AMERICAN UNIVERSITY OF BEIRUT

# ARCHAEOBOTANY IN LEBANON CASE STUDIES PROVING THE VALUE OF IMPLEMENTING ARCHAEOBOTANICAL ANALYSIS IN EXCAVATIONS

by
MARYA ANWAR SOUBRA

A thesis
submitted in partial fulfillment of the requirements
for the degree of Master of Arts
to the Department of History and Archaeology
of the Faculty of Arts and Sciences
at the American University of Beirut

Beirut, Lebanon
April 2023

AMERICAN UNIVERSITY OF BEIRUT

# ARCHAEOBOTANY IN LEBANON CASE STUDIES PROVING THE VALUE OF IMPLEMENTING ARCHAEOBOTANICAL ANALYSIS IN EXCAVATIONS

by
MARYA ANWAR SOUBRA

Approved by:

Dr. Claire Joanna Malleson — Advisor
Department of History and Archaeology

Dr. Hermann Genz — Member of Committee
Department of History and Archaeology

Dr. Paul Graham Newson — Member of Committee
Department of History and Archaeology

Date of thesis defense: 26 April 2023

AMERICAN UNIVERSITY OF BEIRUT

THESIS RELEASE FORM

Student Name: __Soubra________________Marya_____________Anwar______
Last First Middle

I authorize the American University of Beirut, to: (a) reproduce hard or electronic copies of my thesis; (b) include such copies in the archives and digital repositories of the University; and (c) make freely available such copies to third parties for research or educational purposes:

☒ As of the date of submission

☐ One year from the date of submission of my thesis.

☐ Two years from the date of submission of my thesis.

☐ Three years from the date of submission of my thesis.

Marya Soubra 05/05/2023

Signature Date

# ACKNOWLEDGEMENTS

First and foremost, I would like to thank the Chairperson of the Department of History and Archaeology, Dr. Helene Sader, who has always supported and guided all her students.

I wish to express my sincere gratitude and thanks to my advisor, Dr. Claire Joanna Malleson, who inspired me to tackle this subject. This project would not have been possible without her expertise and knowledge. I would also like to thank my committee, Dr. Hermann Genz and Dr. Paul Graham Newson, who have helped me immensely through their insights and encouragements.

My appreciation goes to the excavation directors who have taken the time to provide me with information concerning the sites mentioned in this thesis: Dr. Bettina Fischer-Genz, Dr. Graham Philip, Dr. Helene Sader, Dr. Hermann Genz, and Dr. Karin Kopetzky.

I am grateful for our Administrative Assistant, Nabeeha Osailly, who has always planned all the relevant logistics, and provided me with supplies.

Last but not least, I would like to thank my parents, my brother, and my sister, who have always shown interest in my work. My friends from the department, the archaeologists and the historians, and from the Archaeological Museum, for always supporting me and cheering me on.

ABSTRACT
OF THE THESIS OF

Marya Anwar Soubra for Master of Arts
Major: Archaeology

Title: Archaeobotany in Lebanon: Case Studies Proving the Value of Implementing Archaeobotanical Analysis in Excavations

This research aims to prove the importance of archaeobotanical analysis in archaeological contexts. In Lebanon, many archaeological excavations are conducted. Yet, the number of archaeobotanical analyses implemented for the sites are meager. Only a few sites are well represented, such as Tell Burak, Tell Fadous-Kfarabida, and Sidon. Unfortunately, that is not the case for all sites. This research presents three different case studies from different Lebanese sites: Qornet ed-Deir, Tell Kubba, and Tell Mirhan. These sites are located in different areas and were settled in different periods, which will prove the efficacy of archaeobotanical analysis in all locations and from all periods. The research process of archaeobotanical samples was conducted using the flotation method, then studied on a macrobotanical scale to identify the ancient seeds. Then, after the results are analyzed, the nature of the site and its available natural resources, and economic activity were investigated. Finally, a reflection on the potential of archaeobotany in Lebanon was discussed, as well as its possible enrichment of knowledge on Lebanese archaeological sites.

TABLE OF CONTENTS

# ILLUSTRATIONS

Figure

# TABLES

Table

# ABBREVIATIONS

AMS- Accelerator Mass Spectrometry

APJM- The Association for the Protection of Jabal Moussa

BCE- Before Common Era

CE- Common Era

cf.- To be compared with

EBA- Early Bronze Age

FN- Feature Number

IA- Iron Age

MBA- Middle Bronze Age

PPNC- Pre-Pottery Neolithic C

SW- Southwest

# CHAPTER I

# INTRODUCTION

Archaeobotany is the study of plant remains extracted from archaeological contexts. These remains offer a lot of information about the diet, fuel sources, and building materials that ancient societies used, as well as the environment they lived in. In essence, archaeobotany is a technique for examining the economy of a society based on plant resources, in addition to the interactions between humans and the environment (Riehl 2015, 30).

The interest in ancient plant remains began with Oswald Heer in 1840, a Swiss paleobotanist who was the first to examine macro-botanical remains from an archaeological excavation (Riehl 2015, 30). Few other scientists and archaeologists took interest in this discipline. In 1860, an Austrian botanist, Franz Unger, dissolved ancient Egyptian mudbricks to extract the botanical remains (Miksicek 1987, 212). In the same century, Carl Sigismund Kunth, a German botanist, also analyzed desiccated seeds from an Egyptian tomb. These discoveries and methods began attracting archaeologists to consider extracting botanical remains during excavations. However, at this stage, only macro-botanical remains found during excavations in contexts such as storage rooms, hearths, and tombs were noticed, which limited the variation and understanding of plant material on site (Killackey 2002, 3). In 1968, the flotation technique used to extract organic material from soil samples was invented by Stuart Struever, which considerably advanced the field of archaeobotany and its integration during excavations (Killackey 2002, 5).

In the founding years of the discipline, interest in plant remains focused on the evolution of crop species. Later, in the 1960s, when calibration curves and radiocarbon dating technology advanced, archaeobotany became classified as a distinct academic field. Archaeobotanical sampling at archaeological sites became more systematic as a result of a growing interest in the role that plants played in forming and developing ancient human communities. Archaeobotanical research has recently become more focused on the origins of agriculture, as well as the evolution of pre-agrarian societies' diets and the impact of the environment on agricultural production (Riehl 2015, 30). This research also impacts other fields of study in the natural sciences, such as the study of paleoclimate.

Lebanon is located in an area that is a crossroads of many different cultures and civilizations. Therefore, it is prone to having interesting archaeological discoveries. Most archaeological projects focus on architecture and other materials, such as pottery. However, because of its strategic location, Lebanon has participated in a lot of the events that interest the scientific community, such as the beginnings of domestication and the climatic changes. When studying archaeobotany, these topics are a main focus and can help in unraveling these processes.

When looking at the data available for Lebanese archaeobotany, there is few to work with. However, there is a lot of data available for the neighboring countries, such as Syria, Jordan, and Palestine. This data is used to understand the spread of agriculture and to determine the founding crops in each area. For the time being, this kind of data is unavailable for Lebanon. The Lebanese area does not have data to provide concerning the beginning of domestication and climatic changes. In addition, the impact of different cultures and civilizations passing through Lebanon could perhaps be traced through food traditions. But, to contribute to the scientific and academic community, and to show the importance of this country in history, more data should be collected concerning its botanical history. One way to achieve this would be to use archaeobotanical methods and interpretations.

The purpose of the research is to shed light on the importance of including archaeobotany in future excavations in Lebanon by proving its efficacy through three case studies, Qornet ed-Deir, Tell Kubba, and Tell Mirhan, that show the advancement of knowledge on the sites provided by the analysis. The questions this research proposes are: what kind of knowledge can archaeobotanical analysis add to our understanding of these three sites? And how can it reflect on Lebanese archaeology? As archaeobotanical studies are largely absent in Lebanese excavation reports, this question will motivate archeologists working in Lebanon to start considering the value that archaeobotany can add to their research and their understanding of the site. In addition, it will add to our knowledge about the different lifestyles that people living on the coast and in the mountains had.

# CHAPTER II

# LITERATURE REVIEW

Despite numerous excavations in Lebanon since the twentieth century, the total number of archaeobotanical analyses remains unsatisfactory, and the total number of published articles on the topic does not exceed thirty. In addition, there is a concentration of research on specific sites, in the case where the team has a goal of understanding plant and human interactions. Such sites include Tell Burak, Tell Fadous-Kfarabida, and Sidon. Other sites that have included archaeobotany to a certain extent include Kamid el-Loz, Jiyeh, Tyre, and Tell Labwe. All macro-botanical remains studied in Lebanon are charred seeds and charcoal. The reason behind this is the fact that desiccated plant remains only survive in arid climates, such as in Egypt, whereas the climate in Lebanon is humid, making charred seeds the main type likely to survive (Day 2013, 5807).

Tell Burak has one of the most detailed and extensive botanical analyses. The working team was aware of the gaps existing in the archaeobotanical seed reference collection in Lebanon and made an effort to fill them properly (Riehl and Orendi 2019, 360). Excavations, from 2002 until 2022, focused on multiple botanical analysis methods, such as macrobotany (Riehl and Orendi 2019, Orendi and Deckers 2018), wood identification (Deckers 2019), and phytolith sampling. The wood identification analysis determined the species of wood used to build the Middle Bronze Age palace and the Late Bronze Age retaining structure. These results allowed for a comparison between the two periods and the available resources for both, as well as the economic and political significance of these species.

As for the macro-botanical remains identified, they were especially important in recognizing the function of each room, such as storage facilities or plant processing areas, as well as recognizing the differences in the site's economy between the Bronze and Iron Ages. Since the site also has an Iron Age wine press, the abundance of grape seeds helped clarify the process of winemaking and the facilities and rooms associated with it (Orendi and Deckers 2018, 733). In addition, olive oil production was proven at the site by the presence of crushed olive seeds. These two products were crucial for the economy of Tell Burak during the Bronze and Iron Ages, and this was proved by the archaeobotanical analysis. Many more species were present at the site, which formed the regular diet of the inhabitants of the town; however, grapes and olives were the most abundant.

In Jiyeh, an archaeobotanical analysis was conducted on samples taken from the seasons of 2009 through 2012 (Badura et al. 2016). The samples retrieved were from 213 different contexts and covered multiple areas of the site and periods, ranging from the Iron Age to the Byzantine Period. Various taxa were recovered, olive being the most abundant. Other taxa include figs, grapes, legumes, and grains. The number of seeds extracted was not significant because of poor preservation. Nevertheless, the study was important since it showed the plant diversity at the site. Moreover, since there is an absence of oil and wine presses at the site, the analysis revealed the substantial consumption of olives and grapes as fruit in the diet of the inhabitants. Legumes and vegetables seem to have also constituted a large part of their diet; however, the minor evidence of grains raised the question of whether grains were imported or simply badly preserved.

Tell Fadous-Kfarabida also underwent extensive archaeobotanical analysis. The research focused on macrobotany, phytolith analysis, and wood identification. Samples were collected from the beginning of the excavation in 2004 (Badreshany et al. 2005) and continued until the last season of 2016 (Damick 2019, Genz et al. 2016). The samples represented Early Bronze Age contexts, some of which were mixed with Middle Bronze Age material, and were collected to understand agricultural and natural resources at the site, as well as the environmental conditions. The results showed that emmer wheat and olive were the most abundant plants throughout all phases of the Early Bronze Age.

Similar to Jiyeh, olives were not crushed, and there is no evidence of oil presses at the site, which indicates the consumption of olives as fruits. Other crops were found, such as legumes, grapes, and figs, however, in much lower quantities, as well as wild species. Based on further scientific analysis, mainly stable carbon isotope analysis, it was concluded that crops were not irrigated, but rain-fed agriculture was practiced (Genz et al. 2009, 115). In addition, stable carbon isotope analysis conducted on the barley found was used to understand the climate during the Early Bronze Age and proved stable and balanced climatic conditions (Genz et al. 2016, 92).

During the 2014–2016 seasons of excavations, soil samples were taken for phytolith analysis. The findings revealed that there are date phytolith remains, specifically in storage rooms. However, no date seeds were recovered by flotation throughout the site. It was theorized that palm fronds and/or trunk fibers were imported to be used for matting, considering that date palms do not grow locally (Damick 2019, 588).

At Sidon, samples from the Early Bronze Age were studied on a macro-botanical scale (De Moulins 2009, De Moulins 2019). During the 2007 excavations, 160 kg of charred plant remains were discovered in a grain deposit destroyed by a fire. The cereal grains were identified as two-rowed hulled barley, along with wheat and fava beans. Other crops, such as grapes, flax seeds, and lentils, were found in smaller quantities. Since a large amount of barley was discovered, the archaeologists interpreted this as an indicator of the economic importance of Sidon during the Early Bronze Age in distributing cereal grains for the city and possibly exporting as well. However, using examples from areas where grain rations were documented, it can be noticed that the amount of cereal grains found in Sidon is not large enough to hold economic importance. For example, from Middle Kingdom Egypt, which overlaps into the Levantine Middle Bronze Age, texts were discovered stating that Egyptian workers were given between 6 and 8 Kilograms of cereal grains per 10 days. Therefore, a worker could receive 21 Kilograms of grain per month, which would make 160 Kilograms the amount he would get in 8 months (Miller 1991, 261). Another example would be Roman soldiers, who would have received 1 Kilogram of grain per day, which would make 30 Kilograms per month, making 160 Kilograms equivalent to 5 months' worth of grain (Roth 1999, 19).

This comparison puts into perspective how 160 Kilograms of cereal grains would have been used. The interpretation that this storage room could have been a place where the state divided the rations could be exaggerated, as the amount is not enough to feed hundreds or thousands of Sidonians.

As for the Middle Bronze Age, some samples were taken from the burial ground of the city, from *tannours* and pits (De Moulins and Marsh 2011). The seeds recovered consist of cereal grains (emmer wheat and barley) and a variety of legumes. A few fruit remains, including figs, grapes, and olives, were found. The plant remains at the burial ground indicate food activities concerning funerary rites.

In domestic areas, samples taken from floor contexts contained wheat, barley, legumes, grape pips, and olive stones (De Moulins 2015). This gives us an idea of the plants people used to consume and process in their houses. As for wood identification, burnt olive wooden beams were discovered in a room from a Middle Bronze Age monumental building. As for the Late Bronze Age, another monumental building was built and destroyed by a fire, as wooden *Arbutus* beams were found on the floor of one of the rooms (Doumet-Serhal 2010).

Another project that was done at Sidon and Tyre analyzed pollen samples from harbor sediments in antiquity (Marriner et al. 2004). They found both arboreal pollen and non-arboreal pollen. The arboreal species consist of taxa such as olive, grape, pine, and cedar, and non-arboreal species consist of cereals, legumes, and wild grasses. The tree species found reflect the local forest composition, as well as imported wood. As for the vegetation, it suggests human modification of the landscape used for agriculture.

From the 2011 season at Tell Labwe, 63 samples were analyzed from Neolithic layers (Haidar-Boustani et al. 2011, Haïdar-Boustani et al. 2012). The taxa identified were domesticated wheat and barley in small quantities, various legumes, fruits such as figs, and wild almonds and olives. The wood analysis identified almond, pistachio, and ash, which are trees available in the nearby forest. Since the Neolithic is an understudied period in Lebanon, the team conducting this excavation found it important to study the ancient plant remains to reconstruct the diet of the inhabitants and landscape of the area, as well as understand the presence of domestic and wild species.

At Tell Arqa, during the 2002 and 2003 seasons, Early Bronze Age burnt houses were discovered (Cichocki 2008). Cereal grains were found in large quantities in the storage rooms of the houses. However, the most significant finds were the wooden beams that constituted the roofs of the houses. Most of the wood identified was cedar, the rest were a few samples of juniper, olive, cherry, maple, and oak. This shows the variety of the available wood resources nearby and highlights the importance of trading cedar wood, as it constituted 95% of the samples.

All of these various studies show the potential of archaeobotany in Lebanon, but also the aspects of botany that each team decided to focus on. Not all teams were detailed in their analysis, some only chose to focus on macro-botanical remains, while others included isotopes, phytoliths, or pollen, to get a better idea about the use of plants at the site.

# CHAPTER III

# METHODOLOGY

After the samples were collected during the excavations, they were brought back to the American University of Beirut, where flotation was performed. The process of flotation was done using machine flotation, intercepted by a 250-micron sieve that collects all the macro-botanical remains[1].

This method was first used in the 1960s, after Professor Stuart Struever was able to extract seeds from ashy soil samples using the manual flotation technique of submerging soil in a container of water and extracting the seeds using a sieve. When he used this method, he realized the amount of organic material that was being missed when not performing flotation (Struever 1996, 353). With time, flotation methods advanced, and new techniques were discovered, such as chemical flotation, as well as building machines to make the process of floating samples less laborious and time-consuming (Killackey 2002, 7).

After the remains were left to dry, they were sieved to get rid of modern roots and twigs that contaminated the samples. The volume of each sample was then measured using a beaker and noted in milliliters. Next, the samples were studied under a Zoom stereo binocular microscope with a 6 – 30X magnification, and the seeds were picked out with a small tweezer. The seeds were examined closely to determine their family or species, depending on their level of preservation. After the seeds were determined and

[1] The flotation equipment used to process the samples was funded as part of the EduBioMed project "Capacity Building for Education And Applied Research In Mediterranean UNESCO's Biosphere Reserves".

counted, they were stored in labeled foil or small containers and placed in a plastic Ziplock bag. Then, the results of each site were added to an Excel worksheet, where all the relevant sample information was specified, and the identified species were noted along with the number of seeds found in each context.

# CHAPTER IV

# RESULTS

The results will be presented from three sites: Qornet ed-Deir, Tell Kubba, and Tell Mirhan (Figure 1).


Figure 1: Map showing the locations of three sites that will be discussed: Qornet ed-Deir, Tell Kubba, and Tell Mirhan (Google Earth 2023).

## A. Site (1): Qornet ed-Deir

The site of Qornet ed-Deir is located 1359 meters above sea level in the Jabal Moussa Biosphere Reserve (Figure 2). Its name means "The hill of the monastery", and it was considered a sacred site in recent history by the locals. It is situated at the bottom of a rocky outcrop, on a hiking trail, and is often visited by tourists and hikers. Qornet ed-Deir suffered from attacks by treasure hunters who used destructive methods to search for valuables, such as bulldozing. For this reason, the site needed immediate professional attention to preserve what remains (APJM 2020, 4).

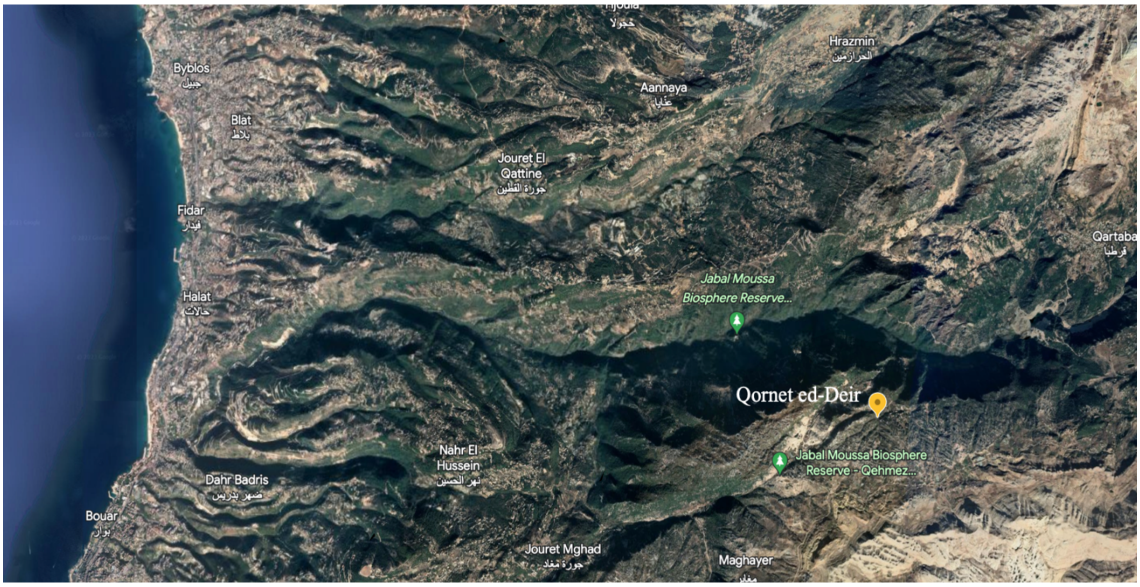


Figure 2: Map showing the location of Qornet ed-Deir (Google Earth 2023)

The site has been divided by the archaeologists into two areas, Area 1, and Area 2. Area 1 consists of Roman architecture (Figure 3) and Area 2 consists of a multi-room building with a long occupation history (Figure 4) (Fischer-Genz et al. 2018, 245). The excavated areas at the site belong to the Middle Bronze Age, Roman, Byzantine, and Crusader periods (APJM 2020, 4). The results from this site present a large collection of plant remains from all periods.


Figure 3: Picture of Area 1 at Qornet ed-Deir (Fischer-Genz et al. 2018, p. 247).


Figure 4: Aerial picture of Area 2 at Qornet ed-Deir (APJM 2020, p. 4).

In 2009, a survey was conducted for the Association for the Protection of Jabal Moussa (APJM), to try and identify the archaeological sites present on the trail. Not only were multiple settlements found in the area, but also a Roman road connecting the coast to Afqa, which passes through the mountain (Doumet-Serhal 2010, 12).

In 2017, an excavation permit was granted by the Directorate General of Antiquities for two soundings, one in the Roman building in Area 1, and the other in the multi-room building (Fischer-Genz et al. 2018, 246). Surface cleaning was conducted before the excavation to draw the preliminary architectural plan and collect the exposed pottery (Fischer-Genz 2017, 1). Four excavation seasons were then completed during the summers of 2017, 2018, 2019, and 2020.

The seasons represented in the study are 2018 and 2019. The samples were taken from many different contexts and installations belonging to multiple periods. The chronologies of the samples were divided according to their stratigraphical position into the Middle Bronze Age, Roman/Byzantine, Mixed Medieval/Roman, Crusader Period Phase 1, Crusader Period Phase 2, and Crusader Period Phase 3.

From the 2018 season, 33 samples were gathered, out of which 11 were analyzed. Four samples belong to the MBA:

| Sample # | Context # | Find # | Bag # | Volume (L) | Context date | Context description |
|---|---|---|---|---|---|---|
| 1 | 2105 | 268 | 1/1 | 7 | MBA | Inside the fireplace |
| 2 | 2052 | 245 | 3/4 | 9 | MBA | Yellowish clayey soil |
| 24 | 2097 | 228 | 2/2 | 9 | MBA | On top of the floor 2052 |
| 32 | 2097 | 228 | 1/2 | 7 | MBA | |

Table 1: 2018 Qornet ed-Deir Middle Bronze Age samples.

One sample belongs to the Roman/Byzantine periods, which was a burial context:

| Sample # | Context # | Find # | Bag # | Volume (L) | Context date | Context description |
|---|---|---|---|---|---|---|
| 17 | 2025 | 245 | 1/4 | 7 | Roman/Byz. | Tomb |

Table 2: 2018 Qornet ed-Deir Roman/Byzantine samples.

Three samples belong to the Mixed Medieval/ Roman periods:

| Sample# | Context# | Find# | Bag# | Volume (L) | Context date | Context description |
|---|---|---|---|---|---|---|
| 8 | 5010 | 37 | 1/1 | 14 | Mixed Medieval/Roman | N/A |
| 26 | 5008 | 21 | 1/1 | 6 | Mixed Medieval/Roman | Burnt patches |
| 29 | 5006 | 16 | 1/1 | 10.5 | Mixed Medieval/Roman | Upper big stone layer/collapse |

Table 3: 2018 Qornet ed-Deir Mixed Medieval/Roman samples.

Two samples belong to the Crusader period:

| Sample # | Context # | Find # | Bag # | Volume (L) | Context date | Context description |
|---|---|---|---|---|---|---|
| 21 | 3023 | 34 | 1/1 | 2 | Crusader | N/A |

| | | | | | | |
|---|---|---|---|---|---|---|
| 31 | 3022 | 30 | 1/1 | 3.5 | Crusader | |

Table 4: 2018 Qornet ed-Deir Crusader samples.

One sample's context is yet unclear:

| Sample# | Context# | Find# | Bag# | Volume (L) | Context date | Context description |
|---|---|---|---|---|---|---|
| 18 | 2014 | 254 | 1/1 | 1 | N/A | from QED17 would be MBA, but FN is too high |

Table 5: 2018 Qornet ed-Deir samples from unclear periods.

From the 2019 season, 61 samples were collected, and 22 were analyzed.

Eight belonged to the MBA:

| Sample # | Context # | Find # | Bag # | Volume (L) | Context date | Context description |
|---|---|---|---|---|---|---|
| 108 | 2052 | 328 | 1/4 | 7 | MBA | Yellowish Clayey soil |
| 110 | 2016 | 35 | | 8 | MBA | QED17 under "tannour" |
| 111 | 2052 | 316 | | 8 | MBA | Yellowish Clayey soil |
| 113 | 2052 | 328 | 4/4 | 9 | MBA | |
| 114 | 2052 | 328 | 3/4 | 7 | MBA | |
| 116 | 2052 | 328 | 2/4 | 8 | MBA | |
| 117 | 2116 | 339 | | 7 | MBA | Brown soil on top of fireplace |

| | | | | | | |
|---|---|---|---|---|---|---|
| 143 | 2115 | 358 | 3/4 | 6.5 | MBA | N/A |

Table 6: 2019 Qornet ed-Deir Middle Bronze Age samples.

Fourteen belong to unclear contexts:

| Sample # | Context # | Find # | Bag # | Volume (L) | Context date | Context description |
|---|---|---|---|---|---|---|
| 107 | 6027 | 151 | 1/1 | 2 | N/A | Fill of FN133 |
| 112 | 7008 | 40 | 2/4 | 6 | N/A | Soil+stones in passage |
| 122 | 7007 | 25 | 3/4 | 8 | N/A | Soil+small stones |
| 129 | 6021 | 206 | 1/1 | 5.5 | N/A | Layer of burnt material |
| 130 | 6033 | 197 | 2/2 | 6 | N/A | Pavement |
| 131 | 6018 | 104 | 2/4 | 7.5 | N/A | Fill in FN93, under 6017 |
| 133 | 7009 | 41 | 1/1 | 8.5 | N/A | Soil+stones, SW corner |
| 134 | 6005 | 76 | 1/4 | 8.5 | N/A | N/A |
| 142 | 6031 | 170 | 1/4 | 8 | N/A | Brown soil+stones |
| 144 | 6028 | 137 | 1/2 | 5 | N/A | Brown clayey fill |
| 145 | 6024 | 184 | 1/2 | 6 | N/A | Stone packing-pavement |
| 150 | 7010 | 58 | 2/3 | 6 | N/A | Yellowish-brown soil |
| 151 | 6035 | 201 | 1/1 | 1 | N/A | Burnt clay |
| 159 | 6017 | 98 | 2/6 | 8.5 | N/A | N/A |

Table 7: 2019 Qornet ed-Deir samples from unclear periods.

A total of 35 bags of samples were analyzed, ranging in volume from 5mL to 550mL after flotation. The samples that were chosen for analysis covered all of the contexts from the site. One bag was selected from each context at random. Due to time constraints and the large number of samples taken, the remaining samples are yet to be analyzed.

While a large portion of the seeds was badly preserved and unidentifiable to species, plant families were identified. From the Middle Bronze Age, the most notable remains were *Vitis vinifera* (Grape), *Hordeum vulgare* (Barley), *Triticum* sp. (Wheat), *Portulaca oleracea* (Purslane), and cf. *Astragalus* sp. (Milk-vetch). As for the Byzantine period, Leguminosae (Legumes) and *Allium* sp. (Garlic) seeds were documented. The rest of the seeds could belong to wild species naturally present in the soil or that contaminate the settlement through the wind.

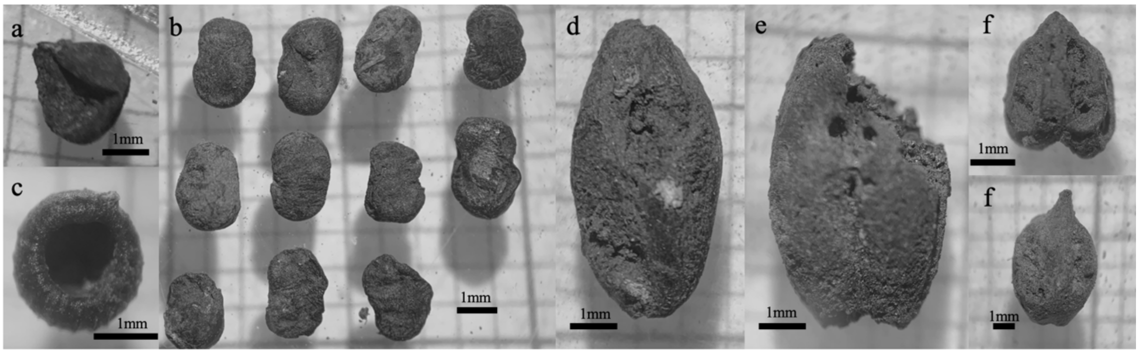
One organic find that was abundantly present in the samples was fungal sclerotia, which are round compact masses that form in the soil. These masses are fungus that is waiting for the right climatic conditions to grow into a fungal organism (Obase et al. 2014, 708). This type of fungus is heavily present in the soil of forests, which is applicable for Qornet ed-Deir. At first, these sclerotia were thought to be round plant seeds, as they were found in very large numbers. However, after consulting with other archaeobotanists, it was determined that these seeds were in fact modern fungal sclerotia.

| Taxa | Total |
| --- | --- |
| Amaranthaceae | 3 |

| | |
|---|---|
| Chenopodium | 1 |
| *Allium* sp. | 13 |
| *Allium* sp. fragment | 3 |
| Asteraceae | 1 |
| Caryophyllaceae | 2 |
| Cyperaceae | 1 |
| cf. *Astragalus* sp. | 106 |
| cf. *Astragalus* sp. fragments | 17 |
| *Lens* sp. | 4 |
| *Lens* sp. fragment | 2 |
| *Vicia* sp. | 6 |
| *Vicia* sp. fragment | 6 |
| *Abutilon* sp. | 1 |
| *Ficus carica* | 1 |
| *Veronica hederaefolia* | 3 |
| *Veronica hederaefolia* fragment | 1 |
| Cereal embryo | 1 |
| Glume base | 8 |
| Grain | 6 |
| Grain fragment | 92 |
| *Hordeum vulgare* | 4 |
| *Hordeum vulgare* fragment | 1 |
| *Phalaris* sp. | 1 |

| | |
|---|---|
| *Triticum* sp. | 4 |
| *Triticum* sp. Glume base | 2 |
| *Triticum* sp. Glume base fragment | 3 |
| Vesicular grain | 2 |
| *Portulaca oleracea* | 15 |
| *Galium* sp. | 8 |
| *Vitis vinifera* | 5 |
| *Vitis vinifera* fragment | 1 |
| Calyx/Pedicel | 1 |
| Indeterminate | 184 |
| Indeterminate fragments | 3 |
| Indeterminate type 1 | 636 |
| Indeterminate type 2 | 1 |
| Indeterminate type 3 | 9 |
| Indeterminate type 4 | 1 |
| Indeterminate type 5 | 1801 |
| Indeterminate type 6 | 320 |
| Indeterminate type 7 | 18 |
| Indeterminate type 8 | 216 |
| Indeterminate type 9 | 5 |
| Indeterminate type 10 | 211 |
| Modern | 4 |

Table 8: 2018/2019 Qornet ed-Deir archaeobotanical analysis results.




a: *Allium* sp. b: cf. *Astragalus* sp. c: *Veronica hederaefolia* d: *Triticum* sp.
e: *Hordeum vulgare* f: *Vitis vinifera*

Figure 5: Pictures of some of the species found in the Qornet ed-Deir samples.

The most commonly found remains from Qornet ed-Deir are the indeterminate types. Indeterminate type 5 is the most abundant (1801 seeds), followed by Indeterminate type 1 (636 seeds), Indeterminate type 6 (320 seeds), Indeterminate type 8 (216 seeds), and Indeterminate (184 seeds). These indeterminate types form 90% (3368 seeds) of the entire assemblage. The rest of the Indeterminate types (7,3, 9, 2, and 4) form 1%.

The most abundant consumable plants are cereal grains (119 seeds). They form 3.1% of the assemblage. cf. *Astragalus* sp. is the second largest group of consumable plants (123 seeds). It forms 3% of the assemblage. The rest of the assemblage holds negligible percentages. It includes *Allium* sp. (16 seeds), *Portulaca oleracea* (15 seeds), *Vicia* sp. (12 seeds), *Galium* sp. (8 seeds), *Vitis vinifera* (6 seeds), *Lens* sp. (6 seeds), *Veronica hederaefolia* (4 seeds), Amaranthaceae (3 seeds), Caryophyllaceae (2 seeds), Chenopodium (1 seed), Asteraceae (1 seed), Cyperaceae (1 seed), *Abutilon* sp. (1 seed), *Ficus carica* (1 seed), and *Phalaris* sp. (1 seed).

The samples belong to multiple periods. 20% of the samples are from the Middle Bronze Age, 3% are from the Roman/Byzantine period, 9% belong to the Mixed Medieval/Roman period, 6% are from the Crusader period, and 40% are yet undated.

## B. Site (2): Tell Kubba

The site of Tell Kubba is located 60 km north of Beirut, on the fertile coastal plain south of the Chekka Plateau (Figure 6). The site is divided into two separate locations Tell Kubba I and Tell Kubba II. Tell Kubba I consists of a low mound, 100 m east of the Mediterranean. It is 5 ha in size on a rocky outcrop, Ras Shiqaa. This outcrop is characterized by natural caves, which would have been an attraction as a shelter in early periods. Kubba I presents evidence of a settlement dating back to the Paleolithic until the Early Bronze Age II. Kubba II is located 600 m east of the Mediterranean, on the access road from the south through Ras Shiqaa. The location of the site is strategic as it has access to water sources and land for agriculture. The remains indicate its belonging to the Early Bronze Age III (Badreshany et al. 2019, 75).

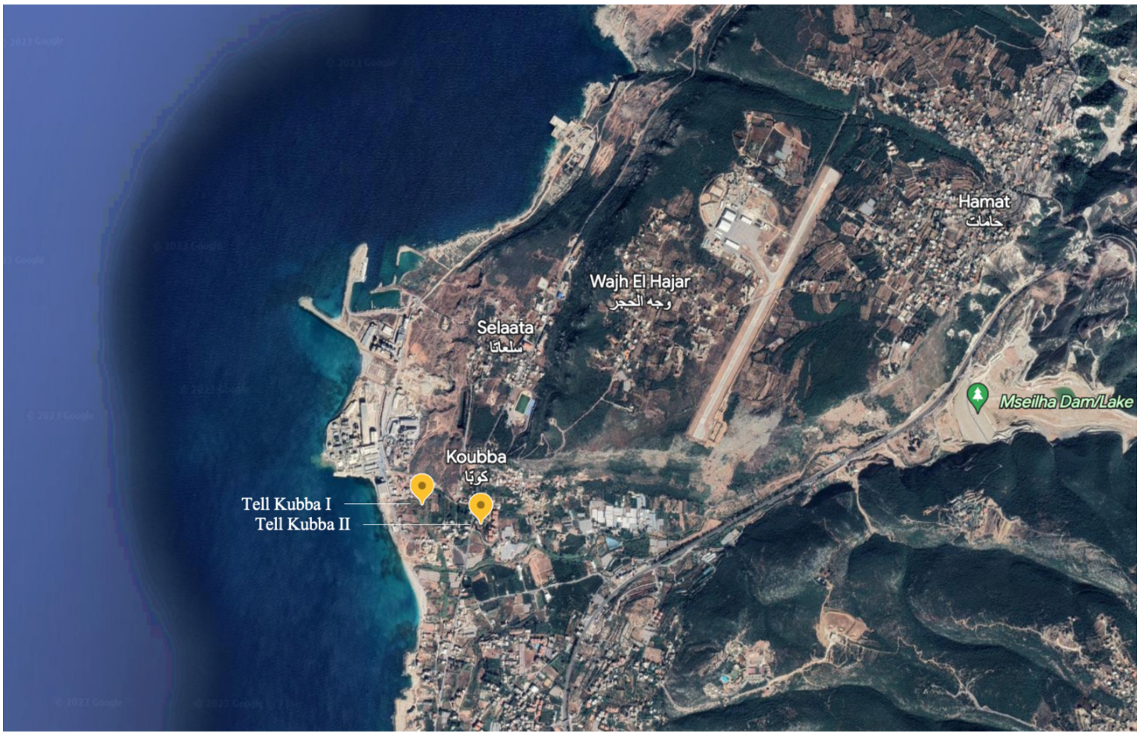


Figure 6: Map showing the location of Tell Kubba I and II (Google Earth 2023).

Tell Kubba I was first noted by Copeland and Wescombe in the 1960s (Copeland and Wescombe 1965, 101), and it was concluded that the site belonged to the Chalcolithic and Neolithic periods.

The first season of the Tell Kubba excavations was conducted by a team from the American University of Beirut and Durham University during the summer of 2015. The survey revealed an occupation period longer than expected, going back from the Early Bronze Age II to the Paleolithic (Badreshany et al. 2019, 75).

The excavation between 2015 and 2017 revealed two main layers of occupation: The Ceramic Neolithic and the Early Bronze Age II. From the Neolithic, the artifacts found, such as obsidian, indicate trading activities with neighboring areas. Other materials found include faunal and botanical remains. The architecture of the site was not extensive but included work areas, a *tannour*, and fragments of a plastered surface. As for the EBA II, a monumental stone wall was found, before the site was abandoned in the same period (Badreshany et al. 2019, 76).

Tell Kubba II was being destroyed by modern dwelling constructions, therefore, a rescue excavation was requested to save what remains of the site, as it seems to have been the continuation of Kubba I after its abandonment. After an initial survey of the site, the ceramics found indicate a close connection between Kubba II and other neighboring EBA III sites, such as Tell Fadous-Kfarabida and Byblos (Badreshany et al. 2019, 77).

The samples studied belong to the excavation from the 2019 season, which provided 32 bags of samples, ranging in volume from 5 mL to 100 mL after flotation. The samples are from various periods, contexts, and locations. Some belong to the Pre-Pottery Neolithic C and others belong to the Early Bronze Age II and III. The samples from the

PPNC belong to the site of Tell Kubba I, and the samples dating to the EBA II-III and EBA III belong to the Tell Kubba II site.

Seven samples belong to the Pre-Pottery Neolithic C, from the site of Kubba I:

| Sample# | Context# | Find# | Bag# | Volume (L) | Context date | Context description |
|---|---|---|---|---|---|---|
| 25 | 2047 | N/A | 2/2 | 3.5 | PPNC | Fill around burial |
| 27 | 2047 | N/A | 1/2 | 5 | PPNC | |
| 13 | 2048 | N/A | 1/1 | 10 | PPNC | Dark brown soil under the burial (2047) |
| 26 | 2048 | N/A | 1/1 | 6 | PPNC | |
| 5 | 2049 | N/A | 1/2 | 9 | PPNC | Pebble layer |
| 32 | 2049 | N/A | 2/2 | 8 | PPNC | |
| 31 | Kubba I bulk sample 1 | N/A | 1/1 | 0.75 | PPNC | Soil from skull |

Table 9: 2019 Tell Kubba Pre-Pottery Neolithic C samples.

Twenty-one samples belong to the Early Bronze Age II-III, from the site of Kubba II:

| Sample# | Context# | Find# | Bag# | Volume (L) | Context date | Context description |
|---|---|---|---|---|---|---|

| | | | | | | |
|---|---|---|---|---|---|---|
| 9 | 10040 | 16 | 2/3 | 13.5 | EBA II-III | Collapse - including a lot of stone and mudbrick fragments, lots of pottery, some lying horizontally |
| 10 | 10040 | 17 | 3/3 | 15 | EBA II-III | |
| 12 | 10040 | | 1/1 | 12 | EBA II-III | |
| 14 | 10040 | | 1/1 | 11 | EBA II-III | |
| 20 | 10040 | | 1/1 | 13 | EBA II-III | |
| 21 | 10040 | | 1/1 | 11 | EBA II-III | |
| 22 | 10040 | | 1/1 | 13 | EBA II-III | |
| 24 | 10040 | 15 | 1/3 | 14 | EBA II-III | |
| 29 | 10040 | | 1/1 | 15 | EBA II-III | |
| 2 | 10041 | | 1/1 | 17 | EBA II-III | Wash layer, includes lithic debitage and some Ceramic Neo sherds, so contains some derived material |
| 11 | 10041 | | 1/1 | 8 | EBA II-III | |
| 15 | 10041 | | 1/1 | 22 | EBA II-III | |
| 16 | 10041 | | 1/1 | 19 | EBA II-III | |
| 19 | 10041 | | 1/1 | 8.5 | EBA II-III | |
| 23 | 10041 | | 1/1 | 16 | EBA II-III | |
| 4 | 10058 | 30 | 2/2 | 12.5 | EBA II-III | Collapse deposit, contains a lot of small stones |
| 1 | 10059 | 37 | 2/2 | 13 | EBA II-III | Thick clay deposit, compact fill-type material containing many sherds - possible surface |
| 6 | 10059 | 36 | 1/1 | 13.5 | EBA II-III | |
| 17 | 10059 | 43 | 2/2 | 11.5 | EBA II-III | |
| 18 | 10059 | 42 | 1/1 | 16 | EBA II-III | |
| 30 | 10059 | 38 | 3/3 | 14 | EBA II-III | |

Table 10: 2019 Tell Kubba Early Bronze Age II-III samples.

Three samples belong to the EBA III, from the site of Kubba II:

| Sample# | Context# | Find# | Bag# | Volume (L) | Context date | Context description |
|---|---|---|---|---|---|---|
| 3 | 10025 | | 1/3 | 13 | EBA III | Extensive midden layer, rich in ceramics and lithics - including restorable vessels |
| 7 | 10025 | | 3/3 | 15.5 | EBA III | |
| 8 | 10025 | | 2/3 | 7 | EBA III | |

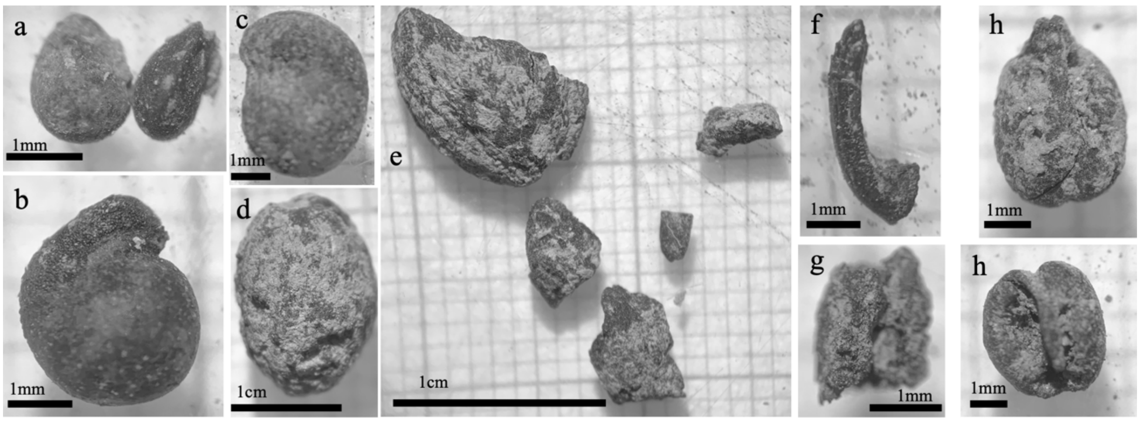
Table 11: Tell Kubba Early Bronze Age III samples.

The preservation of the seeds in Tell Kubba is relatively good. The preserved seeds have retained their shape and are easy to identify. The samples had modern contaminations; however, they were easy to spot. The remains that have been identified are *Triticum* sp. (Wheat), cf. *Astragalus* sp. (Milk-vetch), *Vitis vinifera* (Grape), *Olea europaea* (Olive), Boraginaceae cf. *Heliotropium* sp. (Heliotrope), *Capparis* cf. *spinosa* (Capers), and Chenopodiaceae.

| Taxa | Total |
|---|---|
| Chenopodiaceae | 10 |
| Boraginaceae cf. *Heliotropium* sp. | 12 |
| *Capparis* cf. *spinosa* | 47 |
| cf. *Astragalus* sp. | 1 |

| | |
|---|---|
| *Olea europaea* | 1 |
| *Olea europaea* fragment | 13 |
| *Triticum* sp. glume base | 1 |
| Vesicular grain fragment | 1 |
| *Vitis vinifera* | 6 |
| *Vitis vinifera* fragment | 2 |
| Indeterminate type 1 | 16 |
| Modern | 7 |

Table 12: 2019 Tell Kubba archaeobotanical analysis results.




a: Boraginaceae cf. *Heliotropium* sp. b: *Capparis* cf. *spinosa* c: cf. *Astragalus* sp.
d: *Olea europaea* e: *Olea europaea* fragments f: *Triticum* sp. glume base
g: Vesicular grain fragment h: *Vitis vinifera*

Figure 7: Pictures of some of the species found in the Tell Kubba samples.

The most abundant species from Tell Kubba is *Capparis* cf. *spinosa* (47 seeds), which forms 40% of the assemblage. Indeterminate type 1 (16 seeds) forms 13%, *Olea europaea* (14 seeds) forms 11%, Boraginaceae cf. *Heliotropium* sp. (12 seeds) forms 10%. The rest of the seeds form less than 10% of the assemblage. Chenopodiaceae (10 seeds) forms 8.5%, *Vitis vinifera* (8 seeds) forms 6.5%, the cereal grains (2) form 1.7%, and *Olea europaea* (1 seed) forms 0.85%.

The samples belong to three periods. 44% of the samples are from the Pre-Pottery Neolithic C, 3% are from the Early Bronze Age II-III, and 11% belong to the Early Bronze Age III.

### C. Site (3): Tell Mirhan

The site of Tell Mirhan was a settlement located on a small flat coastal strip 70 km north of Beirut, between the promontories of al-Herri and Anfeh, in Chekka (Figure 8) (Kopetzky et al. 2019, 105). It lies directly on the shore of the Mediterranean Sea, 7 meters above sea level (Kopetzky et al. 2019, 114). Its location at the foothills of Mount Lebanon makes way for a couple of rivers and streams, watering the plain (Kopetzky et al. 2019, 106). The site today is only 1,000 $m^2$ in size, due to the construction of a cement factory on top of the site, as well as buildings, houses, and gardens nearby. The original size of the Tell would have been between 6 and 7 hectares, based on aerial pictures from the 1960s, before the site was destroyed (Kopetzky et al. 2019, 113).

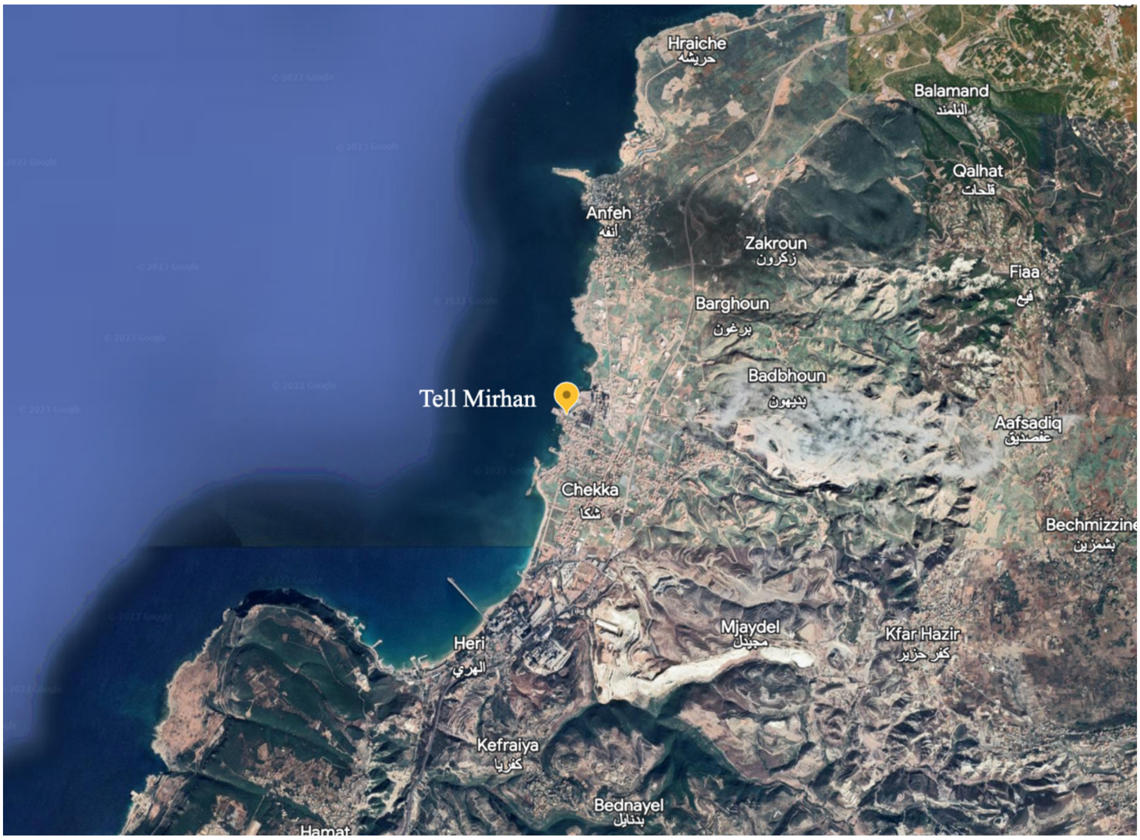


Figure 8: Map showing the location of Tell Mirhan (Google Earth 2023)

The surveys and excavations have uncovered occupation levels from the Middle Bronze Age and the Iron Age. The MBA remains consist of a fortification wall and pottery sherds (Figure 9) (Kopetzky et al. 2019, 118). The IA yields more significant remains, consisting of architectural and material remains (Kopetzky et al. 2019, 120).


Figure 9: Picture of the Middle Bronze Age fortification wall at Tell Mirhan.

Archaeologically, very little is known about the area between Chekka and Anfeh (Kopetzky et al. 2019, 106). In 1966, the site was noted during the survey by Copeland and Wescombe, as Bronze Age pottery was visible on the surface (Copeland and Wescombe 1966, 161). In 1978, the site was noted again by Pritchard, who documented the destruction of the site and the small area preserved (Pritchard 1978, 11).

In 2016, the archaeological project of the Chekka region began with a partnership between the Institute for Oriental and European Archaeology and the American University of Beirut (Kopetzky et al. 2019, 105). The first step taken was a survey and a mapping of the site. Then, excavations began as a form of cleaning the section that was created by the modern road, which revealed the rampart used for the fortification system. The cleaning yielded pottery from the Early Bronze Age up to the Byzantine period.

During the excavations of 2018 and 2019, two main areas were defined: Area A/I–b/33, c/33, f/32, and Area A/I–b/29–30, c/30 (Figure 10). The first area was located on top of the rampart, where MBA and IA were found in a compact dark grey soil layer (Kopetzky et al. 2019, 118). Modern disturbances were noted in b/33/c/33, as a robbing trench was found (Kopetzky et al. 2019, 119). As for the second area, the same hard grey layer was encountered at the top. Under this layer, two parallel walls and a perpendicular wall were found. They were constructed using beach pebbles and limestone ashlars, and they formed a square room, dating to the IA II. The floor of the room consisted of two layers. The first layer uncovered consisted of flat stone slabs, and the one below it was a cobbled floor (Kopetzky et al. 2019, 120).

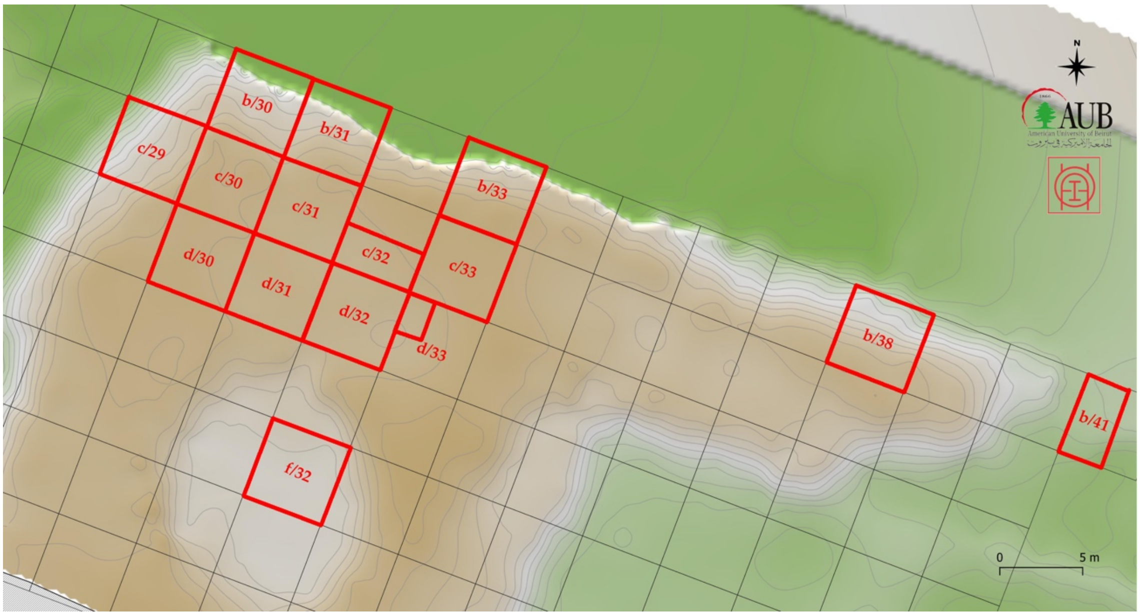



Figure 10: Plan of the site of Tell Mirhan (Genz et al. 2023).

Another excavation season was conducted in 2022, which continued to uncover the fortification system and aimed to understand the role of the rooms previously uncovered. The main materials collected from the excavations of Tell Mirhan consist of MBA and IA local pottery, as well as imported pottery from Egypt, Greece, and Cyprus. This shows the relevance of the site and its importance as it had trade connections with the neighboring powers at the time (Kopetzky et al. 2019, 121).

Twenty-nine samples were studied from the 2022 season. The sample sizes were relatively small, ranging only from 1mL to 5mL after flotation. The samples belong to the Middle Bronze Age and Iron Age II (800-700 BCE) and come from different contexts and squares. Contexts 2503 and 2508 belong to square A/I-D/30, while 2706, 2709, 2714, 2717, 2726, and E-W section belong to square A/I-D/31.

Three samples belong to the MBA:

| Sample # | Context # | Find # | Bag # | Volume (L) | Context date | Context description |
|---|---|---|---|---|---|---|
| 2 | E-W Section | | 1/1 | 1 | MBA | The wall section of the fortification wall. From several layers of the MBA glacis |
| 4 | E-W Section | | 1/1 | 1 | MBA | |
| 5 | E-W Section | | 1/1 | 0.75 | MBA | |

Table 13: 2022 Tell Mirhan Middle Bronze Age samples.

Twenty-six samples belong to the IA II:

| Sample # | Context # | Find # | Bag # | Volume (L) | Context date | Context description |
|---|---|---|---|---|---|---|
| 3 | 2503 | 9 | 1/3 | 3 | IA II | Dark brown clayey soil, it appears to be a fill layer, such as a pit, cut through a bigger context (2505) |
| 6 | 2503 | 9 | 3/3 | 4.5 | IA II | |
| 7 | 2503 | 9 | 2/3 | 3 | IA II | |
| 1 | 2508 | 23 | 1/1 | 4 | IA II | Light brown soil, containing |

| | | | | | | |
|---|---|---|---|---|---|---|
| | | | | | | inclusions of pottery sherds and cobblestone. Possibly a construction fill layer. |
| 9 | 2706 | 92 | 1/1 | 1 | IA II | Compact grey soil. Many cooking pot pottery sherds, which could make this layer a possible cooking area. |
| 18 | 2706 | 93 | 1/1 | 1 | IA II | |
| 19 | 2706 | 91 | 1/1 | 0.5 | IA II | |
| 16 | 2709 | 32 | 1/1 | 1 | IA II | Reddish-brown soil with small pebble inclusions, possibly the same Context 2506. |
| 11 | 2714 | 51 | 1/1 | 1 | IA II | Located within Context 2706. It is characterized by a pottery structure that is outlining a fire pit. Inside the |
| 12 | 2714 | 49 | 1/1 | 1 | IA II | |
| 13 | 2714 | 53 | 1/1 | 1 | IA II | |
| 14 | 2714 | 38 | 1/1 | 1 | IA II | |
| 15 | 2714 | 36 | 1/1 | 1 | IA II | |
| 17 | 2714 | 34 | 1/1 | 1 | IA II | |

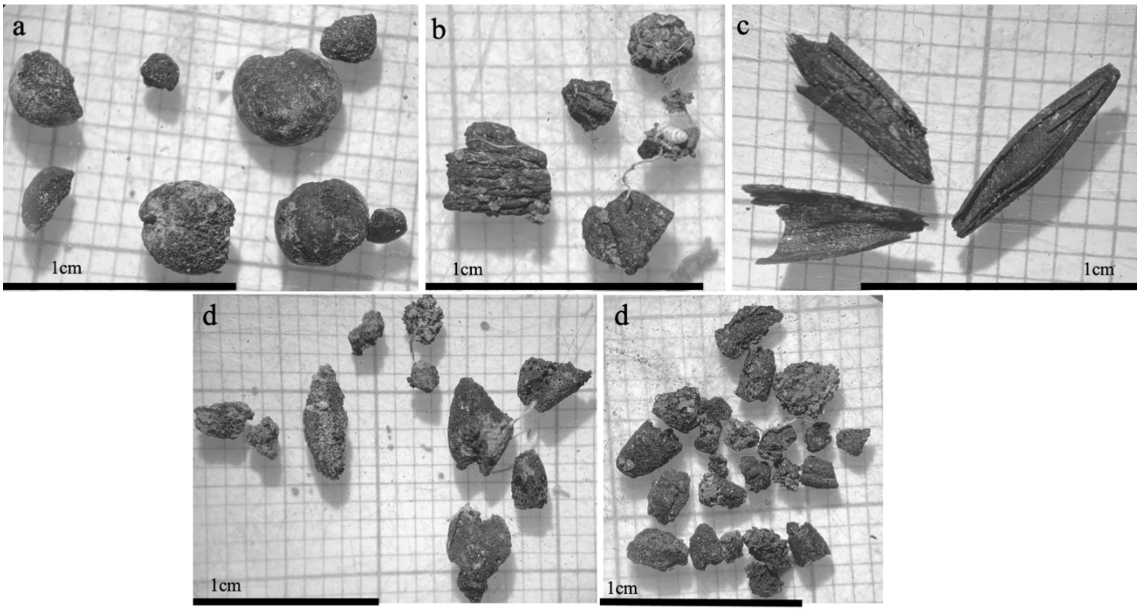
| | | | | | | |
|---|---|---|---|---|---|---|
| 20 | 2714 | 48 | 1/1 | 2 | IA II | pit is ashy soil, which is the indicator of the firing function of the pit. |
| 21 | 2714 | 60 | 1/1 | 1 | IA II | |
| 22 | 2714 | | 1/1 | 1 | IA II | |
| 23 | 2714 | 41 | 1/1 | 2 | IA II | |
| 24 | 2714 | 47 | 1/1 | 1 | IA II | |
| 25 | 2714 | 59 | 1/1 | 0.5 | IA II | |
| 26 | 2714 | 54 | 1/1 | 1.5 | IA II | |
| 27 | 2714 | 56 | 1/1 | 0.25 | IA II | |
| 28 | 2714 | 50 | 1/1 | 0.25 | IA II | |
| 29 | 2714 | 35 | 1/1 | >0.25 | IA II | |
| 10 | 2717 | 42 | 1/1 | 1 | IA II | Compact reddish layer in the corner of square D-31. |
| 8 | 2726 | 95 | 1/1 | 1 | IA II | Compact dark brown soil that has charcoal inclusions. It is located under the fire pit 2714. |

Table 14: 2022 Tell Mirhan Iron Age II samples.

The seeds recovered were well preserved and easily identified, without modern contaminations. The Middle Bronze Age samples were especially rich in vesicular grain fragments and *Olea europaea*. From the Iron Age II, Tell Mirhan presents a variety of grain species: multiple species of *Triticum* sp. (Wheat), *Hordeum* sp. (Barley), and *Avena sativa* (Oat), as well as wild grasses, such as Poaceae (wild) cf. *Lolium* sp. (Ryegrass).

| Taxa | Total |
|---|---|
| *Vicia* sp. fragment | 26 |
| *Olea europaea* | 1 |
| *Olea europaea* fragment | 20 |
| *Avena* cf. *sativa* floret | 6 |
| Glume wheat spikelet fork | 1 |
| Vesicular grain fragment | 124 |
| *Hordeum* cf. *nudum* | 1 |
| Poaceae (wild) cf. *Lolium* sp. | 3 |
| *Triticum aestivum/durum* | 1 |
| Triticum fragment | 1 |
| Rosaceae family | 1 |
| Indeterminate | 1 |
| Indeterminate fragment | 1 |

Table 15: 2022 Tell Mirhan archaeobotanical analysis results.




a: *Vicia* sp. fragments b: *Olea europaea* fragments c: *Avena sativa* floret
d: Vesicular grain fragments

Figure 11: Pictures of some of the species found in the Tell Mirhan samples.

Most of the remains found in the Tell Mirhan samples are vesicular grain fragments (124 seeds), which form 66% of the assemblage. *Vicia* sp. (26 seeds) forms 13%, and *Olea europaea* (21 seeds) forms 11%. The rest of the seeds form less than 10% of the assemblage. *Avena* cf. *sativa* (6 seeds) forms 3.2%, non-vesicular cereal grains (4 seeds) form 2.1%, *Lolium* sp. (3 seeds) forms 2.5%, and one Rosaceae seed forms 0.5%.

The samples belong to two periods. 88% of the samples are from Iron Age II, and 12% are from the Middle Bronze Age.

# CHAPTER IV

# DISCUSSION

The results presented above show their significance in the overall interpretation of the sites, and in the interpretation of each context they were found in. When comparing the three sites together, it is useful to compare the number of seeds per liter, to show the concentration of seeds in each site.

In this case, it is clear that the site with the most abundant plant remains is Qornet ed-Deir (Figure 12). The number of seeds per liter for the site is 16, while it is 0.3 for Tell Kubba, and 5 for Tell Mirhan. Since Qornet ed-Deir is located in the Jabal Moussa Biosphere, a forest densely populated by trees and wild species, that can be the reason behind the high frequency of seeds found in the samples, as well as the nature of the contexts sampled.

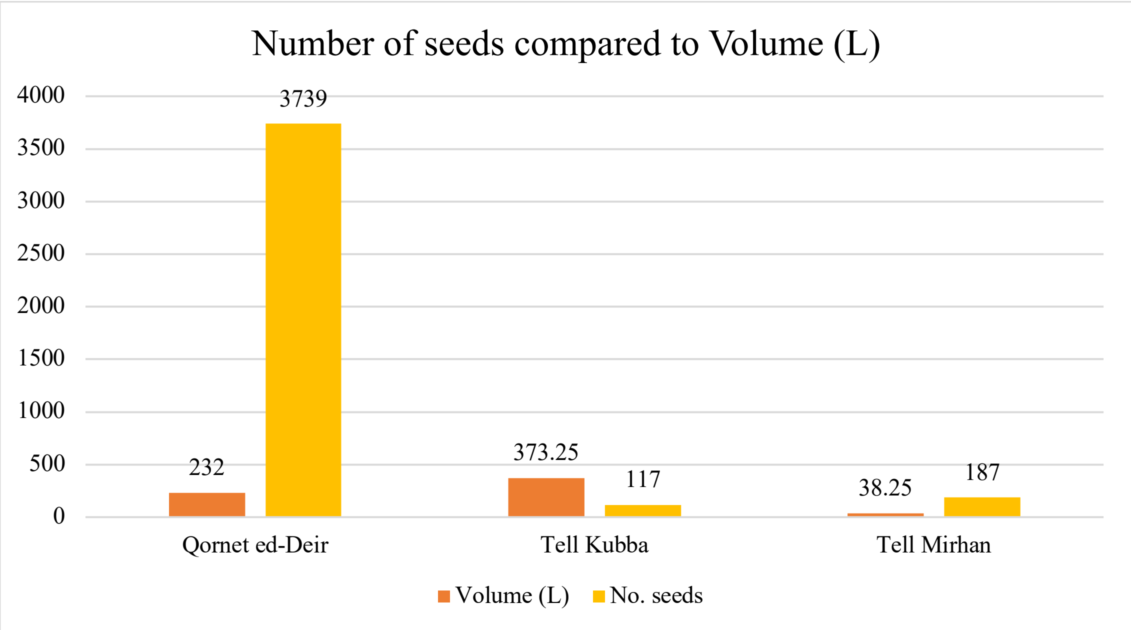



Figure 12: Chart showing the number of seeds compared to the volume (L) for each site.

This theory can be proven by the fact that most of the plant remains found at Qornet ed-Deir were indeterminate because of their undiagnostic shape, indicating that they are likely to be wild species of grasses and bushes that naturally grow in the forest (Figure 13). Wild species make up almost 95% of the total assemblage, leaving only 5%, for domesticated crops and fruits. Their abundance in the whole site can also be attested by the fact that the indeterminate wild species were the most present in the total number of contexts, which indicates that they were widespread through all the periods (Figure 14).

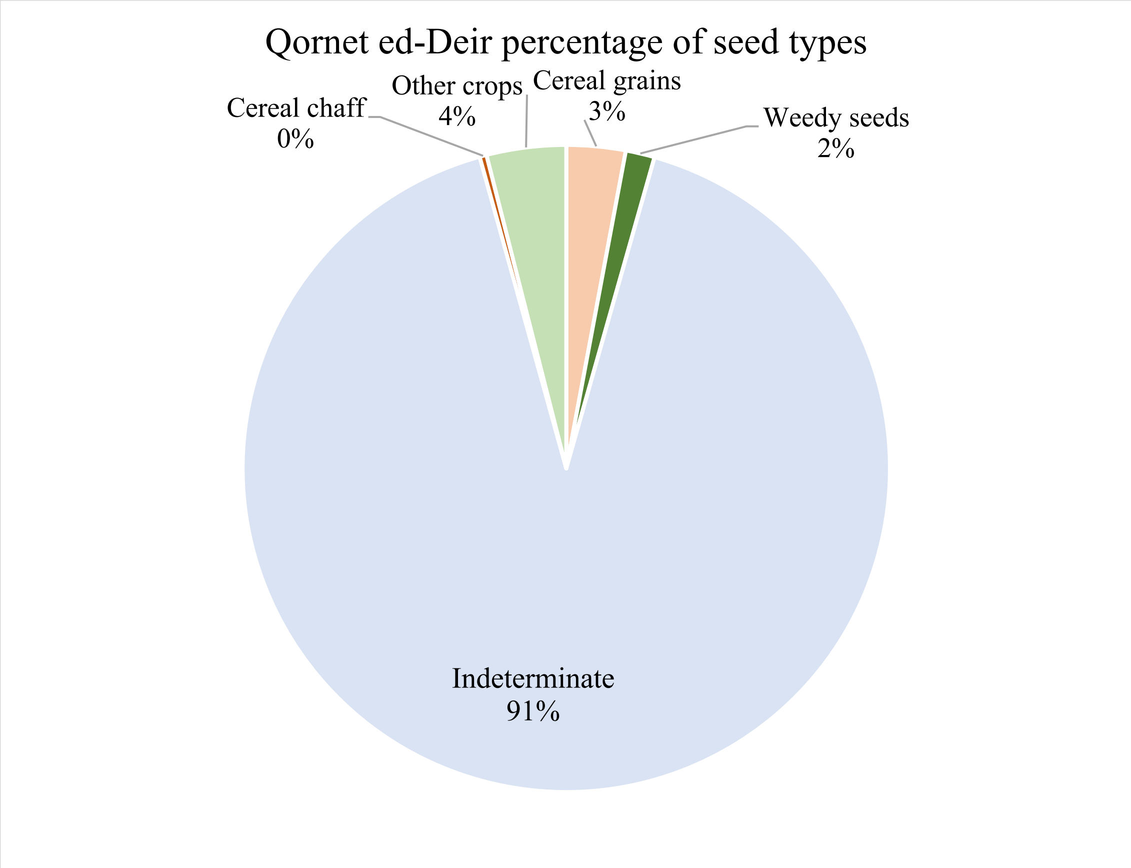



Figure 13: Chart showing the percentage of each seed type in the Qornet ed-Deir assemblage.

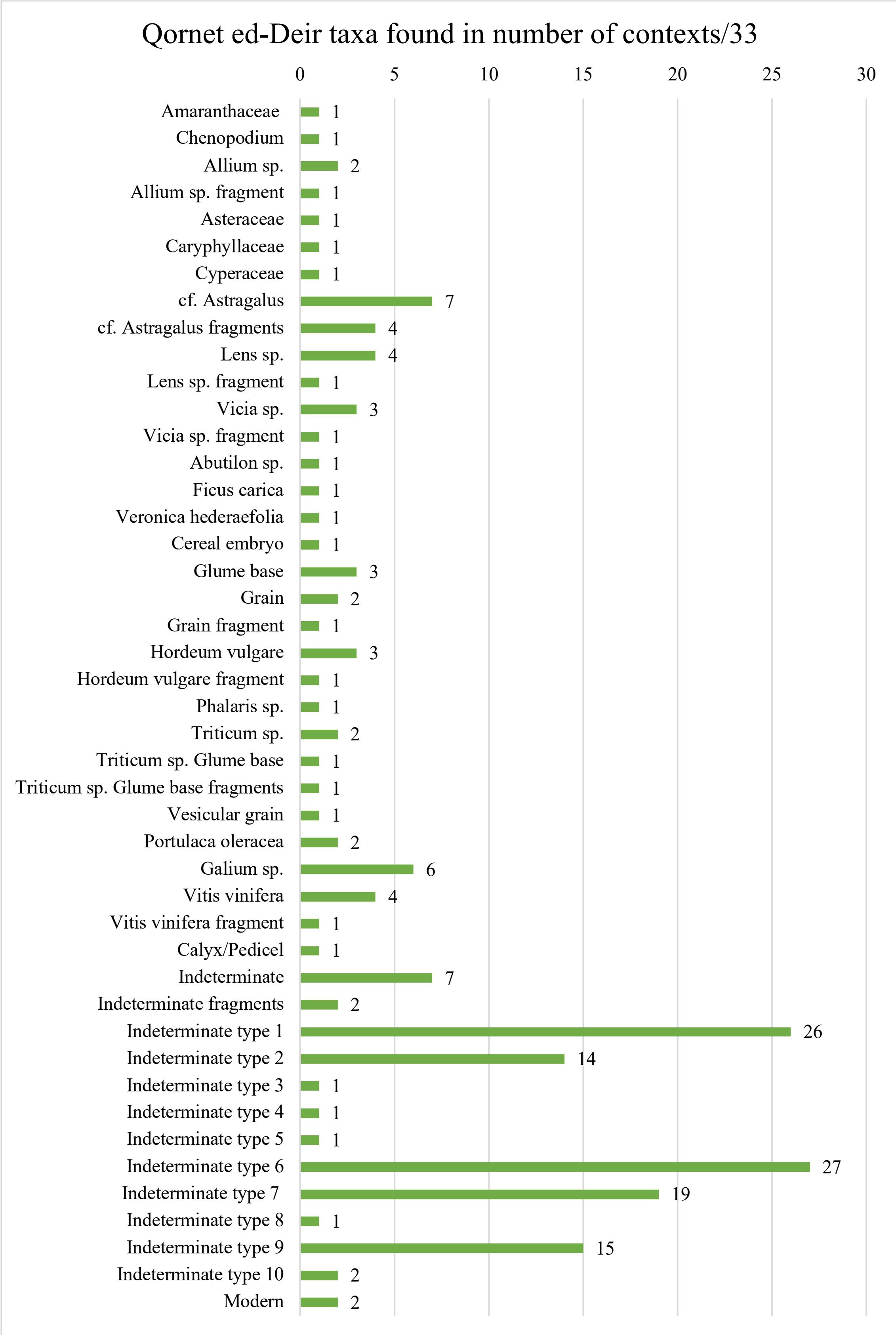



Figure 14: Chart showing the number of contexts a taxon was present in from Qornet ed-Deir.

As for Tell Kubba, unlike sites of similar location and period, the most abundant plant type is the weedy seeds, making up 63% of the assemblage, followed by other crops such as grapes and olives (Figure 15). Since the site is located on the coastal plain, the nature of the environment is fields of crops and weeds, which would justify the presence of these types of plants. This is supported by the fact that the most consistently found plants in the 10 contexts are grapes, capers, and indeterminate, which would be abundant in a coastal plain setting (Figure 16).

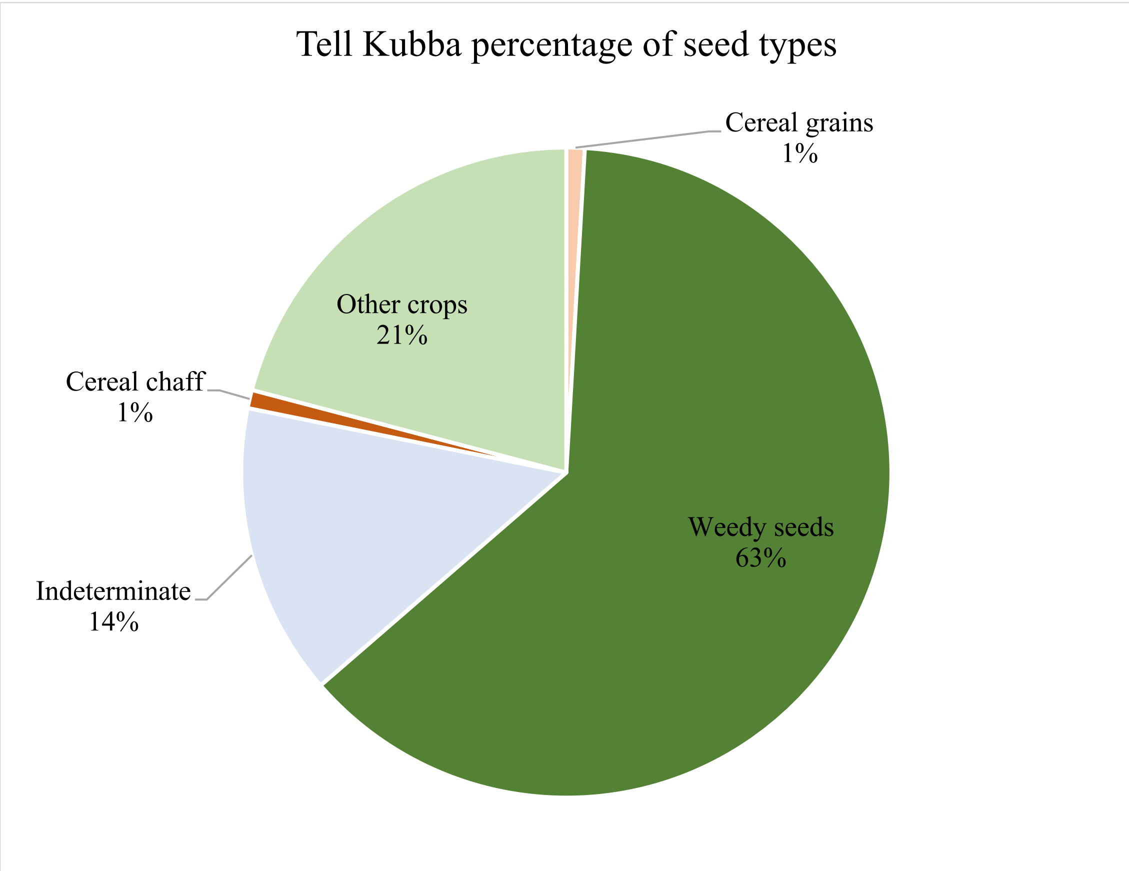



Figure 15: Chart showing the percentage of each seed type in the Tell Kubba assemblage.

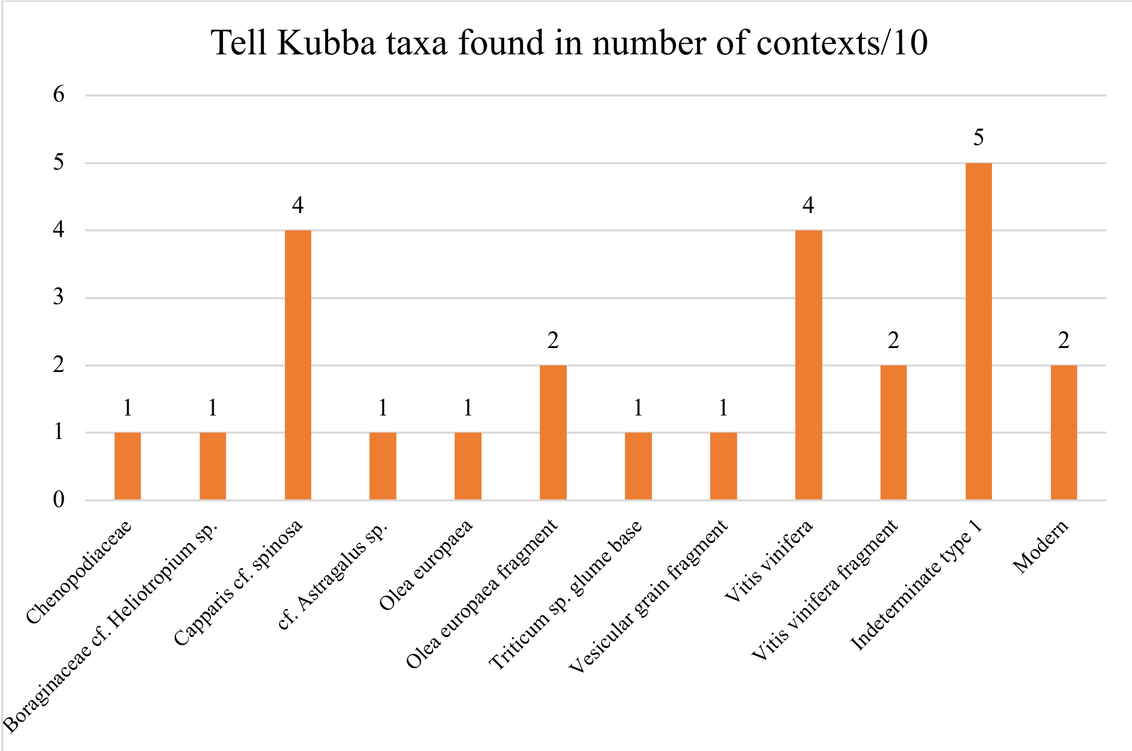



Figure 16: Chart showing the number of contexts a taxon was present in from Tell Kubba.

Concerning Tell Mirhan, it has a large percentage of grain remains. 71% of the sample is made up of cereal grains, which is an indicator of an economy based on cereals as well as good preservation of plant remains (Figure 17). In addition, vesicular grain fragments were the most consistently found seeds in the contexts, found in 5 out of 8 (Figure 18). The other consistent taxa include olives and Vicia, which are the second largest majority of seed types found at the site and are included in the other crops. This shows that cereal grains and other cultivated crops (olive and Vicia), were the main type of plants processed and consumed at the site.

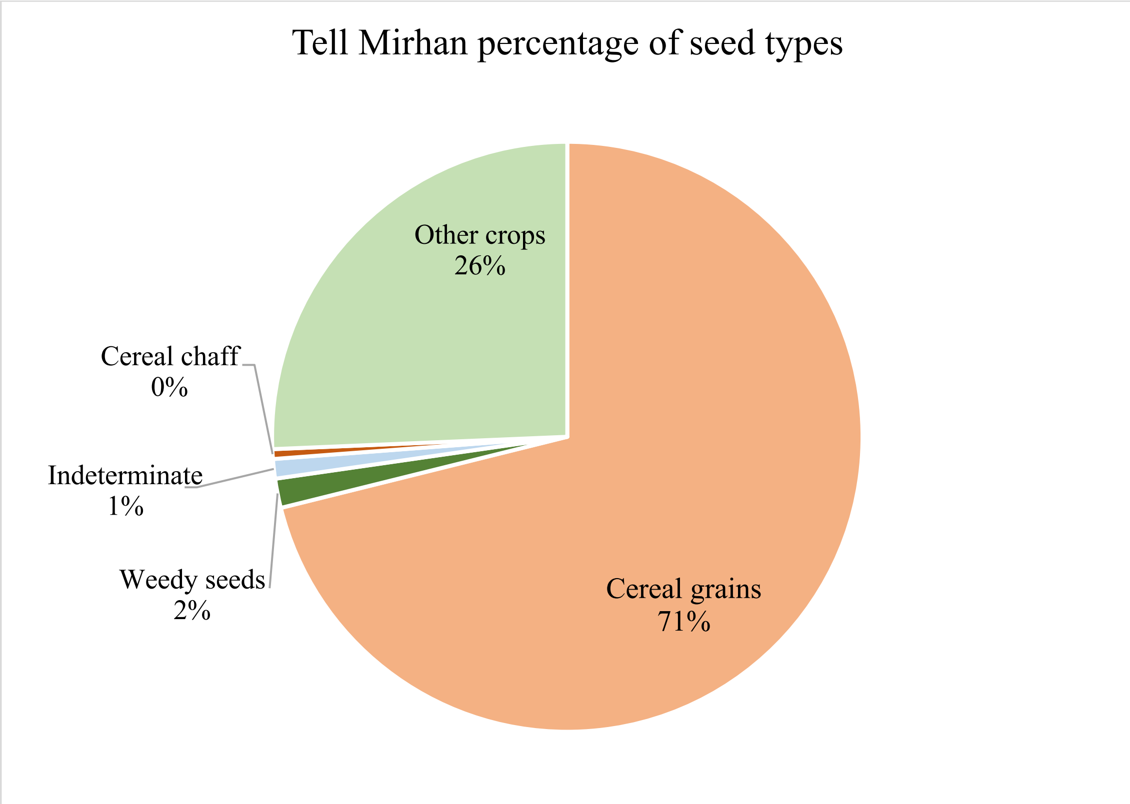


Figure 17: Chart showing the percentage of each seed type in the Tell Mirhan assemblage.

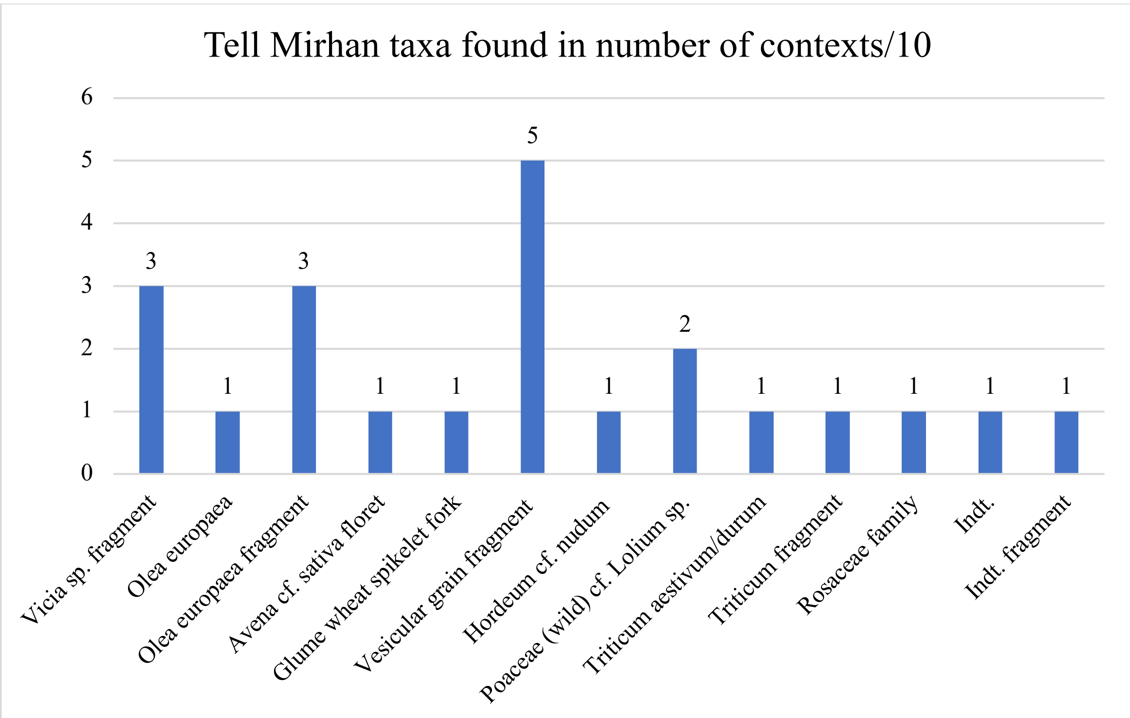


Figure 18: Chart showing the number of contexts a taxon was present in from Tell Mirhan.

When comparing the three sites together, the difference in the composition is clear. Qornet ed-Deir is richest in indeterminate seeds, Tell Kubba is richest in weedy seeds, and Tell Mirhan is richest in cereal grains. This can indicate the function of each site, and the way food was processed[2].

### A. Qornet ed-Deir

The lack of consumable plant remains during the periods when the site of Qornet ed-Deir was resettled raises suspicion that the function of the site could have been different than a regular settlement (Figure 19). There is a clear difference in the number of seeds from the Middle Bronze Age, to the Roman, Medieval, and Crusader periods, which could indicate a change in settlement type or food preparation (Figure 19). However, if the unidentified contexts were to belong to the Roman or Crusader periods, this would change this interpretation.

[2] The potential issues associated with these assumptions will be addressed in Chapter VI.

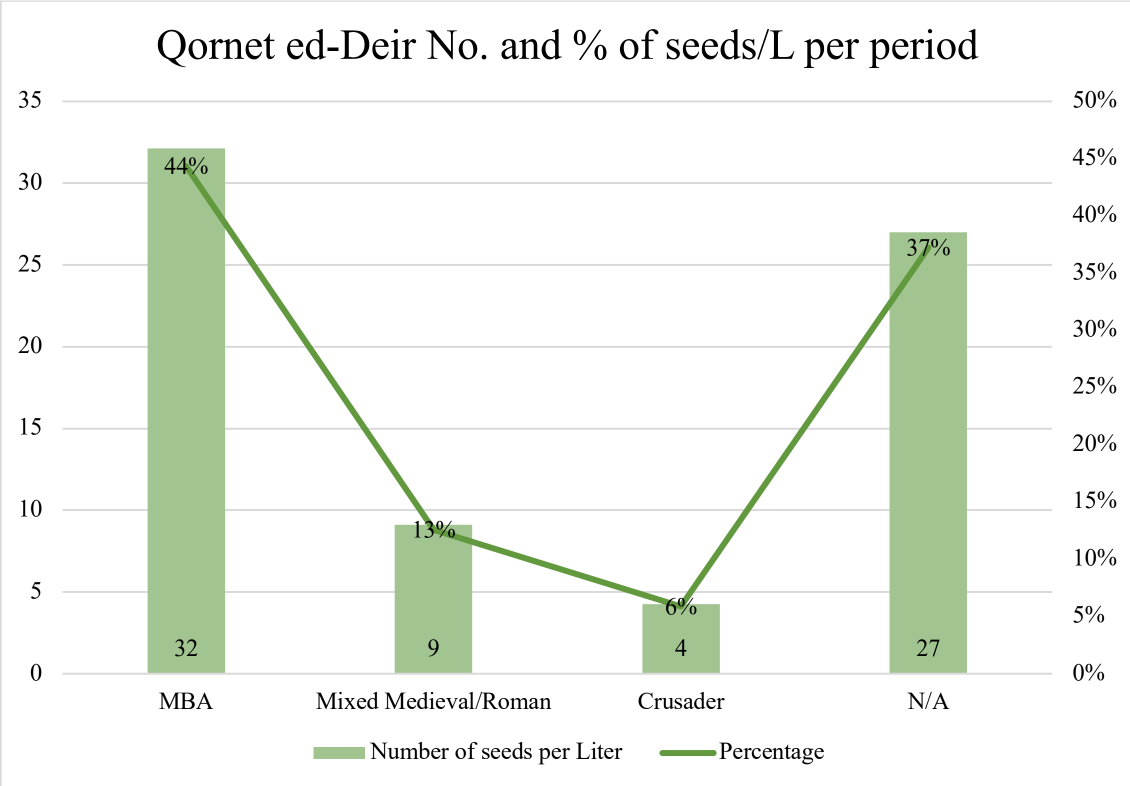


Figure 19: Chart showing the number and percentage of seeds per liter from the Qornet ed-Deir assemblage per period.

### *1. Site Analysis*

a. <u>The Middle Bronze Age</u>

The MBA sections of the site yielded remains of storage vessels, and domestic types of pottery (Fischer-Genz et al. 2018, 249). Settlers could have lived there during this period as the site has a good climate during most of the year and a variety of flora and fauna. Additionally, during the Middle Bronze Age, the Lebanese coastal cities, mainly Byblos, were famous for exporting wood to neighboring countries such as Egypt. In Egyptian texts, there is extensive reference to Lebanese Cedarwood, more than any other tree species. However, this was not the only wood being exported to Egypt. Other trees, such as Pine, Juniper, and Fir, were also heavily exported to Egypt and other locations, such as Mesopotamia (Mikesell 2969, 14).

The forest of Jabal Moussa is rich in *Pinus brutia* (Calabrian Pine), *Pinus pinea* (Umbrella Pine), *Juniperus oxycedrus* (Prickly Juniper), *Quercus cerris* (Turkey Oak), *Quercus calliprinos* (Evergreen Oak), all of which are considered precious woods for construction (Tohmé and Tohmé 2013, 102). During the MBA, Byblos exported these types of wood. Therefore, the state would have needed wood loggers to keep up with the demand. In this case, it could be the case that Qornet ed-Deir was a settlement for the wood loggers during the MBA who delivered the wood to Byblos.

In addition, most of the tree species at Jabal Moussa produce resin, which is a substance that was also exported to Egypt. A new study on 26th Dynasty Egyptian tombs revealed the types of oils and resins used in mummification. These consist of Juniper and/or Cypress essential and fragrant oils, as well as *Pistacia* sp. resin (Rageot et al. 2023, 288). However, the date of these tombs is much later than the Middle Bronze Age of Lebanon. The earliest evidence of resin being used in mummification comes from the Late Bronze Age (Stern et al. 2003, 458).

However, there is a possibility that resin and tree oils were collected during the Middle Bronze Age used for purposes other than mummification. While there is no direct evidence that they would have been exported in large quantities to Egypt or other areas during this period, resin was used as incense, varnish, and adhesive (Serpico 2000, 430). Though the main export during this period was wood, some resin and oil could have been collected to be used locally or exported in moderate quantities, which would be a secondary activity at the site.

b. The Early Roman Period

As for the Early Roman period, the site could have had a different function since it does not present the same type of structural remains. Based on an intriguing rectangular room with a grand entrance, the site could have served the purpose of a sanctuary. In addition, it could have also been a domestic settlement for farmers working in nearby orchards. From the Roman periods, it is attested that some Romans lived in mountainous areas for hunting, herding, wood cutting, as well as worship (Hitti 1965, 60).

c. The Late Roman and Medieval Periods

The Qornet ed-Deir site is described by the APJM (2023) as "[located] on the top of a hill, overlooking the Roman road and it presents itself as an almost circular flat space within a natural compound enclosed on all sides by rocks some over 4 to 5m high protecting it from any outside incursion". In addition, next to the site are multiple Hadrian Inscriptions that were placed there to protect the tree species reserved for the use of the emperor Hadrian (Breton 1980, 7). Most importantly, from the Late Roman period, a guard post was discovered in Area 1 of Qornet ed-Deir, which is located at the bottom of Area 2, the area being discussed (Fischer-Genz et al. 2018, 248). Therefore, it could be theorized that the site of Qornet ed-Deir was a settlement for guards who watched over the Roman road to monitor the travelers and protect the trees during the Late Roman period. In that case, it would not be unusual if the guards were supplied with already processed and/or cooked food.

From Roman Egypt, we have evidence of guards working in stone watchtowers built along Roman roads. They are documented through a name list of the guards, and their time on duty. From one watchtower located in the Eastern Desert, an ostracon states that two guards were on duty together, and they alternated with another two daily (Alston 2002, 81). This also means that the watchtowers did not require the presence of many guards, which could add to the explanation for the low number of seeds.

This is also attested through letters found in garrisons of the Eastern Desert. One of the most reoccurring topics in the letters is the food supply and food gifting. For example, one Roman soldier wrote to the army general Pompeius about bread delivery (Alston 2002, 97). This is an indicator that the troops were supplied with ready-made food and did not always need to process the plants and meat they received. Nevertheless, they receive whole cereal grains as well (Alston 2002, 98), which could explain the presence of cereal grains at the site, but not abundantly. Gifts of food were also documented, such as a soldier receiving olives from an acquaintance (Alston 2002, 97).

The combination of all these factors could be a potential explanation behind the number of seeds found at the site during the Roman period. However, only mixed Roman/Byzantine/Medieval contexts have been found, as in no purely Roman samples. In addition, since there is yet absence of direct proof of military activity at the site, this theory cannot be proven.

As for the types of seeds found, if the number of indeterminate seeds is disregarded for the Mixed Roman/Medieval period, the most abundant seeds identified would be *Allium* sp. and *Portulaca oleracea* (Figure 20). Both of these plants are local and grow all over Lebanon, including the Jabal Moussa Biosphere (Baydoun et al. 2017, 4; Tohmé and Tohmé 2007, 384). Today, multiple species of *Allium* grow naturally in Jabal Moussa, as well as Chenopodium, Cyperaceae, *Portulaca oleracea*, and *Veronica* sp. (Tohmé and Tohmé 2012, 137). These species could have contaminated the soil by their natural presence at the site, or they could have been foraged or cultivated by the inhabitants of the settlements.

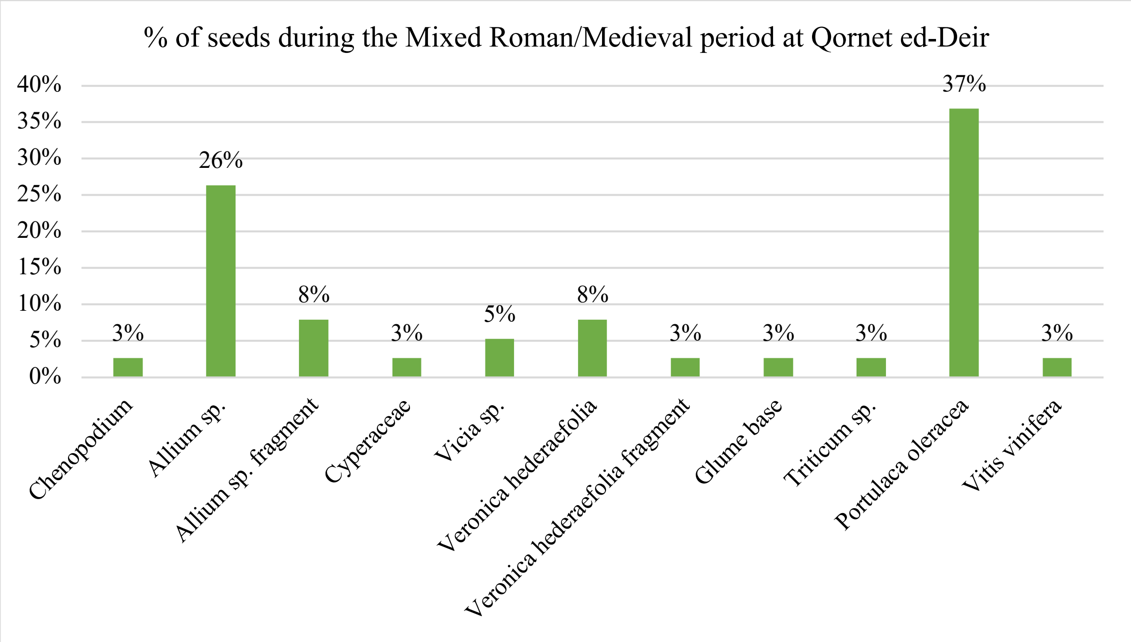



Figure 20: Chart showing the percentage of seeds during the Roman period without the indeterminate species at Qornet ed-Deir.

In the assemblage, there is also presence of *Vicia* sp., *Triticum* sp., and *Vitis vinifera*. Which could have been brought from another location to the Qornet ed-Deir settlement. The diet of Roman soldiers and troops is well documented through texts and letters (Davies 1971, 124). Troops would forage for food as well as bring their own reserves, in addition to being supplied with food from nearby towns and villages (Davies 1971, 122). Therefore, depending on their location, their diet would vary considering the local flora, fauna, and the meals and plants the locals used to cook and store.

Based on textual evidence, the basic diet of a Roman soldier living in Rome would consist of bacon, cheese, corn, some vegetables, and wine. However, this diet changes when they are moved to different locations. For example, when in Egypt, their diet would consist of wheat, lentils, and different kinds of meat (Davies 1971, 125). In Vindonissa, Switzerland, the texts speak of various kinds of fruits such as apples, pears, plums, and cherries, as well as nuts and honey, all of which grow locally. Closer to Lebanon, in Masada, Palestine, the Roman troops ate olives, grapes, dates, pomegranates, and plums, also grown locally, and similar to the crops of Lebanon (Davies 1971, 132).

Therefore, the botanical assemblage associated with Roman troops could include cereal grains, fruits, and foraged plants, which would portray what the troops would have prepared themselves. As they could have also taken processed and/or cooked food from nearby villages, some of the plants consumed could leave no trace. The botanical remains of Qornet ed-Deir could very well reflect the diet of the Roman troops in Mount Lebanon, as there is presence of wheat, legumes, grapes, and foraged plants such as garlic and purslane.

In addition, since there is a guard post located right under the site, and considering that the guards needed a living space, the site could have acted as a settlement. However, since a large portion of the site remains unexcavated, it is possible to discover new rooms and features that could indicate additional or different usages of this site. For example, the site could have also contained administrative offices, or on the contrary, domestic contexts.

Another theory that would be relevant would be that Qornet ed-Deir could have been an industrial site. Its location next to the Hadrian inscriptions indicates the richness of the area in wood and timber resources. Therefore, the site could have been used as a settlement and working space for wood loggers. If that was the case, the food resources the workers could have used might have been similar to those of the Roman army.

It is also possible that the site was in fact a settlement for the guards, in addition to being an industrial site. As previously mentioned, the number of guards on duty per day would be around two, which would give time for the other guards at the site to perform other activities. The guards or troops could have engaged in both military and industrial activities, which could include wood logging.

At least twenty skeletons were found at the site, two of which were scientifically analyzed using Accelerator Mass Spectrometry (AMS). One of the skeletons belonged to the Late Roman period ($4^{th}$ century CE), and the other to the Byzantine Period ($7^{th}$ century CE). The analysis of the bones revealed a diet consisting of mostly agricultural products, such as cereal grains, fruits, and vegetables (Fischer-Genz et al. 2018, 257). This evidence does not contradict the evidence found from the botanical samples for the mixed Medieval/Roman periods. It could prove that these plant species were consumed, since most of the diet consisted of these types of plants. As for the Roman/Byzantine periods, since all of what was found in the samples were indeterminate seeds, this could be an indication of what the people would have consumed (Figure 21).

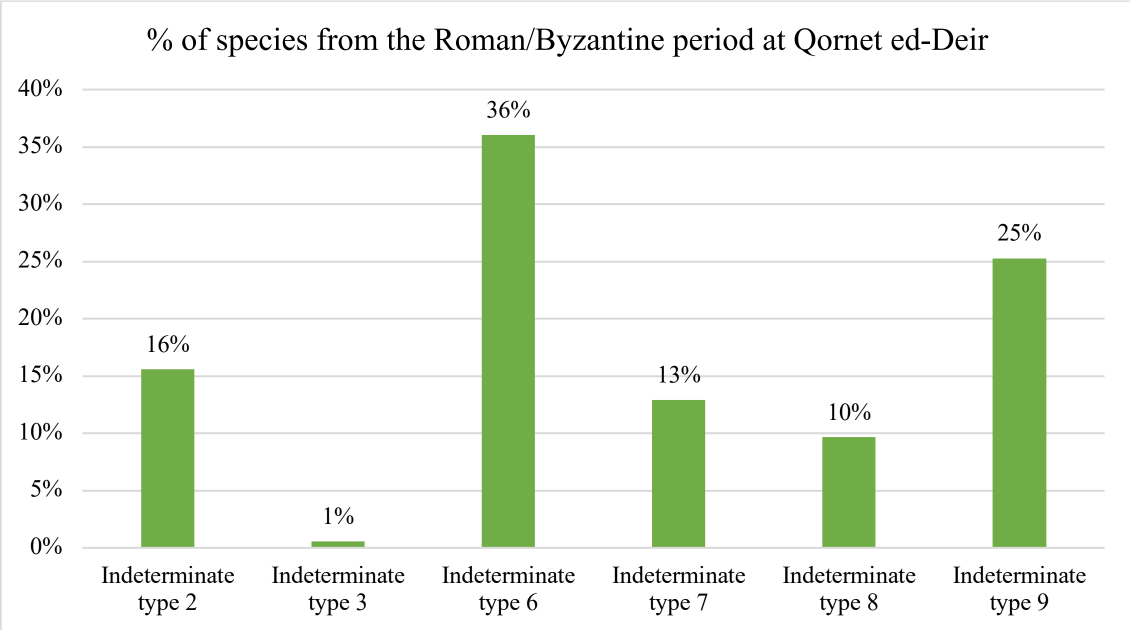



Figure 21: Chart showing the percentage of seeds during the Roman/Byzantine period at Qornet ed-Deir.

As for the Crusader period, the botanical evidence mostly presents indeterminate seeds (Figure 22). However, the archaeological evidence identifies a strong fortification system during this period. There was construction of stone walls using massive ashlar blocks, consisting of two consecutive walls, giving the site twice the protection. In addition, two bronze spearpoints were found in Crusader contexts. This gives the impression that the site could have had military importance during the Crusader period. Since there is no description of the contexts from which the samples were taken, the lack of botanical material could be due to the context's nature.

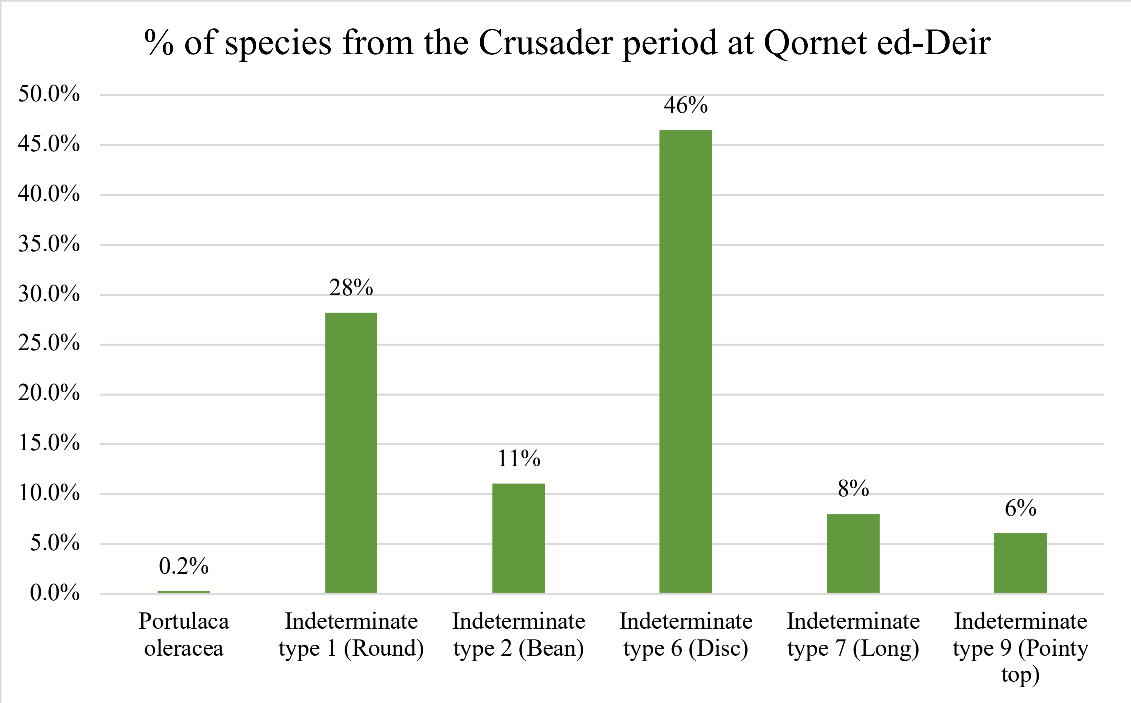



Figure 22: Chart showing the percentage of seeds during the Crusader period at Qornet ed-Deir.

The main obstacle to correctly identifying the settlement type is the fact that a large portion of the site is as yet unexcavated. This leaves potential for finding new structures and new botanical material in a different area.

## *2. Analysis of the Plant Remains*

The plant remains from the Middle Bronze Age consist of milk-vetch, wheat, barley, and grapes (Figure 23).

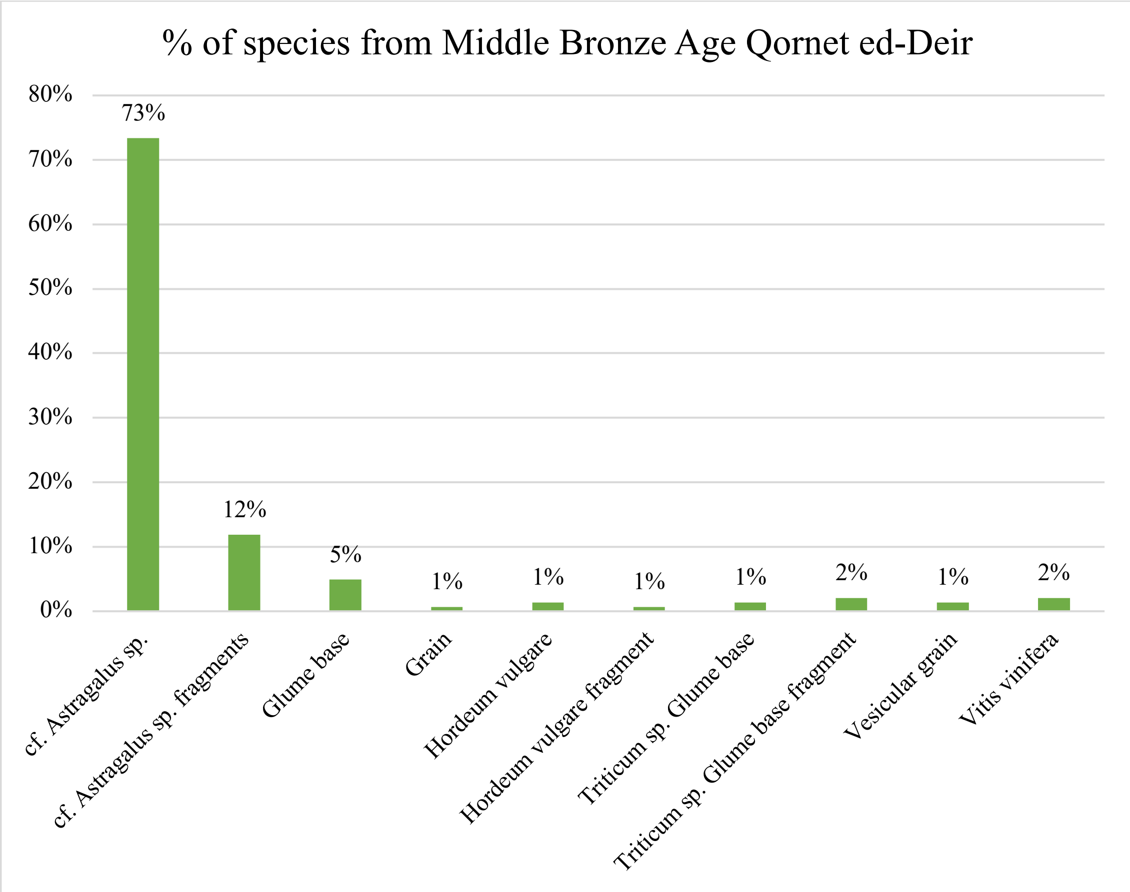


Figure 23: Chart showing the percentage of species without the indeterminate species from Middle Bronze Age Qornet ed-Deir.

Based on the evidence available so far, the context with the most botanical material is Context 2016 from the Middle Bronze Age, which is a context located under a *tannour* (Figure 24). Therefore, it is natural to find a large amount of plant remains, and they should indicate what was being processed and cooked in the oven.

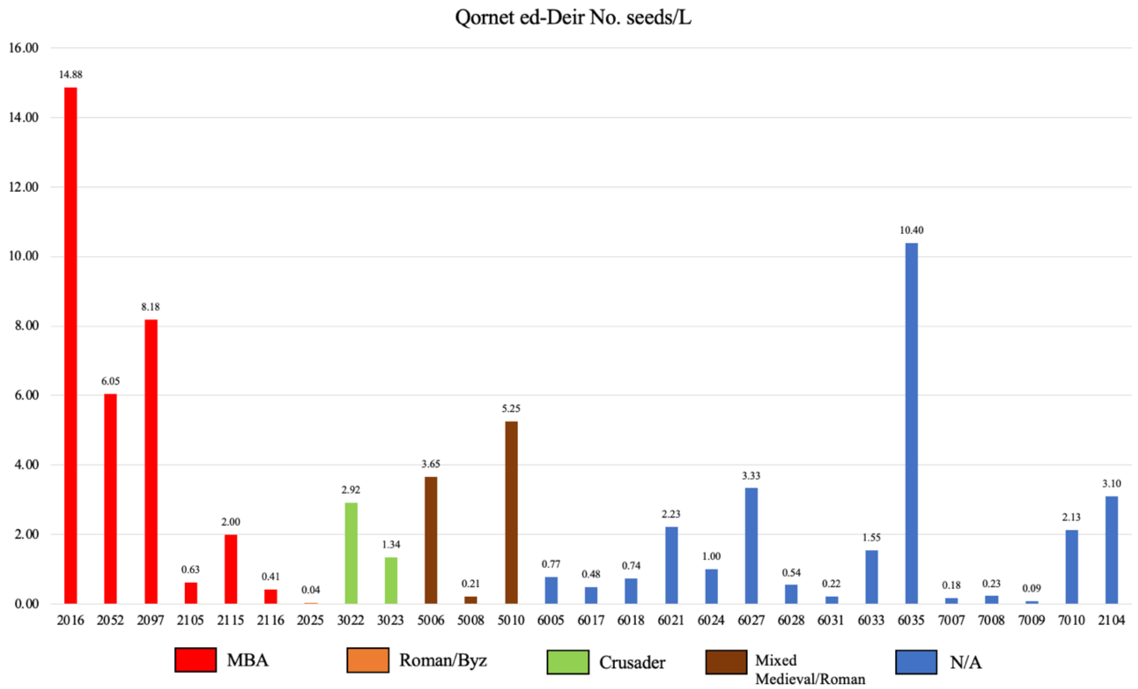



Figure 24: Chart showing the number of seeds per liter from the Qornet ed-Deir assemblage.

As clear from the chart below, and excluding the indeterminate seeds, the two main plant remains are *Astragalus* sp. and cereal grains (Figure 25). Cereal grains have always been used to make bread, bulgur, and as an addition to many other dishes. It is a staple in the Mediterranean diet, and very frequently found in Lebanese archaeobotanical assemblages (De Moulins 2015, 39). As cereals are not found in abundance and do not easily grow in mountainous areas, and the MBA settlement presented a large number of storage/transport vessels, the inhabitants of the site could have been supplied with grain from nearby settlements that had suitable conditions for cultivating crops. Or, if the settlement was seasonal, the inhabitants could have brought with them their supply of grain from their original settlement.

As for cf. *Astragalus* sp., it could have been used in various ways. For example, from ethnographic studies, it is noted that milk-vetch pods could be eaten raw (Tanji and Nassif 1995, 618). In other cases, the root of the plant is boiled to extract the medicinal benefits. One of the species, *Astragalus gummifer*, is attested today in the Jabal Moussa Biosphere, and it is characterized by "Tragacanth gum", which is a natural emulsifying, thickening, and suspending agent used in food preparation. In addition, this substance also possesses medicinal properties, as do the leaves of the plant (Vaughan and Judd 2013, 10). Therefore, the plant could have been used in cooking and as medicine, with each part providing a different healing and/or nutritional function.

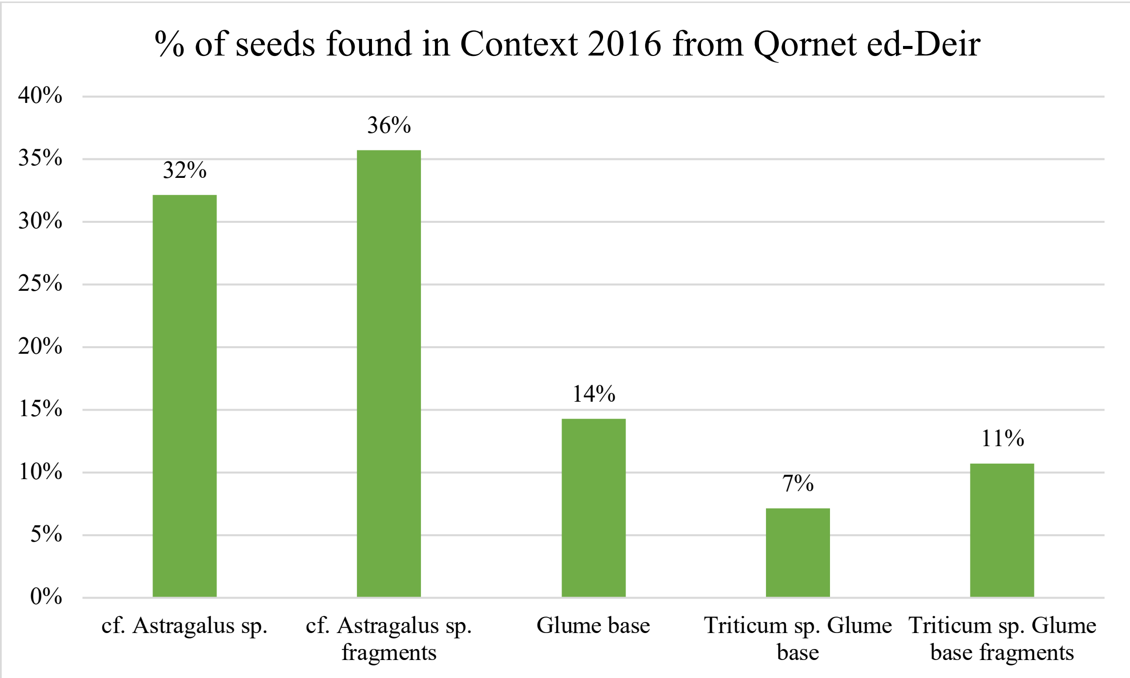



Figure 25: Chart showing the percentage of seeds found in Context 2016 from Qornet ed-Deir.

The second most abundant context from the Middle Bronze Age is Context 2097. It consists of the layer above a floor (Context 2052). Excluding the indeterminate seeds, the most abundant species is cf. *Astragalus* sp., with the presence of one *Vitis vinifera* seed (Figure 26). In this context, the number of astragalus per liter is identical (2.3) to the one for Context 2016. Therefore, both locations could have similar properties in the way milk-vetch was consumed or processed.

The existence of one grape seed in this context is not significant. However, its presence indicates that the inhabitants consumed fruits, and that they might have had a supply of grapes nearby, as they can grow in the mountains. It is possible that nearby orchards grew grapes, which is where they got their supply from. It is most likely that the grapes were only consumed as fruits, as there is no evidence of any wine press to process the grapes. Since fruits are eaten raw, there is a lower probability of their seeds being preserved, as they are not processed over fire. If, by accident or on purpose, a fruit seed fell into the fire, its presence could be potentially noted.

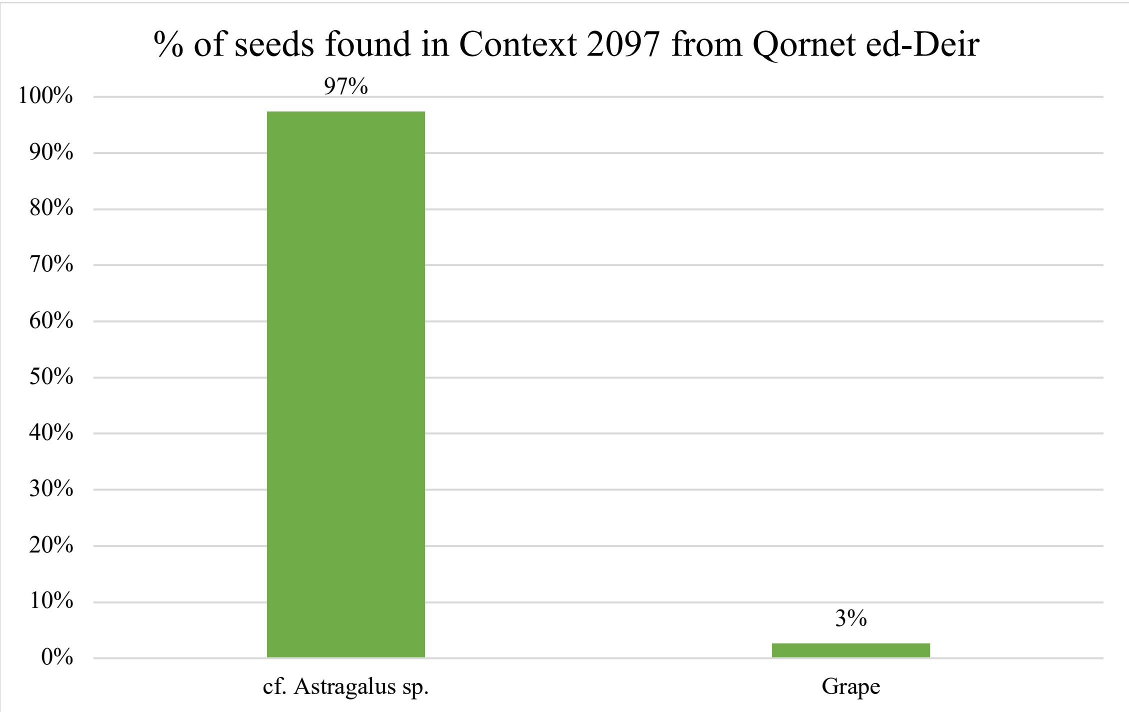


Figure 26: Chart showing the percentage of seeds found in Context 2097 from Qornet ed-Deir.

Overall, the main difference between the Middle Bronze Age samples and the Roman/Medieval ones is the fact that the MBA samples were collected from parts of the site that were identified as working areas where food was processed, and activities were performed. For example, the pottery found in the Middle Bronze Age layers indicated domestic contexts. The most common finds were storage jars. The other domestic pottery type was two body sherds of large baking trays, but no cooking pots were identified (Fischer-Genz et al. 2018, 249). The domestic structure from this period includes a round pottery structure resembling a *tannour* found in Context 2009, around ashy grey soil. However, it is not clear if it was found in situ or if it was moved to a different location. Under the *tannour* was red clay soil, which could have been the floor level (Fischer-Genz et al. 2018, 250).

Based on the botanical remains of the Middle Bronze Age, the dominant seeds in the assemblage are cereals such as *Hordeum vulgare* and *Triticum* sp., and cf. *Astragalus*, and *Vitis vinifera*. This is an indicator of the important role cereals played in the nutrition of the Middle Bronze Age settlers of Jabal Moussa. The only other sites yielding remains from the MBA in Lebanon are Sidon and Tell Mirhan. The only two species in common with Qornet ed-Deir were *Hordeum* sp. and *Vitis vinifera* (De Moulin 2015, 42).

However, the Medieval, Byzantine, and Crusader samples were taken from the settlement area, such as rooms and houses, which are usually not rich in plant remains, as rooms would be regularly cleaned, getting rid of any evidence. In addition, the locations yielding the most remains would naturally be where the plants and food were processed. Regardless, from these periods, while there is no direct proof of the food the inhabitants consumed, the skeletal remains helped in specifying the general diet using AMS analysis.

The Mixed Medieval/Roman plant remains consist of cereals, *Vitis vinifera, Portulaca oleracea, Veronica hederaefolia*, *Allium* sp., and Cyperaceae, all of which are edible, and were potentially consumed. From this period, only the site of Jiyeh has published botanical analyses, which include cereals and *Vitis vinifera* (Badura et al. 2016, 490). These plants would have been widespread in the Lebanese areas.

Concerning the contexts that have not been dated, they present a large percentage of grain fragments, all of which have been found in one context (Context 6018), which is described as a fill layer (Figure 27). Since it is a fill layer, the reason for the abundance of grain remains cannot be determined. In addition, since the context is not yet dated, these remains cannot be assigned to a certain processing method or a specific way of consumption.

In this assemblage, there is also presence of *Lens* sp. and *Vicia* sp. (11%), which shows consumption of legumes. As for the fruits, the remains indicate the consumption of figs and grapes (3%). While these do not comprise a large percentage of the assemblage, that is not expected as fruits are generally eaten raw, which does not leave any evidence in the archaeobotanical record.

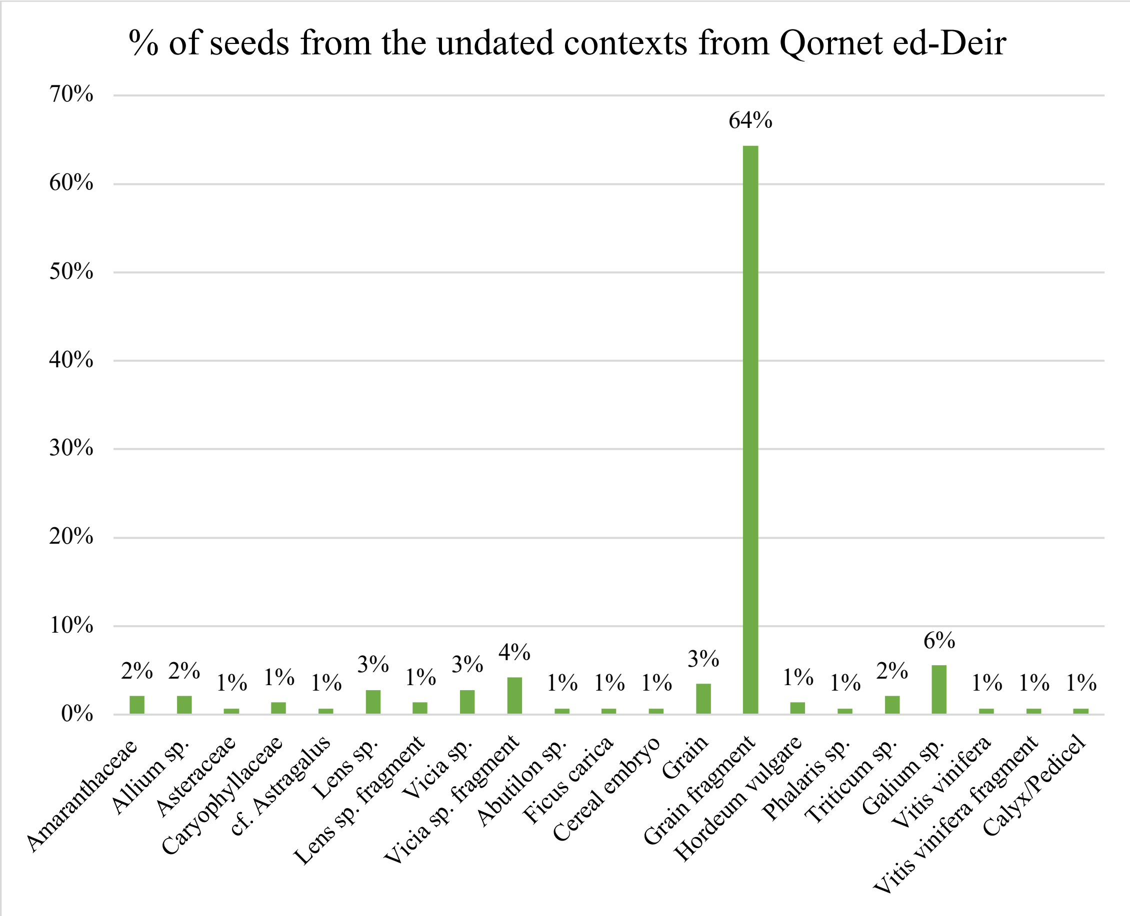


Figure 27: Chart showing the percentage of seeds from the undated contexts of Qornet ed-Deir.

In all the periods that the site was inhabited, there is the possibility that it was a semi-permanent settlement. While the climate of Qornet ed-Deir is warm for most of the year, it is still located in Jabal Moussa, which is a mountain that receives snow and has a cold climate during the winter. If the inhabitants of the site were settled there for industrial purposes, it is possible that these activities were abandoned during the winter, and resumed in the spring when the weather becomes suitable once again.

When it comes to the military aspect, it is unlikely that the site would be abandoned even in the winter, since it is crucial to protect this area, especially during the Crusader Period, since the site is located at the borders of the County of Tripoli and the Emirate of Damascus. As for the Roman Period, it could be more likely that guards where not positioned year round in this area, especially in time of peace. However, it cannot be determined if the site was always settled or not, this would depend on historical texts.

## B. Tell Kubba

Regarding Tell Kubba, Kubba I was settled from the Pre-Pottery Neolithic till the Early Bronze Age II, while Kubba II was settled during the Early Bronze Age III. The transition period from EBA II-III is also present at Kubba II. However, there is a clear difference in the number of seeds per liter between the PPNC/EBA II and the EBA III (Figure 28).

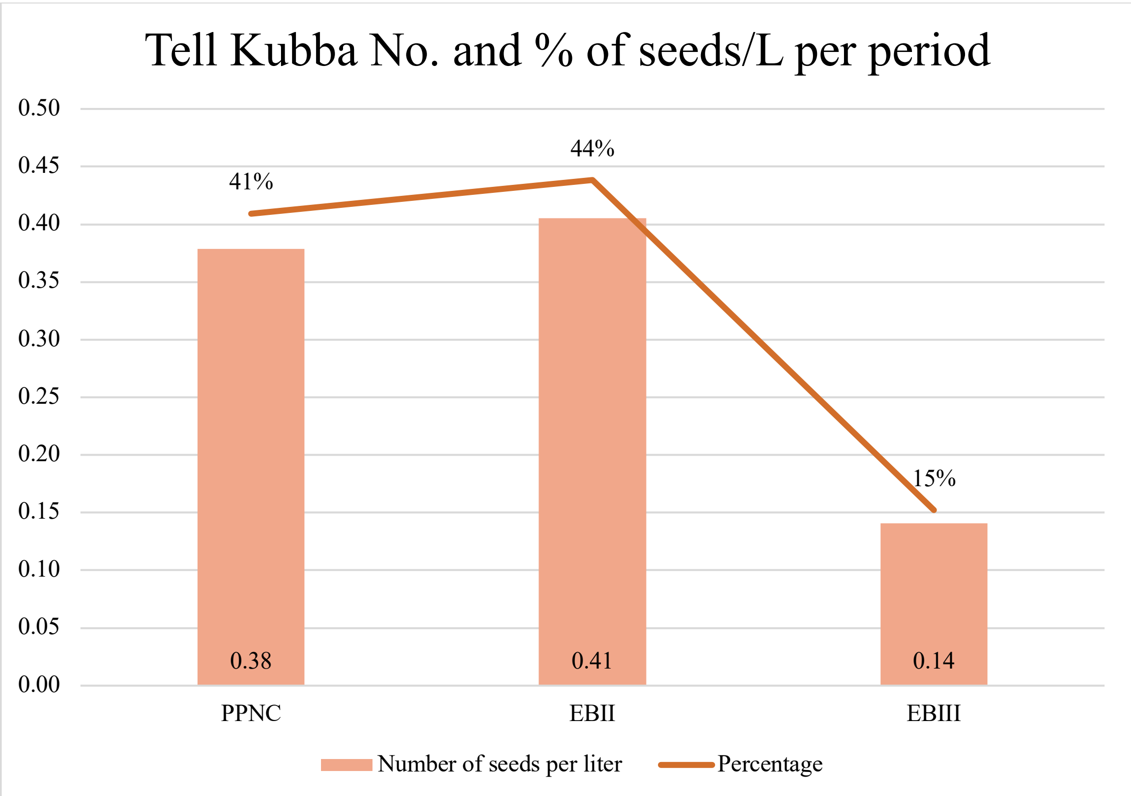



Figure 28: Chart showing the number and percentage of seeds per period for Tell Kubba.

### *1. Site Analysis*

While the context that presented the greatest number of seeds per liter is Context 2047 from the PPNC (Figure 29), the only plant remains are Indeterminate type 1 (100%), which does not convey any information about the site. The absence of consumable plants does pose a question concerning the nature of the site and its function during this period. The samples were taken from three contexts associated with a burial (2047, 2048, and Kubba I bulk sample 1), and one context associated with a pebble layer (2049). Two of the burial contexts (2047 and 2048) presented the only botanical remains from the PPNC (Figure 29). The third burial context (Kubba I soil sample 1) consisted of soil taken from the surroundings of the skull, but no plant remains were found. As for Context 2049, it is a pebble layer indirectly associated with the burial, as it is located under Context 2048, under the burial itself. This context also did not present any plant remains.

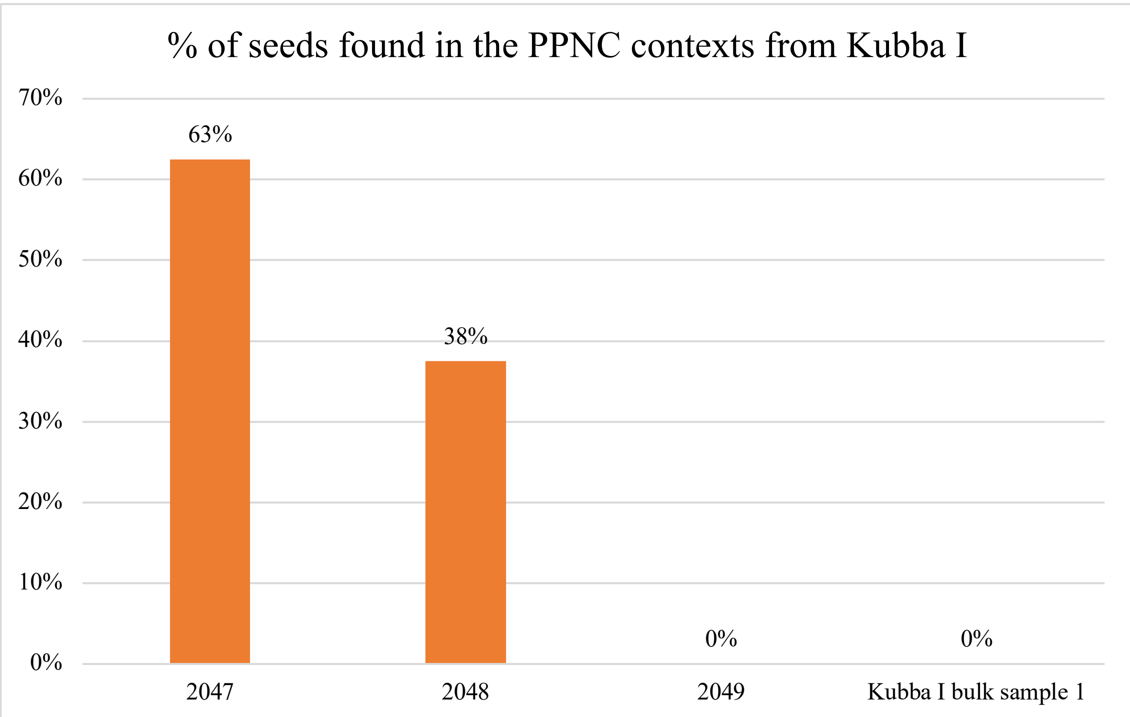



Figure 29: Chart showing the percentage of seeds in PPNC contexts from Kubba I.

Botanical remains in burial contexts can reflect activities related to the burial, such as rituals and offerings. However, sometimes, the burial can have material associated with it simply because of the presence of these plants on the site, or as residue material mixed with the backfill. In addition, charred plant material would be less common in a burial fill, as there are no processing activities taking place inside the fill (Lennstrom and Hastorf 1995, 715). Therefore, the presence of plant material in the burial fills at Tell Kubba does not necessarily indicate any form of activity that took place next to the burial, or any ritual or offerings associated with it. In addition, since the only type found was indeterminate seeds, these could be remnants of wild species that got burned in a fire, then got mixed with the soil.

While the EBAII -III and the PPNC yielded a similar number of seeds per liter, the difference lies in the species found. From the EBA II-III samples, there is a wide variety of consumable plants, such as capers, olives, cereal grains, and grapes, and a low presence of indeterminate wild species (Figure 30).

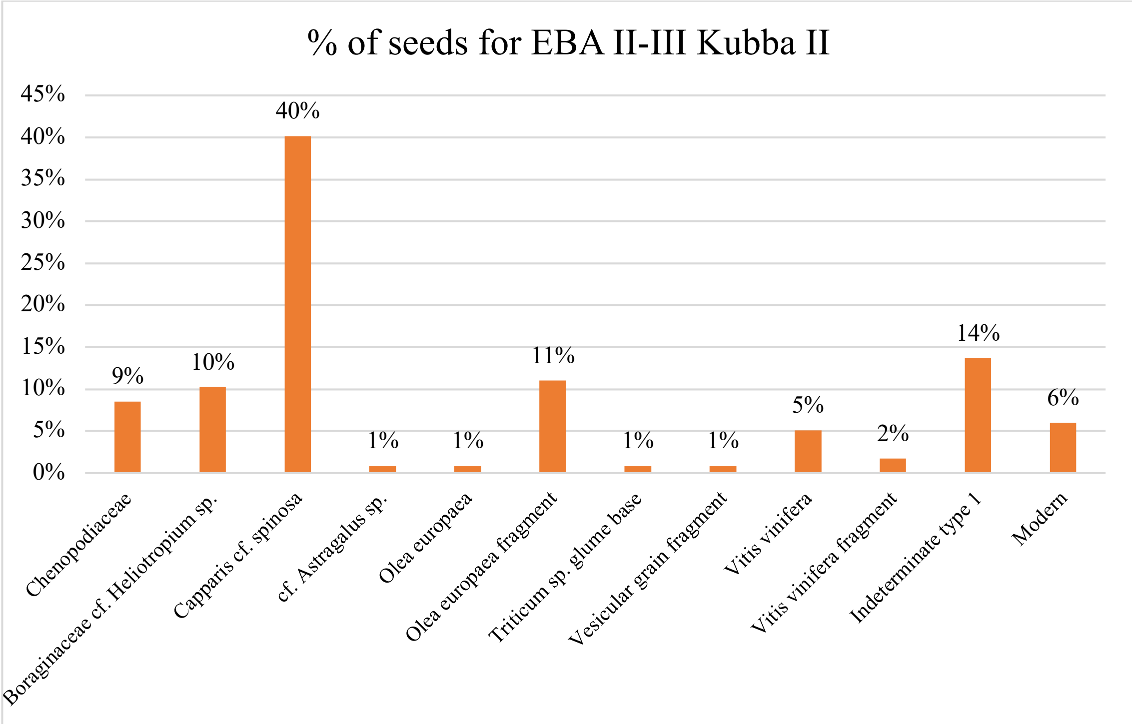



Figure 30: Chart showing the percentage of species from EBA II-III Kubba II.

### 2. *Analysis of the Plant Remains*

The most abundant species present at the site is *Capparis* cf. *spinosa*. It is dominant in one main context, Context 10040 (Figure 31). This context consists of a collapse layer, where lots of stones and mudbrick fragments were found, as well as a lot of pottery. It is possible that this collapse was near an area where capers were processed or near a cooking fire. The seeds of capers are used in cooking, as they add lots of flavor to dishes, as well as being eaten raw as fruits (Rivera et al. 2002, 304). In addition, the roots and seeds of this species have well-known medicinal characteristics and are used to treat multiple diseases (Shahrajabian et al. 2021, 2). The seeds were also used as an aphrodisiac, as evident in the Bible (Rivera et al. 2002, 304). It is not possible to know what the inhabitants of Tell Kubba were specifically using it for, as the remains were found in a collapse layer. However, its usage as food remains likely as the seeds were charred, which indicates their processing over a fire, such as cooking.

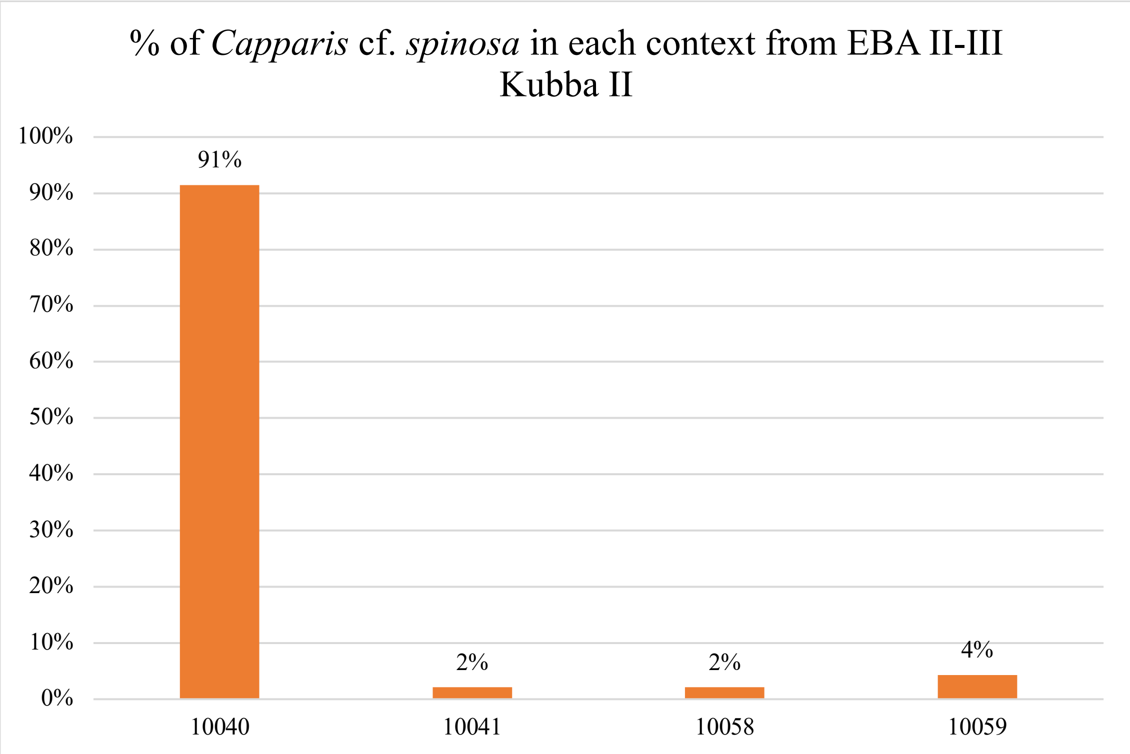



Figure 31: Chart showing the percentage of *Capparis* cf. *spinosa* from Early Bronze Age II-III contexts at Kubba II.

The next most dominant plant in the Tell Kubba EBA II-III assemblage is olives. Similar to capers, olive pits were mostly found in one context, Context 10059 (Figure 32). This context is described as having a thick clay deposit with compact fill-type material and containing many sherds, which could make it a possible surface. This layer belongs to the earlier EBA II-III phase of the building, located under the collapse layer previously mentioned.

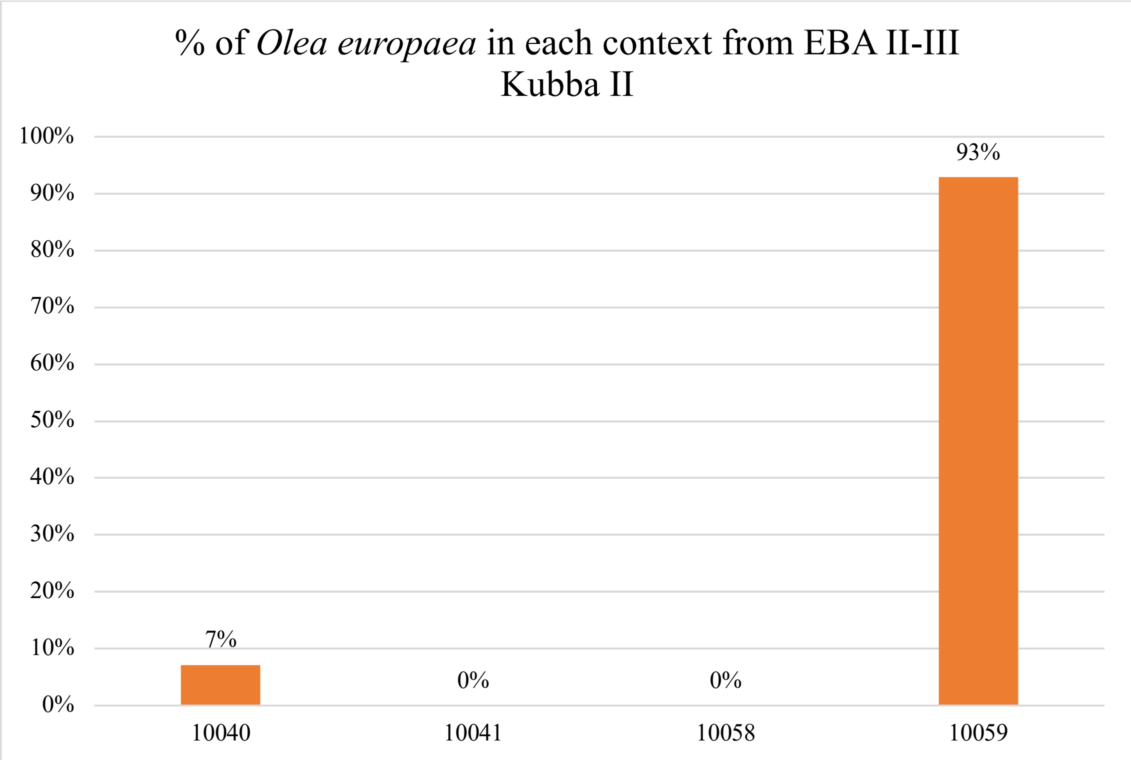


Figure 32: Chart showing the percentage of *Olea europaea* from Early Bronze Age II-III contexts at Kubba II.

Most of the olive pits found were fragments, which indicates processing the olives in ways other than consuming them as fruits (Figure 33). If the olives were consumed as fruits only, the pits found would mostly be whole. Processing olives differently, such as pressing them for oil, will crush the pits and leave mostly fragments in the assemblage. However, as there are no oil presses yet discovered on site, it cannot be assumed that the olives were pressed using an oil press. There are other methods of extracting oil from olives, such as using a mortar and pestle, or a stone roller. These methods do not grind the olive pits too finely, which makes the assemblage consist of both whole pits and larger-size fragments than a standard oil press would produce (Warnock 2007, 81).

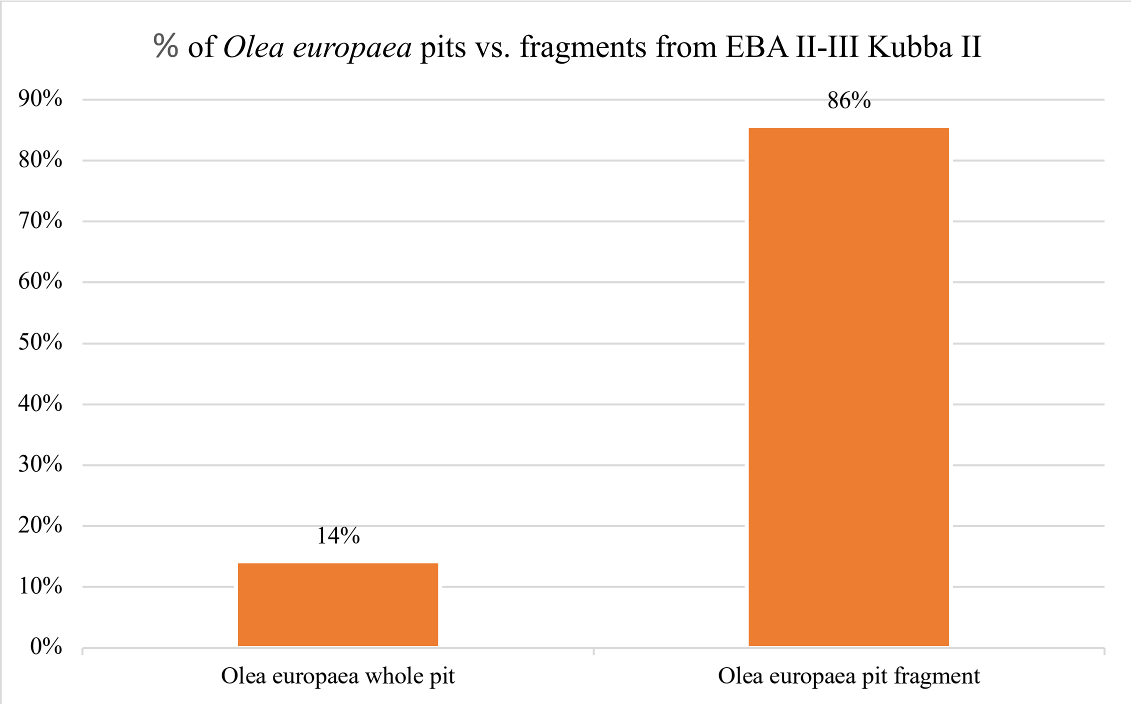



Figure 33: Chart showing the percentage of *Olea europaea* pits vs. fragments from EBA II-III Kubba II.

The reason for finding charred olive pit fragments could be due to the fact that the grinding residue was used as fuel. This practice is widespread among cultures that cultivate olives. It is a well-known effective fuel source; it burns effectively and makes a long-lasting fire. However, it is also known that if olive pits were fired, they would not leave any residue, they would turn to ash (Warnock 2007, 47). Therefore, it cannot be ascertained that the olive pits were used as fuel, but it can be theorized, as some fragments could have survived the fire.

As for Boraginaceae cf. Heliotropium sp., the species was also found concentrated in only one context, Context 10040 (Figure 34). This layer is the same as the one in which caper seeds were also concentrated. Both plants are considered wild weed seeds, which could indicate a specific concentration of weed seeds in this particular context. This could indicate an activity involving weeds in this area, such as weeds being processed, cooked, or thrown out as trash.

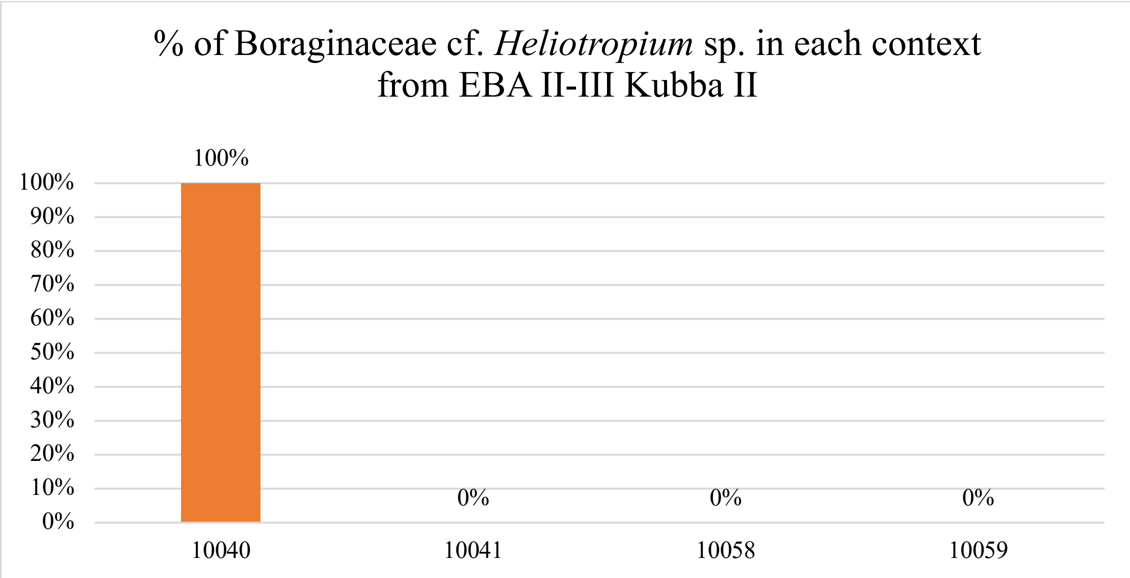


Figure 34: Chart showing the percentage of Boraginaceae cf. *Heliotropium* sp. in each context from EBA II-III Kubba II.

This theory is also supported by the fact the remaining weed seeds, Chenopodiaceae, are concentrated in the same context (Context 10040) (Figure 35). There is also a minimal presence of cf. Astragalus (1%), which could have been collected with the wild plants.

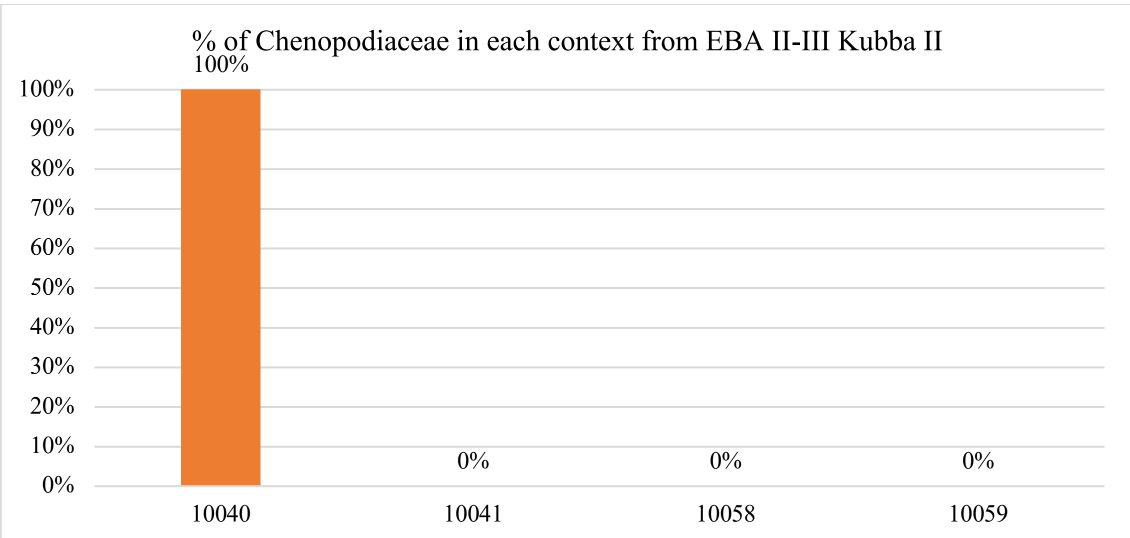


Figure 35: Chart showing the percentage of Chenopodiaceae in each context from EBA II-III Kubba II.

Context 10040 presents the greatest number of seeds per liter in comparison to other EBA II-III samples, the second most considering all periods (Figure 36). It also presents the most variety and representative material, as Context 2047 presents purely indeterminate species.

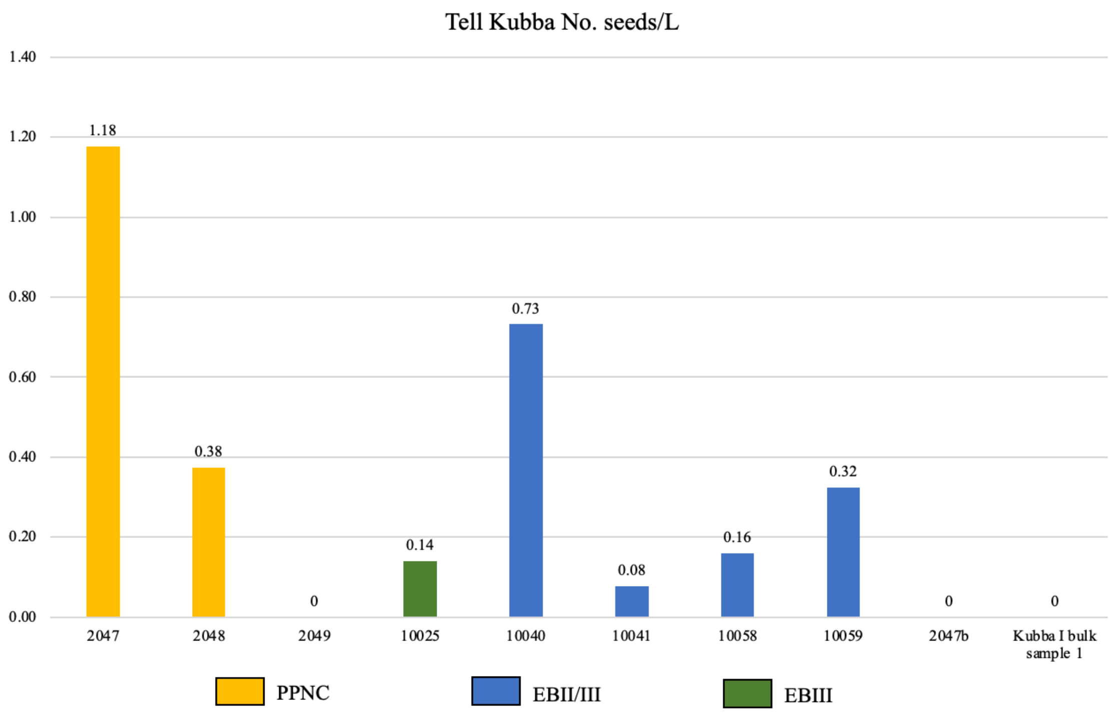



Figure 36: Chart showing the number of seeds per liter from the Tell Kubba assemblage (PPNC: Kubba I, EBII/III, EBIII: Kubba II).

The other plant remains found include wheat and grapes. Wheat is present in two contexts, Context 10041, and Context 10059 (Figure 37). Context 10041 is a wash layer that consists of clay that could have been brought in from an earlier period. Therefore, the cereal grains cannot be dated with certainty, as they could belong to other earlier periods.

As for the *Triticum* sp. glume base, it was present in Context 10059, which is the same context the olive pits were concentrated in. This could indicate that this context was in an area used to process food, or where food refuse was thrown, as it is a compact fill-type layer. Olive fragments and discarded wheat parts could have been mixed with the soil as trash, then used as clay later on.

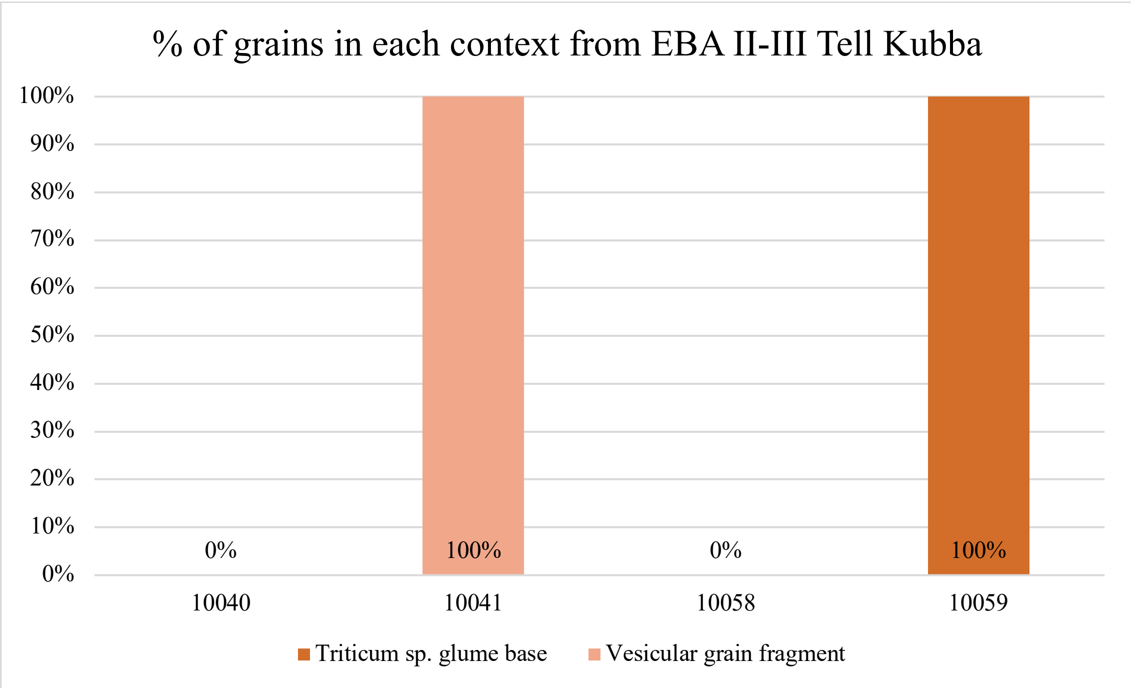


Figure 37: Chart showing the percentage of *Triticum* sp. and vesicular grain fragments in each context from EBA II-III Tell Kubba.

The grape seeds were dispersed among the EBA II-III contexts (Figure 38). Both Context 10040 and 10058 are collapse layers, and Context 10059 is the clay deposit layer. This could indicate their integration into the layers as food refuse. In addition, since the number of pips (6) and fragments (2) is not large, the grapes would have likely been consumed as fruits, and the small number of seeds could have been burned by accident or thrown into the fire similarly to the olives.

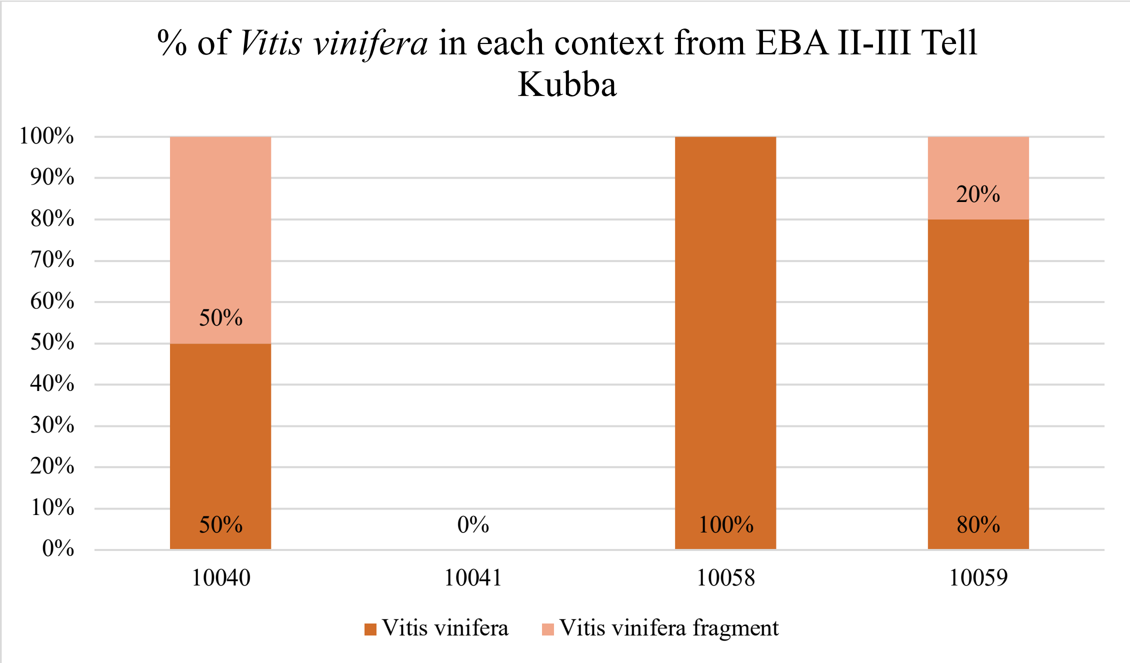


Figure 38: Chart showing the percentage of *Vitis vinifera* whole pips and fragments in each context from EBA II-III Tell Kubba.

From the EBA III, only one context has been sampled (Context 10025). The only remains found were of one grape pip and indeterminate type 1 (Figure 39).

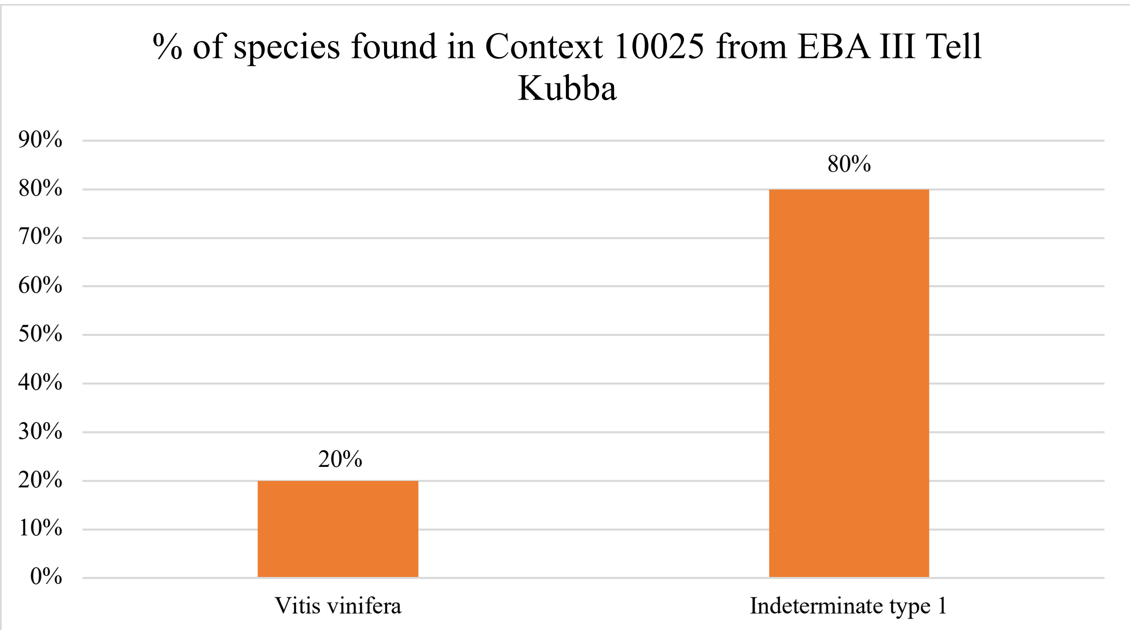


Figure 39: Chart showing the percentage of species found in Context 10025 from EBA III Tell Kubba.

In this context, EBA II and EBA III cooking pot sherds were found. It is also rich in lithics and various other ceramic types. It is assumed to be the layer located on top of the last floor made from the previous periods, before the new EBA III layer was constructed. Since it is described as a midden layer, it would be assumed that lots of botanical material could be found. That is not the case in this context. The dumped, condensed material that constituted this layer could have served purposes other than plant processing or cooking. However, cooking pot sherds were found, along with of other types of pottery vessel sherds and lithics. In addition, charcoal was found. Therefore, wood was the main fuel source, and plant debris could have been used differently.

The Tell Kubba samples presented important information concerning the possible plant resources used as food during the Early Bronze Age, but there is a lack of plant remains from the Pre-Pottery Neolithic C. The only botanical remains from the Pre-Pottery Neolithic C were the Indeterminate type 1. Therefore, there is no indication of what plant resources the settlers consumed during this period. This could be due to the fact that the samples were taken from contexts that are not likely to contain a significant amount of botanical material and were associated with burials. It is also possible that there is a lack of remains at the site, which could be proven through future sampling. Consequently, all the other remains belong to the Early Bronze Age II and III.

While no soil samples were taken from the Pottery Neolithic, the finds found in Kubba I include sickle blades as well as faunal remains of domesticated animals. In addition, arrowheads and wild animals were also found, which shows a mixed way of life between hunting and gathering, and agriculture and domestication. In the pottery remains of the Neolithic, a *tannour* was found in an external working area (Badreshany et al. 2017, 76). All of these finds can indicate that from the Pottery Neolithic onwards the inhabitants relied on agriculture and cultivating crops. This can be considered when examining the Early Bronze Age samples.

The Early Bronze Age II-III botanical remains include cereal grains, fruits, and wild species such as *Capparis* sp. and Chenopodiaceae. As for the EBA III, the only remains were of *Vitis vinifera* and Indeterminate type 1. Therefore, the EBA II-III is the only period well documented on the site. The results from the other periods could be improved by taking more samples from varied contexts, as well as choosing suitable layers where botanical remains are more likely to be found.

The composition of the Tell Kubba EBA samples resembles those of Sidon and Tell Fadous-Kfarabida. Sidon also presents *Triticum* sp., *Vitis vinifera*, *Olea europaea*, and Chenopodiaceae (De Moulins 2019, 29). As for Tell Fadous-Kfarabida, it also presents *Triticum* sp., *Vitis vinifera*, and *Olea europaea* (Badreshany et al. 2005, 86). These three sites share a similar coastal location, which could be one of the reasons behind the similarities in the species found.

The site sharing the most similarities with Tell Kubba is Tell Labwe. It is located in the northern Beqaa valley, close to the Anti-Lebanon, and was settled during the Pre-Pottery Neolithic C and the Pottery Neolithic. The Neolithic assemblage consists of 68% wild plants, 27% other crops, and 5% cereals (Gyurova 2016, 1). Similarly, the Early Bronze Age II Tell Kubba assemblage is composed of 63% wild plants, 21% other crops, and 2% cereals. Similar plant species were also found, such as *Heliotropium* sp., *Olea europaea*, and *Triticum* sp. The location of Tell Labwe is very different than that of Tell Kubba. While Tell Labwe is located inland and is 950 meters above sea level, Tell Kubba is coastal and is only around 20 meters above sea level. This difference between the two sites does not allow the comparison of climate and local plants. In addition, the samples sharing similarities do not belong to the same periods. However, it can allow comparing the lifestyle and activities people engaged in, in different areas of the Lebanese landscape.

It is useful to compare Lebanese sites together since the common plants used at the time can be noted. This will indicate the main diet of the inhabitants of the Lebanese areas. The differences in the assemblages are arguably more important as they show the differences in the landscapes and the sustenance economy for each site.

## C. Tell Mirhan

As for Tell Mirhan, the site presents valuable information from the Middle Bronze Age and the Iron Age II. The period yielding more remains is the Middle Bronze Age (Figure 40).

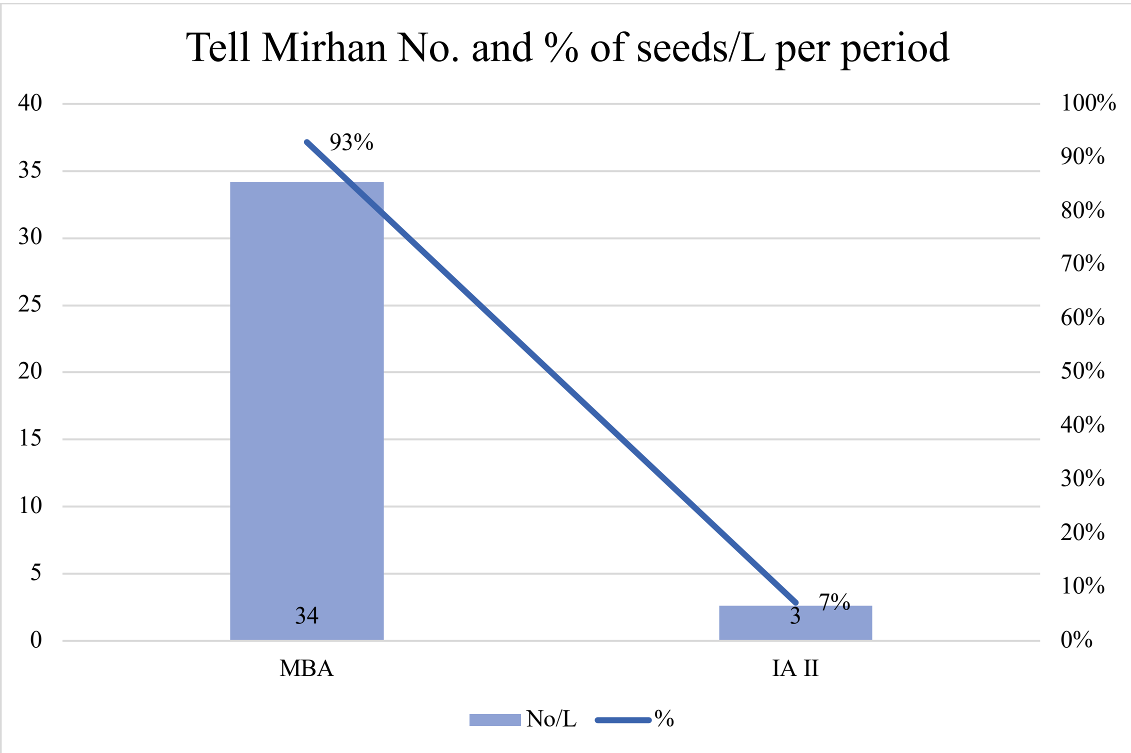



Figure 40: Chart showing the number and percentage of seeds per period for Tell Mirhan.

The most abundant context in plant remains is the E-W Section, which is the MBA section of the fortification wall (Figure 41).

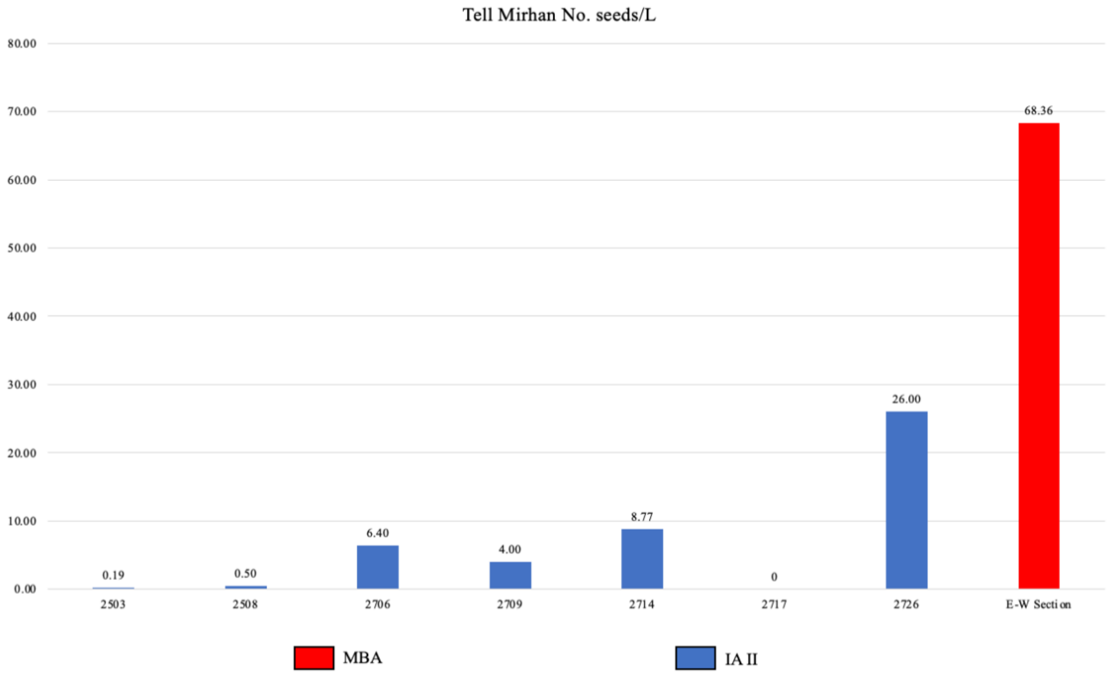



Figure 41: Chart showing the number of seeds per liter from the Tell Mirhan assemblage.

The E-W Section presents mostly vesicular grain fragments, and some olive pit fragments (Figure 42). Considering that this context is a fortification wall and does not represent stratigraphical layers by period, one cannot assume the date or the reason behind the presence of these species. They could belong to the MBA, or earlier periods, as soil and clay would have been gathered from several locations on the site to build the fortification wall. However, the abundance of vesicular grain in this context can be an indication of the consumption of grain at the site. In addition, when surveying the top of the Tell in 2016, grinding stones were found (Kopetzky et al. 2019, 114). In general, it is theorized that barley would have been used for bread and everyday cooking, while wheat would have been reserved for special occasions (De Moulin 2015, 39).

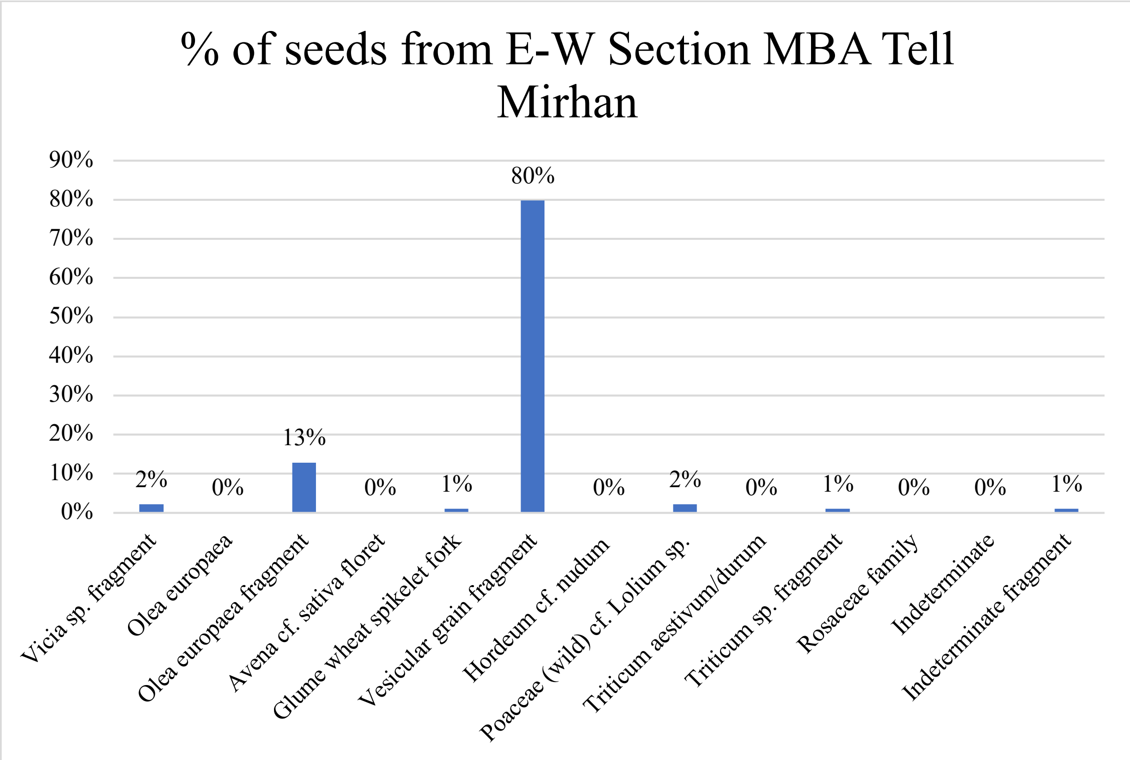


Figure 42: Chart showing the percentage of seeds in the E-W Section from Middle Bronze Age Tell Mirhan.

The fact that most of the grain remains found at Tell Mirhan are vesicular can indicate certain firing and processing methods (Figure 43). A vesicular grain is characterized by its shape and state of preservation. It becomes hollowed, heavily pitted, and distorted, and can sometimes lose its original shape, where it turns into a lump (Boardman and Jones 1990, 4). This is caused by high firing temperatures and/or long exposure to heat. Cereal grains can become vesicular even at low temperatures, but it depends on the type of grain and how long they were exposed to the heat. For example, *Triticum aestivum* (Bread wheat) becomes vesicular at very low temperatures (250-300°C) (Boardman and Jones 1990, 8). Since the cereal grains were very distorted, the type of grain found could not have been determined. Therefore, the charring condition cannot be determined.

As there is preservation of only one glume wheat spikelet fork (Figure 43), this can be an indication that either the temperature was too high, or the temperature was low, but the cereal grains were exposed to heat for a longer period, since spikelets cannot survive such conditions (Boardman and Jones 1990, 8). However, it is also possible that the low number of spikelets is due to the location of plant processing. If the cereal grains were threshed and winnowed in a different part of the settlement, there would not be an abundance of chaff, spikelets, and glumes, as they could have been discarded somewhere else.

The amount of grain and the multiple grinding stones found during the survey could indicate the way the cereal grains were processed by being ground, and that the economy of the site relied on cereal grains as a staple in their diet.

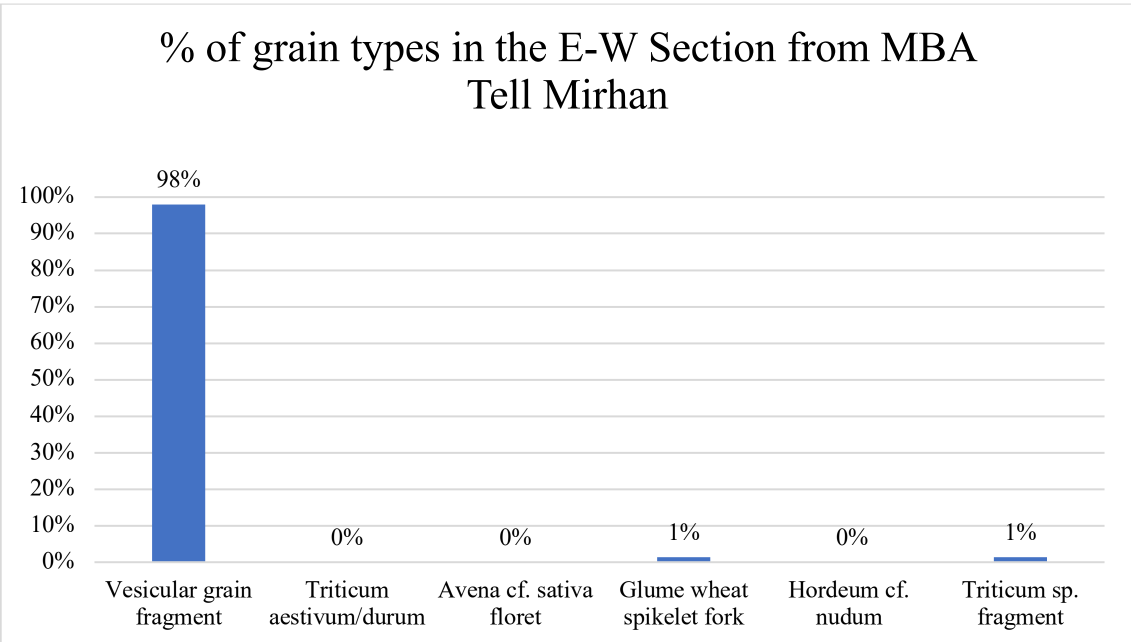


Figure 43: Chart showing the percentage of grain types in the E-W Section from Middle Bronze Age Tell Mirhan.

The presence of *Lolium* sp. is not surprising considering the diversity of cereal grains found. Ryegrass grows as a weed alongside cereal crops. However, it is toxic and cannot be consumed. Its presence indicates that it grew with the cereal crops in the fields and was brought back to the site with the cereal grains. The fact that it was found burnt could indicate that after the cereal grains were sieved, the ryegrass was picked out and thrown into the fire as waste (De Moulin 2015, 39).

Concerning the olive pits, comparable to Tell Kubba, the majority of the remains were fragments (95%) (Figure 44). Since there is still an absence of oil presses at the site, the olives could have been consumed as fruits. However, as the majority of the site was destroyed, the presses could have been located somewhere in the missing areas. Therefore, it cannot be concluded if the olives were processed as oil or were only consumed as fruits, but the presence of charred olive seeds could also indicate their use as fuel after consumption (De Moulin 2015, 39).

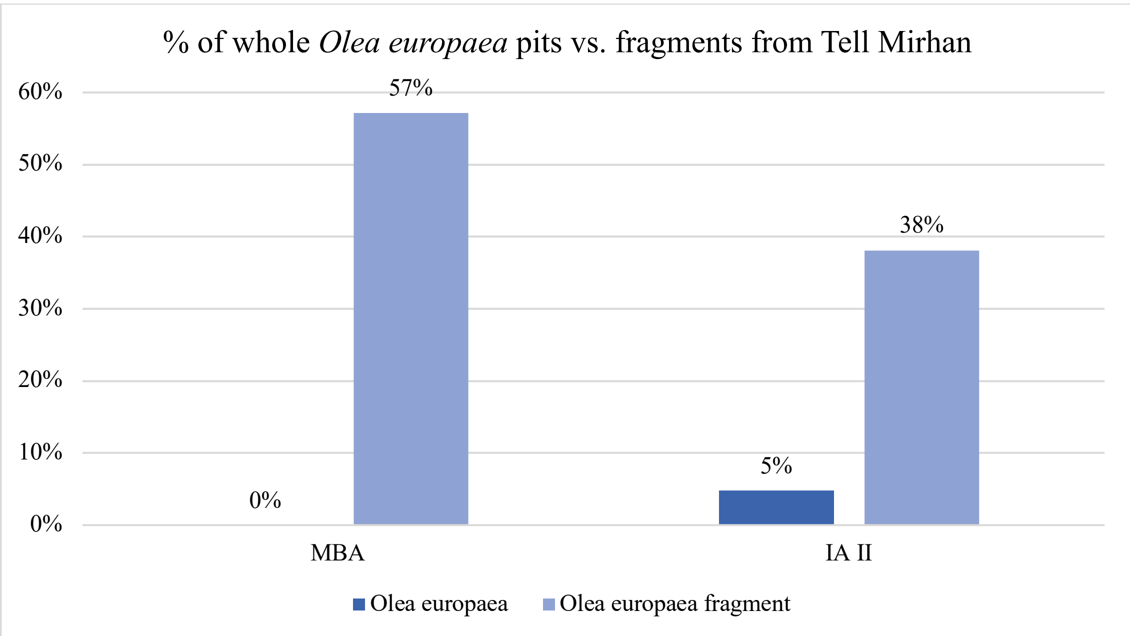



Figure 44: Chart showing the percentage of whole *Olea europaea* pits vs. fragments from Tell Mirhan.

As for the Iron Age II, the most dominant plant type remains are vesicular grain fragments, followed by *Vicia* sp. fragments (Figure 45).

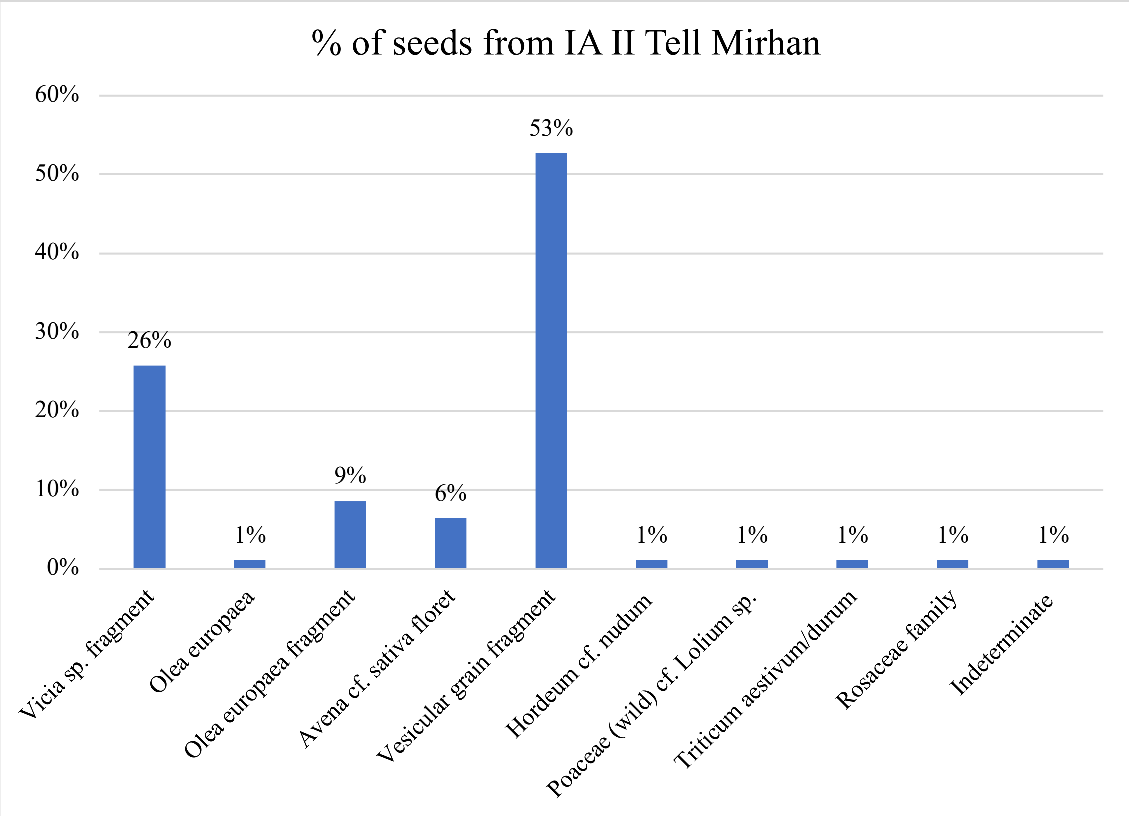



Figure 45: Chart showing the percentage of seed types from Iron Age Tell Mirhan.

The vesicular cereal grains are mainly concentrated in Context 2714 (Figure 46). This context is described as a pottery structure lining a fire pit. This pit is filled with ashy soil, indicating a fireplace or a *tannour*. This context is located within Context 2706, and Context 2726 is located under the *tannour,* Structure 2714. This could explain why the concentration of vesicular cereal grains lies in the *tannour*, and around it, as demonstrated in the chart below (Figure 46).

Since the vesicular grain fragments are located in the tannour, this suggests that the cereal grains were cooked in this area. As previously discussed, the cereal grains could have turned vesicular because of the high heat of the fire, or because they were left in the heat for a significant period of time. Nevertheless, the large representation of cereal grains in the Iron Age II samples could indicate continuity in relying on cereal grains as a staple in the inhabitants' diets.

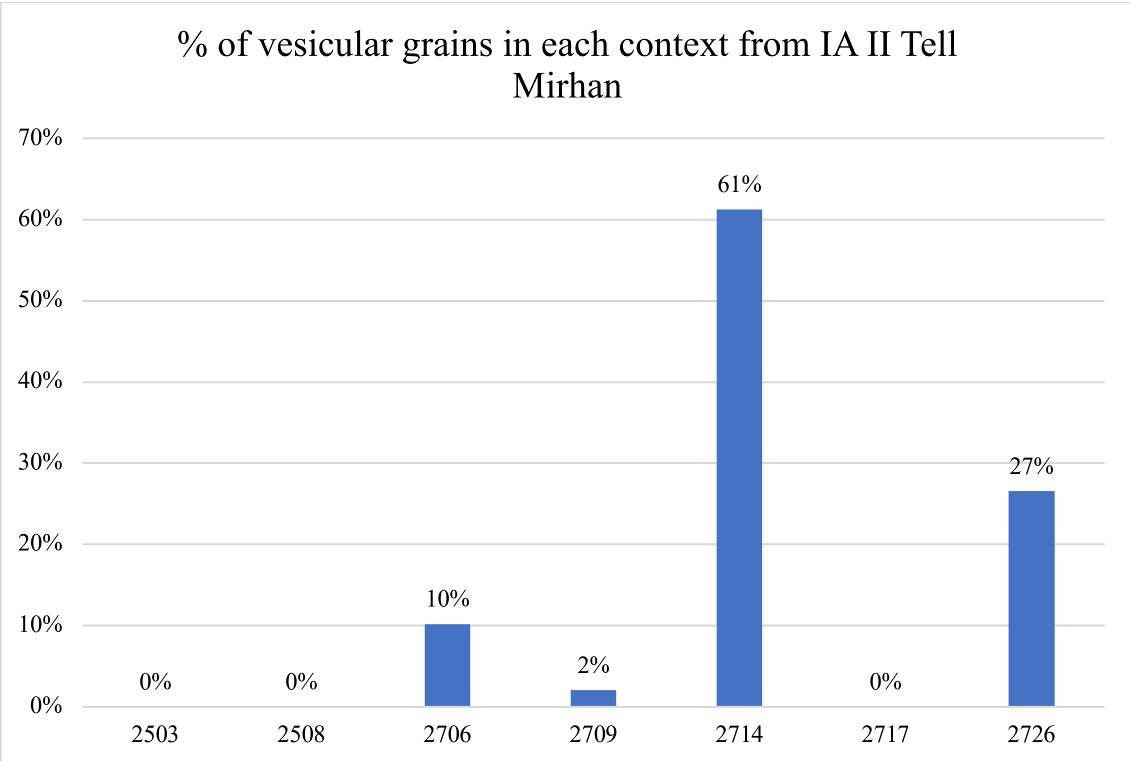



Figure 46: Chart showing the percentage of vesicular grain fragments in each context from Iron Age II Tell Mirhan.

Since Context 2714 is an area where food was cooked, it is important to examine all of the plant remains available to assess what was being cooked as food. As previously stated, the most dominant plant type is vesicular grain fragments (44%). Following that are *Vicia* sp. fragments (34%) (Figure 47). It is well-attested that legumes made up a large portion of the diet during the Iron Age in Lebanon (De Moulin 2015, 39). The fact that Vicia is present in the *tannour* context signifies their cultivation and consumption at the site.

As for the olive pit remains, once again, the majority found are fragments (Figure 44). As previously discussed, the fragments could have been leftovers from olive processing methods such as oil pressing. Since the fragments are present in the fireplace, it could be theorized that in this case, the olive pit fragments were used as fuel for cooking. In the case where they were not used as fuel, perhaps they were discarded into the fire as trash or were processed in a method using the fireplace, or near it.

In addition to the cereal grains found, there is also presence of oats in Context 2714. Therefore, oats were possibly included in the diet of the Iron Age inhabitants, as it could have been available in the fields where the other cereal grains were cultivated. This is also attested by the fact that ryegrass was found, which is an indication that the cereal grains were cultivated from the fields.

The interesting aspect of the oats found is the exceptional preservation of the floret. The outer protection of the seeds remains, which is rare to survive the fire. Perhaps the survival of the oat floret is an indication of firing at low temperatures. This could imply that the vesicular cereal grains are of a free-threshing species, such as bread wheat, which becomes vesicular at low temperatures (Boardman and Jones 1990, 8).

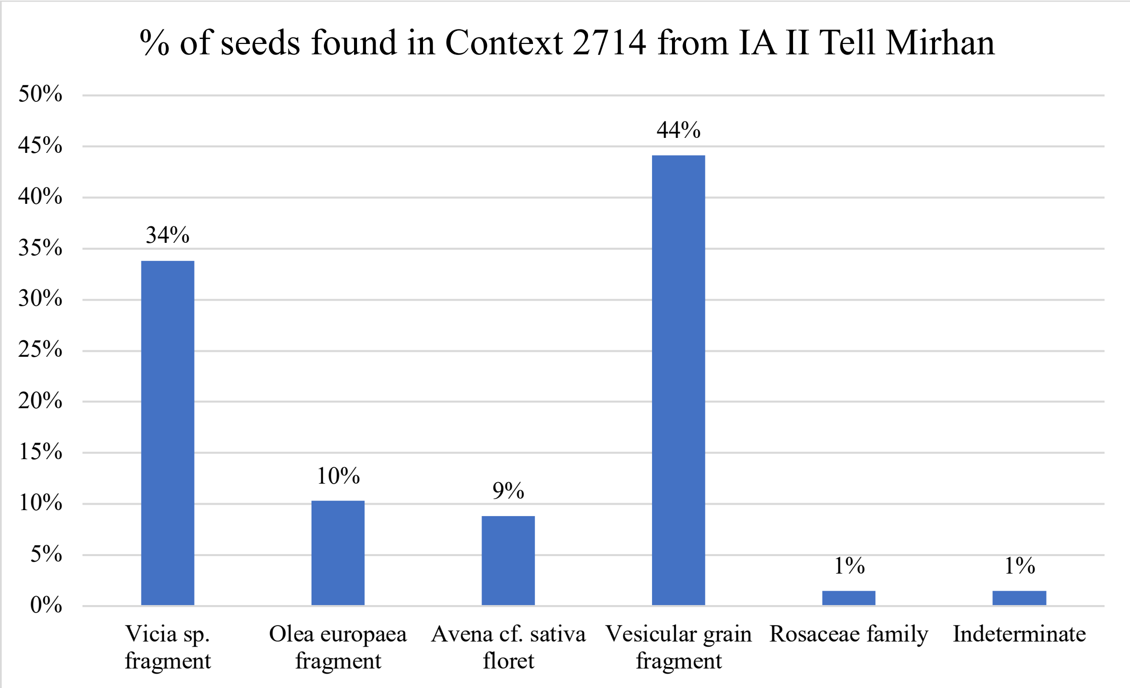


Figure 47: Chart showing the percentage of seeds in Context 2714 from IA II Tell Mirhan.

Another type of grain was found in Context 2706, which is barley (Figure 48). The presence of barley in the mix of cereal grains adds to the diversity of the grain resources the inhabitants of Tell Mirhan had during the Iron Age and supports the theory that these cereal grains were collectively cultivated from the fields near the site. Since ryegrass is also present in this context, it can be theorized that this was the location where the cereal grains were processed. Usually, ryegrass is not consumed, but it grows alongside cereals in the field, which is why it is present next to the grain assemblage. Since it is not consumed, it could have been either picked out of the cereal grains and discarded into the fire, or some of the ryegrass grains infiltrated the grain supply and burned in the fireplace with the rest of the cereal grains.

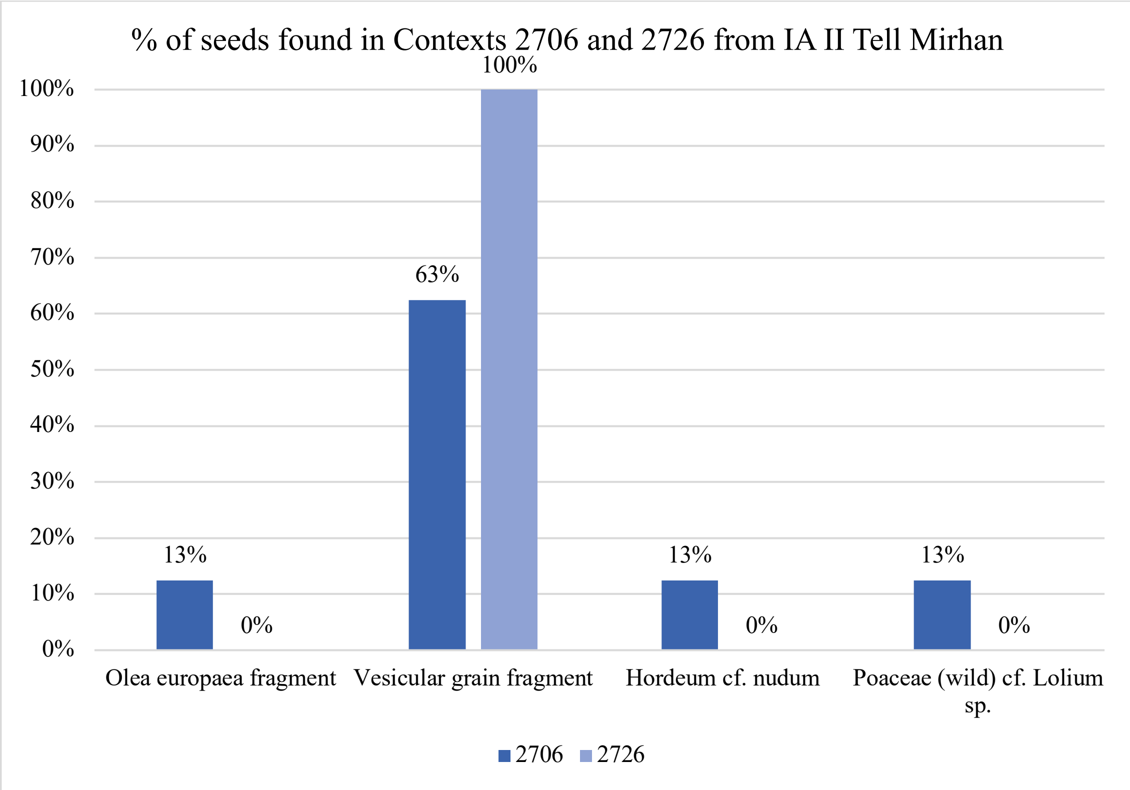


Figure 48: Chart showing the percentage of seeds in Contexts 2706 and 2726 from Iron Age II Tell Mirhan.

The composition of the botanical samples found at Tell Mirhan closely resembles the ones found at Tell Burak, Jiyeh, and Sidon during the Iron Age. Tell Burak presented Triticum sp., Hordeum sp., Lolium sp., *Olea europaea*., and Vicia sp., during the Late Iron Age (Orendi and Deckers 2018, 724). In the Iron Age II, Jiyeh presented Hordeum sp., Poaceae, Fabaceae, and *Olea europaea* (Badura et al. 2016, 490). As for Sidon, the results from Iron Age layers presented *Triticum* sp., *Hordeum* sp., *Lolium temulentum*, *Olea europaea*, and *Vicia* sp. (De Moulins 2015, 48). The similarity between Tell Mirhan and these three sites can be attributed to similar geographical settings, where they are all Lebanese coastal sites less than 50 meters above sea level. As for Tell Labwe, it is one of the only sites that recorded the presence of *Avena* sp. from the Pottery Neolithic (Gyurova et al. 2016, 1).

Tell Mirhan provides valuable information concerning the sustenance of the inhabitants of the site during the Iron Age II. Since there was a *tannour* found, the plant remains associated with it hint at the diet of the inhabitants during this period. It seems that they relied on cereal grains and legumes as food, as well as olives, possibly pressed for oil and eaten as fruits. The presence of *Lolium* sp. in the contexts with cereal grains could also indicate that the cereals were cultivated from the fields. The site is located on a coastal plain; therefore, these crops would naturally grow nearby the site.

As for the Middle Bronze Age remains, they cannot be considered representative of the crops the people consumed during this period. The samples were collected from the fortification wall that was built from the soil around the site. This means that the soil does not strictly belong to one period from one defined context. However, it could represent a small portion of what the inhabitants might have consumed during or before the MBA, or what the workers who constructed the fortification wall consumed.

# CHAPTER VI

# IMPLICATION OF RESEARCH

This research's purpose is to advance the field of archaeobotany in Lebanon since there is a clear lack of specialists working on Lebanese archaeobotany and studies concerning the ancient diet and plant resources during Lebanon's history. For this reason, the research focused on three Lebanese sites from different periods and locations, to prove that performing archaeobotanical analysis can help archaeologists understand the sites they are excavating better.

Generally, archaeobotany is applied in excavations taking place in other countries in the Levant. For example, lots of evidence can be gathered from Syrian and Palestinian sites, since the archaeologists excavating are aware of the importance of taking soil samples for archaeobotanical analysis. In addition, there are many archaeobotanists who concentrate their work on these areas. The results of the analysis will not only add additional data for the excavation report and publication but will also help in proving the interpretations of the archaeologists concerning the site and the function of each context.

From the research presented in the discussion above, more information was gathered about the sites, and more details were uncovered. Combining material finds, such as pottery, flint, structures, and architecture, from the excavations with the botanical assemblage helped in explaining the function of the site, as well as the presence of certain species in certain contexts.

For example, from the site of Qornet ed-Deir, the Middle Bronze Age contexts uncovered belong to domestic contexts, based on the pottery: such as storage jars and baking trays, and the structures: such as the *tannour*. Therefore, when analyzing the results, the plant remains found are interpreted as seeds used for domestic purposes, and as a food source. The remains that were found are milk-vetch, cereal grains, and grapes. The milk-vetch and the cereal grains were mostly found in a context related to a *tannour*, which supports the theory that these plants were prepared and cooked for consumption during the Middle Bronze Age.

As for the Roman/Byzantine period, there were no identifiable seeds found. In this situation, there was a good indicator of the plants the people consumed at that time, which were the human skeletons found. One of the studied skeletons belonged to the Roman period, and the other to the Byzantine period. Through technological advancements, it is now possible to get a general idea of the diet of people based on their bone remains. It was found that these two individuals consumed mostly agricultural products. In this case, the bones found were able to balance the lack of botanical material.

However, it is not always the case that bones are found on site. In addition, the skeletons of only two people cannot represent the diet of the whole population of Qornet ed-Deir. There could be individual differences. Additionally, bone analysis alone cannot specify what exactly the people consumed, but it can only offer an idea. This analysis only reveals the diet of the last seven years of the lives of these individuals, which cannot represent the whole Roman/Byzantine period. Scientific methods such as bone analysis could also be prone to error.

This is also true for archaeobotanical analysis. It can be prone to error as well. Some of the seeds could be identified mistakenly, or the contexts sampled do not reflect the true reality of what was being done on another part of the site.

For example, Tell Kubba and Tell Mirhan both present remains of olive pit fragments, which could be a sign of oil pressing. From both sites, no evidence of oil presses was found. In this scenario, it cannot be concluded if the olives were pressed to extract olive oil or were only consumed as fruits. There are many types of oil pressing techniques that can be used to get oil from olives that do not require an oil press, such as pounding or rolling. However, with the absence of any object or structure at the sites, it cannot be concluded whether that was the way of processing olives. It is just as likely that the inhabitants of these sites had other processing methods for olives that are not yet detected.

However, there remains an advantage of archaeobotany. Since olive pit fragments were identified, any structure or object with an undetermined function could be assessed to see if it could have been used in processing to extract oil. Otherwise, these objects would not have been associated with olive processing methods if the remains were not noted. This is an example of how archaeobotany can be used to understand the site, and how the site could be understood using archaeobotany.

In the case of trying to reconstruct the diet of the inhabitants, archaeobotany is the closest evidence one can get about the matter. However, it is not always representative of the plants people actually consumed at the site. For example, from an undated site at Qornet ed-Deir, there was one grape pip found. The issue with fruits, such as the case of the grape in this context, is that fruits are usually consumed raw. Most fruits are not cooked or processed in a manner that would leave a trace. In this case, one grape pip could have fallen into the fire by mistake and gotten charred. Therefore, if at the settlement people consumed a lot of fruits, this would not be reflected in the botanical assemblage of the site, and it would be assumed that the inhabitants consumed a low number of fruits. It should be realized that the absence of certain crops and fruits does not mean they were not consumed, rather that they were processed in a way that does not leave a trace, usually not involving fire.

This is also similar to the case of crops or vegetables that are processed far from the settlement and the excavation area. For example, crops such as cereal grains were usually processed in the fields. Activities such as winnowing and threshing cereal grains could take place outside of the settlement. This is reflected in the archaeobotanical assemblage in a way that only seeds are represented without any of the other parts of the cereal. In the case of cereal grains, it is sometimes crucial to have other parts of the plant to identify the species of the cereal grains. Regarding the grain remains found at Tell Mirhan, most of the cereal grains found were vesicular. This indicates that the seeds either suffered from charring at very high temperatures, or from a long period of exposure to low heat. Combined with the grain remains were the remains of oats. The oat grains had very well-preserved florets, which are the protective chaff engulfing the grain. Since this chaff survived the fire, and this is a rare preservation, it could be assumed that the fire did go up to very high temperatures, as the chaff would have burned. Yet, the cereal grains found were vesicular, and if the theory of a low temperature was valid, then the charred cereal grains belong to a type that easily becomes vesicular, which is the free-threshing type.

Based on this analysis, the type of grain could be determined without the presence of a diagnostic feature or other components of the cereal, such as the spikelet and glume bases. This theory could be disproved by the fact that the fireplace was not only used for one day when the grain was cooked, so it cannot be known if the cereals and oats burned together at the same time. However, speculations can be made, and if more evidence is found in new samples gathered from the next season, the theory can be proven or disproven.

The grain theory of Tell Mirhan also has another aspect. The presence of oats and ryegrass alongside the grain indicates that the grain was gathered from the fields nearby the site, since these two species grow naturally with cereal crops. This theory can help in understanding the activities of the inhabitants of Tell Mirhan during the Iron Age II and will also help in explaining the other artifacts found at the site, such as the lithics and the grinding stones. This is another example of how archaeobotany can help archaeologists understand the activities people engaged in by specifying the species of cereal grains found in the *tannour*.

However, other activities could be missed, such as foraging. Some foraged species leave evidence in the archaeobotanical record, such as in Tell Kubba, where there was a high concentration of capers and milk-vetch. However, that is not the case for all foraged plants. It is possible that some plants were only foraged for their leaves or roots, parts that do not have seeds. The seeds are the most commonly found remains from the plants, and if no seeds were brought to the site, or if they were not burned purposefully or accidentally, then the plant will not be represented. This is another limitation of archaeobotany, where it will never show the entire assemblage of plants consumed at the site.

This is also why it is important to compare sites together. For example, if two sites have similar geographical locations and they share a lot of the plants and species found, the missing plants from the other site can be taken into consideration as potential seeds to look out for when analyzing the samples. It is possible that sometimes seeds are missed, misidentified, or unidentified. When a certain list of plants is present at multiple similar sites, this can make the process of identification easier. This is the case for the Lebanese coastal sites. As previously completed, Tell Kubba and Tell Mirhan's botanical assemblages resembles those of other Lebanese coastal cities such as Sidon, Tell Fadous-Kfarabida, and Tell Burak. This is not to say that all of these sites have identical botanical assemblages, but they share certain species that were potentially processed and consumed in the same manner.

The advantage of applying archaeobotanical methods in excavations is that this analysis can help archaeologists determine the type of site they are excavating. Plant remains could give an indication of the purpose behind the site's usage. This is done through the number of seeds found, the species found, and the type of plant remains found.

For example, based on the information gathered so far from the site of Qornet ed-Deir, there is a clear difference in the number of seeds per liter between the Middle Bronze Age contexts and the Roman/Byzantine/Medieval ones. Based on the large number of seeds found from the MBA, in addition to the large storage jars found, it could be assumed that this was a permanent or semi-permanent settlement, where the inhabitants spent most of the year living at this site, perhaps excluding the harsh winters. Moreover, the site appears to be domestic, as the plant remains indicate household processing and cooking of the plant resources.

Meanwhile, during the Roman through Medieval periods, the number of seeds drastically decreases, and there is a change in their types. While the plant resources from the MBA were dominated by milk-vetch and cereal grains, during the later periods they became dominated by wild seeds, which could have been foraged from the forest and fields or could have naturally been present at the site.

The fact that the plant composition changed indicates a change in the lifestyle of the inhabitants. The MBA pattern can demonstrate a domestic permanent or semi-permanent settlement. As for the Roman and Medieval periods, the assemblage indicates more of a seasonal industrial/military function. This is due to the fact that there are fewer seeds present at the site, which can indicate ready-made food. When the staples of the diet, such as cereal grains and legumes, have very little visibility, it could be possible that they were cooked and processed elsewhere. For that to be the case, the site had to be settled by people who are not required to prepare their own food, which is similar to the case of workers or troops hired by the state.

Based on the information provided so far on the site, there is a possibility that the site was in fact a settlement for workers or troops. On the one hand, the botanical assemblage can be interpreted in a way that complements the theory proposed. On the other hand, the same remains can be used to negate the theory. For example, the lack of botanical material can be due to the fact that the contexts are not located in food processing areas or dumps where food waste was thrown. In addition, there were many undated contexts that could belong to the Roman and Medieval periods. If these contexts were dated and more domestic contexts were excavated, there might be an increase in the quantity and quality of the plant types at the site.

If that was the case, this could be used to negate the fact that the site was a seasonal settlement for troops, but it could change the interpretation of the activities the inhabitants engaged in. For example, it is currently assumed that the settlers could have been provided with ready-made food. If a lot of plant remains were found at the site, this could signify that they prepared their own food, which would indicate other activities that people had to engage in, such as cooking or storing food. However, it cannot be known if the troops were supplied with their rations from the government or if they had to cultivate it themselves, this can only be proved by historical texts.

What archaeobotany can help us understand about the site of Qornet ed-Deir is that the people who lived there had connections to other sites in the area or on the coast. Since there are cereal grains in the samples, and such crops were unlikely to have been grown around the site, the supply of cereal grains was likely acquired from other areas. This is due to the site's location, where few fields and flat surfaces are present. This could be the reason behind the storage jars available at the site, in addition to potentially storing oils and resin for trade. If the site was seasonal, the inhabitants could have brought their supply of grain during their trips. Or, if the site was permanent, this could signify that the food was provided by the state or that this village was connected to other villages that could produce these types of crops.

The botanical assemblages also allowed the comparison between the supposed diet of the settlers of Qornet ed-Deir with the well-documented diet of the Roman army. In this scenario, the botanical assemblage was explained through the archaeological remains, which indicated that this site might have been used by guards or troops during the Late Roman period. This allowed the comparison between what was found at Qornet ed-Deir and other well-known sites used by Roman troops and texts that have detailed information concerning the supply of the state with certain types of plant resources for food.

As for the site of Tell Kubba, the plant remains indicate that the inhabitants of the site relied mostly on foraged plants such as capers and milk-vetch during the Early Bronze Age II-III. However, the contexts from which the samples were collected were not ideal for botanical preservation. These layers consisted of collapse and wash layers, which usually do not have a lot of representative material of consumable plants. Nevertheless, when comparing the site of Tell Kubba with Tell Labwe, multiple similarities were noticed, and the general composition of the botanical assemblages was similar.

In addition, from the Pottery Neolithic, sickle blades were found. This find could help in clarifying the botanical assemblage from the Early Bronze Age II and III. From these two periods, very few cereal grains were found. However, since the Pottery Neolithic people started cultivating cereals, as evident by the presence of sickle blades, it could be assumed that cereals were part of the diet of the inhabitants, but they are not represented in the assemblage. One of the reasons this could be the case is the previously mentioned issue of the contexts being of a type that does not usually preserve botanical material, or the cereals could have been processed elsewhere and the waste not being used as fuel.

If the other relevant contexts preserved at Tell Kubba do not contain a lot of preserved botanical material, this does not necessarily mean that the inhabitants did not consume plants. There could be multiple causes for this, such as the settlement being seasonal, where it is only visited a few times per year, or was settled for certain seasons. This will decrease the number of seeds found since not much time is being spent at the site. In addition, one cannot know where the plants were processed or cooked. Therefore, they could have performed these activities in another location, not yet been excavated.

The analysis of the botanical remains for Tell Kubba's new seasons will be crucial to determining whether the site is naturally deficient in plant remains, or if the nature of the contexts chosen for the 2019 samples were unsuitable. In this case, it is useful to compare Tell Kubba with other nearby Neolithic sites in an attempt to understand what the inhabitants might have consumed, so perhaps the site could be approached differently.

As for Tell Mirhan, through the botanical analysis of the site, it was learned that the settlers of the Iron Age II most likely cultivated the crops of the coastal plain, based on the presence of cereal grains, and the wild grasses that grow alongside them. Through the additional presence of many grinding stones, this theory is supported by implying that cereal grains constituted a large portion of the sustenance at Tell Mirhan.

As for the Middle Bronze Age fortification wall section, it presented valid and important findings as well. However, an issue in contexts such as this one is that the botanical analysis cannot determine the location or the date of these seeds. Since they are located in the MBA wall, then they either belong to the MBA or any other period before it. In addition, another limitation is that one cannot understand the role that these plants played in the diet of the inhabitants. This is due to the fact that the seeds do not belong in a clearly defined context, where its function is determined. But it is located in a mixture of soil collected and used for the purpose of fortifying the town. This does not imply that these remains should be discarded or overlooked, but it should be made clear that these remains have no direct correlation with the diet of the settlers of Tell Mirhan during the Middle Bronze Age.

It is evident that archaeobotanical research on these three Lebanese sites has advanced our understanding of their types and functions. Archaeobotanical analysis presents many advantages and can help immensely in interpreting a site and adding to the information gathered about its inhabitants. However, as previously discussed, it does have limitations and cannot always be accurate.

On the one hand, the contexts that are sampled could have been contaminated by wild plants, carried by the wind, and animals, that were not cultivated by the settlers of the site. On the other hand, the settlers might have processed these plants outside of the settlement and the area being excavated, which will not leave a trace in the archaeobotanical record. Therefore, the plant remains found in the samples could make up a small percentage of the diet, or they could represent more than what was consumed.

Overrepresentation is similar to the example of Qornet ed-Deir, where most of the remains found were indeterminate. This does not add to our knowledge about the diet of the people, but it helps us understand the ecosystem the people lived in. Since there is an extensive presence of wild indeterminate seeds, it is a reflection of the forest environment, where there is a wide variety of plants. It could possibly imply that either a lot of the food was foraged, or the site had an industrial function that involved wild plants.

Underrepresentation could be the case of Tell Kubba, where the number and type of seeds found most likely do not represent the whole assemblage of seeds consumed. This can be mitigated by choosing various good contexts to find some of the best when it comes to preservation, as well as comparing the site to others nearby.

The botanical assemblages of the sites have potential to be expanded. There are more samples to be studied from Qornet ed-Deir and Tell Kubba. Additionally, since the excavations for all three sites are ongoing there should be additional sampling taking place. This will assist the future researchers in advancing our knowledge about these three sites specifically, and about Lebanese archaeobotany in general.

# CHAPTER VII

# CONCLUSION

This research has presented new archaeobotanical data from three yet unstudied Lebanese sites. It has helped advance knowledge about these sites and could help in interpreting the structures and artifacts found. These methods are usually applied in excavations outside Lebanon, and they are seen as an important part of the excavation report. However, in Lebanese archaeology, this science has been long ignored and understudied in Lebanon. It is important to start developing this field further in Lebanon to start understanding the ancient landscape and diet of the people inhabiting its areas.

The lack of archaeobotanical studies in Lebanon could be due to several reasons. Since archaeobotanical analyses were only done by foreign expeditions, there has been no Lebanese specialist in archaeobotany, which does not introduce Lebanese archaeology students to this field of study and does not give them the opportunity to engage in its activities and learn its methods. All the steps involved in the process of archaeobotanical analysis are crucial for the success of the study.

Therefore, it is important for Lebanese archaeology students to learn about its processes. For example, the process begins with collecting the samples from the contexts. It is important to learn how to extract the samples and which contexts to choose. Then, performing flotation on the samples will ensure the proper collection of the seeds needed for analysis. Before the construction of the flotation machine on the American University of Beirut campus two years ago by Dr. Claire Joanna Malleson, there was no advanced flotation device available on campus for students to interact with and learn more about this method. It was only during some excavations that the students could learn how to use these machines.

What would also be useful to teach students are the different types of plant preservation, and how they survive in the archaeological record. This would educate students, especially in archaeology, about the different types of plant material they might encounter during excavations and what to look for while digging. Being aware of material that could be present at the site is extremely useful in preparing students before going on excavation and will teach them the proper method of excavating when encountering such remains. All archaeologists learn about the different materials present in archaeological sites, such as pottery, lithics, and bones. However, plant remains can sometimes be overlooked as they are not regarded as important and significant as the other material found.

There is general interest from the public as well as Lebanese archaeologists in learning more about archaeobotanical methodologies and what they can indicate about the lives of people in the past. This research has attracted many individuals, including archaeologists, specialists in the field, and even students from other majors. This is an indication that archaeobotany in Lebanon has the potential to thrive and attract people's attention.

One of the ways to attract the audience is to publish articles and papers about the subject, including why it is important to learn about this type of remains. It could also be useful to include information concerning plant remains when explaining the history of Lebanon in general, and the history of each site specifically. Learning about the ways people used plants in the past can elevate the way history is understood and perceived. It is possible to track the way of life as it developed and changed by observing the changes in the archaeobotanical assemblages through the ages.

A similar concept was observed throughout this research. The aim behind this work is to better understand Lebanese sites by observing their botanical assemblages. For Qornet ed-Deir, several theories were discussed concerning the possibility of the site being a permanent or semi-permanent settlement during the Middle Bronze Age, as both the pottery and the botanical assemblage suggest. In addition, when looking at the broader history of Lebanon during this period and the location of the site, it was speculated that Qornet ed-Deir could have possibly been a settlement for wood loggers and oil/resin collectors who worked for the Kingdom of Byblos, which is famous for exporting goods to Egypt.

As for the Early Roman period, it was theorized that the site could have been a domestic settlement used by people exploiting the natural landscape for work, or farmers, based on the architectural remains. During the Late Roman period, the site's type changed, and it became a site of military or administrative importance, as a building with large solid walls was built next to the hill of the settlement. The site seemed to have carried this military importance through the Crusader period, when a fortification system was built to protect the settlement. In the case of these periods, from the Late Roman until the Crusader, the archaeobotanical assemblage was interpreted based on the architectural remains. The theory stemmed from the architecture and structures found, and the plant remains were understood through this lens to complement the archaeology.

As for Tell Kubba, the samples that were collected from the Pre-Pottery Neolithic C did not yield any informative plant remains, which does not indicate a lack of plants in the diet of its inhabitants, only a lack of plant material present in this context. All contexts from this period were burial contexts, which do not always carry relevant botanical material representing the diet or burial practices of the people. It is crucial to get more samples from better contexts from this period, which is very underrepresented in Lebanese archaeology in general, and even more so in archaeobotanical analysis.

As for the Early Bronze Age II-III levels, while the plant remains at the site mostly represent foraged plants. However, that could be inaccurate, as the contexts sampled were described as collapse or wash layers, which are generally not ideal for botanical sampling. Nevertheless, he small number of other cultivated plants could offer an insight into what the rest of their diet looked like, even if they were not found in great quantities. Here, comparing with nearby sites would be useful to note if the assemblage is truly dominated by wild species, or could be a misrepresentation. For example, other EBA sites such as Tell Fadous-Kfarabida and Sidon present mostly cultivated crops such as cereal grains, legumes, and fruits.

The Early Bronze Age III contexts offered a similar scarcity of plant material as the Pre-Pottery Neolithic C contexts. Even though the context samples are from a midden layer, which is usually rich in botanical material, they did not yield a large number of seeds. In addition, most of the seeds found were of an indeterminate type. This layer may be located in an area where activities unrelated to food processing were performed. Even if the context is a midden layer, if the activities taking place are not related to food processing or cooking, then very few remains will be present. Therefore, it is important to sample other areas from the Early Bronze Age III to find out where the food processing activities were taking place.

Concerning Tell Mirhan, the samples taken from the Middle Bronze Age layers represent plant material that would constitute a good diet for people during this period.

However, since the samples were taken from the fortification wall of the fortification, these plant remains cannot be attributed to the Middle Bronze Age. They could have belonged to earlier periods, or they could have come from areas outside of Tell Mirhan.

As for the Iron Age II samples, these provide valuable stratigraphic information from well-defined contexts. The species found could very well represent the diet of the Iron Age people, as the remains were similar to others found at different sites from the same period. For Tell Mirhan, it is theorized that the main crops consumed in their diet were cereal grains, because of the large number of grain seeds found at the site. In addition, the presence of other wild grasses in the assemblage indicates that the cereal grains were cultivated from nearby fields on the coastal plain.

All of these sites benefited from having analyses done on their soil samples. The analyses were crucial to being able to theorize about the type of site it was, and the types of activities people engaged in. In addition, it provided pointers as to where the food processing activities took place at the site, or if other areas should be explored. In Lebanon, since there is not much archaeobotanical data available, even small-scale analyses in which a few key seeds are identified can help further the knowledge of Lebanese archaeobotany and landscape.

In the upcoming excavations in all the Lebanese areas, it is important to start incorporating archaeobotanical analysis as a staple in the methodology of excavating and interpreting a site. Lebanese archaeologists should be trained to collect samples from appropriate contexts and process their remains. Having local Lebanese archaeobotanists that can participate in these excavations and the post-excavation studies will advance the knowledge on these sites immensely, helping to construct the whole reality of the Lebanese diet through the ages.

Having local archaeobotanists will also help in transmitting knowledge to other archaeologists, which will free them from having to rely on foreigners. This can save funds for archaeological projects by allocating the money that would have been spent on exporting these samples to other countries, to support local aspiring archaeobotanists.

The future of archaeobotany in Lebanon is bright. It is beginning to receive more attention, and hopefully, this is the beginning of a long journey to catch up with the rest of the countries that are working hard to uncover the secrets of the interaction between plants and people in the past. It is hoped that this research will inspire other Lebanese archaeologists to take on the challenge of unraveling our country's mysteries.

# BIBLIOGRAPHY

Allué, E., Griffiths, D. (2006) "Identification of Wood from Bronze Age Contexts at Sidon". *Archaeology and History of Lebanon*, vol. 24, pp. 23-33.

Alston, R. (1995) *Soldier and Society in Roman Egypt*. London: Routledge

Asouti, E., Griffiths, D. (2003) "Identification of the Wood Used in the Construction of the "Sunken Room" at Sidon". *Archaeology & History in Lebanon*, vol. 18, pp. 62-69.

Association for the Protection of Jabal Moussa APJM. (2020) *From a Threatened Mountain to a Thriving Protected Area: The Story of Jabal Moussa in Mount Lebanon.*

Association for the Protection of Jabal Moussa APJM. (2023) *Trails and Facilities: Qornet ed-Deir Loop*. Available at: https://www.jabalmoussa.org/trails-facilities. (Accessed: 28 March 2023).

Baas, J. (1980) "Ein bedeutsamer botanischer Fund der Gattung Echium Linne aus Kamid el-Loz. Bericht über die Ergebnisse in Kamid el-Loz". In R. Hachmann (ed.) *Kamid el-Loz 1968-70*. Bonn, Rudolf Hablet Verlag GMBH, pp. 111-115.

Badreshany, K. Genz, H. and Sader, H., Breuer, P., Çakirlar, C., Deckers K. Jungklaus, B., Nader, F., Riehl, S., Rokitta, D., Yanni, S. (2005) "An Early Bronze Age Site on the Lebanese Coast. Tell Fadous-Kfarabida 2004 and 2005: Final Report". *Bulletin 'Archéologie et d'Architecture Libanaises*, vol. 9, pp. 5-115.

Badreshany, K., Sader, H., Philip, G. (2017) "New Neolithic and Early Bronze Age Discoveries at Tell Koubba in Northern Lebanon". *Bulletin for the Council for British Research in the Levant*, vol. 12, no. 1, pp. 74-78.

Badura, M., Rzeźnicka, E., Wicenciak, U., Waliszewski, T. (2016) "Plant Remains from Jiyeh/Porphyreon, Lebanon (seasons 2009–2014). Preliminary Results of Archaeobotanical Analysis and Implications for Future Research". *Polish Archaeology in the Mediterranean*, no. XXV, pp. 487-510.

Baydoun, S.A., Kanj, D., Raafat, K., Aboul Ela, M., Chalak, L., Arnold-Apostolides, N. (2017) "Ethnobotanical and Economic Importance of Wild Plant Species of Jabal Moussa Bioreserve, Lebanon". *Journal of Ecosystem and Ecography*, vol. 7, no. 3, pp.1-10.

Behre, K.-E. (1970) "Kulturpflanzenreste aus Kamid el-Loz. Bericht über die Ergebnisse der Ausgrabungen". In R. Hachmann (ed.) *Kamid el-Loz (Libanon) in den Jahren 1966 und 1967*. Bonn. IV, pp. 59-69.

Boardman, S., Jones, G. (1990) "Experiments on the Effects of Charring on Cereal Plant Components". *Journal of Archaeological Science*, vol. 17, no. 1, pp. 1-11.

Breton, J. F. (1980) *Inscriptions Grecques et Latines de la Syrie. Tome VIII, 3 – Les Inscriptions Forestières d'Hadrien dans le Mont Liban*. Bibliothèque Archéologique et Historique. Paris: Librairie Orientaliste.

Cichocki, O. (2008) "Analysis of Charcoal Samples from Early Bronze Age Strata at Tell Arqa". *Archaeology and History in the Lebanon*, vol. 27, pp. 99-109.

Cichocki, O. (2019) "Synopsis of Investigations on Sidon Charcoal Finds". *Archaeology and History in the Lebanon*, vol. 49, pp. 123-129.

Copeland, L., Wescombe, P.J. (1965) "Inventory of Stone Age sites in Lebanon: Part I", *Mélanges Université St. Joseph*, vol. 41, pp. 1–185.

Copeland, L., Wescombe, P.J. (1966) "Inventory of Stone Age Sites in Lebanon: Part II", *Mélanges de l'Université Saint-Joseph*, vol. 42, pp. 1–174.

Damick, A. (2019) “The First Identification of *Phoenix Dactylifera* (date palm) from Early Bronze Age Lebanon”. *Vegetation History and Archaeobotany*, vol. 28, no. 5, pp. 583-589.

Davies, R. W. (1971) “The Roman Military Diet”. *Britannia*, vol. 2, pp. 122–142.

Day, J. (2013) “Botany Meets Archaeology: People and Plants in the Past”. *Journal of Experimental Botany*, vol. 64, no. 18, pp. 5805-5816.

De Moulins, D. (2009) “Sidon: Grain from the Storerooms”. *Archaeology and History of Lebanon*, vol. 29, pp. 11-15.

De Moulins, D. (2015) “Plant Remains from Middle Bronze Age to Iron Age: Samples of the College Site, Sidon”. *Archaeology and History of Lebanon*, vol. 42, pp. 32-54.

De Moulins, D. (2019) “Early Bronze Age Plant Remains from Sidon’s College Site”. *Archaeology and History of Lebanon*, vol. 48, pp. 16-35.

De Moulins, D., Marsh, A. (2011) “Sidon: Plant Remains from the Middle Bronze Age”. *Archaeology and History of Lebanon* vol. 34, pp. 236-258.

Deckers, K. (2019) “Charcoal Analysis Results from Middle and Late Bronze Age Contexts at Tell el-Burak”. In J. Kamlah and H. Sader (eds) *Tell el-Burak I, The Middle Bronze Age*. Harrassowitz Verlag, Wiesbaden, pp. 369-378.

Deckers, K., Riehl, S., Tumolo, V., Genz, H., Lawrence, D. (2021) “Intensive Olive Production at Levantine Sites. New Data from Fadous-Kfarabida and Khirbet-ez Zeraqon". *Journal of Archaeological Science: Reports*, vol. 36, no. 102841, pp. 1-11.

Doumet-Serhal, C. (2010) “Sidon during the Bronze Age: Burials, Rituals and Feasting Grounds at the "College Site”. *Near Eastern Archaeology*, vol. 73, no. 2/3, pp. 114-129.

Doumet-Serhal, C. (2010) *Jabal Moussa: Archaeological Survey,* Brochure.

El-Hajj, H. (2021) “Monitoring Damage to Cultural Heritage Sites Using Open Source Sentinel-1 and Sentinel-2 Data”. In: C.W. Hess, F. Manuelli (eds) *Bridging the Gap: Disciplines, Times, and Spaces in Dialogue*, vol. 1, pp. 155-171.

Fischer-Genz, B. (2017) “Jabal Moussa - Qornet ed-Deir Archaeological Project: Report on the Stratigraphic Relation Between Contexts and Pottery Collections of the 2017 Season”.

Fischer-Genz, B., H. Genz, N. Elias, Doumet-Serhal, C. (2018) “Report on the 2017 Archaeological Soundings at Qornet ed-Deir, Jabal Moussa Biosphere Reserve”. *Bulletin d’Archéologie et d’Architecture Libanaises/BAAL,* vol. 18, pp. 245–261.

Genz, H., Kopetzky, K., Trappe, M., Schwall, C., Börner, M., Connor, S., Dickey, A., Rom, J., Mardini, M., Weiss-Krejci, E., Sender, C. (2023) “Preliminary Report on the Excavations of Tell Mirhan and a Geoarchaeological Survey in the Hinterland of Chekka (Seasons 2019−2022). Unpublished.

Genz, H., Riehl. S., Çakirlar, C., Slim, F., Damick, A. (2016) “Economic and Political Organization of Early Bronze Age Coastal Communities: Tell Fadous-Kfarabida as a Case Study”. *Berytus*, vol. 55, pp.79-119.

Gyurova D., Arranz-Ortegui A., Richter T., Sagnelli D., Haïdar-Boustani M., Ibáñez J.J. (2016) “The Plant Macroremains from Late PPNB and Early Pottery Neolithic at

Tell Labwe South (Lebanon)". *17thConference of the International Work Group for Palaeoethnobotany (IWGP)*, Muséum National d'Histoire Naturelle, Paris.

Haïdar-Boustani, M., Ibáñez, J., Khalidi, L., Himi, M., Arranz, A., Teira, L. (2012) "New Archaeological Work at Tell Labwe South (Bekaa Valley, Lebanon)". In *PPN7 Conference*, Barcelona.

Haïdar-Boustani, M., Ibáñez, J.J., Arranz, A., Gratuze, B., Himi, M., Khalidi, L. and Teira, L. (2011) "Nouveaux travaux archéologiques à Tell Labwé Sud (Béqaʿ nord) Campagne 2011: Rapport Préliminaire". *Bulletin d'Archéologie et d'Architecture Libanaises/BAAL*, vol. 15, pp. 5-28.

Hajar, L., Khater, C., Cheddadi, R. (2008) "Vegetation Changes during the Late Pleistocene and Holocene in Lebanon: A Pollen Record from the Bekaa Valley". *Holocene (Sevenoaks)*, vol. 18, no. 7, pp. 1089-1099.

Höflmayer, F., Dee, M.W., Genz, H., Riehl, S. (2014) "Radiocarbon Evidence for the Early Bronze Age Levant: The Site of Tell Fadous-Kfarabida (Lebanon) and the End of the Early Bronze III Period". *Radiocarbon*, vol. 56, no. 2, pp. 1-14.

Höflmayer, F., Dee, M.W., Riehl, S. (2019) "The Radiocarbon Dating of the Middle Bronze Age Monumental Building". In: J. Kamlah H. Sader (eds) *Tell el-Burak I. The Middle Bronze Age*. Harrassowitz Verlag, Wiesbaden, pp. 210–226.

Höflmayer, F., Kamlah, J., Sader, H., Dee, M.W., Kutschera, W., Wild, E.M., Riehl, S. (2016) "New Evidence for Middle Bronze Age Chronology and Synchronisms in the Levant: Radiocarbon Dates from Tell el-Burak, Tell el-Dabʿa, and Tel Ifshar Compared". *Bulletin of the American Schools of Oriental Research*, vol. 375, pp. 53-76.

Hitti, P.K. (1965) *A Short History of Lebanon*. Macmillan Publishers, London.

Jacomet, S. (2006) “Identification of Cereal Remains from Archaeological Sites”. *Basel University,* Basel.

Jeffers, D., Willis, K.J. (2014) “Vegetation Response to Climate Change During the Last Interglacial—Last Glacial Transition in the Southern Bekaa Valley, Lebanon”. *Palynology,* vol. 38, no. 2, pp. 195-206.

Jeffers, D., Willis, K.J. (2016) “Landscape Erosion, Karstic Activity and the Development of a Wetland in the Southern Bekaa Valley, Lebanon During the Last Glacial Period”. *Wetlands (Wilmington, N.C.),* vol. 36, no. 4, pp. 593-605.

Kamlah, J., Riehl, S. (2020) “Agriculture in the Bronze Age Levant”. In D. Hollander, T. Howe (eds) *A Companion to Ancient Agriculture*, John Wiley & Sons, Inc. Hoboken, NJ, USA. pp. 193-209.

Karakaya, D., Riehl, S. (2019) “Subsistence in Post-Collapse Societies: Patterns of Agro-Production from the Late Bronze Age to the Iron Age in the Northern Levant and Beyond”. In H. Charaf, L. Welton (eds) *The Iron Age I in the Levant: The View from the North (Part I)*, Archaeology and History in Lebanon, vol. 50/51, pp. 136–163.

Killackey, K. (2002) “Sampling at Catalhoyuk: The Theory and Methodology of Archaeobotanical Sampling”. *UC Berkeley McCown Archaeobotany Laboratory Reports,* vol. 56, pp. 1-53.

Kopetzky, K., Genz, H., Schwall, C., Rom, J., Haas, F., Stark, M., Dremel, F., Börner, M. (2020) “Between Land and Sea: Tell Mirhan and the Chekka Regional Survey”. *Ägypten und Levante*, vol. 29, pp. 105-124.

Lennstrom, H. A., Hastorf, C. A. (1995) “Interpretation in Context: Sampling and Analysis in Paleoethnobotany”. *American Antiquity*, vol. 60, no. 4, pp. 701–721.

Marriner, N., De Beaulieu, J.L., Morhange, C. (2004) "Note on the Vegetation Landscapes of Sidon and Tyre during Antiquity". *Archaeology & History in Lebanon*, vol. 19, pp. 86-91.

Mikesell, M. W. (1969) "The Deforestation of Mount Lebanon". *Geographical Review*, vol. 59, no. 1, pp. 1–28.

Miksicek, C.H. (1987) "Formation Processes of the Archaeobotanical Record". *Advances in Archaeological Method and Theory,* vol. 10, pp. 211-247.

Miller, R. L. (1991) "Counting Calories in Egyptian Ration Texts". *Journal of the Economic and Social History of the Orient*, vol. 34, no. 4, pp. 257–269.

Obase, K., Douhan, G. W., Matsuda, Y., Smith, M. E. (2014) "Culturable Fungal Assemblages Growing within Cenococcum Sclerotia in Forest Soils". *FEMS Microbiology Ecology*, vol. 90, no. 3, pp. 708-717.

Orendi, A., Deckers, K. (2018) "Agricultural Resources on the Coastal Plain of Sidon During the Late Iron Age: Archaeobotanical Investigations at Phoenician Tell el-Burak, Lebanon". *Vegetation History and Archaeobotany*, vol. 27, no. 5, pp. 717-736.

Pritchard, J.B. (1978) *Recovering Sarepta, a Phoenician City: Excavations at Sarafand, Lebanon, 1969–1974, by the University Museum of the University of Pennsylvania*, Princeton.

Rageot, M., Hussein, R. B., Beck. S., Altmann-Wendling, V., Mohammed, M. I., Bahgat, M. M., Yousef, A. M., Mittelstaedt, K., Filippi, J. J., Buckley, S., Spiteri C., Stockhammer P. W. (2023) "Biomolecular Analyses Enable New Insights into Ancient Egyptian Embalming". *Nature*, vol. 614, pp. 1-7.

Riehl S., Deckers K. (2007) “Plant Remains”. In: K. Badreshany, H. Genz, H. Sader (eds) *The AUB Tell Fadous (Kfarabida) Rescue Project - A Preliminary Report on the 2004 Season*. Bulletin d’Archéologie et d’Architecture Libanaises/BAAL, vol. 9, pp. 84-88.

Riehl, S. (2012) “Variability in Ancient Near Eastern Environmental and Agricultural Development”. *Journal of Arid Environments*, vol. 86, pp. 113–121.

Riehl, S. (2015) “Palaeoethnobotany”. In M. Beaudry, K. Metheny (eds) *The Archaeology of Food: An Encyclopedia*. Rowman & Littlefield, Lanham, Maryland. pp. 29–31.

Riehl, S. (2017) “Regional Environments and Human Perception: The Two Most Important Variables in Adaptation to Climate Change”. In F. Höflmayer (ed) *The Late Third Millennium in the Ancient Near East: Chronology, C14, and Climate Change*, Chicago. pp. 237–260.

Riehl, S. (2019) “Barley in Archaeology and Early History”. *Oxford Research Encyclopedia of Environmental Science*. Oxford, United Kingdom.

Riehl, S. (2020) “Stable Isotopes in Ancient Agriculture”. D. Hollander, T. Howe (eds) *A Companion to Ancient Agriculture*. John Wiley & Sons, Inc. Hoboken, NJ, USA. pp. 55–81.

Riehl, S., Deckers, K. (2009) “The Botanical Finds from the 2007 and 2008 Seasons of Excavations”. In: H. Genz (ed) *Excavations at Tell Fadous-Kfarabida: Preliminary Report on the 2009 Seasons of Excavations*. Bulletin d’Archéologie et d’Architecture Libanaises/BAAL, vol. 13, pp. 110-116.

Riehl, S., Orendi, A. (2019) "Archaeobotanical Samples from Middle and Late Bronze Age Contexts at Tell el-Burak". In J. Kamlah and H. Sader (eds) *Tell el-Burak I, The Middle Bronze Age*. Harrassowitz Verlag, Wiesbaden, pp. 360-368.

Riehl, S., Pustovoytov K. E., Weippert, H., Klett, S., Hole, F. (2014) "Drought Stress Variability in Ancient Near Eastern Agricultural Systems Evidenced by δ13C in Barley Grain". *Proceedings of the National Academy of Sciences*, vol. 111, pp. 12348–12353.

Rivera, D., Inocencio, C., Obón, C., Carreño, E., Reales, A., Alcaraz, F. (2002) "Archaeobotany of Capers (Capparis) (Capparaceae)". *Vegetation History and Archaeobotany*, vol. 11, pp. 295-314.

Rom, J., Haas, F., Stark, M., Dremel, F., Becht, M., Kopetzky, K., Schwall, C., Wimmer, M., Pfeifer, N., Mardini, M., Genz, H. (2020) "Between Land and Sea: An Airborne LiDAR Field Survey to Detect Ancient Sites in the Chekka Region/Lebanon Using Spatial Analyses". *Open Archaeology*, vol. 6, no. 1, pp. 248-268.

Roth, J. P. (1999) *The Logistics of the Roman Army at War: 264 BC-AD 235*. Brill.

Serpico, M. (2000) "Resins, Amber and Bitumen". In: P. T. Nicholson and I. Shaw (eds), *Ancient Egyptian Materials and Technology*, Cambridge, pp. 430-474.

Shahrajabian, M.H., Sun, W., Cheng, Q. (2021) "Plant of the Millennium, Caper (*Capparis spinosa* L.), Chemical Composition and Medicinal Uses". *Bull Natl Res Cent*, vol 45, no. 131, pp. 1-9.

Stern, B., Heron, C., Corr, L., Serpico, M., Bourriau, J. (2003) Compositional Variations in Aged and Heated Pistacia Resin Found in Late Bronze Age Canaanite Amphorae and Bowls from Amarna, Egypt". *Archaeometry*, vol. 45, pp. 457-469.

Tanji, A., Nassif, F. (1995) “Edible Weeds in Morocco”. *Weed Technology*, vol. 9, no. 3, pp. 617–620.

Tohmé, G., Tohmé, H.S. (2007) *Illustrated flora of Lebanon*. National Council for Scientific Research, Beirut.

Tohmé, G., Tohmé, H.S. (2012) *Guide des Belles Fleurs de la Reserve de Biosphere du Jabal Moussa*. Association for the Protection of Jabal Moussa APJM, Lebanon.

Tohmé, G., Tohmé, H.S. (2013) *Guide des Arbres: Arbustes, Abbrisseaux et Fougères de la Reserve de Biosphere du Jabal Moussa*. Association for the Protection of Jabal Moussa APJM, Lebanon.

Vaughan, J. G., Judd, P. A. (2003) “Astragalus”. In J. G. Vaughan and P. A. Judd (eds) *The Oxford Book of Health Foods*, Oxford University Press.

Vermeersch, S., Riehl, S., Starkovich B. M., Kamlah, J. (2021) “Developments in Subsistence During the Early Bronze Age Through the Iron Age in the Southern and Central Levant: Integration of Faunal and Botanical Remains Using Multivariate Statistics”. *Quaternary Science Reviews*, vol. 253, no. 106776, pp. 1-20.

Warnock, P. (2007) “Identification of Ancient Olive Oil Processing Methods Based on Olive Remains”. *Bar International,* vol. 1635, pp. 1-95.