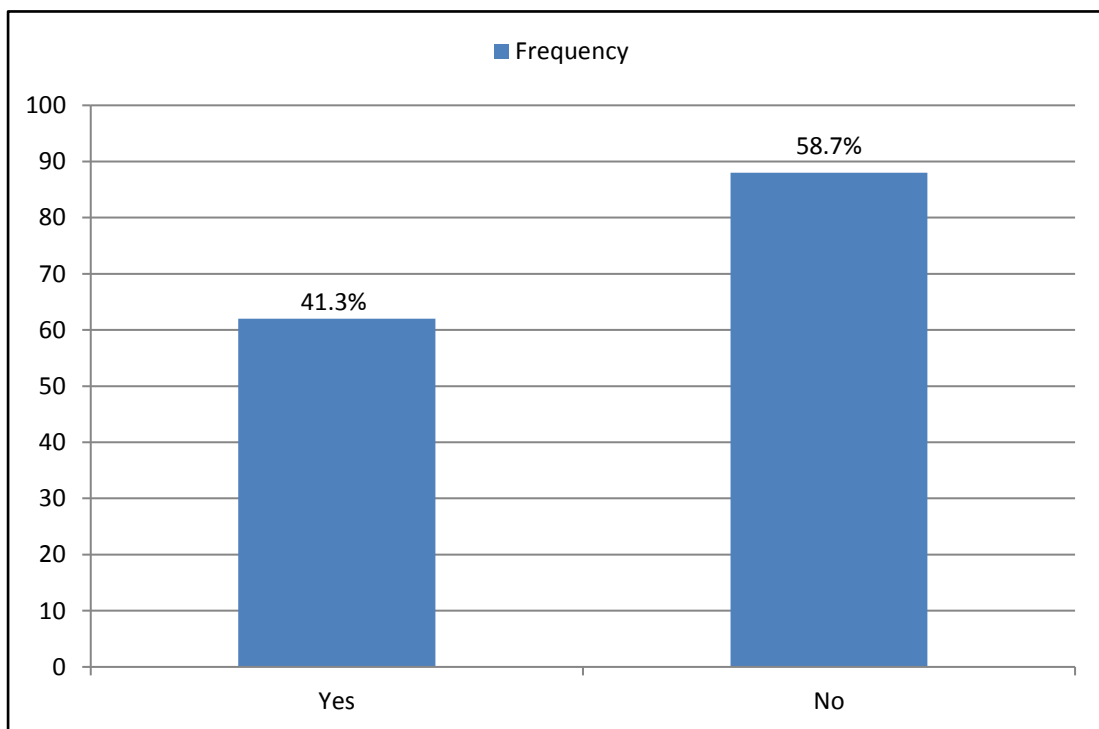


Figure (4.48): Response of the surveyed population (N=150) on the role of the MOA in solving the RPW disaster.

4.6.7. Development and Management of Date Palm Sector

4.6.7.1. Attendance of training courses in Date Palm sector

The results of the current study showed that 89.3% of the interviewed population confirmed that they did not attend any training courses that qualify them to dealing with various issues related to palm trees (Figure 4.49). Some of them inherited experience from their parents and grandparents. The rest respondents confirmed that they attended such courses. These courses dealt with RPW control, usually conducted by Al-Mosadder Society for Rural Development (MSRD), MOA, PNAPD, ASDPD, FAO, EHCRS, PNGOs and ICRC.

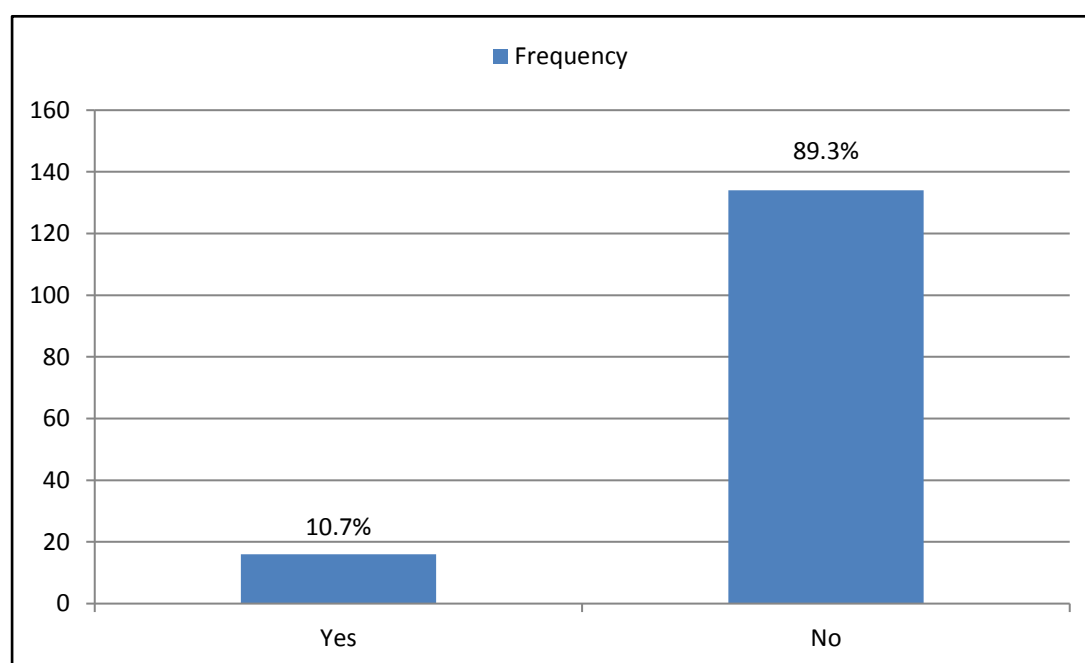


Figure (4.49): Response of the surveyed population (N=150) on the attendance of training courses concerning the management and development of the Date Palm.

4.6.7.2. Bayroha'a El-Nakheel project for the cultivation of Date Palm

The results of the current work showed that only 19.3% of the interviewed people heard about Bayroha'a El-Nakheel project for the cultivation of palm (Figure 4.50). Some of them were not optimistic on this project because it was established on sandy land which needs much water in times the Gaza Strip suffers water shortage. Others were optimistic because the project will increase the number of the Date Palm tree, increase productivity, create jobs and raise income of workers.

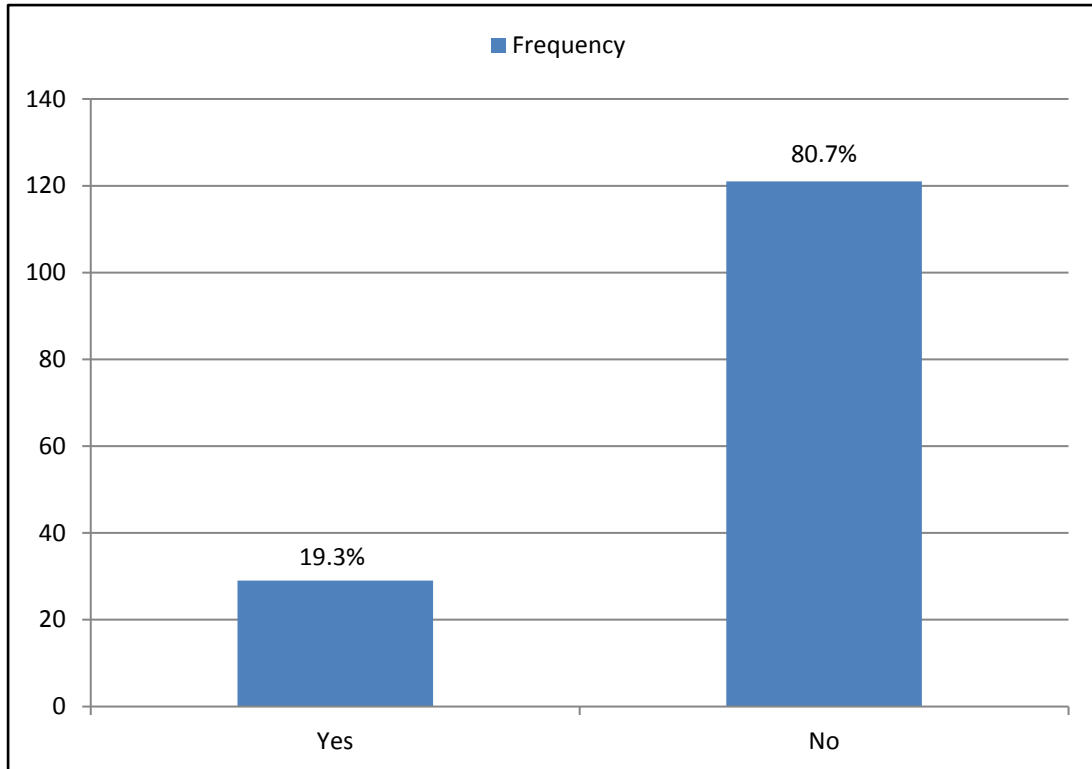


Figure (4.50): Response of the surveyed population (N=150) on Bayroha'a El-Nakheel Project for the cultivation of Date Palm.

4.6.7.3. Importance the projects of Date Palm cultivation

The results showed that 84.0% of the interviewed population (Figure 4.51) believed that the projects of Date Palm cultivation have several environmental and economic benefits as follows:

1. Provision of self-sufficiency and food security.
2. Increasing productivity and national income.
3. Providing a source of livelihood and employment for workers.
4. Reducing unemployment rate in the Palestinian society.
5. Supporting of local product to meet the needs of the community.
6. There are too many industries associated with Date Palm.
7. Roots of trees have a vital function in fixing the soil and preventing soil erosion.
8. Preservation of Palestinian heritages.
9. Increasing the proportion of oxygen and purifying air from toxic gases.

10. Increasing the biodiversity level of the urban environment by providing food, nesting and resting sites and shelter for many insects, birds and other animal categories.

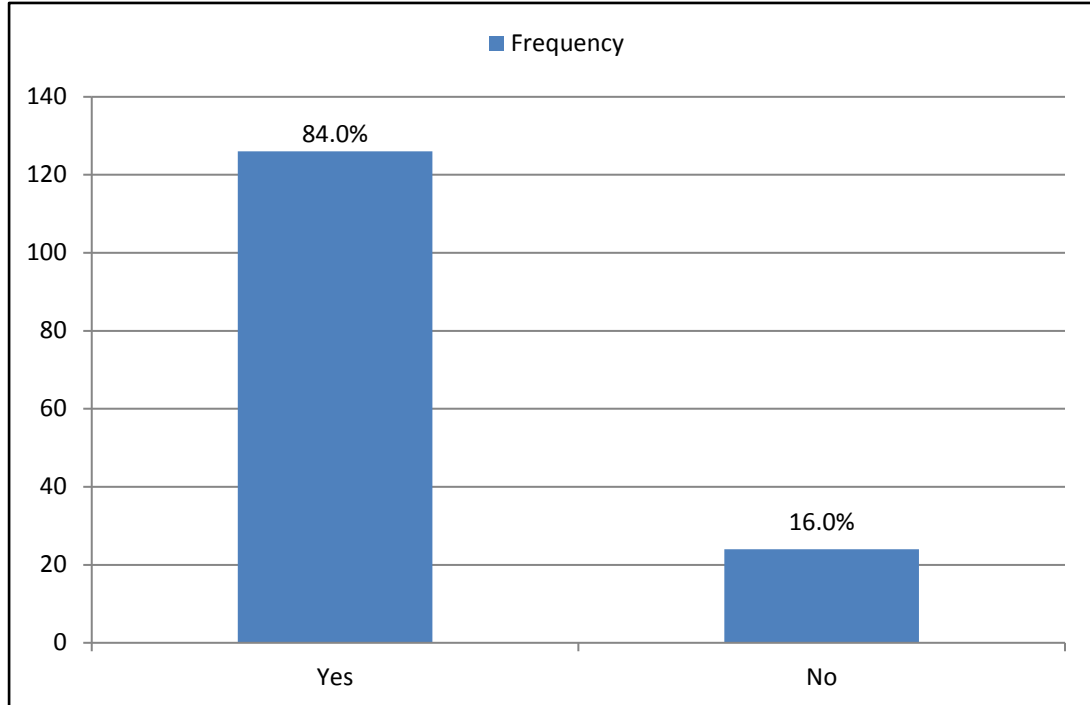


Figure (4.51): Response of the surveyed population (N=150) on the benefits of projects of the Date Palm cultivation.

4.6.7.5. Role of the MOA in the development of Date Palm sector

The results of the current study showed that 42.7% of the interviewed population believed that the MOA has an important and effective role in the development and improvement of palm sector as follows:

1. It provides farmers with good quality offshoots.
2. It adopts appropriate policies that promote the Date Palm sector.
3. It monitors and inspects palm fields.
4. It enacted RPW committees and laws regarding the RPW pest and its control.
5. It supports farmers with necessary pesticides and other modern equipment to eliminate the infested palms.

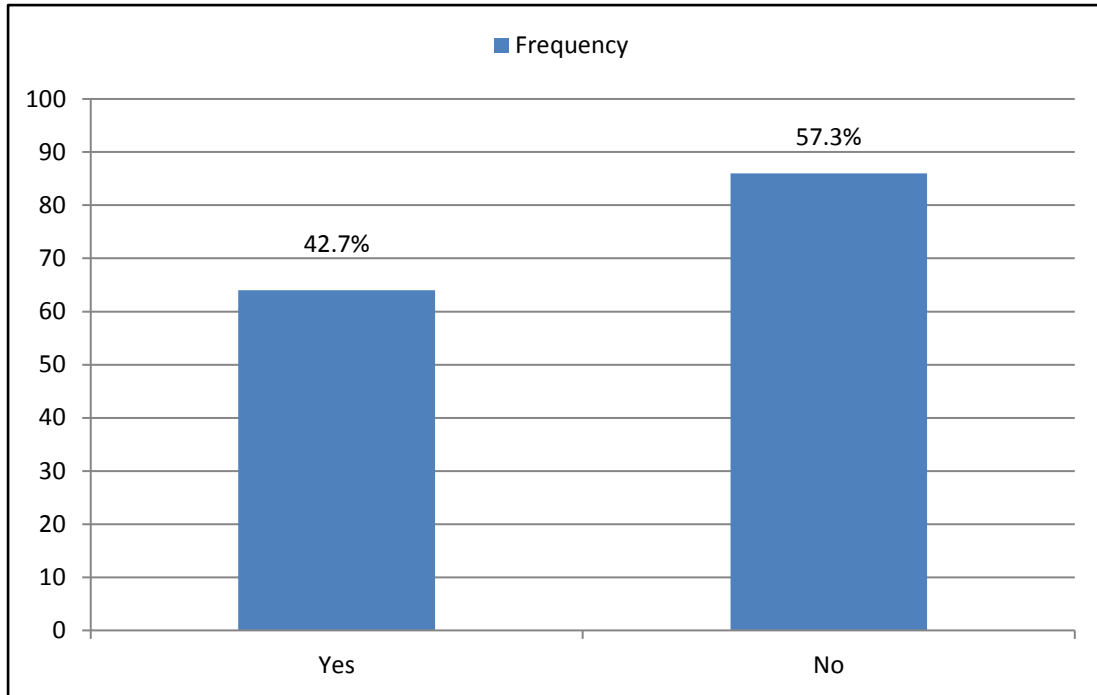


Figure (4.52): Response of the surveyed population (N=150) on the role of MOA in the development of the Date Palm sector.

4.6.7.4. Challenges facing projects of the Date Palm cultivation

The findings of the current work showed that the majority of the interviewed population (71.3%) confirmed on the presence of numerous challenges and constrains face of projects of the Date Palm cultivation (Figure 4.53).

The respondents mentioned the main challenges as follow:

1. Procedures of Israeli occupation.
2. Wide spread of RPW.
3. Limited budget and funds.
4. Shortage of qualified researchers and training staff.

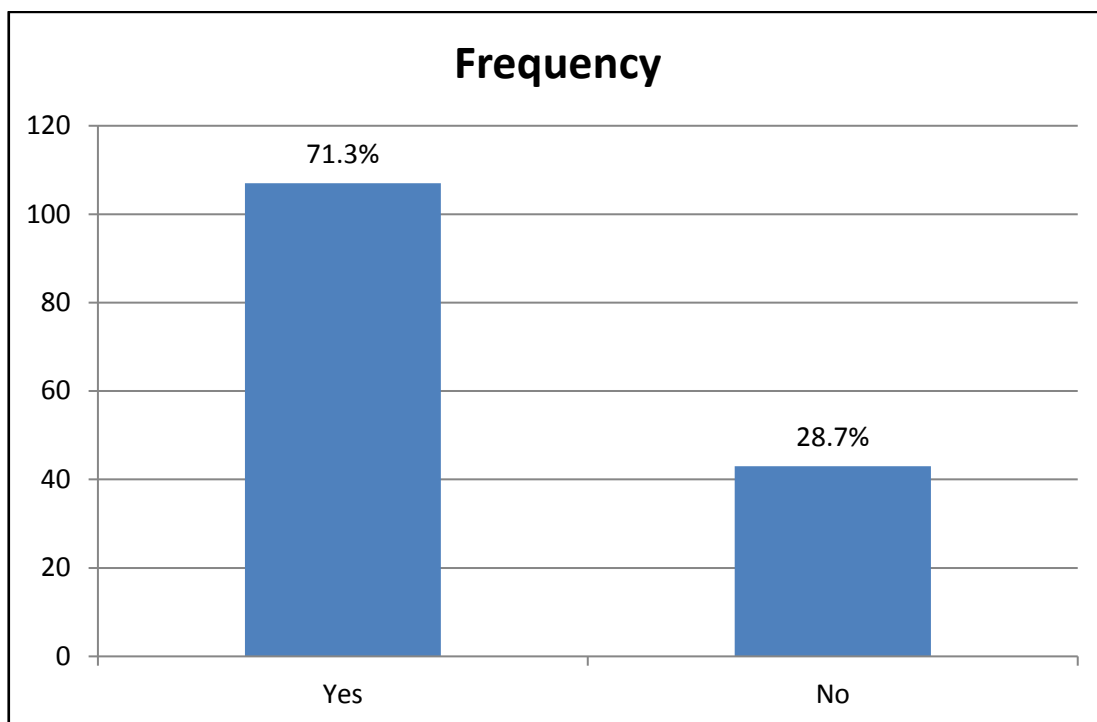


Figure (4.53): Response of the surveyed population (N=150) on challenges facing projects of the Date Palm cultivation.

4.6.7.6. The development of Date Palm cultivation

Finally, the interviewed population confirmed that the Date Palm cultivation needs to be improved and developed. They mentioned such good suggestions as follows:

1. Introduction of new cultivars of Date Palm, which are characterized by their ability to withstand environmental conditions in the Gaza Strip.
2. It needs good marketing and manufacturing techniques throughout the year.
3. There is a necessity to improve the production of Date Palm through agricultural research, tissue culture laboratories, extension programs and financial support.
4. There is a need to implement new technological methods regarding fertilization, insect control, IPM and disease.
5. Establishment of special factories to exploit residues of Date Palm.
6. Establishment of training and developing associations and institutions regarding the improvement of Date Palm sector in Palestine.

Chapter 5

Discussion

Chapter 5

Discussion

5.1. The Date Palm and its Cultivars in the Gaza Strip

Palestine lies in the heart of the Fertile Crescent and the Middle East. Its location at the terrestrial meeting point between Asia, Europe and Africa facilitates the interaction and spread of plants including the Date Palm trees of the three continents (Abd Rabou, 2005). The Gaza Strip which is located at the southern portion of the Palestine coast along the Mediterranean Sea harbors a variety of plants including the Date Palm trees (Abd Rabou et al., 2008). The present survey revealed that a total number of 250,000 Date Palm trees prevails the Gaza Strip, particularly in the Middle Governorate. This figure indicates that Date Palm cultivation has been practiced in the Gaza Strip since ancient times. The Gaza Governorate harbors the least Date Palm trees in the Gaza Strip due to its political, residential and economic status. Abu-Qaoud (2015) confirmed in his recent study that the cultivation of Date Palm in the Gaza Strip is concentrated near the cities of Deir Al-Balah and Khan Younis.

The Gaza Strip has one of the scarcest water availability in the world due to geographical location in an arid to semi-arid land, population growth, higher standards of living, expected climate change and the Israeli practices and restrictions imposed on water resources. Irrigation of agricultural land with saline water increase salinity levels of soils due to deposition and accumulation of salt in the soil. Hence, water shortage and the high salinity levels of water in the Middle Governorate and Khan Younis encouraged farmers to grow Date Palm trees which are known as halophytic plants that tolerate high levels of salinity (Al Hammadi, 2006; Yaish and Kumar, 2015). According to FAO (1982), the Date Palm is more salt tolerant than any other fruit crop.

The 19 cultivars of Date Palm, which are grown in the Gaza Strip, fall within three types: soft, semi-dry, and dry. These cultivars are very difficult to be distinguished by morphology as was indicated by El Kichaoui1 et al. (2013). As a result, they are mostly distinguished by the characters of the fruits, which are produced only after 4-5 years as indicated by Sedra et al. (1998).

The different climatic factors including rainfall, water, light, temperature, relative humidity, air, wind, topography and soil are limiting factors for the growth and development of certain cultivars in the Gaza Strip. For example, Abu-Qaoud (2015) reported that the climate in the Ghor Region, where temperatures range from 12 °C in March up to 50 °C between July and October, is considered ideal for Medjool date production, which requires hot and dry weather. The climatic conditions of Gaza Strip are not ideal for growth and development of this cultivar, as a result, these climatic conditions is more suitable for producing of soft cultivars of the Date Palm. Similar results were reported in other studies by both El-Kichaoui1 et al. (2013) and Qofa (2014), who mentioned that the Hayani, Bentaisha, Barhee and Ameri cultivars are the most famous in the Gaza Strip.

5.2. Production of Date Palm in the Gaza Strip

The production of Date Palm in the Gaza Strip is relatively not stable since decades. Abu-Qaoud (2015) prevailed that the Date Palm production fluctuated from 2,000-6,000 metric tons during the period enclosed between the years 1970 and 2008. The results of the current study prevailed more promising figures. In the last few years, the average of production was estimated as 12,000-15,000 metric tons per year as indicted by MOA (2016), where the average production of each Date Palm tree equals about 130 kg per year. However, most Gazan farmers confirmed that there is a reduction in the production of Date Palm in the last few years in the Gaza Strip. The reasons standing behind this decline were found to be more or less similar to the reasons reported by other studies (El-Juhany, 2010; Qofa, 2014 and Abu-Qaoud, 2015). They mentioned that the reduction in local demand, weak post-harvest infrastructure, marketing difficulties, low yields and a shift to other cash crops were the main reasons for the decline of Date Palm production. As much as 30% of production can potentially be lost as a result of pests and diseases.

5.3. The Current Status of RPW in the Gaza Strip

The current study revealed that the RPW is a main threat facing the Date Palm cultivation and making considerable losses in the Gaza Strip as a microscopic part of the Middle East in terms of area and population. Similar findings were highlighted by Vidyasagar et al. (2016) who confirmed that the RPW is the most dangerous pest of Date Palm sector in Middle East and it is responsible for the death of a large number of palms and consequent yield losses. The RPW is considered one of the most destructive pests for the Date Palm trees all over the world.

The current survey revealed that the number of infested Date Palm trees is increasing year by year and causes severe losses to Gazan farmers. Locally, the absence of inspection and surveillance of the new offshoots which entered through the tunnels connecting the Gaza Strip with the Egyptian Territories and the adult weevils may fly relatively long distances (~ 1 km per day) could play a vital role in the quick and wide spread of infection among the intact trees in the recent years. The life cycle of RPW is reported to vary chronologically depending on the environmental and geographical conditions (Al-Saqer and Hassan, 2011). The larva stage is considered the main damaging stage because it bores into palm trees, feeds on the succulent plant material and remains hidden through most of the life cycle. The local scene and symptoms of infected trees are similar to that reported by Vidyasagar and Aldosari (2011), Al-Saqer and Hassan (2011) and Faleiro et al. (2012). These included the presence of tunnels on the trunk and the base of leaf petiole, hearing of gnawing sounds due to feeding by grubs, Oozing out of thick brown fluid from the tunnels, the presence of chewed plant tissues in and around opening of tunnels with a typical fermented odor, drying and/or death of offshoots in case of severe injuries and breaking of the trunk or toppling of the crown in case of severe and prolonged infestation. In this context, FAO recommended on the establishment of a buffer zone with the Egyptian border to prevent the entry of adult weevils into Gaza Strip. This proposed recommendation originated from the fact that the adult weevils are capable of long distance flight (> 900 meters).

The local control of RPW, as a serious pest infesting Date Palms, depends on using IPM programs. IPM seeks to reduce chemical input through the inclusion of a range

of methods which are environmentally compatible. Different approaches such as agricultural control, chemical control, behavioral control, mechanical control and quarantine control are more or less applied in the Gaza Strip. Agricultural and mechanical controls are sometimes the commonest because of the non-availability or high costs of chemical pesticides. Despite of its importance, the biological control methods are not applied in the Gaza Strip. This was due to several reasons including the shortage or unavailability of qualified staff, specialized research, specialized equipment and funding sources. The political, military and socioeconomic circumstances of the Gaza Strip could not be ignored in this regard. Murphy and Briscoe (1999), Vidyasagar and Aldosari (2011), Aleid et al. (2015), Dembilio and Jaques (2015) and El Kichaoui et al. (2017) mentioned that the concealed nature of the larvae of RPW requires effective methods for its management. They suggested possible methods for the management of RPW by focusing on the IPM strategy which comprises surveillance, pheromone traps, cultural control, chemical treatments, biological control, etc.

5.4. Public Uses and Industries Associated with the Date Palm Tree

There are so many valuable products produced from Date Palm trees in the Gaza Strip. Handicrafts produced from fronds, trunks and other parts are the most famous uses of Date Palms. They are mostly made the Palestinian women. The use of palm tree leaves in making of floor mats, baskets and many others are common as well. These uses were confirmed previously by other Gazan researchers Albanna and Eid (2007) and Qofa, (2014). Barreveld (1993), Hasan et al. (2006), Al-Khalifah and Shanavaskhan (2012) Johnson (2012) and Boufennara et al. (2016) pointed out that the Date Palm over the centuries has provided a large number of products and traditional uses which have been extensively used by local people in all aspects of daily life such as the production of baskets, bowls, broom, ceilings, etc. The reasons standing behind the interest of the Palestinian families in handicraft products are usually related to their characteristics and properties. It is well known that an increase in demand on these products will lead to increase in employment and income of poorer family. In spite of this, these products did not receive the interest, attention and support of the responsible authorities and NGOs. This ignorance and

neglect from the different parties led to the reluctance of many people to continue in such a production.

The current study showed that there are too many industries based on Date Palm. These industries are categorized into two main sections: food industries and industries based on residues of palm trees. Food industries are of a great importance to the Palestinians in the Gaza Strip who are living under blockades imposed by the Israeli army since a couple of years. Many chasses of food industries were highlighted by Al-Shahib and Marshall (2003), Hasan et al. (2006), Al-Khalifah and Shanavaskhan (2012) and Al-Orf et al. (2012), who pointed out that the date fruits are of high nutritional value and are considered a good source of sugars, minerals and vitamins. The products produced from the Date Palm fruits like syrup, jams, ice cream, baby foods and soft drinks are of a great demand in the market locally. They improve the level of standard living, increase the percentage of employment, and require modest equipment and tools. Industries based on residues of palm tree in the Gaza Strip are many as pointed out by Albanna and Eid (2007) and Qofa (2014). MOA (2010) and Qofa (2014) listed tens of food and other industries based on the Date Palm in the Gaza Strip.

5.5. The socioeconomic questionnaire

The questionnaire application was carried out in Deir Al-Balah to describe the current status of the Date Palm tree and its local uses. People in Deir Al-Balah showed good intention to participate in the questionnaire interview.

5.5.1. Personal Profile of the Sampled Population

The sampled population consists of 150 respondents (N=150) covering orchards of Date Palm in Deir Al-Balah area. The study showed that 72.0% of the respondents were 21-50 years old. This means that the young category is the largest group in the community. The Palestinian society is productive in the sense that marriage often occurs at early ages and the fertility rate is great among the Palestinian to the extent that the average number of children per couple is greater than 7 (Abd Rabou, 2005) and this is consistent with findings of present study where 84.0% of the interviewed population were married and 82.0% of the married population have children.

The results showed that 54.7% of the interviewed population had a diploma, university, or master degree (Table 1). These results illustrate that the education level of the respondents is generally very good, which will help in enhancing the level of awareness towards the related issues with Date Palm in the future. Such results are normally expected in the Palestinian society as a whole, since the majority of the Palestinians are educated due to the political, social and economic pressure prevailed in the last years.

5.5.2. Challenges Facing the Date Palm Sector in the Gaza Strip

The challenges facing the Date Palm sector in the Gaza Strip are usually associated with the military operations of Israeli occupation, where vast areas cultivated with Date Palms and other fruit and non-fruit trees were destroyed during the Israel invasions and attacks especially in the eastern parts of the Gaza Strip. ARIJ (2007) denoted to the Israeli restrictions imposed on the Palestinians preventing them from the free movement, marketing and export of their goods including the Date Palm to both national and international markets and areas. Most of the current respondents (90.0%) confirmed such threats facing the cultivation of Date Palm. Moreover, two-thirds of the interviewed populations (66.0%) confirmed the decreases in the production of Date Palm in the Gaza Strip due to many reasons.

More or less threats have been reported in other local and regional studies concerning with the Date Palm tree (El-Juhany, 2010; Jain 2012; Al-Bitar, 2013 and Al-Agha, 2016). In this regard, Al-Bitar (2013) reported multiple and diverse problems which significantly affect the cultivation, production and marketing of Date Palm in Palestine. The most famous of these problems were the increase low quality cultivars, marketing constrains and shortage of the practical experience of mentors and farmers towards the various issues of Date Palm. El-Juhany (2010) added the susceptibility of palm trees to degradation due to extensive exploitation resulting from human over-population and infestation with serious pests and diseases.

5.5.3. The Projects of Date Palm Cultivation in the Gaza Strip

Two projects concerning Date Palm development have been established in the Gaza Strip. They are the Bayroha'a El-Nakheel and the Bahja Gardens projects. These projects are considered the largest development projects locally. The problems facing these projects seem to be best known by the majority of respondents. Many of the problems stated locally have been denoted to in the study of ICARDA (2011), who mentioned such problems slowing down the success rate of these projects. The skilled human resources including the number of skilled research staff are insufficient to carry out diverse and sophisticated development and research activities. The project requirements concerning the training courses, budgets, and many others seem to have little concerns from the different parties involved in such progress and development aspects. About 84.0% of the respondents ensured the importance of these projects. They outlined the benefits drawn from such projects. The benefits stated seem to coincide with that stated by Al-Marshudi (2002) and Arias et al. (2016) in the sense that they minimize the dependency on dates imported from outside, and increase the availability of date products such as Ajwa and sweets in the local markets with low prices. Moreover, these projects are thought to provide job opportunities and improve the economic status, national income and living standards of citizens in times the whole Gaza Strip falls under political and military siege imposed by the Israeli occupation. The unemployment crisis is very serious in the Gaza Strip, and as a result, intensive cultivation of Date Palm projects may partially alleviate this growing issue.

5.5.4. Development and Management of Date Palm in the Gaza Strip

The current study revealed that the Date Palm sector needs to be improved and developed. Many suggestions have been highlighted by respondents. Similar suggestions were stated by Ali (2010) and ICARDA (2011) in the Gulf region. They included:

1. The need for new knowledge and practice tools to improve the production systems of Date Palms.

2. The use of different inputs in the cropping process (fertilizers, pesticides, pollinators, wastewater, etc.) to ensure a good production and a sustainable yield.
3. The necessity to improve cultivars productivity. In this regard, the production of high quality dates needed by consumers and marketing and manufacturing processes are essential.
4. The attempts to control the diseases and pests infesting Date Palm should be promoted and respected by the responsible parties.
5. The best transfer of technology and experience between the partners or parties.
6. The importance of scientific background and tools to enhance Date Palm sector production and improvement. These include genetic diversity, gene banks and tissue culture and biotechnology laboratories.
7. The importance to develop a national strategy with clear objectives to promote the Date Palm sector should be a priority.

Chapter 6

Conclusion and Recommendations

Chapter 6

Conclusions and Recommendations

6.1. Conclusions

The present survey was conducted to assess and investigate the current status of the Date Palm in the Gaza Strip. This study is composed of two parts: field surveys and questionnaire application on 150 randomly selected respondents. The following conclusions could be drawn from the results obtained:

1. A total number of about 250,000 trees of Date Palm trees was revealed in the whole Gaza Strip, with the Middle Governorate and Khan Younis are the mostly cultivated areas with this strategic crop.
2. A total number of 19 Date Palm cultivars was recorded in the Gaza Strip with the Hayani is the most commonly grown cultivar. The average of balah production reaches 12,000 – 15,000 ton per year.
3. The Red Palm Weevil (*Rhynchophorus ferrugineus*) is the most serious pest threatening Date Palms in the Gaza Strip, and as a result, different control techniques have been used locally to combat the pest.
4. Many local public uses and industries are associated with Date Palm trees. Handicraft production and food industries (Ajwa, molasses and balah jam) are the best known products.
5. The Hayani cultivar was grown by all respondents interviewed.
6. 59.2% of the respondents ensured such a decrease of their Date Palm trees because of shortage of water, Israeli procedures and injury of Date Palm trees with pests and diseases.
7. 68.7% of the respondents believed that the Israeli occupation has a significant role in deterioration of palm sector.
8. Tens of floristic and vertebrate faunistic species were stated by respondents to occur in Date Palm orchards.
9. All respondents were aware of the environmental values achieved by Date Palms.

10. A variety of chemical pesticides has been to combat and eliminate palm pests. 76.0% of respondents were not care on using personal protective equipment during application of pesticides.
11. All respondents confirmed such popular and public uses based on the Date Palm tree. About 70.7% of the respondents produced household products such as production of Ajwa, Eid cakes, molasses, balah jam, coffee, biscuits, pies, pastries and luffa.
12. Most respondents believed on the importance of the local Date Palm projects.

6.2. Recommendations

In the light of the above conclusions, the following could be recommended:

1. Improvements on the processes of Date Palm cultivation and production should be adopted and encouraged by the responsible parties. These processes include fertilizations, pollination, irrigation, pruning and fruit thinning.
2. The selection of best Date Palm cultivars that are suitable for the Palestine environmental conditions is of utmost priority. The environmental and/or ecological roles and values of Date Palms should be respected as well.
3. The dependence on the products of the Date Palm as a resistant crop by the Palestinian community should be enhanced and promoted.
4. The challenges and constrains facing the local projects of Date Palm cultivation should be minimized using well-planned policies and management tools.
5. All effective measures to combat RPW should be applied. Special regards should be paid to biocontrol techniques in order to lower environmental harms or injuries. The role of universities and educational and research institutions in this regard is essential.
6. There is a need to provide facilities and training opportunities to the farmers in the Gaza Strip.
7. There is a need to train extension staff and farmers on the Date Palm production and processing by using different extension strategies.
8. The cooperation among the different parties to ensure good sustainable development of the Date Palm sector in the Gaza Strip is very essential.

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Appendixes

Appendix 1: The socioeconomic questionnaire

رقم الاستبانة



الجامعة الإسلامية بغزة

كلية الدراسات العليا

برنامج ماجستير العلوم الحياتية

استبانة للمواطنين حول تقييم واقع النخيل واستخداماته في قطاع غزة



أخي المواطن: إن الهدف من هذه الاستبانة هو جمع المعلومات من سكان دير البلح لدراسة واقع النخيل في قطاع غزة. لذا أرجو منك أخي العزيز التكرم بملء هذه الاستبانة التي هي بمثابة أداة بحث علمي لرسالة ماجستير في العلوم الحياتية بالجامعة الإسلامية، مع العلم بأن المعلومات المتحصل عليها ستبقى خاصة بالبحث فقط إن شاء الله، شاكراً لكم حسن تعاونكم.

التاريخ:

البيانات الشخصية

الاسم (اختياري):

العمر:

الجنس:

الحالة الاجتماعية:

عدد الأبناء:

المستوى التعليمي:

منطقة السكن و الإقامة:

العمل:

معلومات عامة حول بساتين النخيل في مدينة دير البلح

1. كم يبلغ عدد أشجار النخيل الكلي في المزرعة؟
 2. كم يبلغ عدد أشجار النخيل المثمرة في المزرعة؟
 3. كم تبلغ مساحة بستان النخيل الذي تمتلكه أو تعمل فيه؟
- (أ) أقل من دونم
 (ب) 1-3 دونم
 (ج) 4-6 دونم
 (د) أكثر من 6 دونم

4. كم يبلغ متوسط أعمار أشجار النخيل المتواجدة في أرضك؟
- (أ) أقل من 10 سنوات
 (ب) من 11-30 سنة
 (ج) من 31-60 سنة
 (د) أكثر من 60 سنة

5. ما هي أصناف و أعداد أشجار النخيل المزروعة في بستانك؟

العدد	الصنف	العدد	الصنف
	بنت العيش		حياتي
	أخرى		برحي

6. هل تتناقص أعداد أشجار النخيل في مزرعتك؟
- (أ) نعم
 (ب) لا

إذا كانت الإجابة ب (نعم), فما أسباب التناقص؟

7. كيف يتم بيع المنتج؟

- (أ) في السوق
 (ب) حسب الطلب في المزرعة
 (ج) مباشرة إلى المصنع
 (د) تخزينه حتى يتحول إلى رطب
 (هـ) تصنيعه وتحويله إلى عجوة
 (و) أخرى: -----

8. ما مصدر المياه التي تستخدمها في ري أشجار النخيل؟

- (أ) مياه الأمطار
 (ب) مياه صرف صحي (عادية)
 (ج) مياه جوفية
 (د) أخرى -----

9. هل تشاهد حيوانات تستوطن أشجار النخيل في بستانك؟

- (أ) نعم
 (ب) لا

إذا كانت الإجابة ب (نعم), اذكر أسماء هذه الحيوانات؟

الأنواع	الحيوانات
	الثدييات
	الطيور
	الزواحف
	الحشرات
	كائنات أخرى

10. هل يحتوي البستان على أشجار أخرى غير النخيل؟

- (أ) نعم
 (ب) لا

إذا كانت الإجابة ب (نعم), اذكر أنواع هذه الأشجار؟

إنتاج النخيل في قطاع غزة

11. كم تنتج النخلة سنوياً في بستانك (بالكيلو غرام)؟
 12. كيف تقيم إنتاج النخيل في بستانك؟
 (أ) ضعيف
 (ب) جيد
 (ج) جيد جداً
 (د) ممتاز
13. هل تعتقد بوجود نقص في إنتاج النخيل في قطاع غزة؟
 (أ) نعم
 (ب) لا
 إذا كانت الإجابة بـ (نعم)، فما هي أسباب النقص؟

14. هل تعتقد أن الاحتلال الإسرائيلي يساهم بشكل كبير في تدهور قطاع النخيل في قطاع غزة؟
 (أ) نعم
 (ب) لا
 إذا كانت الإجابة بـ (نعم) فسر ما تقول؟

الاستخدامات والصناعات المتعلقة بالنخيل في قطاع غزة

15. ما هي الأهمية البيئية لنخيل البلح في رأيك؟

16. ما هي الاستخدامات الشعبية للنخيل في قطاع غزة في رأيك؟

17. ما هي الصناعات القائمة على منتجات النخيل في قطاع غزة؟

18. هل تقوم أنت وأفراد أسرتك بإنتاج منتجات صناعية منزلية تعتمد على النخيل؟
 (أ) نعم
 (ب) لا
 إذا كانت الإجابة بـ (نعم)، اذكر أهم المنتجات الصناعية المنزلية التي تقومون بإنتاجها؟

19. برأيك هل تلقي المنتجات الصناعية المنزلية التي تعتمد على نخيل البلح تشجيعاً ودعماً من قبل الجهات المختصة؟
 (أ) نعم
 (ب) لا
 إذا كانت الإجابة بـ (نعم)، وضح كيف يتم ذلك؟

الآفات التي تهدد أشجار النخيل في قطاع غزة

20. هل تعتقد بوجود مهددات تواجه زراعة النخيل في قطاع غزة؟
(أ) نعم (ب) لا

إذا كانت الإجابة ب (نعم), فما هي تلك المهددات؟

21. هل أصيبت أشجار النخيل في بستانك بالآفات؟
(أ) نعم (ب) لا

إذا كانت الإجابة ب (نعم), ما هي أنواع هذه الآفات؟ وما طرق مكافحتها؟

طرق المكافحة	الآفة

22. هل تستخدم المبيدات الحشرية في مكافحة الآفات التي تصيب النخيل في بستانك؟
(أ) نعم (ب) لا

إذا كانت الإجابة ب (نعم), ما هي أنواع هذه المبيدات؟

23. من أين تحصل على المبيدات الكيميائية؟
(أ) وزارة الزراعة
(ب) مؤسسات الإرشاد الزراعي
(ج) شركات خاصة
(د) أخرى:

24. هل ترتدي ملابس وأقنعة واقية لتقي نفسك من التعرض والتلوث بالمبيدات الكيميائية؟
(أ) نعم (ب) لا

إذا كانت الإجابة ب (نعم), ما هي الملابس والأقنعة الواقية التي تستخدمها؟

واقع سوسة النخيل الحمراء في بساتين النخيل في مدينة دير البلح

25. هل أصيبت أشجار النخيل في بستانك بحشرة سوسة النخيل الحمراء؟
(أ) نعم (ب) لا

إذا كانت الإجابة ب (نعم), متى أصيبت؟ وما هي الطرق التي اتبعتها في مكافحة سوسة النخيل الحمراء؟

26. ما هو تقييمك للخسائر الناجمة عن إصابة أشجار النخيل بهذه الآفة؟
(أ) ضعيف (ب) متوسطة (ج) كبيرة (د) فادحة

27. برأيك هل تعتبر سوسة النخيل الحمراء من أكثر المهددات التي تواجه زراعة النخيل في قطاع غزة؟
(أ) نعم
(ب) لا

إذا كانت الإجابة بـ (نعم)، وضح رأيك؟

28. ما هو دور وزارة الزراعة في المساهمة في معالجة مشكلة سوسة النخيل الحمراء؟

إدارة وتطوير النخيل في قطاع غزة

29. هل تلقيت دورات تدريبية تؤهلك للتعامل مع أشجار النخيل؟

(أ) نعم
(ب) لا

إذا كانت الإجابة بـ (نعم)، من هي الجهة المسؤولة عن عقد هذه الدورات؟

30. هل سمعت عن مشروع "بيروحاء النخيل" لزراعة النخيل في قطاع غزة؟

(أ) نعم
(ب) لا

إذا كانت الإجابة بـ (نعم)، أين يقع وكيف تقيم أداءه؟

31. من وجهة نظرك، ما هي فوائد مشاريع زراعة النخيل في قطاع غزة؟

32. هل تعتقد بوجود مشاكل أو تحديات تواجه مشاريع زراعة النخيل في قطاع غزة؟

(أ) نعم
(ب) لا

إذا كانت الإجابة بـ (نعم) ما هي تلك المشاكل والتحديات؟

33. من وجهة نظرك، ما هو دور وزارة الزراعة في تحسين وتطوير واقع النخيل في قطاع غزة؟

34. من وجهة نظرك، كيف يمكن تطوير زراعة النخيل في قطاع غزة؟

شكراً لكم لحسن تعاونكم
الباحثة / اقبال سفيان رضوان

Appendix 2: Questionnaire Analysis

Table 1: The characteristics of the research sample (N=150).

Variable	Frequency	Percentage (%)
Sex		
Male	143	95.3%
Female	7	4.7%
Age		
Less than or equal 20 years	3	2.0%
From 21 to 30 years	35	23.3%
From 31 to 40 years	36	24.0%
From 41 to 50 years	37	24.7%
51 years and more	39	26.0%
Educational level		
preparatory and less	26	17.3%
Secondary	42	28.0%
Bachelor or diploma	79	52.7%
Master	3	2.0%
Occupation		
Employee	70	46.7%
Worker	2	1.3%
Practitioner	40	26.7%
Unemployed	38	25.3%
Marital status		
Single	20	13.3%
Married	126	84.0%
Widow	4	2.7%
Children no.		
From 1 to 5 children	63	42.0%
6 children and more	60	40.0%
Have no children	27	18.0%

Table 2: An overview about the Date Palm orchards in the Middle Governorate (N=150).

Variable	Frequency	Percentage %
1. The total number of the Date Palm trees per orchard		
Less than or equal 20	66	44.0%
From 21 to 40 tree	30	20.0%
From 41 to 60 tree	22	14.7%
61 tree or more	32	21.3%
2. Area of the Date Palm orchards		
Less than 1 dunum	43	28.7%
From 1 to 3 dunum	64	42.7%
From 4 to 6 dunum	17	11.3%
More than 6 dunum	26	17.3%
3. Age of Date Palm trees		
Less than 10 years	62	41.3%
From 11 to 30 years	69	46.0%
From 31 to 60 years	12	8.0%
61 years and more	7	4.7%
4. Number of Date Palm cultivars grown by the respondents		
One cultivar	62	41.3%

Variable	Frequency	Percentage %
Two cultivars	40	26.7%
Three cultivars	22	14.7%
Four cultivars or more	26	17.3%
5. Factors standing behind the deterioration of Date Palm trees		
Yes	88	58.7%
No	62	41.3%
6. Methods of selling the product		
Directly to the market	53	35.3%
In the field	28	18.7%
Sent products to the factories	2	1.3%
Store the products until it turns into rutab	18	12.0%
Converting it to Ajwa	33	22.0%
Other (home consumption or presented as a gift)	16	10.7%
7. Source of irrigation water		
Groundwater	92	61.3%
Rain water	43	28.7%
Reclaimed waste water	12	8.0%
Other	3	2.0%
8. Wildlife prevailing in Date Palm orchards		
Yes	83	55.3%
No	67	44.7%
9. Plants prevailing in Date Palm orchards		
Yes	129	86.0%
No	21	14.0%

Table3: Production of Date Palm in the Middle Governorate (N=150).

Variable	Frequency	Percentage %
10. The average production of Date Palm per year		
Less than 70kg	39	26.0%
70-100kg	49	32.7%
101-200kg	44	29.3%
201-400kg	13	8.7%
More than 401kg	5	3.3%
11. Assessment productivity of Date Palm		
Weak	15	10.0%
Good	92	61.3%
Very good	36	24.0%
Excellent	7	4.7%
12. Deficiency in the production of Date Palm		
Yes	99	66.0%
No	51	34.0%
13. Role of the Israeli occupation in the deterioration of palm sector		
Yes	103	68.7%
No	47	31.3%

Table 4: Industries based on the Date Palm tree (N=150).

Variable	Frequency	Percentage %
14. Production of industrial products from Date Palm tree		
Yes	106	70.7%
No	44	29.3%
15. Encouragement and support of household products		
Yes	23	15.3%
No	127	84.7%

Table 5: Threats facing Date Palm trees (N=150).

Variable	Frequency	Percentage %
16. Threats facing the cultivation of Date Palm		
Yes	135	90.0%
No	15	10.0%
17. Pests infecting Date Palm trees		
Yes	114	76.0%
No	36	24.0%
18. Application of pesticides to combat pests		
Yes	116	77.3%
No	34	22.7%
19. Sources of chemical pesticides		
MOA	12	8.0%
Agricultural guidance institutions	12	8.0%
Shops	50	33.3%
Private companies	76	50.7%
20. Use of Personal Protective Equipment (PPE) during pesticide application		
Yes	36	24.0%
No	114	76.0%

Table 6: The reality of RPW in the Date Palm orchards (N=150).

Variable	Frequency	Percentage %
21. Injury of Date Palm tree with RPW		
Yes	112	74.7%
No	38	25.3%
22. Assessment of losses caused by RPW		
Severe	26	17.3%
Great	64	42.7%
Moderate	48	32.0%
Mild	12	8.0%
23. RPW as a Main threat facing Date Palm cultivation		
Yes	131	87.3%
No	19	12.7%
24. Role of the MOA in solving the RPW disaster		
Yes	62	41.3%
No	88	58.7%

Table 7: Development and management of Date Palm (N=150).

Variable	Frequency	Percentage %
25. Attendance of training courses in Date Palm sector		
Yes	16	10.7%
No	134	89.3%
26. Bayroha'a El-Nakheel project for the cultivation of Date Palm		
Yes	29	19.3%
No	121	80.7%
27. Importance the projects of Date Palm cultivation		
Yes	126	84.0%
No	24	16.0%
28. Challenges face projects of the Date Palm cultivation		
Yes	107	71.3%
No	43	28.7%
29. Role of the MOA in the development of Date Palm sector		
Yes	64	42.7%
No	86	57.3%

Appendix 3: The questionnaire Arbitration



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التاريخ/ 2016/05/08م.

الأخ / د. محمد أبو عودة قسم الأحياء بجامعة الأقصى حفظه الله ورعاه،،

السلام عليكم ورحمة الله وبركاته ،،،

الموضوع / التكرم بتحكيم استبانة للطالبة / إقبال سفيان رضوان

يشهد قسم الأحياء بالجامعة الإسلامية بأن الطالبة: إقبال سفيان رضوان طالبة في برنامج ماجستير العلوم الحياتية (تخصص نبات و فطريات) في الجامعة الإسلامية بغزة، و تقوم بإجراء بحث رسالة الماجستير بعنوان:

الوضع الحالي لشجرة نخيل البلح و استخداماتها في قطاع غزة - فلسطين

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ولكم منا جزيل الشكر والتقدير ،،،

رئيس قسم الأحياء والتكنولوجيا الحيوية

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التاريخ / 2016/05/08م

حفظه الله ورعاه،،

كلية الزراعة و البيئة بجامعة الأزهر

الأخ / د. إسماعيل أبو زنادة

السلام عليكم ورحمة الله وبركاته ،،،

الموضوع / التكرم بتحكيم استبانة للطالبة / إقبال سفيان رضوان

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قسم الجغرافيا بالجامعة الإسلامية بغزة
حفظه الله ورعاه

الأخ / د. كامل أبو ظاهر

السلام عليكم ورحمة الله وبركاته ،،،

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التاريخ / 2016/05/08

الأخ / م. صالح بخيت الوكيل المساعد بوزارة الزراعة حفظه الله ورعاه،،

السلام عليكم ورحمة الله وبركاته ،،،

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حفظه الله ورعاه

الأخ / أ. عبدالله الفرا

السلام عليكم ورحمة الله وبركاته ،،،

الموضوع / التكرم بتحكيم استبانة للطالبة / إقبال سفيان رضوان

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