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Seeds can speak: functional roles of structures from Early Bronze Age Ib through archaeobotanical investigation at Arslantepe (Turkey).

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Abstract

This thesis illustrates the results of the archaeobotanical study carried out at the long-lived site of Arslantepe (Malatya), Turkey. The study focusses on 131 carpological samples from the village of the Early Bronze Age (VIB2 period, 3100-2900 cal. BCE) destroyed by a fire. The aim of this study was to shed light on the functional roles of structures from Early Bronze Age Ib using plant remains. 63,941 seeds/fruits, including the estimated ones, have been analyzed. This study has identified 15 taxa belonging to 7 plant families. Cultivated species were found together with wild plants and non-economic weeds. The distribution of plant remains in the rooms allows to find out that Building IX inhabitants were mainly specialized in cereal production. This building has been used for crop processing, storing and food consumption. While Building VIII was not a place where crop processing had been practiced. As regards an isolated room A472, inhabitants of this room cultivated not only cereals but also legumes. Based on results, agriculture at Arslantepe was family based.

Key words: Archaeobotany, Arslantepe, Bronze Age, cereals, pulses, crop processing, storage

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Arslantepe is a famous archaeological site in Turkey (see Figure 1). It is located in Malatya Plain, 38°21′N 38°19′E, 912 m a.s.l. (Dreibrodt et al., 2014), approximately 10 kilometers west of the west bank of the Euphrates River (Piccione et al., 2015). Arslantepe has a long history of occupation, starting from Late Chalcolithic (4200 – 3900 cal. BCE) till Iron Age, Neo-Hittite kingdoms (1100- 712 cal. BCE) (Sadori et al., 2006). This site was occupied again in the late Roman age and then was used as "a cemetery in the Byzantine/Medieval Period" (Frangipane, 2012, p. 968).

Figure 1. Geographical position of Arslantepe

Arslantepe is a very well-studied and documented archaeological site. Since 1961, a scientific group from Sapienza University organizes archaeological excavations (MAIAO, Missione Archeologica in Anatolia Orientale) which allow to investigate Arslantepe using multidisciplinary approaches. The literature regarding archaeological findings and ancillary disciplines is quite wide (e.g. Morbidelli & Palmieri, 2002; Sadori et al., 2006; Alvaro, 2012; D'Anna, 2012; Frangipane, 2012; Dreibrodt et al., 2014; Balossi, 2015; Liberotti et al., 2016; Piccione et al., 2015; Vignola et al., 2018;). The archaeological investigation brought to light several settlements belonging to Late Chalcolithic, Early Bronze Age, Middle Bronze Age, Late Bronze Age and Iron Age.

Agriculture is testified since the beginning of site occupation and was the basis of the Arslantepe economy (Balossi et al., 2010). Arslantepe is located in a semi-arid region but the Malatya Plain has abundant springs, for this reason a dry farming agriculture is practiced (Piccione et al., 2015). Agricultural production was based on different proportions of cereals: einkorn, emmer, free threshing wheat and barley in all phases (Sadori & Masi, 2012).

1.1. Research aim

Plant remains have been identified in all cultural layers at Arslantepe. But, as a huge number of archaeobotanical remains preserved via charring have been unearthed in the cultural layer dated back to the Early Bronze Age 1/b (3100-2900 cal. BCE), VIB2 period of Arslantepe, samples from this period have been selected. The aim of this archaeobotanical study is to compare the functional roles of two different areas of a village, namely Building IX and Building VIII using archaeocarpological analysis to track down differences which could be caused by different household's roles and responsibilities in the village. Furthermore, the study provides an opportunity to observe the difference not only between those two areas, but also comparing it with an isolated room A472, located on the east side of the village, probably a part of another not yet excavated building. Based on previous unpublished studies this room played also a very important role in the crop processing and food consumption.

The purpose of this chapter is to present a general overview of archaeobotany in order to understand the basic concepts of the discipline. The chapter will be based on the review of the literature in two sections. The first section introduces archaeobotany, a subdiscipline of botany. This section also takes into consideration the relationship between human culture and plants. The second section is a historical overview of archaeobotany.

In addition, types of archaeobotanical materials and their conservation are discussed.

2.1. Archaeology needs botany

Archaeology is a relatively old scientific discipline which has been started in the 14^{th} century when "scholars began to question the origins of the ancient monuments located throughout the Mediterranean region" (Brewer, 2012, p.2) but officially it was recognized as a discipline in the 20^{th} century. There are many varieties of answers to the question of what the concepts of archaeology are but all the sub-disciplines (prehistorical, historical, urban, modern, social, public, marine) follow the same purpose: reconstruct the past of human beings with three main elements as excavations, material remains and the past (Drewett, 2001).

Archaeology is considered as a sub-field of anthropology (Renfrew & Bahn, 1991; Hicks, 2013). Consequently, this is a tool to reconstruct the cultural and social development of human beings and their ancestors studying cultural materials such as artefacts and ecofacts. Cultural materials carry out a lot of information which contributes to a better understanding of how the life of people was in the past.

Artefacts are not the only specific elements in archaeology helping in the human past reconstruction. A significant help comes from ecofacts that are mostly food refuse such as seeds, bones (Renfrew & Bahn, 1991) or pieces of charcoal, shells and pollen recovered in archaeological contexts. They have a significant role in archaeology because can provide insight on environment, economy, technology.

Agriculture played the main economic role in the early civilizations and its development became a jerk of human progress. Therefore, materials' studying related to agriculture contribute to the reconstruction of a clear and accurate picture of the past. It has been the subject of many discussed and debated archaeological topics. Archaeologists are interested not only in dating plant remains, but also in classifying and quantifying them to comprehend the "evolution of the human – plant relationship" (Gremillion, 1997, p.2) and its influence on cultural changes. Thereby, the archaeology – botany axis (Gremillion, 1997) is not only fruit of an interdisciplinary collaboration, but it forms a new scientific field as archaeobotany.

Archaeobotany is another term of paleoethnobotany, often used as synonims (Miller, 1995). There is a statement that archaeobotany is a more common term in Europe whereas paleoethnobotany is a term used in North America. Comparing definitions of these two terms, both of them are similar inasmuch as both are the study of archaeologically derived plant remains (Ford, 1979; Wright, 2010; Bruno & Sayre, 2017). The role of archaeobotany is to reconstruct ancient vegetation, human influence (Miller, 1995) and human–plant interrelationships (Wright, 2010) enricheing our understanding of how people lived in a specific period of time.

2.2. The roots of archaeobotany

First archaeobotanical studies were focusing on the origin of agriculture and on the study of plant remains from prehistoric periods.

Carl Sigismund Kunth, a German botanist, is considered the father of archaeobotany because he was the first botanist who studied botanical remains from archaeological contexts in the 19th century (Pearsall, 1989). Later, the Swiss naturalist, Oswald Heer, studied waterlogged materials from perilacustrine settlements of the Bronze age (Pearsall, 1989) and his first paleobotanical paper was published in 1851, before *"Flora tertiaria Helvetiae"* in three volumes was published (Heer, 1883).

At the beginning of the 20th century, there were more publications dedicated to plants studies from other European countries. Only in the second half of the 20th century, archaeobotany became popular among scholars. In addition, the Near East was a new geographical area where that discipline was used for studying plant remains from archaeological sites (Renfrew, 1973; Pearsall, 1989).

Today, archaeobotany is widespread; furthermore, this is a tool to investigate information about the origin of agriculture, plant domestication, resource availability, use of domestic place, plant processing, socioeconomic changes, environmental changes, biodiversity, seasonality, diet and social status.

2.3. Archaeobotanical materials and taphonomic processes

Two archaeobotanical categories of plants are known as macro-remains and micro-remains.

Macro-remains are all the plant remains visible with the naked eye or under minimal magnification (Weathers, 2007). Seeds, fragmented plant parts, woods, nutshells and fruits are the most common archaeobotanical macro-remains. Flotation, screening or hand collecting in situ during excavation (Wright, 2010) are the methods of recovering macro-remains from archaeological contexts.

By contrast, micro-remains are too tiny so that they are not recognized with the naked eye, they are studied only under microscope magnification (Wright, 2010). Pollen, phytoliths and starch grains are common micro-remains. The heterogeneity of the remains requires a specialization among specialists. Usually archaeopalynology is considered a separate branch and an independent scientific discipline belonging to paleopalynology, "used to reconstruct the history of vegetation through time and past climate/environmental conditions" (de Vernal, 2014). Phytoliths are glassy inorganic micro-remains produced by plants that can be identified thanks to the particular morphology (Neumann et al., 2017). As pollen and phytoliths, starch residues, recovered in specific contexts related to human presence, allow the identification, which is useful for diet reconstruction, and for exploring agricultural beginning and ancient technologies (Copeland & Hardy, 2018).

There are different preservation states of plant macro-remains. All plant remains deteriorate, with the exception of some special conditions that preserve the remains. The most common ways of preservation are defined as carbonization, mineralization, waterlogging, desiccation and freezing with different extent of preservation according to the environmental condition, such as the pH (Day, 2013).

Most archaeobotanical remains are charred (Renfrew, 1973) due to the high frequency of fires in the past (Dimbledy, 1967; Turney et al., 2005). Experiments of heat treatment done by scholars demonstrate that shape, size and proportions of materials are partially changed due to the carbonization process (Boardman & Jones, 1990; Gustafsson, 2000; Renfrew, 1973; Märkle & Rösch, 2008) . It should be considered that many factors influence the final product of the carbonization. Temperature and duration of exposure play a very important role as well as chemical content and amount of moisture in the remains (Wright, 2003). For instance, the result of the experiment made by Renfrew (1973, p. 10 – 13) shows that the length of the cereal grains decreases once charred; on the other hand, the breadth of the grains increases. Thickness of the *Triticum* decreases; while for *Hordeum* it increases. The dimensions of prehistoric carbonized cereal grains are significantly different from their modern counterparts. The different size of cereal grains in the past can be only inferred by charred grains (see Table 1). Moisture also affects the grain, a different experiment shows that if the moisture percentage is lower, carbonized grain size is more representative (Stewart & Robertson, 1971). Moreover, moisture influence the grain width, changes from 11 % to 15 % of moisture clearly affect the size of different taxa (see Table 2).

Table comparing the dimensions of prehistoric cereal grains with those of their modern counterparts

	mm	mm	mm
***Triticum monococcum* – einkorn wheat**			
prehistoric, carbonized	5.18	2.25	2.34
modern, fresh	7.46	1.89	3.24
modern, carbonized	6.87	2.62	3.01
***Triticum dicoccon* – emmer wheat**			
prehistoric, carbonized	5.71	3.06	2.74
modern, fresh	7.29	2.72	2.77
modern, carbonized	6.67	3.52	2.69
***Hordeum vulgare* – hulled six-row barley**			
prehistoric, carbonized	5.3	3.1	2.5
modern, fresh	7.81	3.55	2.68
modern, carbonized	7.2	3.94	3.11
***Hordeum vulgare* var. *nudum* – naked six-row barley**			
prehistoric, carbonized	5.2	2.58	1.97
modern, fresh	7.3	3.12	2.21
modern, carbonized	6.49	3.41	2.97

Table 1. "Table comparing the dimensions of prehistoric cereal grains with those of their modern counterparts" (from Renfrew, 1973)

The effect of moisture percentage on the size of carbonized grain

	Per cent change following carbonization			
	11% moisture		15% moisture	
Grain	Width	Length	Width	Length
T. dicoccon	0 – 6 >	0 – 50<	50<	33 – 55<
T. monococcum	0 – 6 >	33<	0 – 6<	33 – 50<
T. aestivum	12 >	0-6<	12<	25 – 33<
H. distichon	6 >	0-12<	12<	50<
H. vulgare	0 – 6 >	25-33<	12<	50<

Table 2."The effect of moisture percentage on the size of carbonized grain" (from Stewart & Robertson, 1971)

Mineralization occurs due to minerals carried in solution (Jacomet, 2007) that replaced degradable substances (Murphy,2014). Calcium carbonate and silica are common for mineralization. Chemical analysis and X-ray diffraction has brought to the light that the particular archaeobotanical remains had been replaced by calcium phosphate (Green, 1979). In addition, there are also mineralization caused by metal materials such as bronze and iron (Jacomet, 2007). Fine sieving is a good recovering method for mineralized plant remains.

Archaeological deposits preserved underwater provide remains preserved by waterlogging. Waterlogged macro-remains are usually very well preserved due to the anaerobic conditions and slow action of humic acid (Renfrew, 1973). It is very common in temperate regions while quite rare in European Southern countries or in the Near East. The waterlogging process occurs only if the contexts reach the groundwater or sea-level and preferably with low temperature. Although charred remains are better preserved in well-drained soil, they can be recovered also in waterlogged conditions (Jacomet, 2012). Submerged coastal areas, lakeshore dwellings and wells are more common for waterlogged materials. There are also cases when waterlogged preservation was in the stomach content of human corpses (Zohary & Hopf, 2000). These archaeobotanical remains are heavier than carbonized or mineralized material because those remains absorb water; therefore, they do not change in size. The waterlogged botanical remains should not be dried because it will be a result of the complete destruction of plant remains. These remains have to be stored in wet conditions. Therefore, wet screening and sieving or wash-over technique are the best method for recovering waterlogged materials (Tolar et al., 2010; White & Shelton, 2015).

Arid climate preserves archaeobotanical materials in the very original state because it blocks fungal and bacterial decomposition process (Zohary & Hopf, 2000) for the absence of water. This state of preservation is known as desiccation or “mummification” (Renfrew, 1973). There are a lot of cases of desiccated remains in arid areas. In Egyptian contexts many grains, vegetables and fruits were found in the desiccated state of preservation. Leaves and flowers were also very well preserved in Egypt and hardly preserved in other conditions (Zohary & Hopf, 2000). Humidity is the main problem for desiccated botanical remains. Materials should not absorb moisture otherwise the degradation process, blocked by the water lack, will start again (Pearsall, 1989). Due to this fact, fine sieving is the best recovery method for desiccated remains as well as for carbonized.

Mummification by freezing mainly has been found in the cold regions. Low temperature is the result of good state of preservation. Moreover, cold environment is beneficial for plant DNA survival (Schlumbaum, 2007). For example, samples from the colon and ileum of the Neolithic glacier mummy from the Alps have been analyzed (Rollo, 2002). Fine-sieving as well as in situ hand collection are good methods for recovery.

The archaeological site of Arslantepe rises in the Malatya Plain. Arslantepe is an artificial settlement hill 30 m high and 4.5 hectares wide (see Figure 2). It gets its name, Arslantepe, from the Turkish language: "tepe" means mound and "arslan" means lion, "the lion's mound"; the name is due to the fact that lion statues were recovered on the hill. Excavations on this site allowed to explore the history of the settlement for thousands of years.

Figure 2. Arslantepe. Retrieved from http://www.arslantepe.com/en/.

Climate

The Malatya plain is located in a semi-arid environment with a very reduced precipitation (ca. 400 mm per year). Physical and environmental studies point out that there are ground water flows that allow the high soil moisture content of the plain (Marcolongo & Palmieri, 1983). For this reason the plain is widely cultivated and watered today as it was in the past (Sadori & Masi, 2012).

Stable carbon isotope analyses carried out on plant remains (Masi et al., 2013a, 2013b; Vignola et al., 2018) illustrate climate changes in the Arslantepe history. It shows that there were times of enhanced/reduced precipitation. Two dry events happened at Arslantepe. The first one was in the Late Chalcolithic 5, the second was in the Early Bronze Age 3. Agricultural pressure occurred in the Early Bronze Age 1/a (see Table 3).

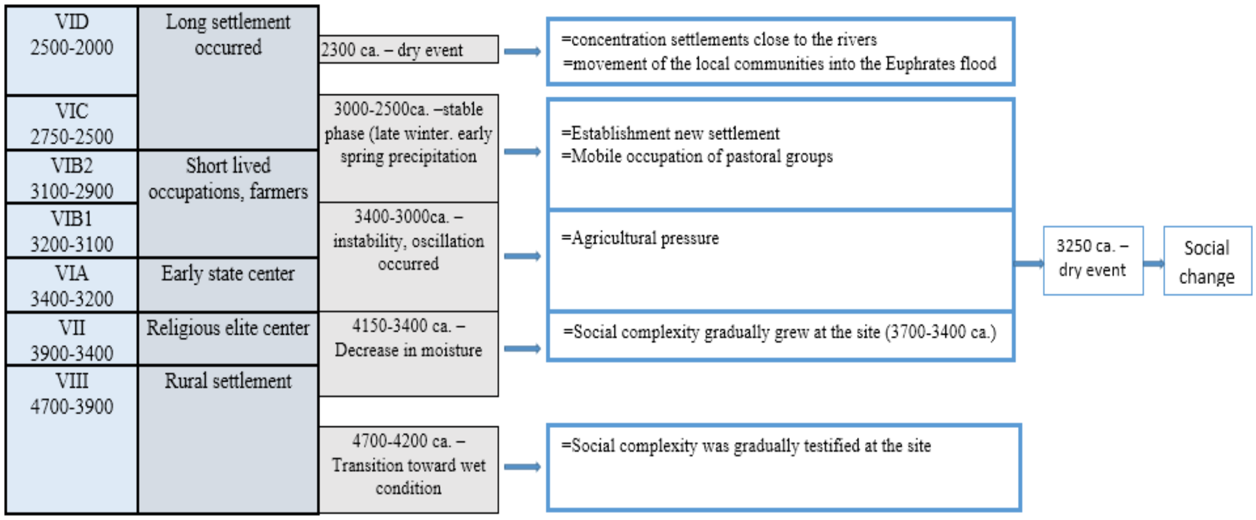


Table 3. Graphic summary of the paper (Vignola et al.,2018) assessing mid-Holocene climate fluctuations and human responses.

Past vegetation inferred by plant remains

Archaeobotanical materials allowed reconstructing the vegetation history around Arslantepe. The results of charcoal analysis allowed identifying two main ecological plant groups around Arslantpe. The first group is characterized “by woody steppe elements” which are very abundant during VI B1 (3200 – 3100 cal. BCE), VI B2 (3100 – 2900 cal. BCE) and VI C (2750 – 2500 cal. BCE) periods and were located in the surrounding. The second group is characterized by “hydrophilous elements” which are common for the Late Chalcolithic, VIA (3400 - 3200 cal. BCE) period and the Early Bronze Age 3, VID (2500 – 2000 cal. BCE) period located in the plateau (Masi et al., 2011, p. 94).

3.1. Archaeology of Arslantepe

The first interest in studying the history of Malatya was in 1894 when several carved slabs were discovered. Von der Osten drew a topographical map of the mound in 1927-1928 during his trip to Asia Minor (Corrado, 2012). The roots of archaeological investigations and excavations of Arslantepe date back to the 1930s (Frangipane, 2012). The French archaeologist and ittitologist Louis-Joseph Delaporte led the first archaeological works on the northeastern side of Arslantepe. The main attention was paid to the building structures and well known “Lions Gate” and its basreliefs; moreover, there was long discussion among researchers to which period does that gate belong. As cited by Dussaud, only in 1939 it was proved that the “Lions Gate” belongs to the Neo-Hittite period (Dussaud, 1944, p.121). Thereby, the earliest archaeological works were devoted mostly to the Iron Age period.

Frangipane (2012) clarified that due to the World War II, archaeological works were stopped. Later on, C. Schaeffer resumed excavations (Alvaro, 2012) with a duration of 2 years (1949-1951), but those excavations were less effective (Frangipane, 2012). After that, Arslantepe was not digged for 10 years. Archaeological investigations were resumed only in 1961 by the Italian team of archaeologists from La Sapienza University of Rome. The archaeological works started under the directorship of Prof. S. M. Puglisi; later, excavations were led by Prof. A. Palmieri. Since 1990 the archaeological works have been led by Prof. M. Frangipane, who is still the director of the archaeological expedition.

The Italian team works at Arslantepe already 58 years. The team studied not only the Iron Age period and brought to light archaic cultural layers such as Bronze and Chalcolithic Ages; in addition, multidisciplinary approaches have been applied.

The Italian team re-excavated the same north eastern area which was studied before by French archaeologists. But later the area of excavation was expanded, southwestern area was chosen due to the fact that “the oldest formations are free of the consistent Hittite and Neo-Hittite level which lie over the north-eastern area” (Frangipane & Palmieri, 1983, p.288). In 2008 north-east zone again was resumed already using new methodology (Frangipane, 2012).

3.2. Arslantepe chronology

The archaeological site of Arslantepe was dated not only by relative dating but also by hundreds of conventional and AMS ^{14}C dating. Dendrochronological dates have been also obtained. Charred seeds and fruits were recently used in order to obtain more precise dates. Seeds and fruits represent the last phase of use of each layer; therefore, this is the best way to distinguish sub-phases in detail. The beta counting results gave younger dates in comparison to the AMS results (atom counting), for example, Early Bronze Age I resulted to be earlier than what previously obtained with the beta counting method (Vignola et al., 2019).

General chronological sequences of Eastern Anatolia	Arslantepe periods	Date cal. BC
Late Roman and Byzantine age	I	
Iron Age	II-III	1100-712
Late Bronze Age 2	IV	1600-1200
Late Bronze Age 1	VB	1750-1600
Middle Bronze Age	VA	2000-1750
Early Bronze Age 3	VI D	2500-2000
Early Bronze Age 2	VI C	2750-2500
Early Bronze Age 1/b	VI B2	3100-2900
Early Bronze Age 1/a	VI B1	3200-3100
Late Chalcolithic 5	VI A	3400-3200
Late Chalcolithic 3-4	VII	3900-3400
Late Chalcolithic 1-2	VIII	4700-3900

Table 4. Chronological sequence of occupation at Arslantepe.

Late Chalcolithic

The Late Chalcolithic is the oldest documented period of occupation at Arslantepe. The Late Chalcolithic has three phases at Arslantepe named VIII, VII and VI A periods. The first and the – up to today - earliest sequence (VIII) is dated back to 4700-3900 cal. BCE. This period is also considered as the end of Ubaid culture. There were found "3 superimposed building levels" where equipment for cooking food was preserved (Frangipane, 2012, p. 971). The size of the settlement was probably 1.6 hectares (Corrado, 2012).

The next period (VII) is dated to the beginning - mid of fourth millennium BCE (3900-3400 cal. BCE). The area of occupation is bigger in that period than in period VIII. Frangipane (2012) highlights that "the settlement… covers the whole surface of the present mound" (p.972). Alvaro (2012) documents that "new enlargement area was built directly above the virgin soil and reached an extension of 3.5 hectares" (p. 350). In addition, this phase has better illustration of spiritual and material culture. Archaeologists found out that people were buried underneath of the floors or very close to the house. There were buildings built of mudbrick walls over 1 meter thick with the traces of painting on the walls. Those buildings are considered as elite structures. A Ceremonial building (Temple C) with tripartite floor plan was also a key element of VII period (Balossi, 2012; Frangipane, 2012).

The last phase of Late Chalcolithic period is VIA, dated to 3400-3200 cal. BCE. This period was the time of state formation (Angle et al., 2002; Balossi Restelli, 2012). Frangipane (2012) describes this phase as a period of centralization, “economic and political centralization reached its climax” (p. 974). Two temples were located in the new complex. The total dimension of the public area was approximately 2000 m^2 (Balossi, 2012).

Bronze Age

At Arslantepe the Bronze Age period is dated to 3200-1200 cal. BCE. This period is tripartite (see Table 4). At the beginning it has been occupied by pastoralists (VI B1 Arslantepe period) but later it became again a permanent residence for people (VI B2). During that period people reestablished settlement, agricultural village was formed with new houses; in addition, a new political system had been installed. Both settlements of Early Bronze Age 1 (VI B1 and VI B2 periods were destroyed by fire. The next period, Early Bronze Age 2 (VIC, 2750-2500 cal. BCE) was occupied once more by nomad people, who stayed at the site seasonally. Archaeologists found that there was absolute cultural change in the Early Bronze Age 2. Investigation was based on analysis of houses’ shape, pottery features and domestic equipment which were the evidence of “fragmentation of groups and pronounced provincialism” (Frangipane, 2012, p.984). Already in the Early Bronze Age 3 (VID, 2500-2000 cal. BCE) the settlement expanded in consequence of population increase. In that period Arslantepe became again a key center in the Malatya Plain.

The Middle Bronze Age (VA, 2000-1750 cal. BCE) had only one occupation level. The Middle Bronze Age settlement was superimposed to the Early Bronze Age 3 one. Frangipane (2012) describes this phase as continuity of architectural and material culture of the Early Bronze Age 3 while there were some changes such as new classes of wheel-made ware. The architecture was not very well preserved due to the fact that buildings were near to the top of the mound, also due to “later terracing operations” (p. 985).

The next period was Late Bronze Age; this period represents two periods. The first period is Late Bronze Age 1 (V B, 1750-1600 cal. BCE). This occupation was very short and affects the south-western slope of the mound. The structures were built on terraces (Frangipane & Palmieri, 1983). A town gate with two bipartite quadrangular towers was built at the end of Late Bronze Age 1 and was interpreted as influence of the eastward-expanding Hittite state (Frangipane, 2012).

The next sequence was the Late Bronze Age 2 (IV, 1600-1200 cal. BCE) which was not described in detail. The gate of the town was also the same as the gate of previous phase but Frangipane (2012) has pointed out that there was different ground plan of the gate.

Iron Age

Iron Age (II-III) dates back to 1100-712 cal. BCE. This phase was studied earlier by Louis-Joseph Delaporte mainly by concentrating on the famous “Lion Gate” built during Neo-Hittite period (Iron Age). In 2016 new discoveries belonging to this phase were made. Amongst these, the archaeologists found out a plaque made of ivory.

Roman – Byzantine- Islamic periods

The Arslantepe sunset is assumed to be happened in 712 (when the site was occupied by the Assyrian army of Sargon II). Occupation of Arslantepe steadily declined after the conquest of the Malatya Kingdom by Sargon II, later it was abandoned. As it is written on the official webpage of Arslantepe site[1], “Arslantepe was used as the headquarters” when Romans arrived to Malatya region. During Byzantine and Islamic period, there was a necropolis; in addition, “a small Ottoman building was found on the northern edge of the mound”.

3.3. VI B2 – Early Bronze Age 1/b – focus of this study

Early Bronze Age 1 had two periods during this short time (3000-2750 cal. BCE). The first period is VI B1, and the second one is VI B2 (see Table 4). Seasonal settlements were common for the VI B1 period which were used by pastoralists. People used to live in “sub-quadrangular huts with wattle and daub walls coated with mud”; furthermore, handmade pottery was popular in that phase (Frangipane, 2012, p. 981).

In contrast, VI B2 is an important period at Arslantepe. Use of mudbrick constructions and wheel made pottery of local and Uruk origin are found. Pottery shape became more diverse but typological features were used as in the earlier previous period, the VI A. The knowledge of pottery making with the earlier typological features were preserved due to the fact that there were sedentary inhabitants on the other areas of the plain who co-existed with pastoralists. It was

[1] Official webpage http://www.arslantepe.com/en/i/

supported by the finding of similar fragments of pottery in period VI B1, which were common for the VI B2. The VI B2 is a period in which a new type of power and new political system appeared (Frangipane, 2012).

Domestic activities mostly took place in the small mud-brick dwellings which were located in the village settled outside the great wall along the slope of the mound (Frangipane, 2012). People lived in small families, as suggested by the house dimensions and by the fact that the capacity of the majority of vessels is less than 10 liters. There were vessels found with a capacity of more than 10 liters in some residential complexes. They were interpreted as used only for some special meals. But there were not anymore vessels with up to 18 liters capacity, common in the Late Chalcolithic period (Piccione & Lemorini, 2012).

Houses of the VIB2 period were very well stocked because many storage vessels were found in each house. Storage vessels had different shapes based on the purposes of use. Piccione and Lemorini (2012) found out that dry food as legumes was found mostly stored in the "burnished handmade wide-mouthed containers" (p. 285). Botanical remains found on the streets suggest that cereals were not stored only in the rooms (storage vessels) but probably they were also stored in the attic spaces (Piccione & Lemorini, 2012).

The VI B2 settlement was destroyed by fire and suddenly abandoned (Piccione et al., 2015). Specialists believe that the fire became a reason why this phase was very well preserved because it "created conditions that sealed in a remarkable amount of archaeological material" (Piccione & Lemorini, 2012, p. 280).

The research was carried out in the laboratory of Archaeobotany and Palynology of the Department of Environmental Biology at Sapienza - University of Rome. The study has been based on carpological analysis of charred remains from the VI B2 period of Arslantepe, Turkey. Archaeobotanical studies of this archaeological site were carried out since the 1980s by many researchers and students (Follieri & Coccolini, 1983; Sadori et al., 2006; Sabato, 2010; Balossi et al., 2010; Sabanov, 2018). Such a huge amount of materials could not be studied by single persons; excavation at the site is still ongoing and new remains arrive to the laboratory every year.

4.1. Materials and context

Two types of botanical samples were studied. The first type was a group of samples already sieved, separated from its sediment. The second type was the original soil in which carpological remains still were in their sediment. So, they underwent subsampling, sieving, before sorting light and heavy fractions, identification and counting. Within this study, 131 samples have been studied coming from 12 different contexts of VI B2 period.

Analyzed plant remains were recovered starting from the 1977, then in 1979, 1982, 1983 and 1985. All plant remains of this study are coming from the village of the VIB2 period. Recovered plant materials were always preserved by charring, due to the fire which caused the village destruction. An of area1500 m^2 was excavated. The common characteristic of village structures is mudbrick walls with stone foundation used for room construction. The settlement was annihilated by a total destruction (Piccione et al., 2015). Actually, fire has not always negative effects to the artifacts and ecofacts preservation. Not only charred seeds have been discovered in the rooms of the village but also storage vessels and artefacts indicating crop processing. Moreover, based on these finds, agricultural practices have been reconstructed in the village of the VIB2 period (Balossi, 2010).

The contexts have been chosen to complete the carpological studies from this period; moreover, focus was made on the south houses of the excavated area. Plant macroremain samples are from room A475, A108, A166, A170, A175, A177, A179, A200, A153, A167, A274. Besides rooms, street (A324) next to the north-eastern corner of the room A167 and the pit K416 were studied too. Some rooms have been grouped in the buildings in order to shed light to functional roles. It was done for wider observations and concise interpretation. That is why rooms A108, A166, A170, A175, A177, A179, A200 are considered as Building IX, rooms A153, A167, A274 constituent Building VIII and only one isolated room A472 is considered as individual area (see Figure 3).

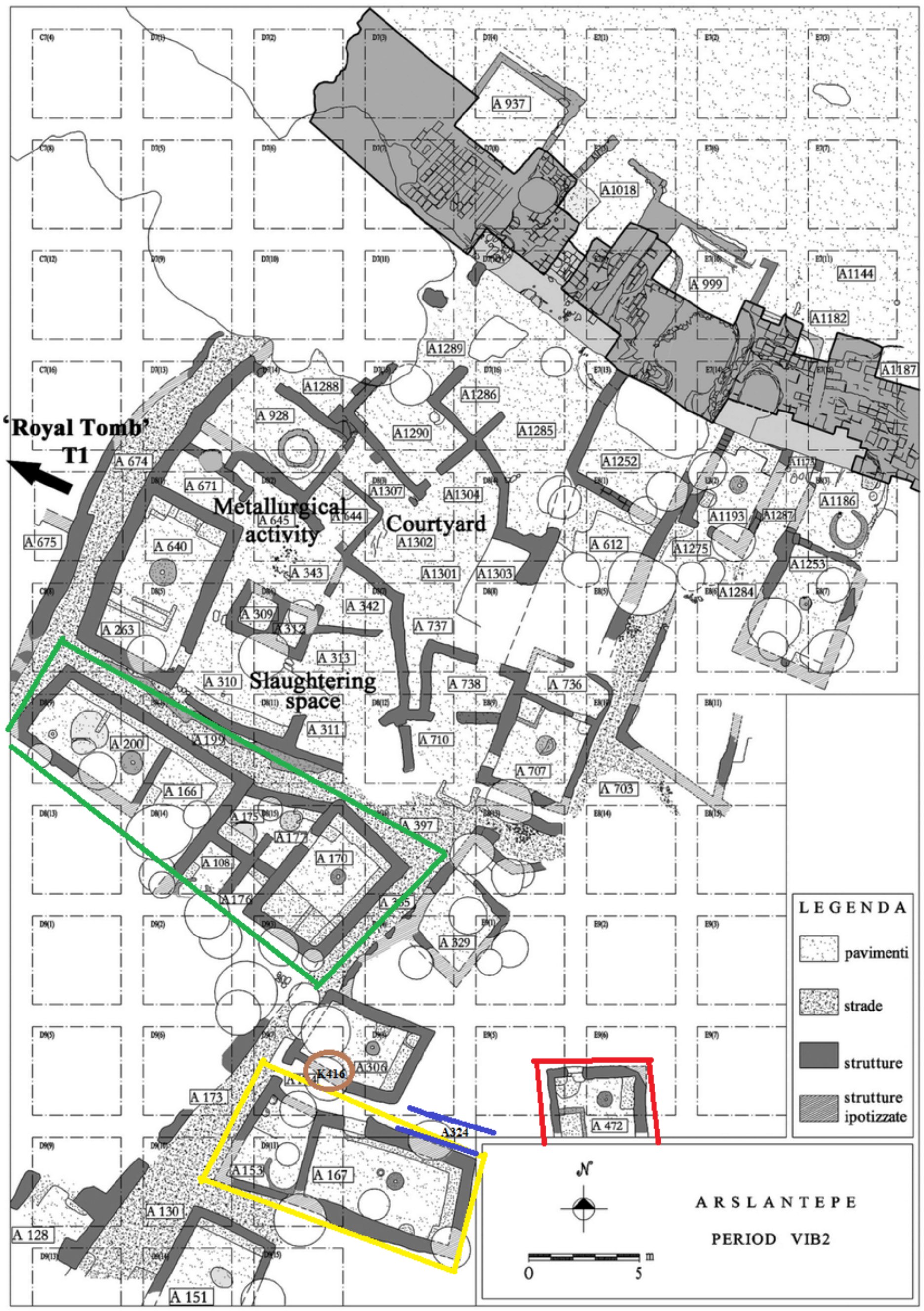


Figure 3. Arslantepe, plan of the excavated area of the VI B2, late phase Building IX is marked by green line, Building VIII by yellow line, room A472 by red line, brown circle is pit K416, the blue lines indicate the street area A324.

Room - A472

Room A472 was located in the south-eastern side of VI B2 village, it is not connected to any other rooms, at least on the already excavated. The room has a rectangular shape. There was a circular hearth with a diameter of 67 cm (Balossi, 2015) and platforms inside of the room. Twenty-one storage vessels, sometimes containing cereal grains were found out in this room. Many different ceramic varieties were excavated in the room. Besides ceramic artifacts such as vessels and jars, there were also many macro-lithic tools like flint blades, pounders, a hammer, a grinder, a grinding slab and a grinder-pestle (Piccione & Lemorini, 2012). Archaeobotanical remains of this room had been partly examined; forty more samples were studied.

Building IX

The building IX (see Figure 4) was composed of 7 rooms; it was located on the south-western side of the settlement. Archaeobotanical remains were recovered in 6 out of 7 rooms of the building and one raised area in the room A170. The building, an elongated rectangle, has few internal passages from one room to another. Architecturally it looks as one structure, but it is made by two houses, which are divided by a wide wall. Therefore, this building had two sides. The eastern side (side A) consists of rooms A170, A177, A175, A108 and a working surface in room A170 named A179. The rooms A 200 and A166 belong to the west side of the building, named side B.

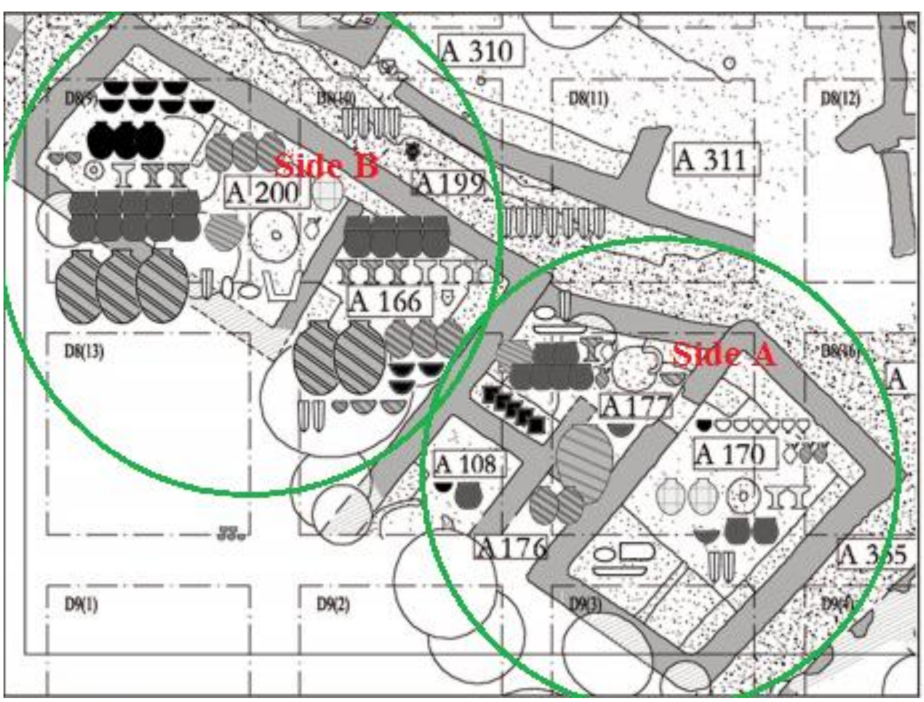


Figure 4. Arslantepe, plan of the Building IX of period VIB2. Green circles divide the two houses. This figure also represents the recovered pottery remains and lithic tools found in situ (Piccione & Lemorini 2012).

Room – A170

The room A170 was excavated till 1985. Room A170 is a large room, with a hearth in the center. A flint insert for a threshing sledge and flint blades for harvesting have been recovered. Frangipane and Palmieri (1983) described this area as a room featured by "a fireplace with a rimmed concavity in the middle and clay benches" (p. 530). Room A170 does not have an outdoor, there is only one pass leading to another smaller room A177. Only 6 samples were analyzed from this room. It should be noted that many samples from the room A170 have been already studied (Piccione & Lemorini, 2012).

A raised area – A179

Inside the room A170, there was a raised surface along the southern wall on which several tools have been recovered. Archaeologists found out a stone slab, a pestle part, a flat muller. Considering findings, archaeologists claim that this area was used for cereals' handling (Frangipane & Palmieri, 1983). Only one sample has been studied within this study. The grains were recovered in 1979.

Room – A177

A177 is the room that led to A170. There is a bench with a shallow pit for cereals attached to the north-eastern corner. Piccione and Lemorini (2012) suggest different uses: in the room A170 ceramics were used for serving and consuming food, while in the room A177, pots and jars were used for cooking and storage. Thirty samples of various sizes were analyzed.

Room A 175 and Room A108

` Room 175 was considered as a part of the room A177 (Frangipane & Palmieri, 1983). There was one bench adherent to the southeastern wall. Next to that bench, there was a shallow pit for cereals. Nineteen samples were analyzed.

Room A108 was not mentioned by Frangipane and Palmieri (1983) and in other articles where Building IX was described. The room is small; it does not have any passages to other rooms because there is a wall between A108 and A175. An oven was placed in the south-western corner. The oven has a diameter of 118 cm with an opening of 50 cm (Balossi, 2015). Only one sample was examined.

Room A200

Room A200 is located in the opposite side (western wall) of the house. There was a navel round hearth with a diameter of 100 cm near the eastern wall of the room. A stone mortar, a pestle, and flint insert of a threshing sledge were found there. In addition, a small pit was near the hearth which was "full of remnants of burnt straw, probably produced when the cereals were cleaned" (Frangipane & Palmieri, 1983, p. 534). All those findings suggest that this room also was used for crop processing, as room A170. This suggests that probably Building IX consisted of two different houses because each house had its own room for processing grains. There is a large assemblage of cooking pots, storage jars and vessels for service and consumption (Piccione & Lemorini, 2012). The room A200 has a connection with room A166. Nine samples have been analyzed.

Room A166

A166 is the room adjacent to A200. This room was only partially preserved. The ceramic assemblage is almost the same as in room A200. Twenty storage vessels were recovered in rooms A166 and A200 together. In total, thirteen archeobotanical samples were investigated in room A166. The samples have been recovered in 1979.

Building VIII

The Building VIII is located South East of Building IX. It was made of 2 rooms (see Figure 5). The smallest room is A153. The biggest room has three floors; which were documented with separate labels. The A167 is followed by A274 and then by A326. Within this study, only samples coming from the layers A167 and A274 were studied.

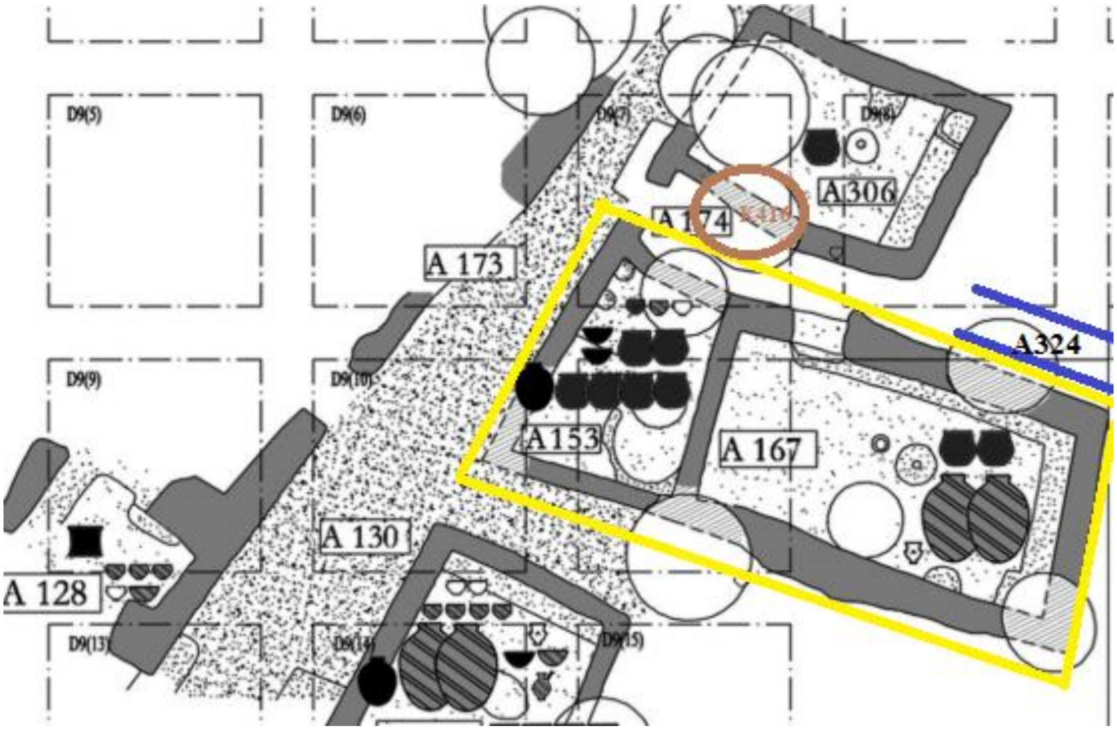


Figure 5. Arslantepe plan of the excavated area of the VIB2, late phase Building VIII is marked by yellow line, brown circle is pit K416, the blue lines indicate the street area A324

<u>Room –A167 –A273</u>

The room has a rectangular shape. Benches along the eastern and northern walls were placed in the room. There was a hearth with a diameter of 74 cm (Balossi, 2015) in the middle of the room. Frangipane and Palmieri (1983) document that hearth was "with a protruding rim and a small rimmed concavity in the center" (p. 530). As pointed in figure 5, cooking pots, a wide mouthed jar (large) and a jarlet were found but there were no stone materials in this room. Ten samples from A167 and two samples from A274 were examined.

<u>Room – A153</u>

Room A153 has a trapezoid plan. Although the room is adjacent to room A167 there is no direct connection between them. A semicircular oven with 144 cm of diameter was discovered there, positioned in the south eastern corner (Frangipane & Palmieri, 1983; Balossi, 2018). The remains of cooking pots, necked jar, bowls and cups were lying in this room. One sample was studied.

<u>Street Area – A324</u>

A324 is the continuation of a small street outside A167 (A174). Only sample comes from this area.

Pit – K416

K416 is a pit cut of A306 room. It is not in phase with the room. This pit appeared later but it is still dated to VIB2 on the basis of the materials. Two samples have been analyzed within this study.

4.2. Methods

Sampling and field recovery

Sampling strategy is essential to obtain representative samples and to avoid loss of materials. At Arslantepe, soil samples are collected from every room and dry sieving is used to extract botanical remains. Flotation cannot in fact be applied because causes deterioration of charred plant remains. Botanical remains were always hand-picked if visible to the naked eye. The rest was separated from the soil by dry-sieving. A progressive archaeological number was given to all samples on the field too. Later, when samples were delivered to the laboratory, they were registered and inserted into a database.

Sub-sampling in the laboratory

Only one sample was subsampled due to its amount, all the other ones were completely analyzed or had been already subsampled on the field. The original bags recovered from the field were subsampled to ¼. Sample was measured by volume, for this reason ration calculation was used in counting process. Subsampling was made with a handmade riffle box at the initial stage.

Plant taxa identification

Due to the fact that samples were macro-remains, morphological traits of carpological remains were identified by naked eye. A fine paintbrush was used as an instrument for sorting and gently moving seeds that are fragile. In addition, when necessary, the samples were examined using Leica M205C stereomicroscope (see Figure 6) capable of 16:0.78 zoom, 8x to 100x magnification and up to 864 lp/mm resolution. Stereomicroscope was used mostly for fragments and for not very well preserved grains.

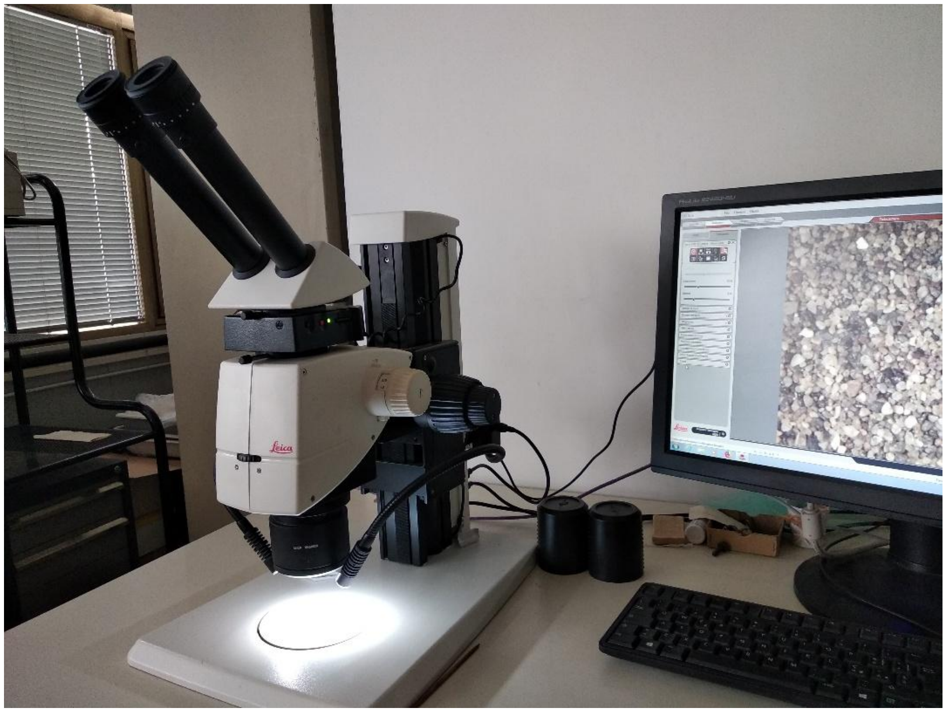


Figure 6. The Leica M205 C stereomicroscope used for taxa identification and photographic documentation.

Moreover, high-quality photographs were taken using the microscope and the Leica IC80 HD camera connected with the program Leica Application Suite (4.5.0). In order to avoid problems of depth of field and to have the whole seed in focus, Helicon Focus software (6.6.1 Pro) was used to merge 5 to 8 photos of the same sample with different focuses (see Figure 7). Based on the remains' size, different magnification was used for taking photographs. The photographs were edited with Adobe Photoshop to remove fine grains of sand, which was used for holding seeds in the required position for taking photos of ventral and dorsal sides.

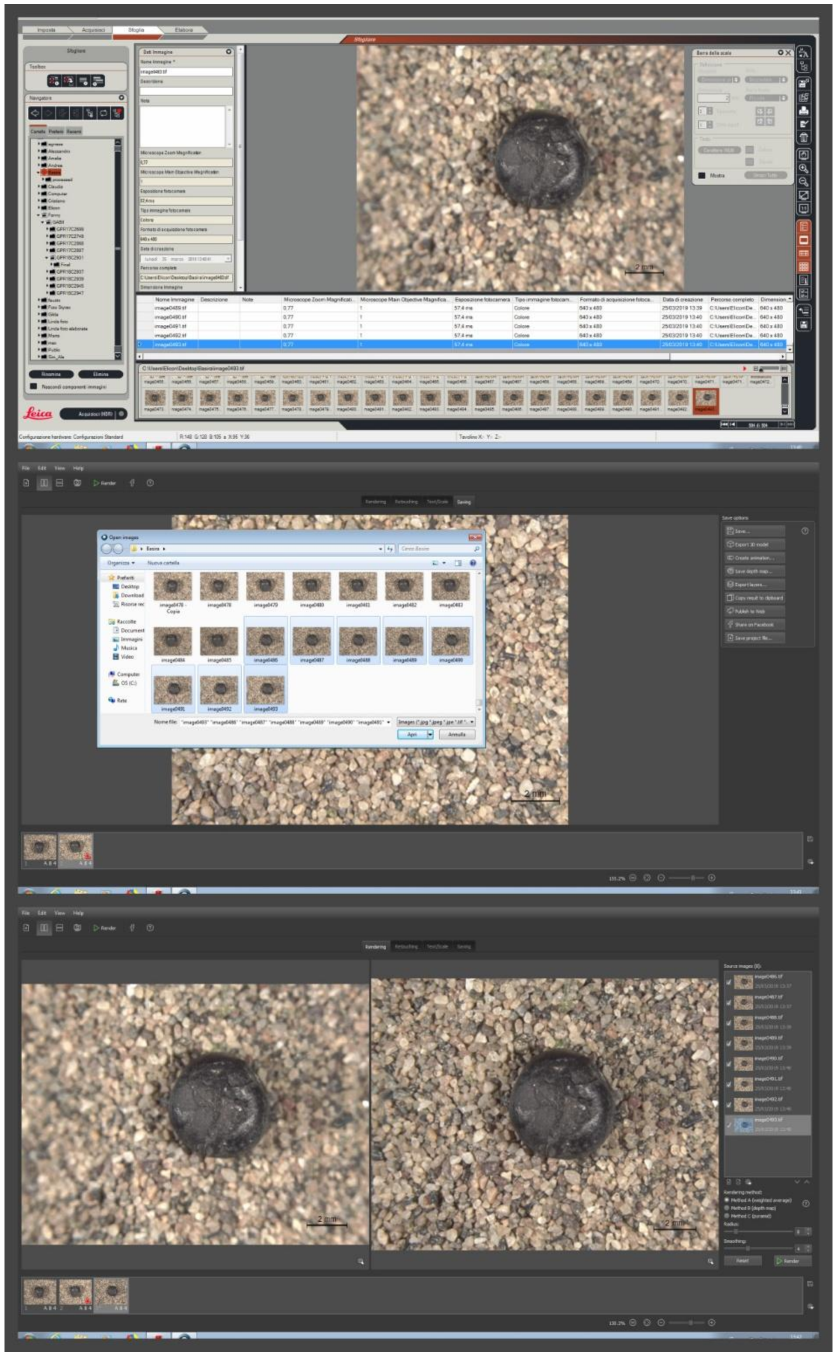


Figure 7. The process of taking photos with a help of Leica Application Suite and Helicon Focus software.

Identifications of seeds and fruits is based on morphology. Each specimen was examined against references such as the *Digital Atlas of Economic Plants in Archaeology* (Neef et al., 2012), *Identification of Cereal Remains from Archaeological Sites* (Jacomet, 2006) and *A Manual for the Identification of Plant Seeds and Fruits* (Cappers & Bekker, 2013).

Seed morphology was used as an instrument for taxa identification, because each taxon has its own morphological characteristics which make it unique. Morphological features have to be considered in complex in order to avoid mistakes; especially, mistakes are possible with fragments' identification. Only one characteristic sometimes became a reason of subjective identification. As it was already mentioned, carbonization process effects the original morphology of the seeds due to different factors such as temperature of the heating, exposure time and moisture. Therefore, color, shape, size and texture were taken into consideration during characterization.

Taxa identification is like a rise to the pyramid. We do not jump to the top of the pyramid if we wish to know what is there, we climb slowly from a broad base to the pointed top as well as in archaeobotanical analysis of seeds. The first step is to identify plant family; knowing the family provides the possibility to clarify genus, and paying attention to more features, species, when possible, come to the light (see Figure 8).

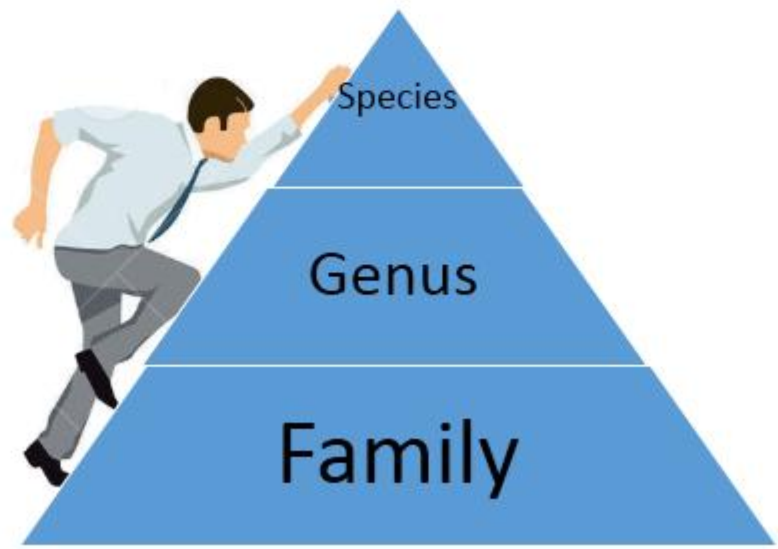


Figure 8. Steps of plant identification

Special attention was paid to the dorsal, lateral and ventral views and embryo end of cereal grains during the analysis (see Figure 9). Hilum, coat and shape were observed for legumes identification. Fragmented carpological remains with diagnostic features were also analyzed, while fragments without diagnostic features were assigned to genus. Fragments that are not assigned to any genus were classified as indeterminate.

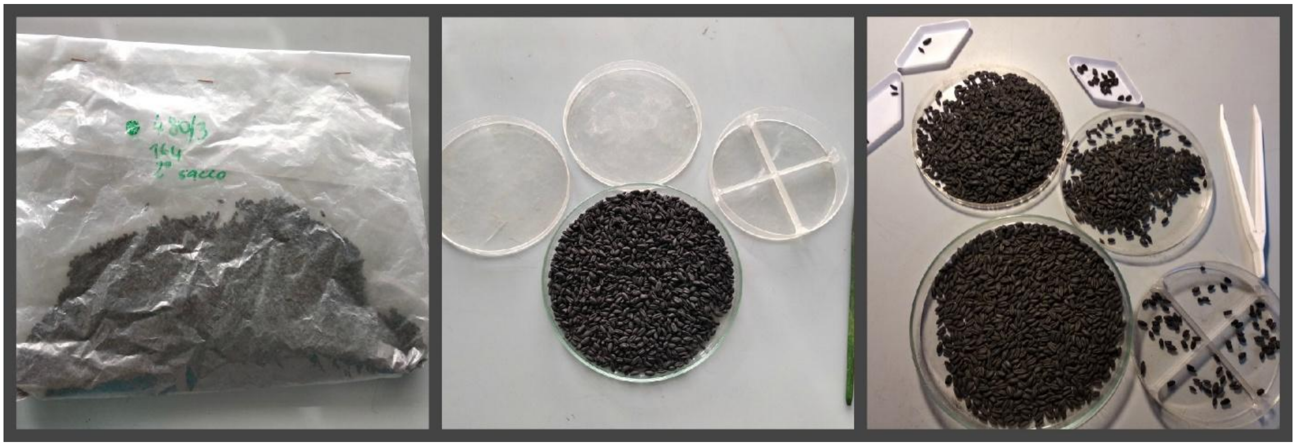


Figure 9. Sorting and identification process of archaeobotanical remains from an archaeological site, Arslantepe, Turkey

Counting remains

The remains were counted once identification was completed. All entire seeds were counted as one. Fragmented of identified remains were weighed. Average specimen weight was estimated. One hundred (100) caryopses of each species were weighed in order to obtain the average weight of one caryopsis. Subsequently, the weight of all fragments of each taxon was divided to the weight of one caryopsis providing estimation of quantity for each taxa of each sample (see Table 5). Entire leguminous seeds were counted as one, while cotyledons were counted as 0.5.

Taxa	*Context*	*№ of seeds/fruits*	*Weight of unit (g)*	*Estimated weight of one grain (g)*
Pisum sativum	A479/9	100	4.24	0.0424
Cicer arietinum	A479/2	100	3.37	0.0337
T. dicoccon	K	100	1.56	0.0156
T. monococcum	A164	100	1.12	0.0112
T. aestivum/durum	A516	100	1.65	0.0165
Hordeum vulgare	A472/5	100	1.28	0.0128
Rosa sp.	A472/5	100	1.02	0.0102
Vitis vinifera	A177	5	0.04	0.008

Table 5. Fragment estimation

Once studied, the samples were packed into aluminum foil to avoid fragmentation and placed into the plastic bags. Labels were written on the plastic bags indicating the name of the site, archaeological context and botanical number. Identifications were included in the database for managing and interpretation.

For data analysis, abundance and non-abundance measures were applied. Relative abundance (RA) measures have been used in order to observe which plants were used more or less. It was calculated by dividing the number of one taxon by the total assemblage and the result was multiplied by 100.

As non-abundance measures, ubiquity measures have been used. It was applied due to the fact that it is presence/absence analysis. This type of analysis does not measure of taxonomic abundance because “ubiquity measures how commonly a particular taxon is represented in sample elements, but not how abundant it is in those sample elements”(Butte & Ware, 2005, p.109). The main benefit of this analysis that we could analyze how spread out and concentrated taxon in our sample elements. It is calculated as a proportion where the number of samples of taxon was divided by total number of samples and multiplied by 100.

5.1. Identified taxa

The carpological study has identified 15 taxa belonging to 7 plant families (see Table 6). The total estimated number is 63,941 where 48,754 entire countable charred seed/fruits and 307.89 g fragmented charred plant remains were analyzed. The estimation was not applied for the indeterminate taxa and *Triticum* sp. because grains of different wheat species have different weights Based on the results, the carbonized plant assemblage was dominated by cereal grains, accounting for 92.8% of identified materials. Pulse crops made up 6.8 % of the whole assemblage. Wild plants, weeds, other species and indeterminate taxa (e.g. without family identification) accounted for less than 0.4% of the studied specimen. Due to the fact that there were many fragmented seeds, there are groups such as undifferentiated cereals and pulses. These two groups are not included in any quantitative analysis.

Family	Taxa	Number of intact seeds/fruits	Weight of fragments (g)	Estimated number of fragmented seeds/fruits	Total numbers of seeds/fruits (estimated number)
Poaceae	*Hordeum vulgare* L.	22,265	52.06	5849	28,114
	Triticum sp.*	195	75.35		
	Triticum monococcum L.	3,132	9.27	807	3,939
	Triticum dicoccon Schrank	19,959	111.18	7125	27,084
	Triticum aestivum/durum L.	478	0.08	3	481
	cereals* - undifferentiated		35.89		
Fabaceae	*Pisum sativum* L.	2,594	10.71	253	2,847
	Cicer arietinum L.	1,447.5	2.06	61	1,508.5
	Lens culinaris Medik	21.5			21.5
	Lathyrus sativus L.	1			1
	Vicia/Lathyrus	48			48
	pulses* - undifferentiated		10.86		
Rosaceae	*Rosa* sp.	147	0.12	12	159

Vitaceae	*Vitis vinifera* L.	14.5	0.16	20	34.5
Ranunculaceae	*Ranunculus arvensis* L.	2			2
Brassicaceae	*Raphanus raphanistrum* L.	2			2
Rubiaceae	*Galium* sp.	6			5
	Indeterminate*	18	0.15		

Table 6. Non-estimated and estimated number of grains of each taxon. VIB2, Arslantepe. The number of intact seeds/fruits is given whilst the fragmented have not been counted but weighed. An estimation of their corresponding number is given in column 5. (The number of grains/seeds for taxa marked by asterisk was not estimated due to the fact that the different species have grains with different weight)

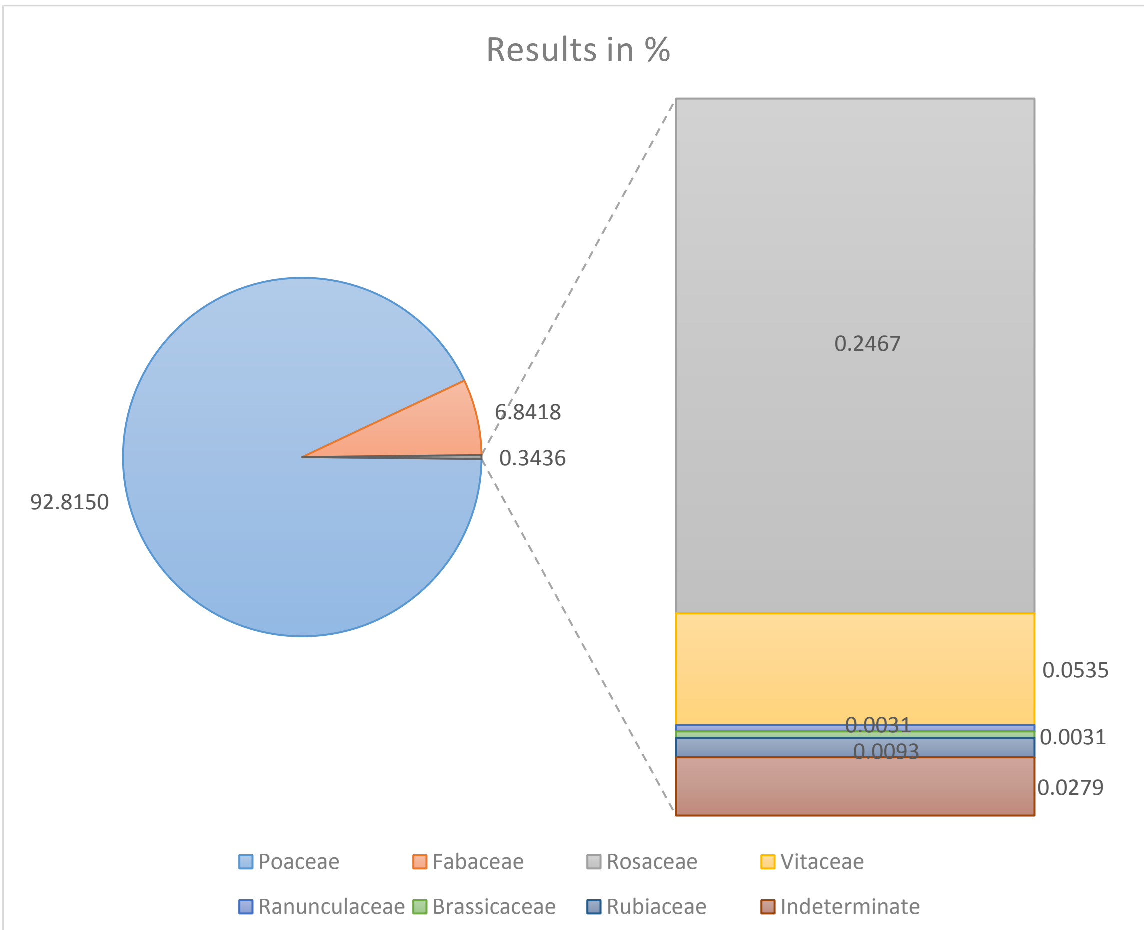


Figure 10. Percentage representation of identified families

Poaceae

The Grass family is made of more than 780 genera and 12,000 species (Christenhusz & Byng, 2016). This is one of the largest families of flowering plants. Poaceae consists of “bamboos, cereals, grasses and the grasses of natural grassland and cultivated lawns and pasture” (Oh, 2018, p. 102).

The data based on studied rooms shows that cereals were the more widespread and used plant in VIB2 period at Arslantepe (see. Figure 10). The caryopses of the Poaceae family are

92.82% of the total number of studied seeds. Cereals have been the most important crops of all civilizations. Four major cereal taxa were identified in this study: *Hordeum vulgare L*. (barley), *Triticum monococcum L*. (einkorn), *Triticum dicoccon* Schrank (emmer) and *Triticum aestivum/durum* L. (wheat).

The nutritive value of cereals is very high. Moreover, cereals are composed of carbohydrates and for this reason were the main source of calories among many late Holocene farming groups (Bates, et al., 2018). The second reason why cereals were the dominant crop is the facts that grains could have been stored for a long period (Zohary & Hopf, 2000). *Hordeum vulgare* and *Triticum dicoccon* are the main crops, their amount is respectively 47% and 45 % of the total studied remains (see Table 11).

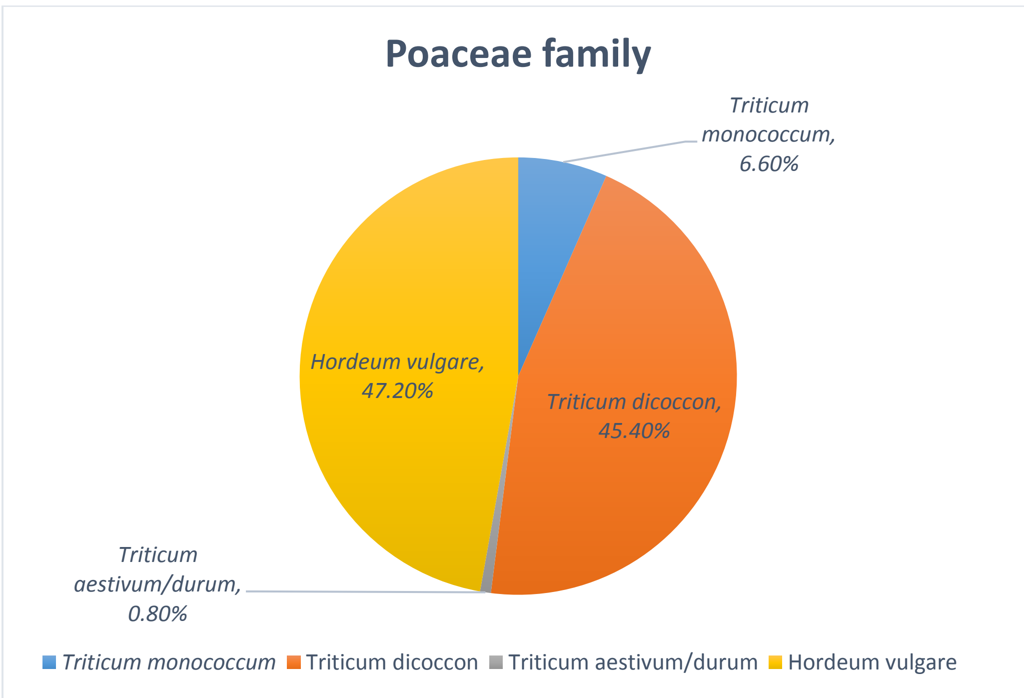


Figure 11. Poaceae family distribution at Arslantepe, VIB2 village.

Hordeum vulgare L.

The first cultivation of barley appeared in Near East ca. 10,000 years ago (Zohary & Hopf, 2000). Therefore, it is considered as the oldest crop species. Barley is stable to salinity, aridity, cool climates (Riehl, 2019), poorer soils (Zohary & Hopf, 2000) and high altitudes of the subtropics (OGTR, 2008); this makes barley one of the most popular crops across different cultures. It was used for baking; in addition, Zohary and Hopf (2012) wrote that it was a companion of wheat, but it was used for the poor people' bread. Baking is not only one way how people used barley, but they also cooked it, fed animals and brewed beer in the past.

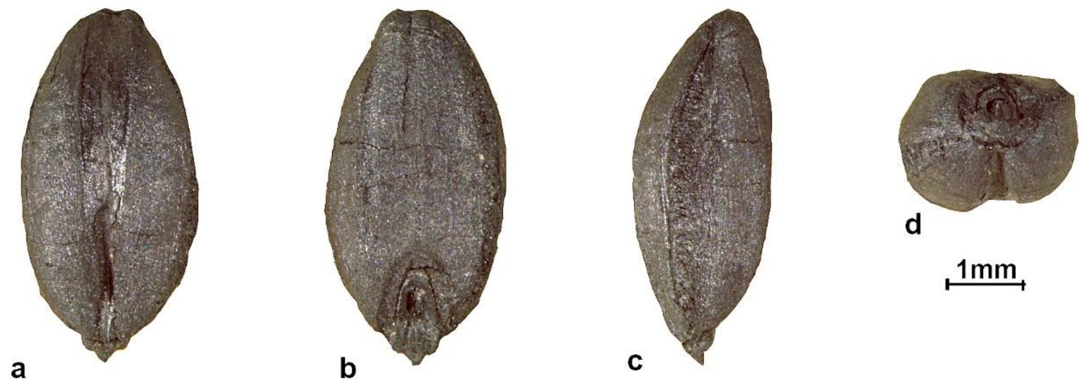


Figure 12. Charred caryopses of Hordeum vulgare *L. from A170 in diagnostic view: a - ventral, b - dorsal, c - lateral, d – transverse*

Hulled barley (see Figure 12) was the dominant recorded cereal grain, accounting for 47.2% of Poaceae and 44 % of all studied plants remains with 87% of ubiquity. Barley grains sometimes shape asymmetrical, evidencing the presence of multi-row barley. But the majority of the grains are straight and not twisted, characterizing two-rowed barley; although, maximum width is in the center of the grain. The highest part is in the middle of grain. The grain shape is spindle and it is a little bit tapering at the top and bottom.

Triticum sp.

Wheat appeared in Near East at the same time of barley. Wheat was a common cereal of Old World agriculture. Zohary and Hopf (2000) state that wheat was the main crops responsible for the principal grain stock of Neolithic agriculture. Wheat has unique backing qualities due to the gluten protein which presents in the seed endosperm (p.19).

Degraded and fragmented grains that still preserve some morphological characteristics have been classified as *Triticum* sp. (see Figure 13).

Figure 13. Charred fragmented remains of Triticum *sp. from A170*

Triticum monococcum L.

Einkorn is a hulled diploid wheat. Einkorn was an important crop in the Neolithic agriculture in the Near East, but later in the Bronze Age it became less popular (Zohary & Hopf, 2000) because replaced by other more productive crops. For this reason, einkorn is not the dominant cereal at Arslantepe during VIB2 period representing only 6.6 % of the Poaceae, and 5.6% of the total studied assemblage.

Cultivated einkorn produces one grain per spikelet, but there are also 2-grained einkorn which is difficult to identify due to similarities with emmer grain. Spikelet of *Triticum monococcum* has an angle between the glumes less than 90^{o}. Side of glume keel does not have lengthwise nerves (see Figure 15).

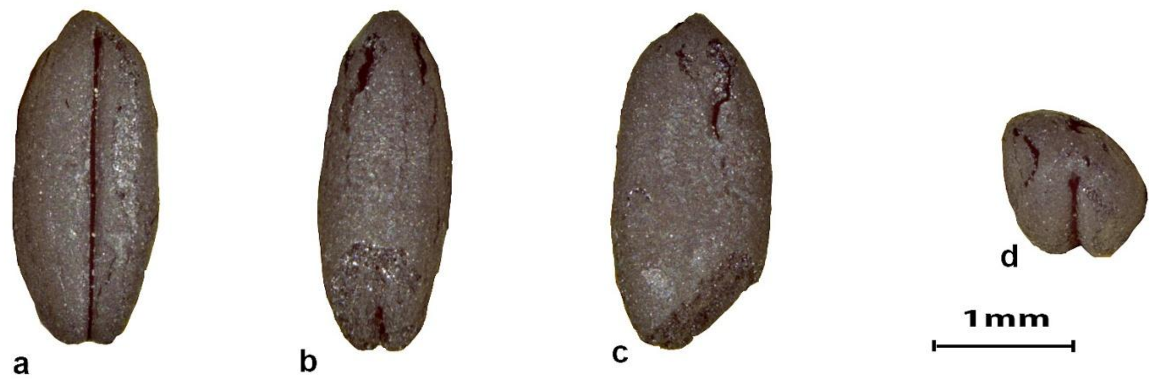


Figure 14. Charred caryopses of Triticum monococcum *L. from A472 in diagnostic views: a-ventral, b - dorsal, c - lateral, d - transverse*

Figure 15. Charred spikelet fork of Triticum monococcum *L. from A472*

The ventral face of the grain is convex; therefore, einkorn grains are a little bit rounded on each side but for 2-grained einkorn, this characteristic was not found (see Figure 14). The shape of the grain apex is quite pointed at the end what is visible from dorsal and ventral sides. The dorsal view shows that the widest point of the grain is in the middle. The position of the embryo is mostly slanting. Embryo end in some cases is curved outwards and there are also grains with flat embryo end of the ventral face. On the dorsal side, there are two slightly visible longitudinal furrows. Ventral furrow is narrow and very deep.

Triticum dicoccon Schrank

Emmer was one of the important wheats of Old World agriculture during the Neolithic and Bronze Ages. Emmer was extensively collected from the wild long before its introduction into cultivation. The beginning of emmer use is earlier than einkorn. In the Near East emmer was the main cereal of Pre-Pottery Neolithic farming settlements; in addition, it was widely grown in Chalcolithic and Bronze Ages in this area. The Linearbandkeramik farmers also mainly cultivated emmer in the 5th millennium BCE in central Europe (Zohary & Hopf, 2000). The result of this study demonstrates that 45,4 % of Poaceae belongs to *Triticum dicoccon*, it is the second commonest taxa after *Hordeum vulgare* in the Early Bronze Age at Arslantepe.

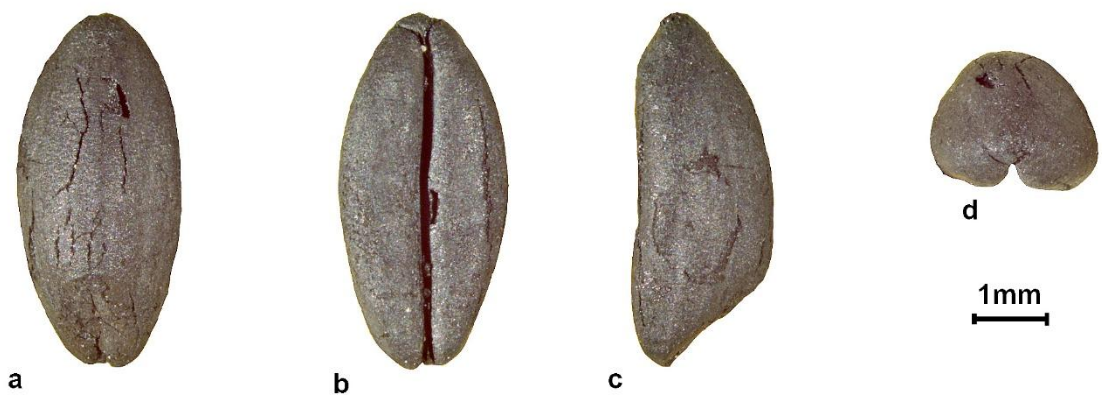


Figure 16. Charred caryopses of Triticum dicoccon *from A472 in diagnostic views: a - dorsal, b - ventral, c - lateral, d - transverse*

In contrast to einkorn, emmer has two caryopses per spikelet; therefore, the dorsal face is convex and the ventral face is weakly convex or in some case it is flat. Most of the grains are drop-shaped. The distal end is slightly rounded; on the other hand, the proximal end is pointed but in some cases is also rounding (see Figure 16). From the lateral view, emmer has a hump where the highest point is above the embryo. The ventral face of the grain is concave. The ventral furrow is deep and narrow. The embryo position is oblique – vertical.

The angle between the glumes of emmer is larger than for einkorn because it contains two caryopses. Sides of glume keel are with very clear lengthwise nerves (see Figure 17).

Figure 17. Charred spikelet fork of Triticum dicoccon *from A472*

Triiticum aestivum/durum L.

Naked wheat (free-threshing or bread wheat) is a widespread crop in the world because about 90 % of the total wheat production is naked wheat. But this type of wheat was less widespread at the beginning of Early Bronze Age because it is less than 1 % in VIB2 period.

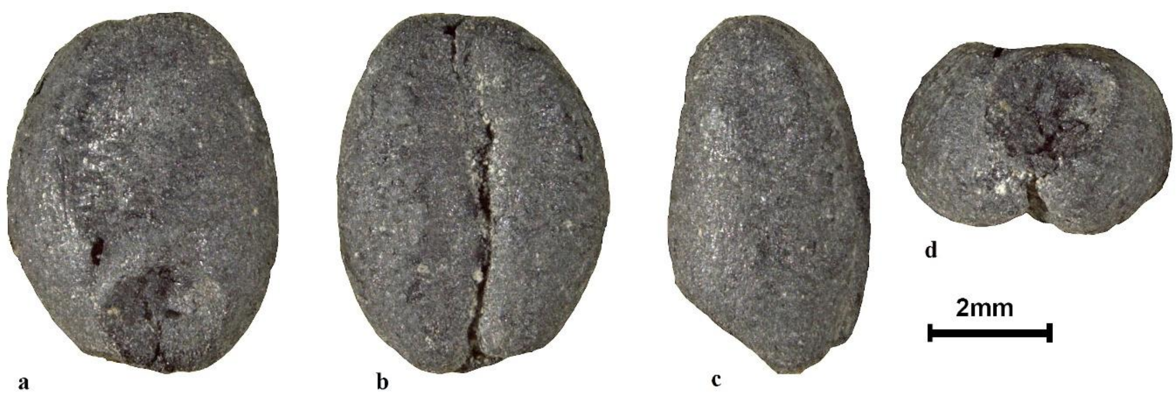


Figure 18. Charred caryopses of Triticum aestivum/durum *L. from A 200 in diagnostic views: a - dorsal, b - ventral, c - lateral, d - transverse*

Naked wheat is oval and a little bit round (see Figure 18), the distal end is conspicuously rounded with dent which is visible on the dorsal and ventral views. The germ area is extending far down. The position of the embryo is in a cavity. From the lateral view, the dorsal ridge has a hump; on the other hand, the ventral surface is convex. The ventral furrow is not very deep and wide in most cases.

Fabaceae

The Pea family is large and includes 751 genera and about 19,500 species (Christenhusz & Byng, 2016). Pulses are the identified group of Fabaceae family at Arslantepe.

If cereals contain mostly carbohydrates as source of energy, pulses are rich in proteins. Together, they contribute to a balanced and varied human diet in particular during the prehistory (Valamoti et al., 2011). Zohary and Hopf (2012) assume that the beginning of pulses history starts very early as well as wheat and barley. Based on archaeological shreds of evidence "the pea, lentil, chickpea, bitter vetch and grass pea were taken into cultivation more or less together with the principal cereals" (p.92). In addition, Zohary and Hopf (2012) consider that the core area of pulses production was in the Near East and later it was spread to Europe and West Asia.

The data of this study shows that pulses represent about 6.8 % of the total archaeobotanical remains with 5 identified taxa. The Fabaceae is represented by *Pisum sativum* L. (pea), *Cicer arietinum* L. (chickpea), *Lens culinaris* Medik. (lentil), *Lathyrus sativus* L. (grass pea) and *Vicia/Lathyrus*. *Pisum sativum* L. and *Cicer arietinum* L. have the highest percentage (see Figure 19).

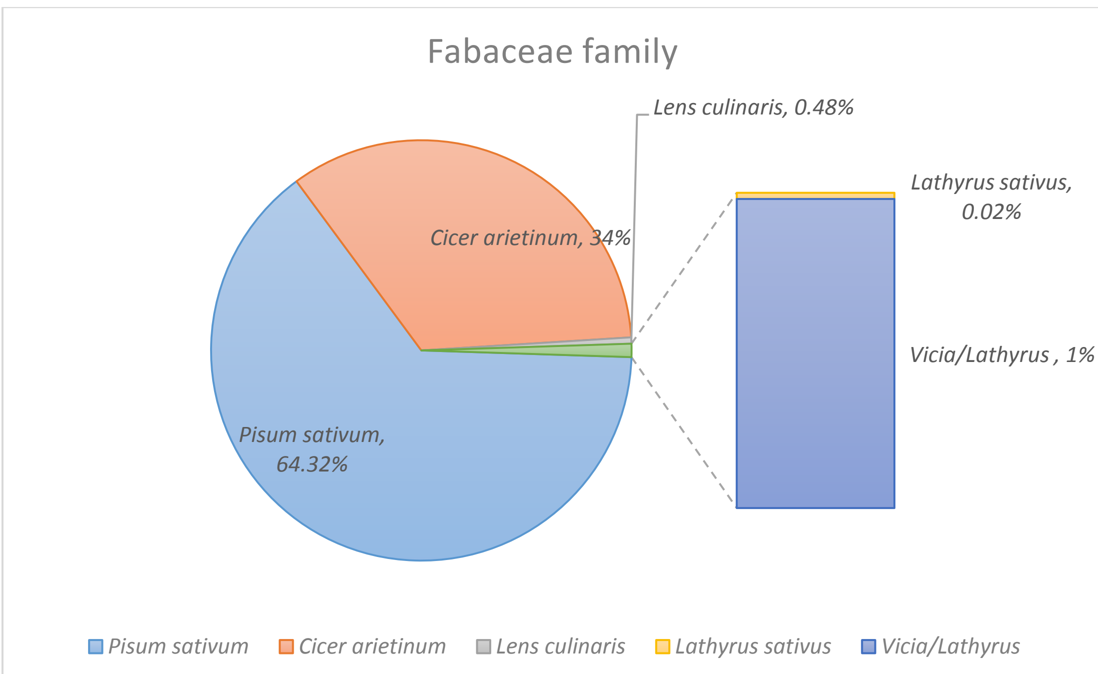


Figure 19. Fabaceae family

Pisum sativum L.

The pea is considered as one of the oldest cultivated legumes used in human nutrition. It is mainly a self-pollinated crop and is tolerant to warm and cool temperate conditions. First remains of pea were found in the Near East on the archaeological sites dated back to the 7th millennium BCE and the second half of the 8th millennium BCE (Pre-Pottery Neolithic period; Zohary & Hopf, 2000).

The seeds of the pea are usually spherical but sometimes they are ellipsoidal; moreover, the shape can be cylindrical due to the conditions of burial. The seed in Figure 20 has a spherical shape. Hilum is not visible because coat is absent, but a hilum print can be observed. Pea is the dominant legume in Fabaceae family of VIB2 period at Arslantepe.

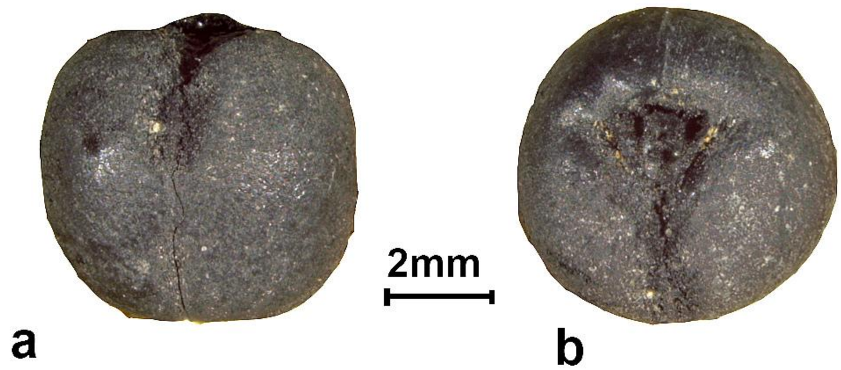


Figure 20. Charred Pisum sativum *from A 472 in diagnostic views: a - hilum side, b - top*

Cicer arietinum L.

Chickpea belongs to the grain crop assemblage of the Neolithic and Bronze Age periods in the Near East. It grows in the post-rainy season and is adapted to subtropical climate. The protein content is high as well as in lentil and pea. It is a self-pollinated crop.

Recovered chickpeas have predominantly angular shape from the dorsal and frontal sides with a beak-like prominence (see Figure 21). The seed has a distinctive edge between dorsal and ventral sides. It should have longitudinal ribs on the ventral side, but it was not observed because the coat is not preserved. Moreover, hilum or its print is not visible on the frontal side. The amount of chickpea is second only to pea with 34 % among Fabaceae and 2.4 % of total macro-remains assemblage.

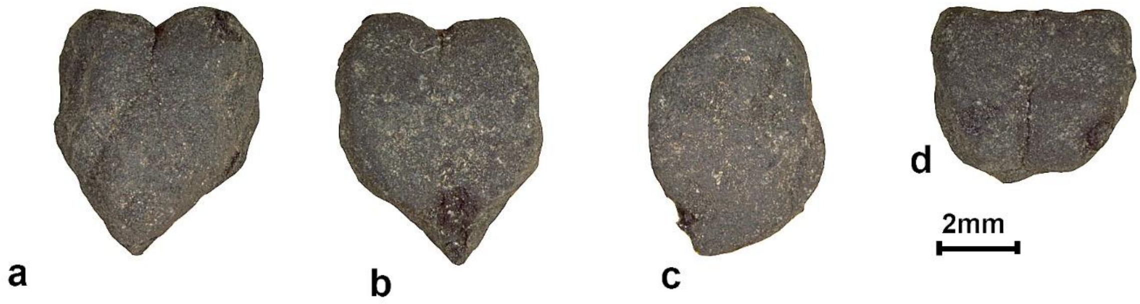


Figure 21. Charred Cicer arietinum *from A 472 in diagnostic views: a – dorsal, b – frontal, c – lateral, d – top*

Lens culinaris Medik

Lentils are one of the oldest cultivated legumes of the Old World. Lentils are rich in plant protein (25%); in addition, they have fibers, micronutrients including iron, zinc, selenium and antioxidants (Choudhary et el., 2017). Lentils are self-pollinated grain crops. Zohary and Hopf (2012) argue that lentils have to be regarded as a founder crop of Neolithic agriculture in the Old World. Few lentil seeds were found in the Palaeo-Mesolithic layers in Greece (Franchthi Cave) and in Sicily (Grotta dell'Uzzo) but probably those seeds represent a local wild lentil, *L. nigricans* (Zohary & Hopf, 2000)

The shape of the seed is lenticular. From the frontal side, the seed is flattened (slightly ellipsoid), hilum is not preserved due to the lack of coat (see Figure 22). From the lateral view, it has an ellipsoid shape with rounded ends. In studied samples, lentils represent only 0.48 % of Fabaceae and 0.03% of total assemblage.

Figure 22. Charred Lens culinaris *from A 166 in diagnostic views: a – lateral, b – frontal*

Lathyrus sativus L.

The oldest grass pea remains were found in Turkey dated back to the 8th millennium BCE. The grass pea mostly belongs to the crop assemblage of the Early Neolithic period. In contrast to lentils, pea, chickpea, grass pea is not very healthy, because it contains "a water-soluble non-protein aminoacid, lathyrin" (Zohary & Hopf, 2000, p.119). The consumption of the grass pea can cause different diseases such as paralysis of the lower limbs (lathyrism), and neurological disease causing a person to become unable to walk or move properly. In order to avoid these diseases, it has to be carefully boiled. The grass pea was mainly intended for an animal feed.

Figure 23.Charred Lathyrus sativus *from A 472 in diagnostic views: a - top, b – frontal, c - lateral*

The top view looks triangular, while the lateral side is truncated from one end and slightly rounded from the opposite end. The hilum is not identified on the frontal side. This seed is larger than long (see Figure 23).

Vicia/Lathyrus

Due to the fact that seed-coat is missing, and the shape is changed because of buried condition, the exact taxon was not identified for some seeds, but general characteristic allowed to classify them as belonging to *Vicia* or *Lathyrus* genera. Forty-eight seeds were classified as *Vicia/Lathyrus (*see Figure 24).

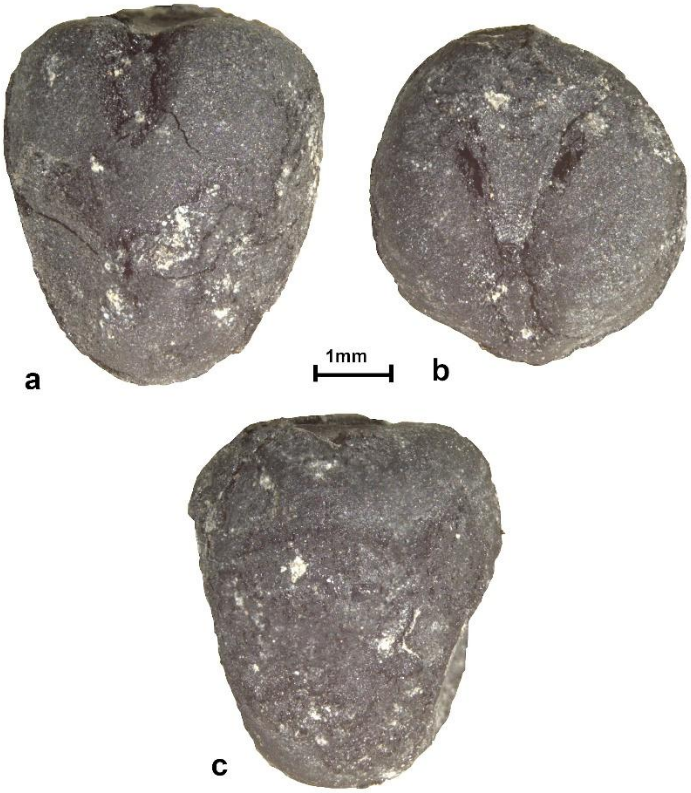


Figure 24. Charred Vicia/Lathyrus *from A 472 in diagnostic views: a - frontal, b - top, c - lateral*

Rosaceae

The Rose family includes approximately 91 genera and 2,950 species (Christenhusz & Byng, 2016). This family consists of trees, bushes and herbs (Hummer & Janick, 2009). Plants of this family have been known and used for millennia, they are economically important and used for several purposes like medicinal ones.

Rosa sp.

As Martin and Barkley (1961) proposed, the seeds of the Rose family "have no consistent identifying features, partly because some of them are achenes, others are pits of drupes and many other are true seed" (p.164). Due to the lack of enough references and to avoid mistakes, the identification remained at a genus level.

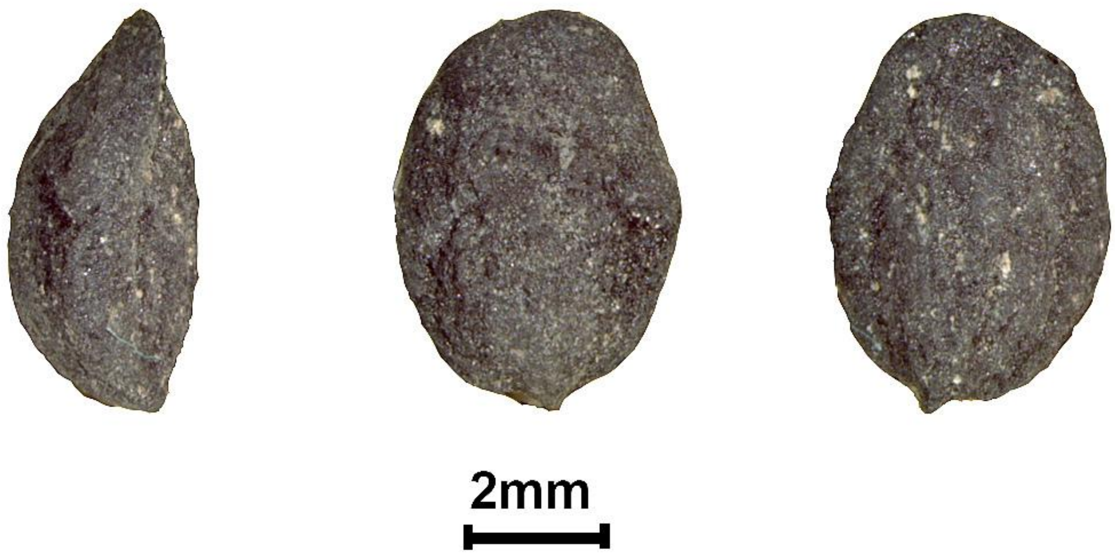


Figure 25.Charred Rosa *sp. from A 472 in diagnostic views: a - lateral, b - dorsal, c - ventral*

The shape from dorsal and ventral sides is oval. The "seed" (achene) itself is rounded-triangular. The apex is straight with a short remnant. The base is obtuse. The lateral view has a drop shape. It has a rounded back and two flattish faces joined into an edge (see Figure 25). Within this study 159 seeds were identifying, they correspond to ca. 0.25 % of the total macro-remains assemblage. Some seeds were with remnants of fruit.

Vitaceae

Vitaceae comprises 14 genera and more than 910 species (Christenhusz & Byng, 2016). It played an important economic role over time. The most significant fruit in food economy is grape. Not only berries of *Vitis vinifera* are edible, but also stems, leaves and sap. The Vitaceae family is distributed in the temperate, subtropical and tropical regions.

Vitis vinifera L.

Grape vine is the oldest group of fruit tree. It is adapted to the climate with an average temperature of at least 16-17 °C during the summer period and more humid conditions because it is sensitive to moisture changes. The berry is rich in sugar. In the Early Bronze Age, it was eaten as a fresh fruit, also dried and stored; in addition, grape fermented juice was used to wine production. Georgia was a major initial contributor to grape domestication (Maghradze et al., 2016, p.6). But there are still many arguments regarding grape cultivation because there is broader geographical area for cultivation and domestication of the grapevine which is between the Black Sea and Iran" (Terral et al., 2010, p.443-444).

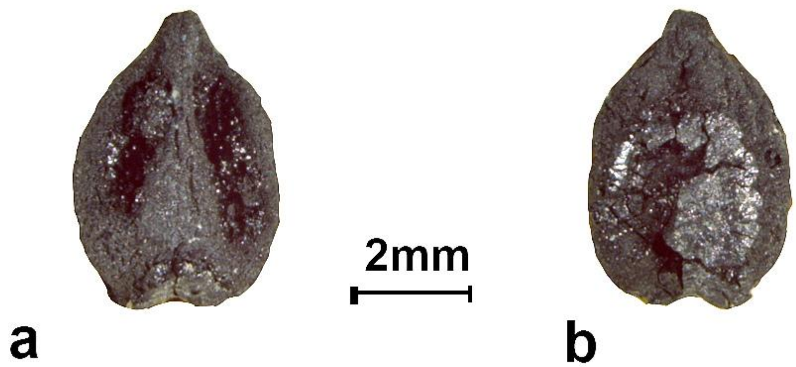


Figure 26.Charred Vitis vinifera *from A 274 in diagnostic views: a - ventral view (inner), b - dorsal view*

Seeds of grapevine are pyriform in shape. At Arslantepe, the pips are elongated and belong to the cultivated grapes (Renfrew, 1973, p.127-129). From the ventral view, two deep ventral infolds (long grooves) are located along the central raphe, there is not well preserved oval-circular chalaza knot (spoon-shaped structure) on the dorsal side, apical and basal grooves are not preserved (see Figure 26).

Ranunculaceae

Ranunculaceae consists of 43 genera and 2,346 species (Christenhusz & Byng, 2016). Among this family, there are toxic plants and they are not used for consumption. The famyly has a world wide distribution and plants are adapted to different temperatures because they grow in subantarctic and tropics to the arctic zones (Emadzade, 2010).

Ranunculus arvensis L.

Corn buttercup is an annual meadow plant. It was probably originated in Mediterranean area. The corn buttercup has another name as “Devil's Currycomb” due to the spiny projections on the fruits (Barron, 1972).

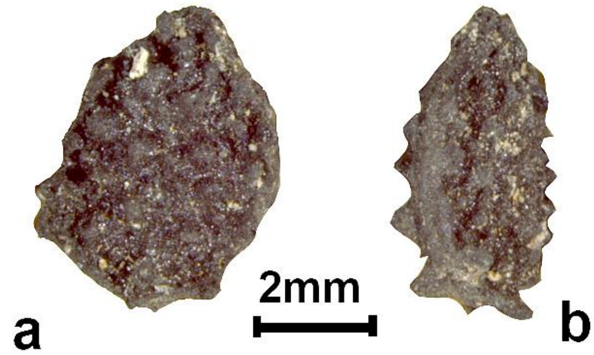


Figure 27. Charred Ranunculus arvensis *achene from A 177 in diagnostic views: a – lateral, b – perspective*

The achene (fruit) is slightly asymmetric. Small depressions (papillae) are visible on the surface. From the perspective view, along the spine, is possible to see the form of papillae which have an acute shape (see Figure 27). Only two achenes were identified in this study.

Brassicaceae

The Cabbage family belongs to genus *Brassica* (Cappers & Bekker, 2013). Brassicaceae comprises 328 genera and 3,628 species (Christenhusz & Byng, 2016). The *Brassicaceae* is considered as one of the most economically important plant groups because some crops are used for oil production, some of them are eaten as vegetables (OECD, 2016). Moreover, in the Bronze Age, plants of Brassicaceae family were actively used in rituals in Europe (Mora et al., 2017).

Raphanus raphanistrum L.

Wild radish is an annual weed. The plant was originally growing in the Mediterranean region. It is classified as a noxious and poisonous weed (Smith 2014 p.20). Wild radish can occur on waste places, open fields, and cultivated lands.

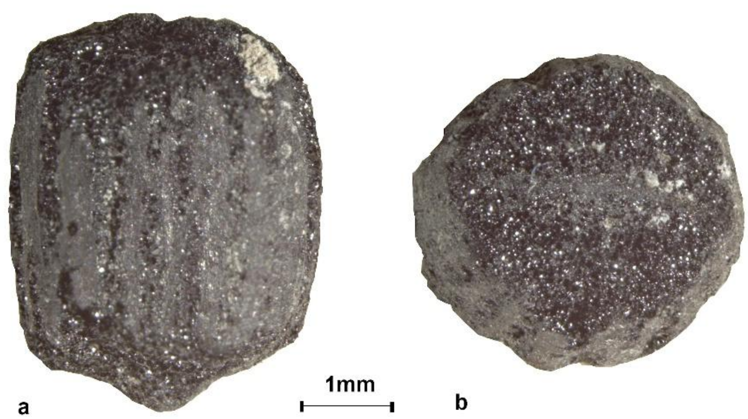


Figure 28. Charred Raphanus raphanistrum *segment of pod from A 177 in diagnostic views: a - side, b - top*

Only segments of the pod were present, seeds were not found separately. The surface of the pod's segment is ribbed. The shape of each segment is cylindrical (see Figure 28). The segments of pod look like beads which are connected to each other organizing a chain. Only two capsules (pod's segment) were identified among 63,941 studied carpological remains within the study. It seems that pods have a sponge-like composition (see Figure 28, b).

Rubiaceae

Rubiaceae consists of 590 genera comprising 13,620 species (Christenhusz & Byng, 2016). It is distrubuted worldwide. Since antiquity the roots of these plants (e.g. *Rubia tinctorium*) have been used for dying textile in red colour; moreover, the first evidence of using madder plants as dying was found in India dating to the 3rd millennium BC. In China, at Yanghai archaeological site, a textile dyed with a plant of the Rubiaceae dated to 1261–1041 cal. BCE (Kramell et al., 2014) was found. The studies show that the ideal temperature for seed germination of this family is between 20 and 30^{o} C (Gallon et al., 2018).

Galium sp.

Galium is a very large genus in the Rubiaceae family. *Galium* sp. is a native weed plant species in the Asian part (Anatolia) of Turkey (Marhold, 2011). *Galium* sp. was found in the Mersin-Yumuktepe (Turkey) archaeological site already in the Neolithic period (Fiorentino et al., 2017). At the Polgár-Bosnyákdomb site (Hungary) Galium sp. seeds were also discovered on the level of Late Neolithic (Moskal-del Hoyo & Lityńska-Zajac, 2016). It indicates that plant was widespread in Neolithic time on the terittory of Near East as well as in Central Europe. Already in the Bronze and Iron Age, a large number of *Galium* sp. was found in southeastern Kazakhstan, Begash archaeological site (Spengler et al., 2013). It was used mostly for curdling milk in cheese-making, used as medicinals and it was also considered as forage crops in the Uruk period (Tell Brak site, Syria) (Green, 1999).

Figure 29. Charred Galium *sp. from A 472 in diagnostic views*: *a – top, b – side*

Galium sp. is a tiny seed which is approximately 1.5 mm. The seed has a globose shape with a round sunken perforation (see Figure 29). *Galium* sp. corresponds to less than 0.01% (0.0095%) with only 6 seeds.

5.2. Room data

In the following subchapter, the results corresponding to each building are presented. It is done in order to demonstrate the distribution of the plant remains in each context that will be discussed and interpreted in the next chapter. The first presented results will refer to the Building IX, the second part of the result is related to the Building VIII and next results come from independent contexts.

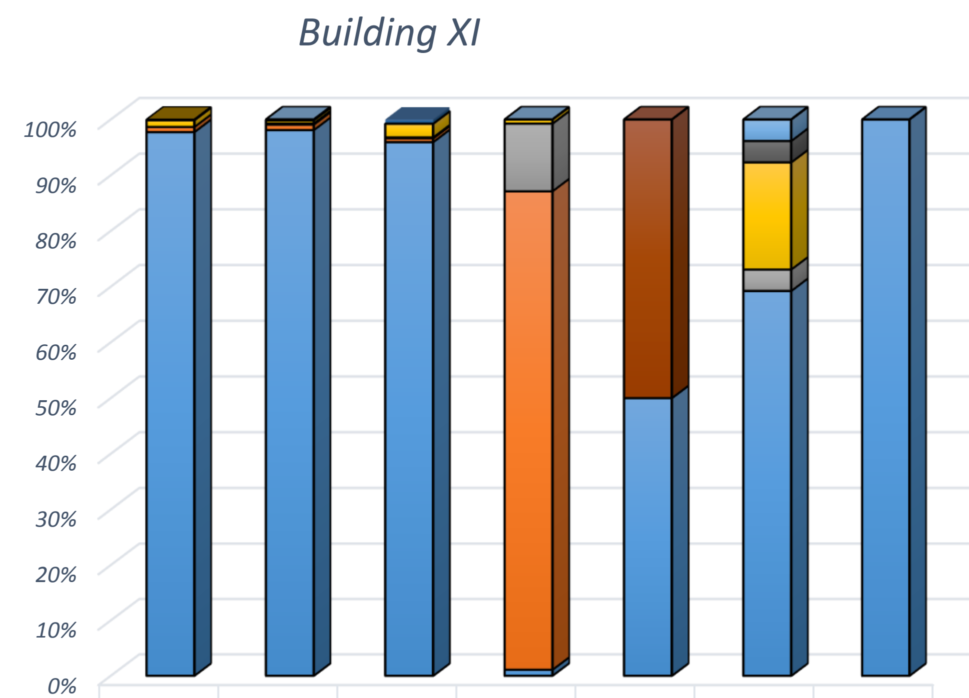
The data presented in this chapter is illustrated by charts and diagrams. In addition, there are tables of the results for each room, where all the counts will be reported with the real count, as well as the estimated number of seeds and fruits as explained in the following chapter. Each room have been summarized here but the detail of each samples can be found in the appendix 1.

Building IX

Seventy-eight samples, coming from 7 archaeological contexts (6 rooms and the raised area A179) of the Building IX, have been studied (see Table 7). Cereals are the most abundant crops in the building and only few legumes were recovered there. In addition, plant remains of weed species were brought to the light belonging to *Ranunculus arvensis, Rapharus raphabistrum* and *Galium* sp. (see Figure 30).

Building IX									
Taxa/context		A166	A177	A200	A170	A108	A175	A179	Total
Hordeum vulgare	n	3,601	8,353	1,545	204	1	14	522	14,240
	g	0.52	29.24	0.36	1.11		0.05	7.62	39
	est	41	2,284	27	87		4	595	3,038
	total	3,642	10,627	1,572	291	1	18	4,511*	**2,0662**
Triticum dicoccon	n	31	102	11	16,150				16,294
	g	0.05	0.05		102.72				102.82
	est	3	3		6,584				6,590
	total	34	105	11	22,734				**22,884**
paired caryopses of T. dicoccon	n				46				**46**
spicklet forks of T. dicoccon	n				1				1
Triticum monococcum	n		18		2,457		1		2,476
	g		0.07		8.66				8.73
	est		7		751				758
	total		25		3,208		1		**3,234**
Triticum aestivum/durum	n	45	59	40	195		2		341
	g						0.05		0.05
	est						3		3
	total	45	59	40	195		5		**344**
Triticum sp.	n				186		1		195
	g		0.19		72.43				72.62g
Pisum sativum	n	2							**2**
Cicer arietinum	n		1						**1**
Lens culinaris	n	1	11.5						**12.5**
Vicia/Lathyrus	n					1			**1**
Vitis vinifera	№	3	6				1		**10**
Rosa sp.	№	2	2						**4**
Ranunculus arvensis	№		2						**2**
Raphanus raphanistrum	№		2						**2**
Galium sp.	№		1		1		1		**3**
cereals - undifferentiated	g				35.42		0.01		35.43
legumes - undifferentiated	g						0.03		0.03
Indeterminable	n		4						4
	g						0.15		0.15

Table 7. List of taxa and numbers of seeds and fruits recovered from the building IX



	A166	A177	A200	A170	A108	A175	A179
Galium sp.		1		1		1	
Rapharus raphanistrum		2					
Ranunculus arvensis		2					
Rosa sp.	2	2					
Vitis vinifera	3	6				1	
Vicia/Lathyrus					1		
Lens culinaris		1	11.5				
Cicer arientivum			1				
Pisum sativum		2					
Triticum aestivum/durum	45	59	40	195		5	
Triticum monococcum		25	3	3,208		1	
Triticum dicoccon	34	105	11	22,734			
Hordeum vulgare	3,642	10,627	1,572	291	1	18	4,511

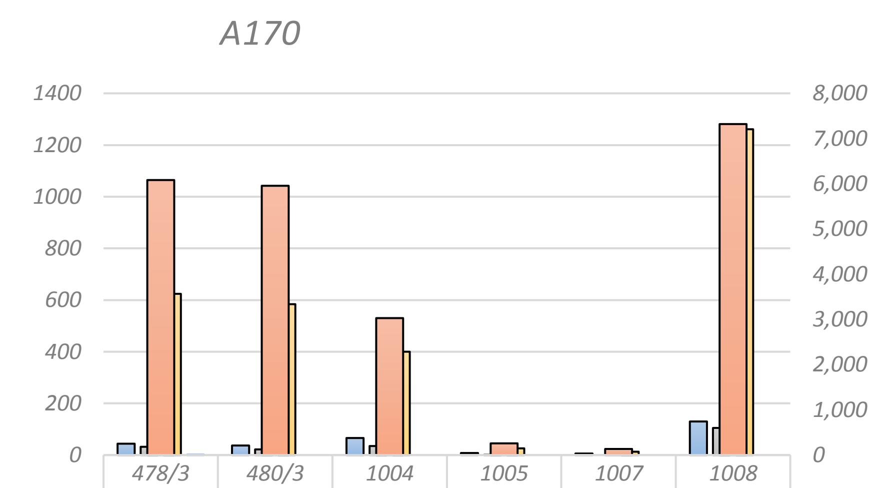
Figure 30. Percentage (top) and Absolute quantities (bottom) of the different taxa recovered from the Building IX

A170

Figure 31. Paired caryopses of T.dicoccon from A170

The first group of samples is from the room A170, which is the eastern room in this building. Six samples have been analyzed from this room. The average density is 731 seeds/kg. The samples contained cereal crops and one weed. *Triticum dicoccon* made up of 87 % of the grain identified from A170 counting 22,734 estimated caryopses plus 46 paired caryopses (see Figure 31).

The second position is taken by *Triticum monococcum*, which accounted for 11 % (3208 caryopses) (see Figure 33). *Hordeum vulgare* and *Triticum aestivum/durum* share the third position because each of them is only 1 %. In addition, there were 186 caryopses and 72.43 g of fragments of *Triticum* sp. It was not estimated and not included in the percentages. The only one *Galium* sp. seed was in the studied samples. It is very important to highlight the fact there was one spikelet fork of *Triticum dicoccon*.



	478/3	480/3	1004	1005	1007	1008
Hordeum vulgare	44	37	66	8	6	130
Triticum aestivum/durum	32	22	35	1		105
Triticum monococcum	624	584	400	26	13	1,261
Galium sp.	1					
Triticum dicoccon	6,082	5,955	3,029	259	135	7,320

Figure 32. Absolute quantities of the different taxa of the samples coming from the A170 (samples: 478/3, 480/3, 1004, 1005, 1007 and 1008)

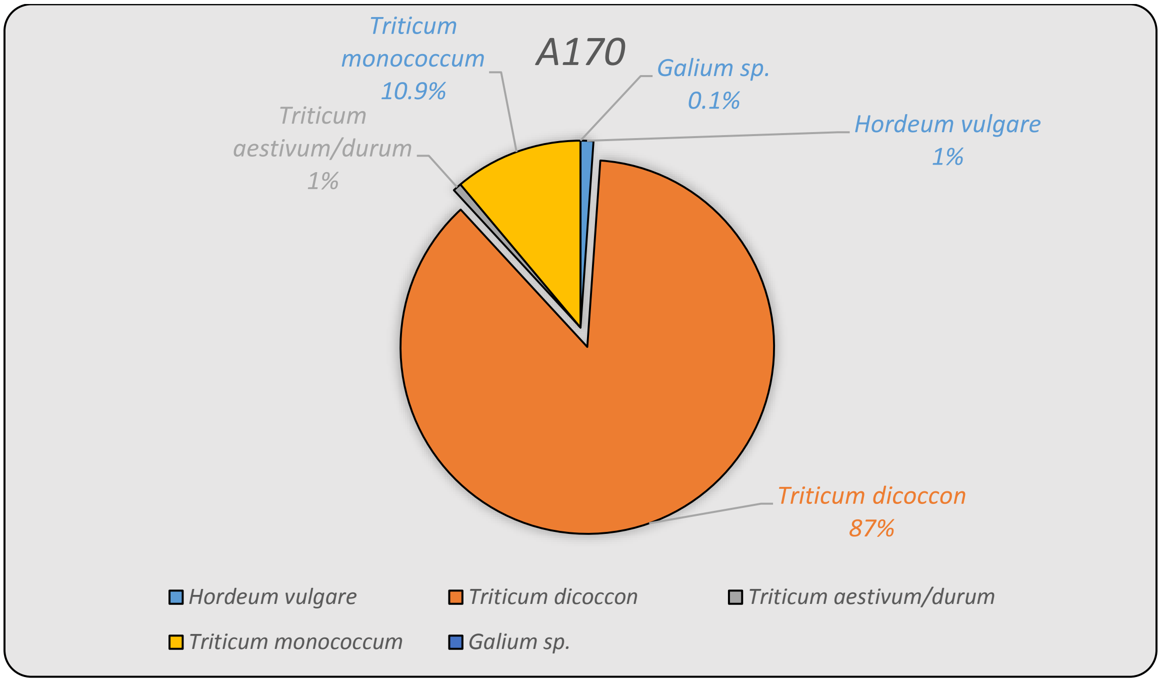


Figure 33. Percentage of the different taxa recovered from A170

A179

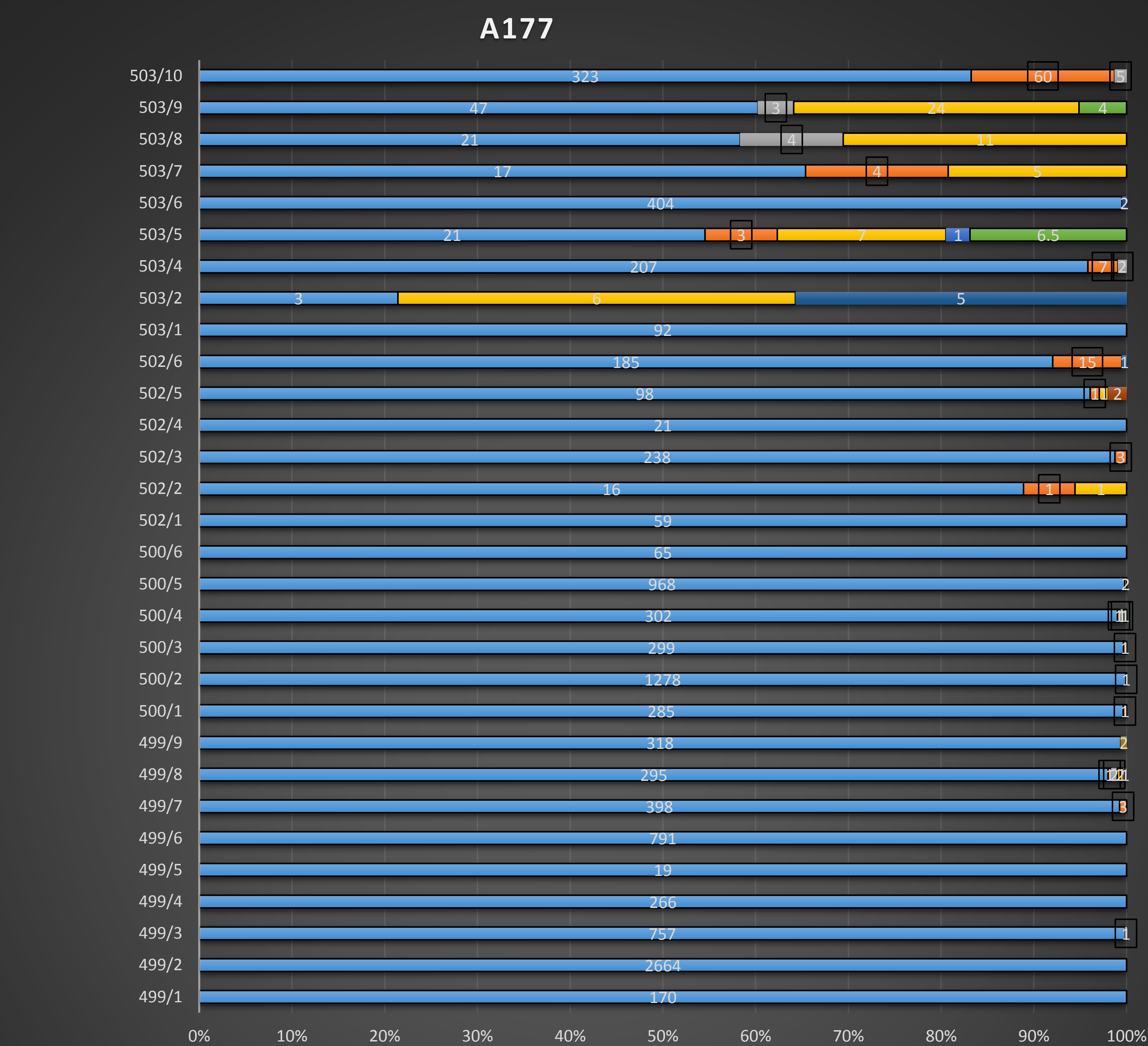
Inside the room A170, there was a raised area A179, only one sample was analyzed from this area. The sample was big; therefore, it was subsampled (1/4), later results were estimated. The density is 752 grains/kg. The most interesting fact is that only *Hordeum vulgare* was found there. Other samples from this area have been analyzed (Alessia Masi, unpublished results), with the same result. In both the studies *Hordeum vulgare* made up 100 % of the whole assemblage from A179.

A177

In the communicating room A 177 which is connected with room A170 by a door, 30 samples were studied (see Figure 34). The max density is 2,264 seeds/kg (sample 499/2) and the min density is 2 seeds/kg (sample 502/4). The crop assemblage of this room is more diverse, because pulses were recorded there; although, there is a small amount of Fabaceae family's remains but it was present unlike A170.

In the contrast to the room A170, barley was the dominant cereal grain, accounting almost 98 % because there were 10,637 estimated barley grains whereas total estimated number of *Triticum dicoccon* was only 102. Besides these, an estimation of 59 caryopses of *Triticum aestivum/durum* and 11 caryopses of *Triticum monococcum* were recorded.

Concerning pulses, their number is very small because only 1 seed of *Cicer arietinum* and 11.5 of *Lens culinaris* were recovered. This room contained 6 pips of *Vitis vinifera*. Wild roses seeds were also found there. The most interesting findings in this room were weed species like 2 achenes of *Ranunculus arvensis* and 2 pods of *Raphanus raphanistrum.* These species were never recorded before in the assemblage of VI B2.

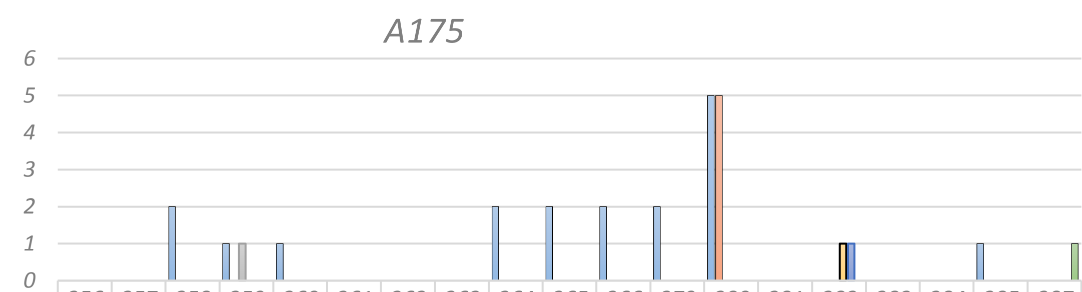


	499/1	499/2	499/3	499/4	499/5	499/6	499/7	499/8	499/9	500/1	500/2	500/3	500/4	500/5	500/6	502/1	502/2	502/3	502/4	502/5	502/6	503/1	503/2	503/4	503/5	503/6	503/7	503/8	503/9	503/10
Hordeum vulgare	170	2664	757	266	19	791	398	295	318	285	1278	299	302	968	65	59	16	238	21	98	185	92	3	207	21	404	17	21	47	323
Triticum dicoccon							3	1		1	1	1	1				1	3		1	15			7	3		4			60
Triticum aestivum/durum			1					2					1											2				4	3	5
Triticum monococcum								2						2			1			1			6		7		5	11	24	
Cicer arietinum																									1					
Lens culinaris													1												6.5				4	
Vitis vinifera																					1		5							
Rosa sp.																				2										
Galium sp.								1																						
Ranunculus arvensis									2																					
Rapharus raphanistrum																										2				

Figure 34. Percentage (top) and absolute quantities (bottom) of the different taxa recovered from the room A177

A175

The plant assemblage of A175 is small. Although 18 samples were analyzed (see Figure 35), only 20 seeds were recorded. Moreover, the average density is 0.2 seeds/kg. Among all of them, the percentage of *Hordeum vulgare* is higher, because it accounted for 70 % of the plant remains recorded in this room. Other taxa such as *Triticum aestivum/durum*, *Triticum monococcum*, *Cicer arientinum*, *Galium* sp, and *Vitis vinifera* sp. were also discovered there (see Figure 36). But there were 6 samples (see appendix 1b) where seeds or fruits were not recorded because they are constituted only by charcoals.



	356	357	358	359	360	361	362	363	364	365	366	379	380	381	382	383	384	385	387
Hordeum vulgare			2	1	1				2	2	2	2	5					1	
Triticum aestivum/durum													5						
Triticum monococcum				1															
Galium sp.															1				
Cicer arietinum															1				
Vitis vinifera																			1

Figure 35. Absolute quantities of the different taxa recovered from room A175

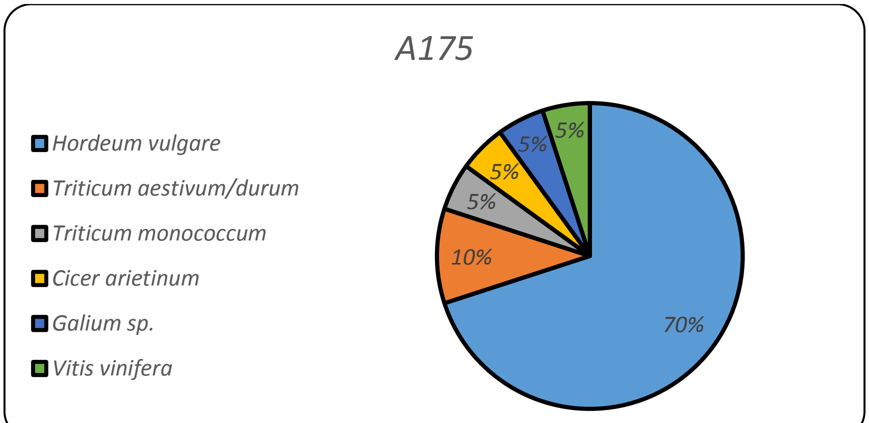


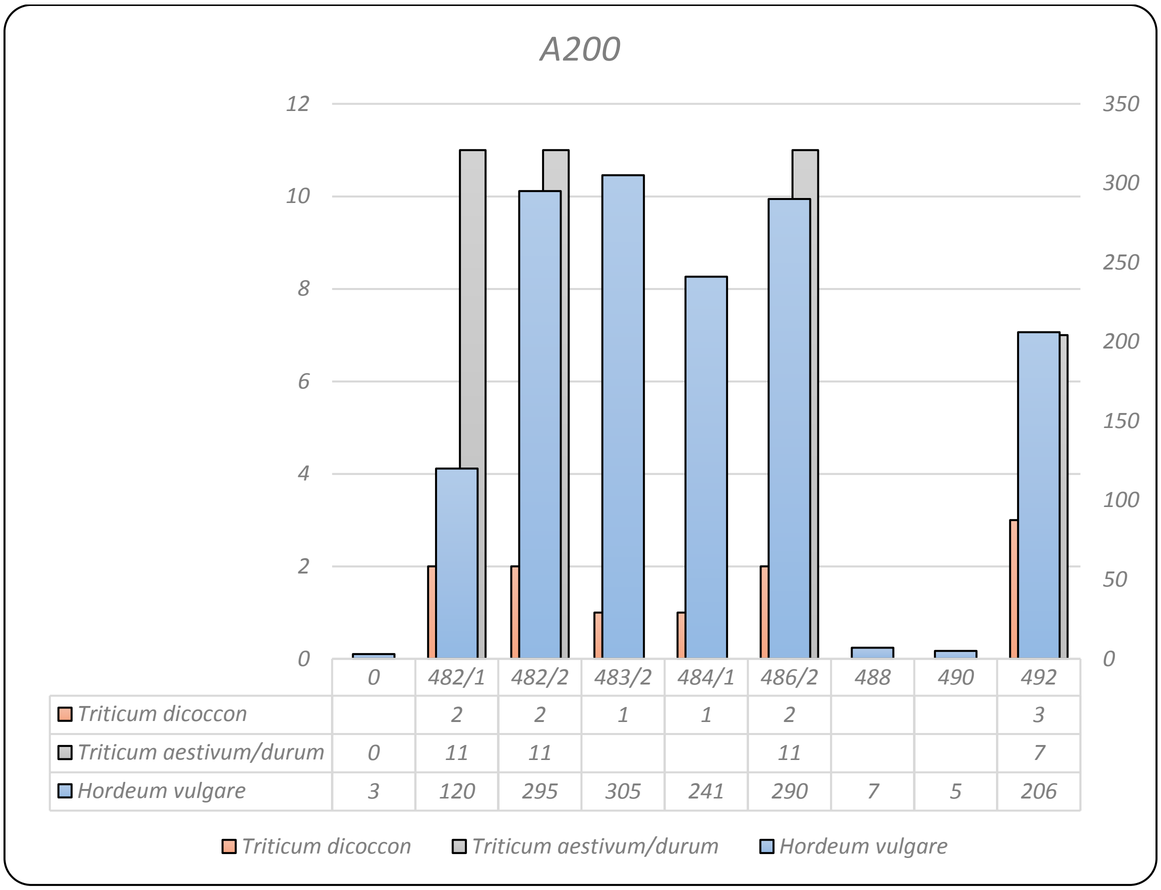
Figure 36.Percentage of the different taxa recovered from the room A175

A 108

Only one sample was taken from room A108. The sample contained only one caryopsis of *Hordeum vulgare* and one seed of *Vicia/Lathyrus*. They were found in the hearth of this room.

A 200

Nine samples were studied (see Figure 37). The average density is 35 seeds/kg. Samples contained only cereals. Among the cereal species, the most abundant was *Hordeum vulgare* because it was presented in all samples and it made up 97% with 1,572 estimated grains (see Figure 38). Besides barley, 40 caryopses of *Triticum aestivum/durum* and 11 caryopses of *Triticum dicoccon* were identified.



	0	482/1	482/2	483/2	484/1	486/2	488	490	492
Triticum dicoccon		2	2	1	1	2			3
Triticum aestivum/durum	0	11	11			11			7
Hordeum vulgare	3	120	295	305	241	290	7	5	206

Figure 37. Absolute quantities of the different taxa recovered from the room A200

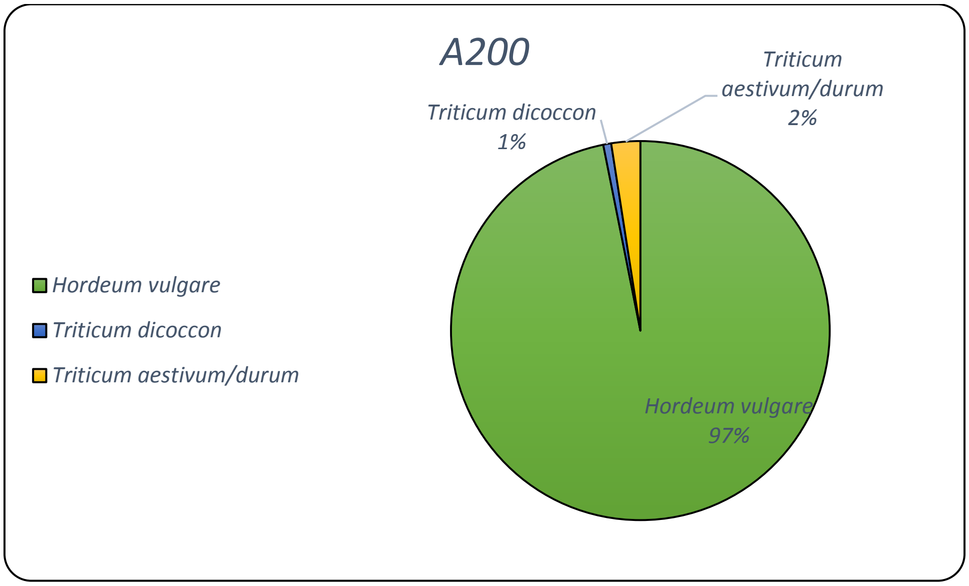
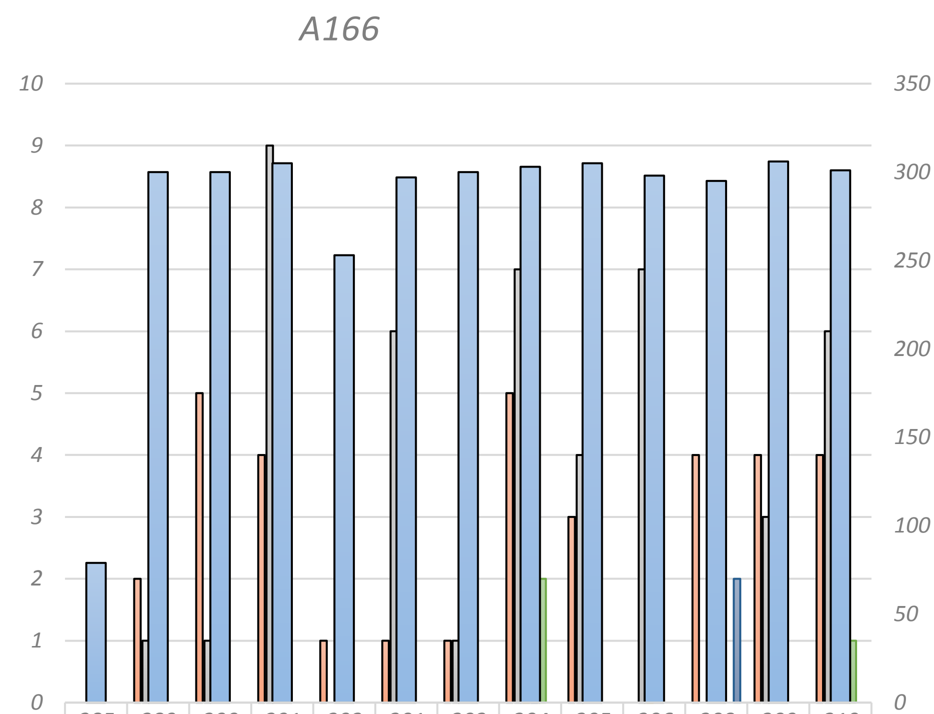


Figure 38.Percentage of the different taxa recovered from the A200

A166

The main identified taxon in the room A166 was *Hordeum vulgare*. The total estimation for barley is 3,642 grains, 98 % of the overall plant remains of 13 samples analyzed in this study (see Figure 39, 40). Apart from the barley caryopses, other cereals were recorded like *Triticum dicoccon* with 34 estimated grains and *Triticum aestivum/durum* with 45 caryopses. In two samples, 304 and 306, one seed of *Pisum sativum* was recorded in each sample; besides presence of 1 seed of the pea in the sample 304, there was also 1 seed of *Lens culinaris*. The pips of *Vitis vinifera* were found in two samples, there are two pips in the sample 304 and one pip in the sample 310. Two achenes of *Rosa* sp. were identified in the sample 308.



	285	289	290	291	293	301	302	304	305	306	308	309	310
Triticum dicoccon		2	5	4	1	1	1	5	3		4	4	4
Triticum aestivum/durum		1	1	9		6	1	7	4	7		3	6
Pisum sativum								1		1			
Lens culinaris								1					
Vitis vinifera								2					1
Rosa sp.											2		
Hordeum vulgare	79	300	300	305	253	297	300	303	305	298	295	306	301

Figure 39. Absolute quantities of the different taxa recovered from the room A166

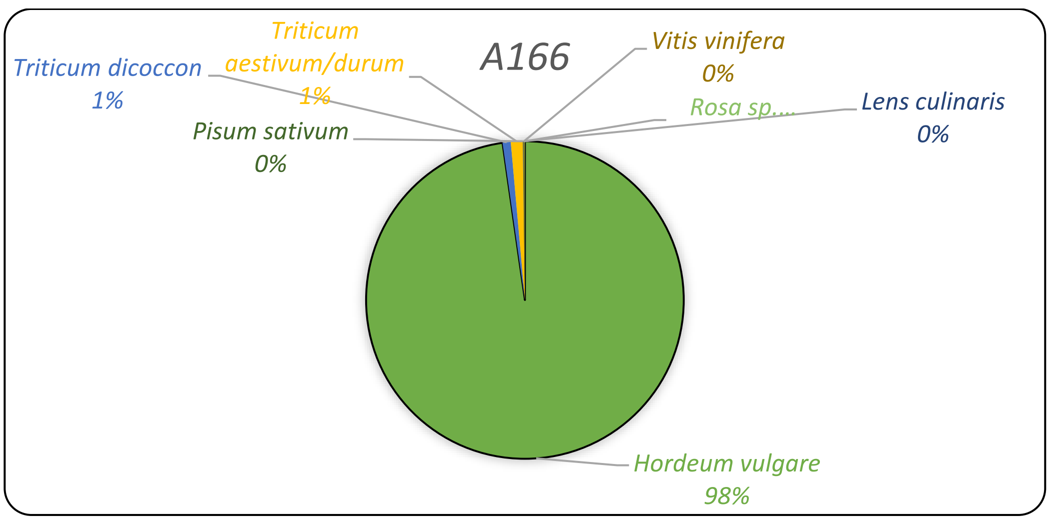


Figure 40. Percentage of the different taxa recovered in the room A166

Building VIII

Thirteen samples have been analyzed from 3 areas in the Building VIII (see Table 8). As in Building IX, cereals are the most abundant crops. The variety of taxa is less than in the previous building because only one seed of pea has been found. Furthermore, there are no weed species.

Building VIII					
Taxa/context		A274	A167	A153	Total
Hordeum vulgare	n	190	1,392	1	1,583
	g		4.63	0.05	4.68
	est		360	4	364
	total	190	1,732	5	**1,927**
Triticum dicoccon	n	18	34		52
	g		0.44		0.44
	est		28		28
	total	18	62		**80**
Triticum monococcum	n	1	2		**3**
Triticum aestivum/durum	n	18	94	2	**114**
Triticum sp.	n		9		9
	g		0.34		0.34
	est		21-30		
Pisum sativum	n	1			**1**
Vitis vinifera	n		1		1
	g	0.16			0.16
	est	20			20
	total	20	1		**21**
Indeterminable	n		13	1	14

Table 8. List of taxa and numbers of seeds and fruits recovered from the Building VIII

A153

Only one sample has been studied from this context. The density is 7 seeds/kg. There were 5 caryopses of *Hordeum vulgare* and 2 caryopses of *Triticum aestivum/durum* (see Figure 41).

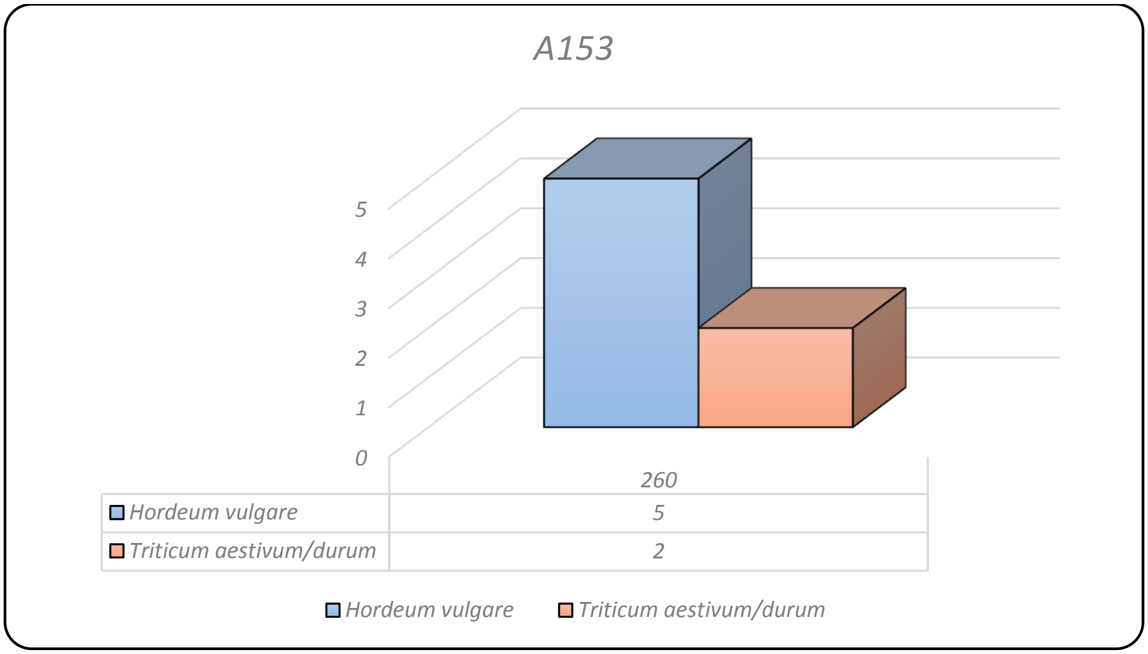


Figure 41. Absolute quantities of the different taxa recovered from the room A153

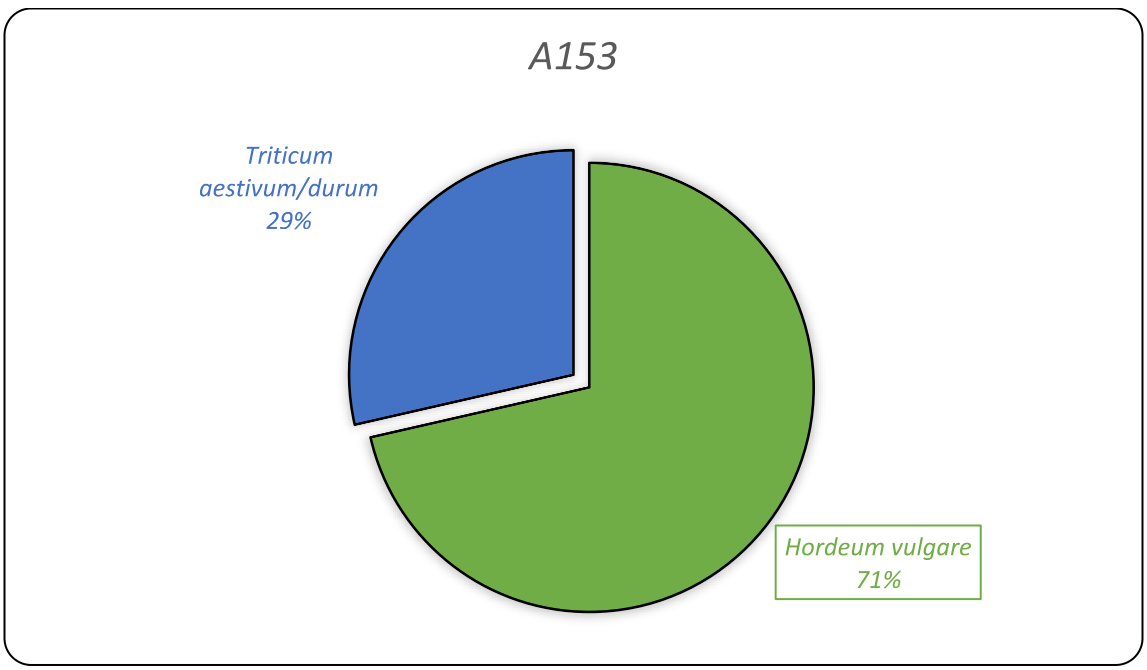
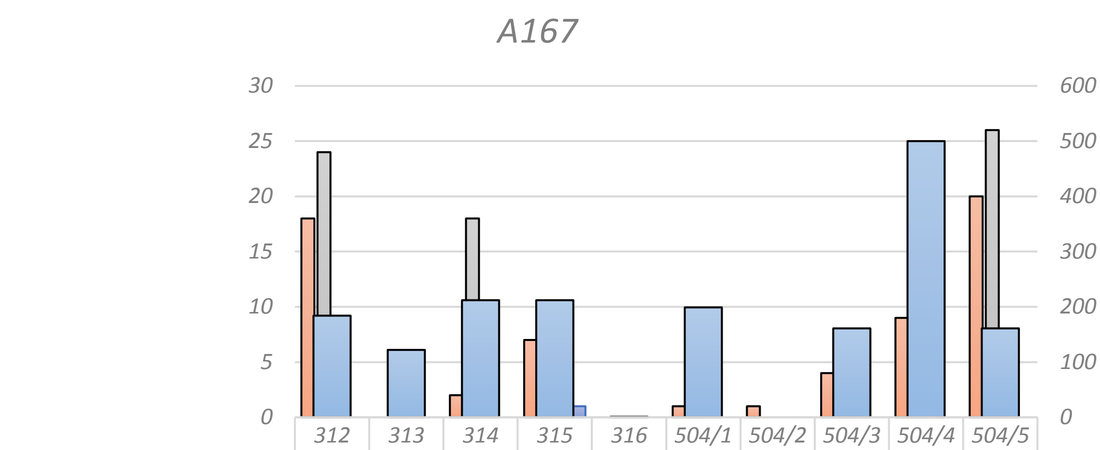


Figure 42. Percentage of the different taxa recovered from the room A153

A167

Concerning the room A167, ten samples were studied (see Figure 43). All of them were coming from the floor. The average density is 88 seeds/kg. The results demonstrate that *Hordeum vulgare* is the most abundant taxon with 1,572 grains, almost 92% of the total (see Figure 44). But there are other cereal crops present, 62 estimated grains of *Triticum dicoccon*, 2 caryopses of

Triticum monococcum and 94 grains of *Triticum aestivum/durum*. Besides cereal crops, there was 1 pip of *Vitis vinifera*.



	312	313	314	315	316	504/1	504/2	504/3	504/4	504/5
Triticum dicoccon	18		2	7		1	1	4	9	20
Triticum aestivum/durum	24	1	18	10		3		3	9	26
Triticum monococcum									1	1
Vitis vinifera				1						
Hordeum vulgare	184	122	212	212	1	199		161	500	161

Figure 43. Absolute quantities of the different taxa recovered from the room A167

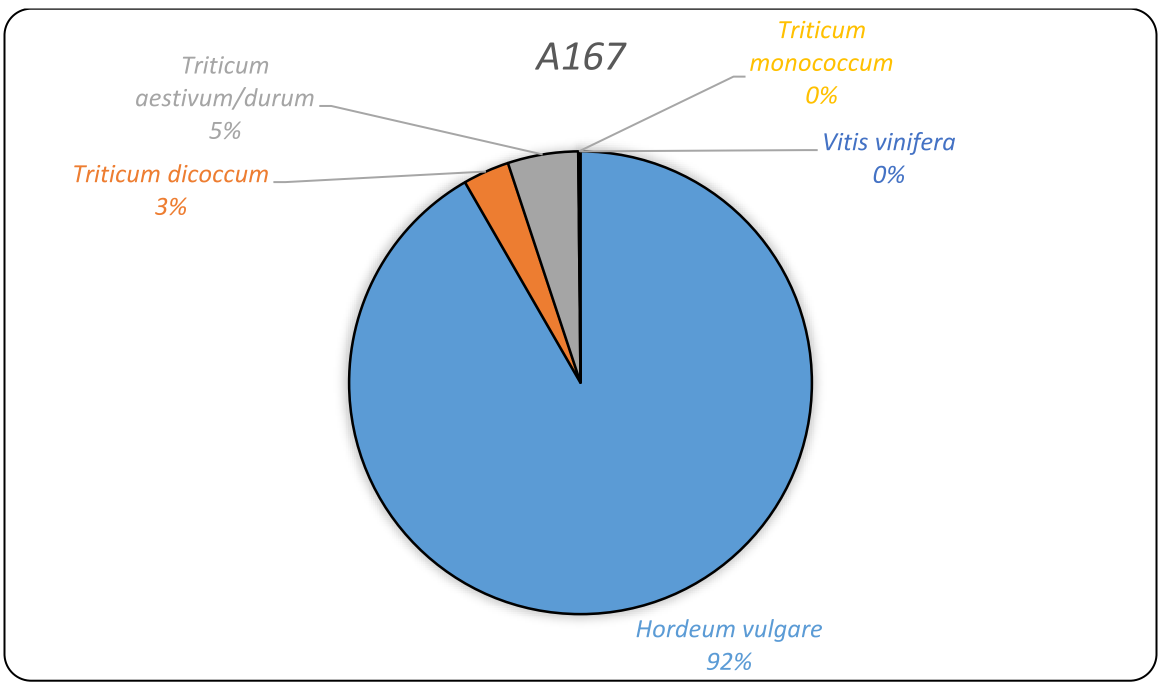


Figure 44. Percentage of the different taxa recovered from the room A167

A274

Two samples have been analyzed (see Figure 45). The findings are similar to A167, with the dominance of cereals, in particular barley that made up 77 % of the total (see Figure 46). The most important findings were 20 estimated pips of *Vitis vinifera*. While pulses are represented only by one seed of *Pisum sativum*.

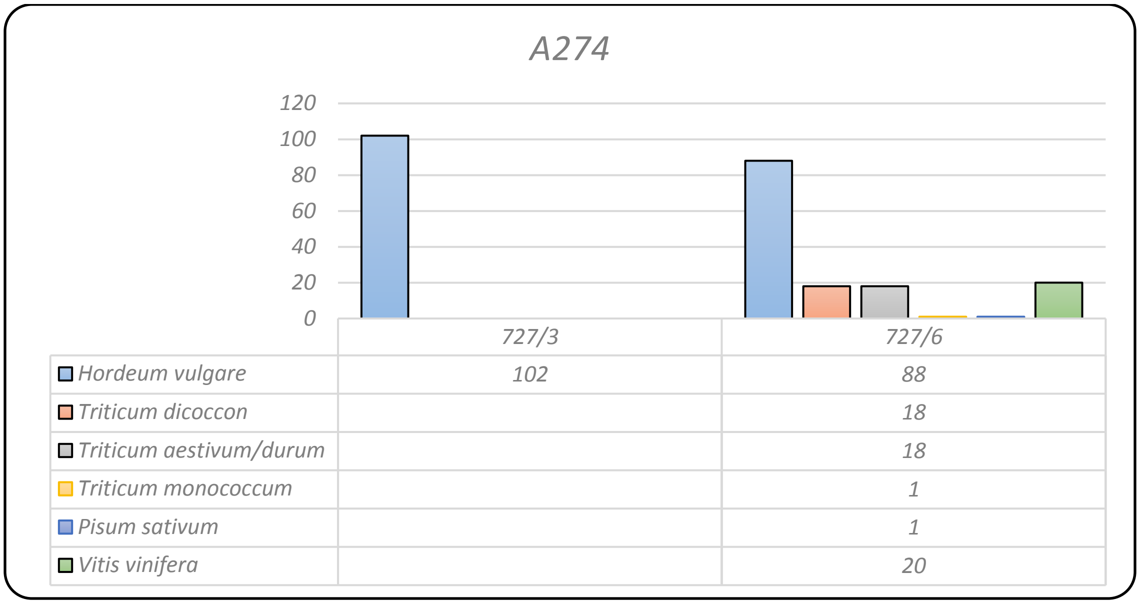


Figure 45. Absolute quantities of the different taxa recovered from the room A274

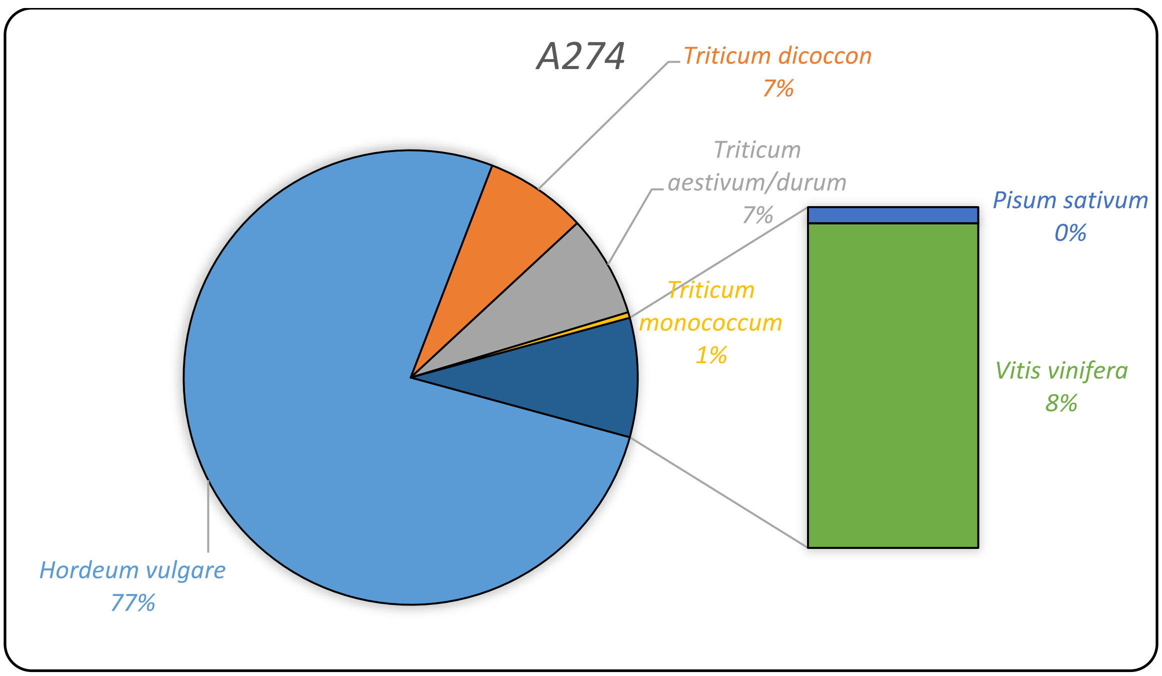


Figure 46. . Percentage of the different taxa recovered from the room A274

A 324

Only one sample came from the street A324, which is located in the northeastern corner of the Building VIII. The sample contained only 101 caryopses of *Hordeum vulgare* with density 51 seeds/kg.

A472

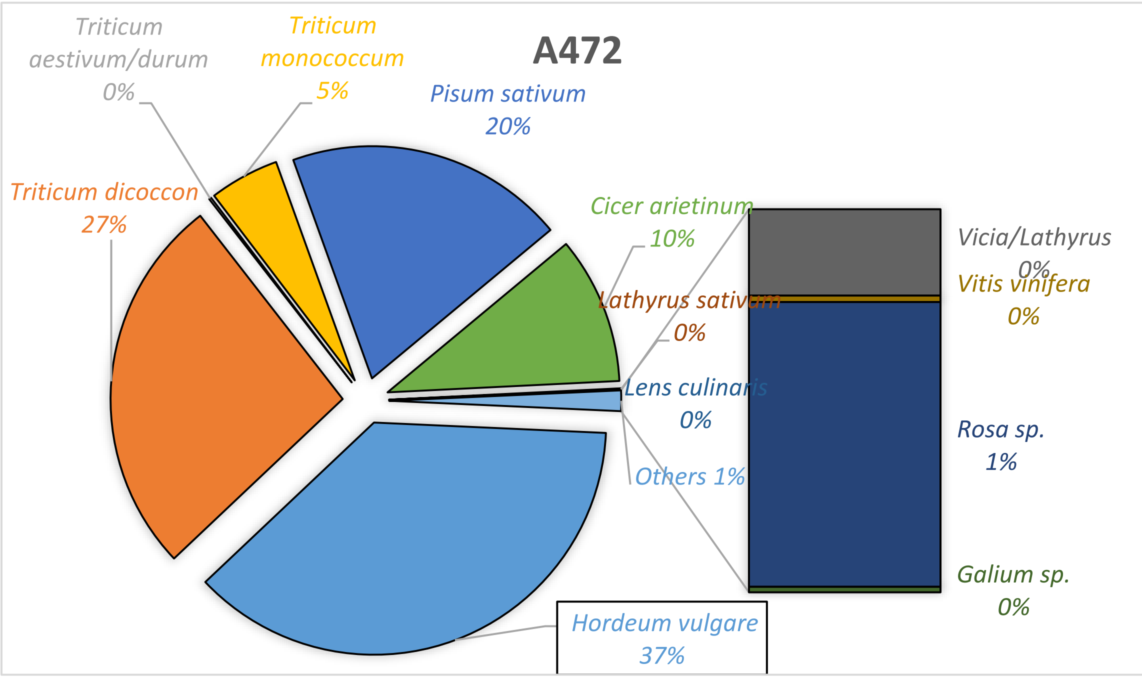


Figure 47. Percentage of the different taxa recovered from the room A472

Due to the fact that many samples have been studied, the data will be presented not by samples but as room, in appendix (1m) there is a full table with data of each sample. Forty analyzed samples contained diverse taxa. Due to the fact that many samples have been studied, the data will be presented not by samples but as one room, in appendix there is a full table with data of each sample. Cereals are the most abundant crops, where *Hordeum vulgare* made up 37 % from the whole amount of plant remains of 40 samples, *Triticum dicoccon* is 27 %, Triticum *monococcum* the 5 % and finally belong to the *Triticum monococcum* and *Triticum aestivum/durum* (see Figure 46).

In contrast to all other buildings and areas, there are very abundant finding of pulses. Pulse crop assemblage constitutes the 30 % a so high percentage is never reached in other contexts. The majority of legumes was identified as *Pisum sativum* with 2,843 seeds followed by *Cicer arientinum* that counted twice less than pea (1,497.5 seeds). Finally, nine seeds of *Lens culinaris* have been recorded. Conserving vetches (*Lathyrus sativum* and *Vicia/Lathyrus* sp.), their number is large compared to other rooms. For example, there were identified 47 seeds of *Vicia/Lathyrus* sp. and 1 seeds of *Lathyrus sativum*. Likewise, relatively large amount of seeds of Rosa sp. were recorded in this room. Only three pips of *Vitis vinifera* were recorder as well as *Galium sp*. (see Figure 48).

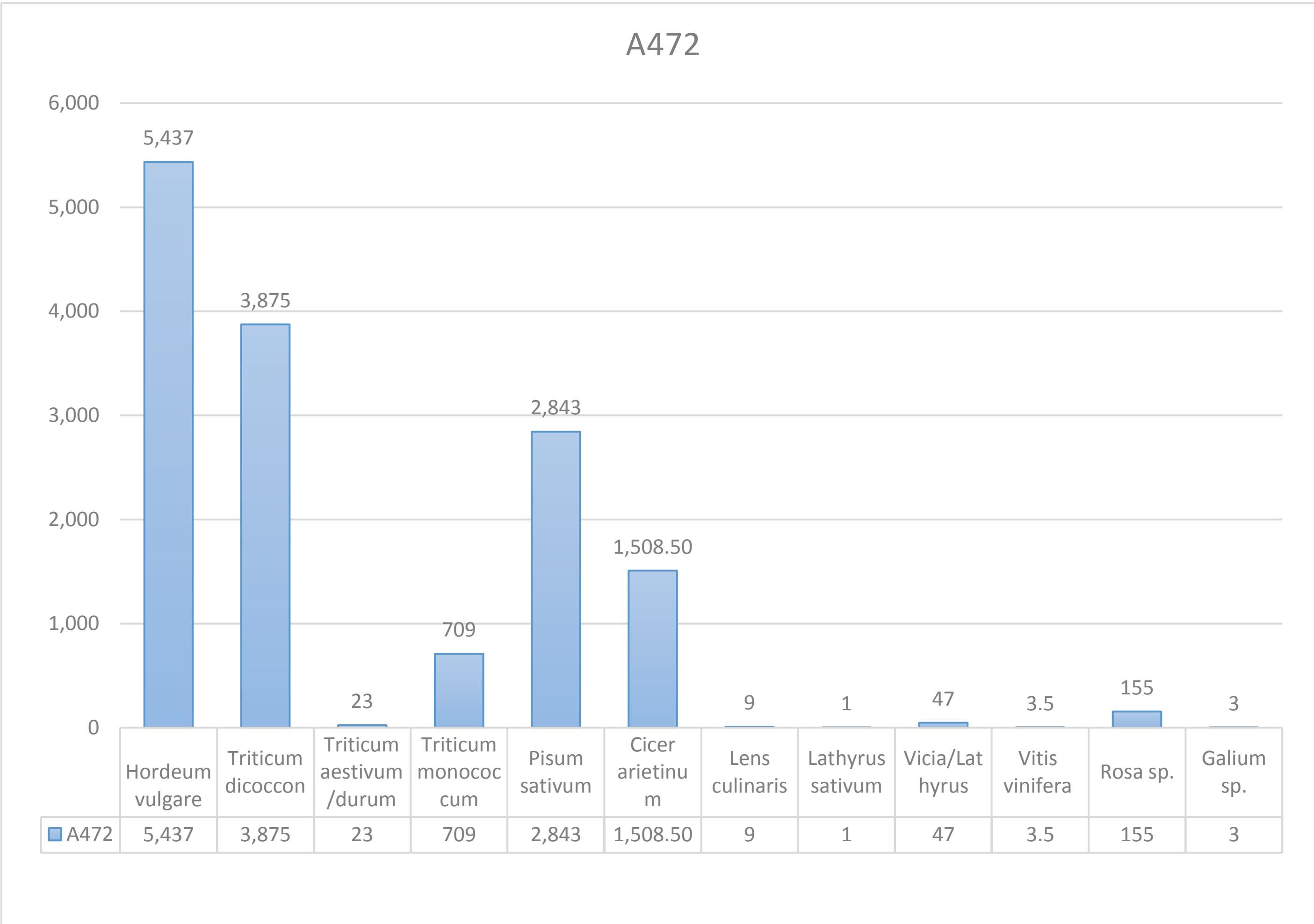


Figure 48. Absolute quantities of the different taxa recovered from the room A472

K416

Only two samples were analyzed in the frame of this research. It is noteworthy that in both samples there were only seeds of *Triticum dicoccon*. Totally, 202 estimated grains were recorded.

The archaeobotanical study of 131 samples, recovered from a cultural layer dated back to the Early Bronze Age 1/b (3100-2900 cal. BCE), namely the VIB2 period of Arslantepe, was aimed to compare the functional roles of Buildings IX, VIII and room A472 using archaeo-carpological analysis to track down differences which could be caused by different household roles and responsibilities in the village.

A total of 63,941 seeds/fruits, including the estimated ones, have been found in the investigated area of the village. The high amount of carpological remains is accompanied by a good state of preservation. This is due to the fact that the settlement was destroyed by a fire that burnt the houses with their stored annual crops. The excellent state of preservation of botanical materials provided detailed information on plant variety and distribution among different rooms of the village.

Previous (e.g. Sadori, 2012; Piccione et al., 2015;) and present studies evidence that cereals are the most used crops in VIB2 period (see Figure 49). The assemblage was dominated by *Hordeum vulgare* (barley) followed by glume wheat, mainly *Triticum dicoccon* (emmer) and in minor quantity *Triticum monococcum* (einkorn) and by some grains of free-threshing wheat *Triticum aestivum/durum*.

A small amount of legumes was recorded. *Pisum sativum* (pea) was the most abundant finding; *Cicer arietinum* (chickpea), *Lens culinaris* (lentil) were present too, but in minor quantity. In addition, a few amounts of *Vicia/Lathyrus* and *Lathyrus sativus* (grass pea) seeds were recorded.

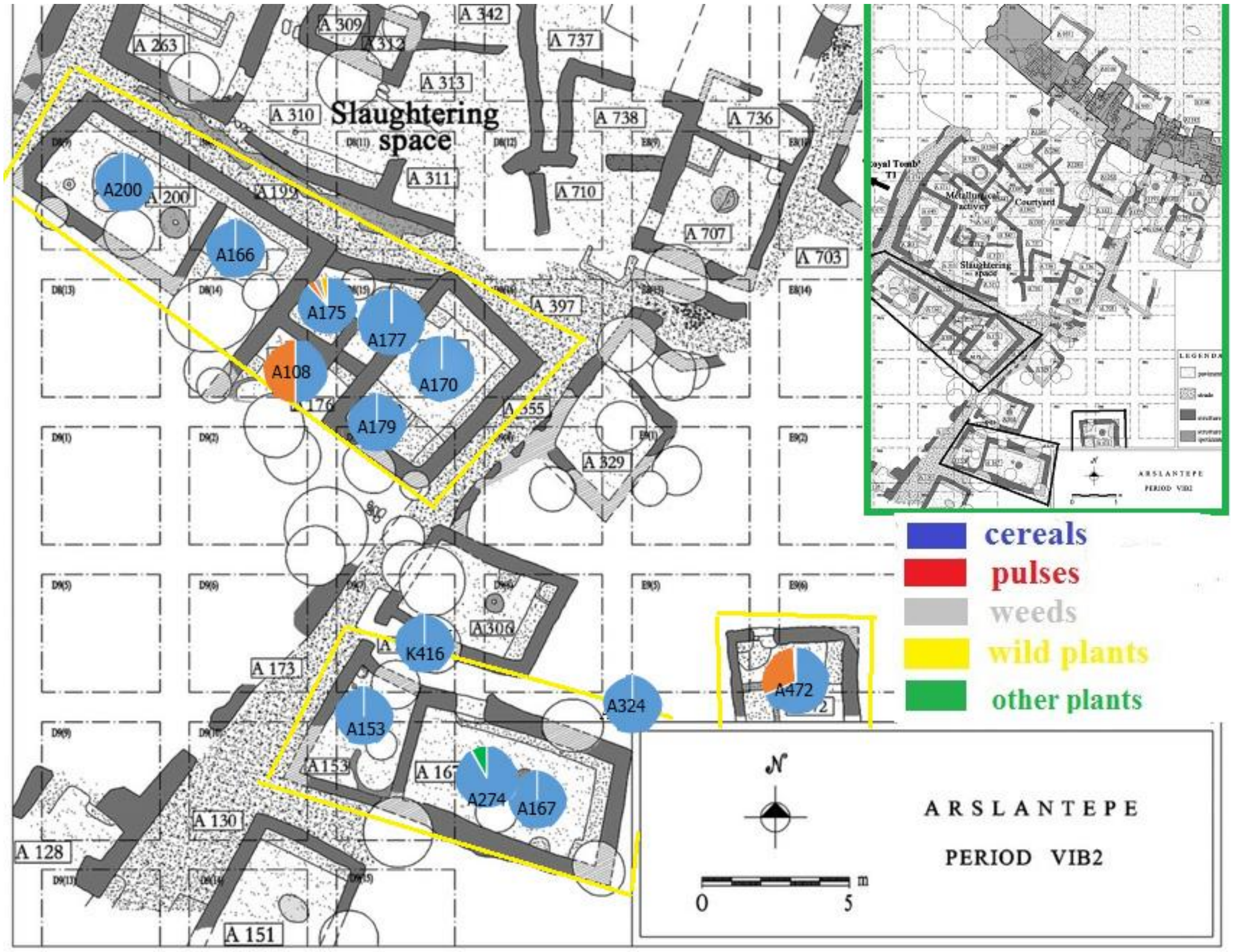


Figure 49. Arslantepe. Distribution of plant remains in the studied areas

Weeds or non-economic taxa were poorly represented. Only *Galium* sp., *Ranunculus arvensis* and *Raphanus raphanistrum* have been identified in a small quantity. Even if weeds are non-economic plants, they provide interesting information. Weeds were found mainly in the rooms A472, A170 and A177. The number of weeds is very small, the fact that only 10 specimens were discovered in three rooms is not an indication of crop cleaning, but just of a random presence. Crops were cleaned, carefully sifted and sorted before being stored. In room A 170 (Building IX), only one spikelet fork of *Triticum dicoccon* was found on a total of 22,734 caryopses. According to Stevens (2003), well cleaned crops can be an indication of large-scale community organization of labor what was not a characteristic of Arslantepe. In case of Arslantepe, it demonstrates the high level of agricultural development. Previous carpological analyses of samples from A170 carried out by Dr. Alessia Masi (unpublished data) document a large amount of spikelet forks of *Triticum dicoccon* (ratio of 14:1). Taking into consideration the different results, possibly some grains had been already sieved and prepared for storing, while some others had not yet been sieved. Crop processing as well as storing and consuming took place in this room. In room A472, 193 spikelet forks of *Triticum dicoccon* and 119 spikelet forks of *Triticum monococcum* were also recorded. The ratio of emmer grains to spikelet forks is 20:1 and of einkorn is 6:1.

The rooms A170 and A472 are different from other rooms because not only weeds and spikelet forks were discovered, but also paired caryopses; in addition to botanical remains, artefacts such as grinding tools provide additional evidence for agricultural activity in the village associated with crop processing (Oybak & Demirci, 2014).

Large amount of damaged or fragmented grains were identified only at the genus level, *Triticum* sp. Since the dominant crop is emmer and small amounts of einkorn and free-threshing wheat species were recorded, it is reasonable to advance the hypothesis that these fragments represent most likely emmer. It has also to be considered that large quantities of emmer fragments were identified. The fragments could represent the remains of bulgur, but this hypothesis has to be confirmed. Bulgur is considered a traditional food in Balkan countries and in the Middle East (Bacvarov, 2016). Moreover, bulgur was already produced in the Neolithic period in Central Anatolia (Çatalhöyük) (González Carretero et al. 2017) and in Bulgaria, at the Yabalkovo archaeological site (Bacvarov, 2016). In the case of Arslantepe, it is not yet clear if those fragments are bulgur or not; there is the need of knowing food processing modalities, investigating the broken surfaces of the grain pieces. In this case Scanning Electron Microscope (SEM) (Valamoti et al. 2008) observation could be applied in order to explore the possible processing treatment such as boiling to facilitate the removal of the chaff.

6.1. Comparisons between Buildings

Barley was the dominant crop with ubiquity of 87%. It was present in all studied rooms of Building IX, Building VIII, A472 and even on the road A 324 where barley was the only identified species. A series of studies conducted in Anatolia confirms that barley was cultivated in large scale during the third millennium BC. It seems that barley was an important element of food production in the VIB2 period at Arslantepe. Probably it was used in human diet and for animal feeding. Bread backing is unlikely due to the fact that "gluten is responsible for the rising of dough" but its gluten content is 27% lower than in wheat (Riehl, 2019, p.11); therefore, barley could be used for bread backing only with a mixture of other cereals, or maybe it was used as groats for porridge, flat unleavened bread or beer brewing because people were drinking beer in the Near East since the Neolithic, but there is no clear evidences for which purposes exactly barley was used. The fact that barley was found in all rooms demonstrates that this crop was available for all the inhabitants of the village.

Emmer was widespread in both buildings as well as barley. The ubiquity is 57 %; the quantity is thus less than barley only for 2 %. It should be pointed out that emmer was the dominant crop only in room A170 and that also a large, even if minor, quantity of emmer was recorded in room A475 (see Figure 50) together with 6,584 fragmented grains (102.72 g). Emmer was also identified in pit K416. This pit was likely a storage place for emmer because grains were very well clean and not too much fragmented, just few grains were broken. The break was probably due to seed recovery or transportation. In addition, emmer was stored separately because there is no evidence of other crops in the pit.

Regarding einkorn, it was found in both buildings and in room A472. But it was mainly concentrated in Building IX in room A170, where it consisted of 11% of studied remains; the quantity of einkorn is in second position after emmer. Also a large quantity of einkorn was in room A472. Only a few caryopses of einkorn have been found in all other rooms of both buildings. The naked wheat was the least present cereals, even if the ubiquity was the same as einkorn (36%). Based on the description mentioned above, it is clear that Building IX and room A472 are more abundant in crop than Building VIII. In addition, the quantity of naked wheat is greater in A170, but it is however only 0.7% within the room assemblage. Naked wheat is 4.88% in room A167 and 7.2% in room A274. The results show that naked wheat was found in all rooms of Building VIII; moreover, it was not the minor species as in the quantitative analysis it is on the second position after barley. Naked wheat was probably used as one of the components of bread. If today bread is made only from wheat, in the past bread was a mix of grains, barley included. Naked wheat became more popular in the VID period (Sadori & Masi, 2012) and replaced barley. This local diet had already started already during the VIC because the production of naked wheat had increased already in that period, when einkorn quantity had decreased (Sadori et al., 2006).

Pulses (peas, chickpeas and lentils) were mainly found in room A472, only one pea was found in the Building VIII, and a small quantity of pulses such as peas and lentils have been recorded in the Building IX. Pulses were not a rarity during the Bronze Age in the Malatya region. For example, pulses, and especially pea was one of the dominant crops in İmamoğlu Höyük situated in the Euphrates basin, northeast of Malatya. The results of a study on Early Bronze Age

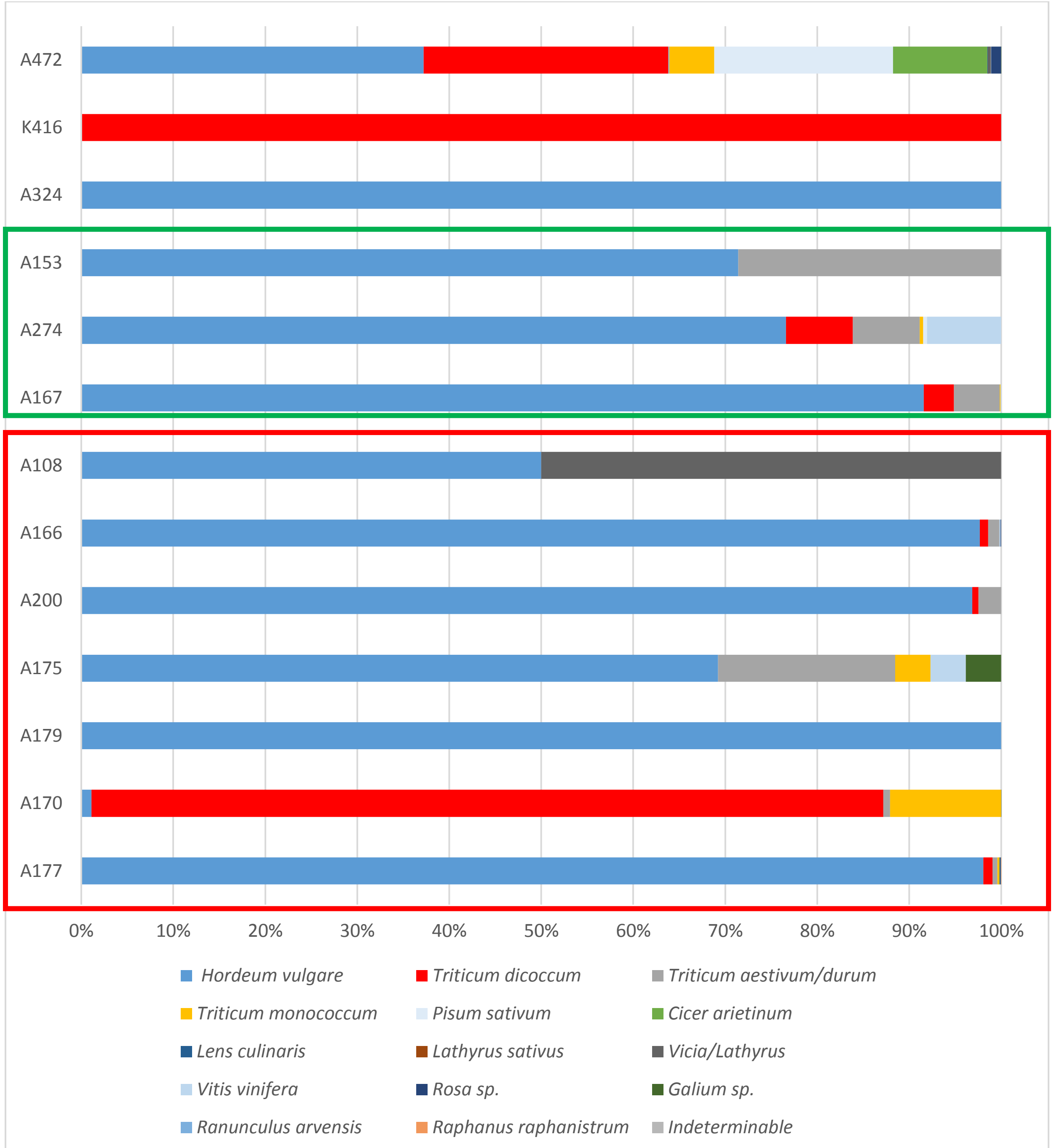


Figure 50. Arslantepe. Percentage distribution of all taxa in the studied rooms

plant remains show that barley and pea were the main findings in İmamoğlu Höyük (Oybak & Demirci, 2014), with pea mainly recorded only in one studied room A472.

Climate could be unsuitable for successful cultivation of pulses, especially, if it was arid or semi-arid (Dugan, 2016). There was a lot of water from springs all over the plain. There was no climatic issue for pulses cultivation at Arslantepe. From ethnographic observations people are less likely to grow legumes if family labor is not enough; therefore, farmers withdraw from pulse cultivation due to the need for a large number of workers for pulses harvest (Palmer, 1999). Pulses were mainly located in one room, room A472. This room was not only a place for crop processing but also for storage; moreover, there were many varieties of crops.

Seeds with the fragments of fruit of *Rose* sp. (see fig. 51) were also mainly found in the room A472. Taking into consideration all findings in room A472, this room was used mainly as a storage room and for crop processing. Because the area was not completely excavated, it is difficult to say if this room was independent or a part of a larger house. But results show that people, who owned that room had greater reserves of food or they were cultivating differentiated crops.

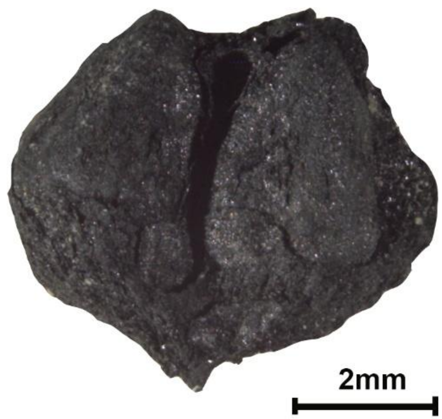


Figure 51 Rose *sp. with a fragmentally preserved fruit*

Building IX consists of many rooms, but based on the archaeological and archaeobotanical findings, the building was formed by two houses. Maybe it belonged to two families or groups of people with family relation. In the Early Bronze Age in Anatolia region, there were small cooperative kinship units (Atakuman, 2017). The Building IX could be considered as one kinship unit, which was specialized in cereal cultivation and production. Not only archaeological evidences like gridding stones, hearths, flint inserts for a threshing sledge, ceramic assemblage and building plans testify that there were two houses, but also botanical remains support this hypothesis.

The first house consisted of room A170 with raised area A179, A177, A175, A108, and A176 (not studied). The second house had only two rooms (A200 and A166). Those two rooms were used mainly for barley and emmer storage. There are no archaeobotanical evidences of crop cleaning and processing. Based on this, there could be an argument why these two rooms cannot be considered only as storage rooms of the Building IX, but considered as two rooms of a separate house. There is a counterargument if we consider other rooms of the Building IX. Mainly room A170, A177 and A179 had been used for storage and processing. Only two seeds were found in the room A108. In room A175, only 25 seeds were identified with approximate and average density 0.2 seed/kg. For example, in room A170 the approximate and average density is 731 seed/kg, in the raised area A179 is 751 seed/kg. Why were rooms A175 and A108 not used as storages but storages were in the rooms A200 and A166? The possible answer is that there was enough space in 2 rooms (A170 and A177) and in the raised area A179 for crop storage; therefore, A108 and A175 were not used. There is no reason to leave the near rooms A108 and A175 and adopt other rooms A200 and A166 for storage. Therefore, I propose, that crop cleaning and processing found a place in the side A (see Figure 6) as well as a storage of one family, while side B was used only as a storage and processing room of another family. My hypothesis is that those two families were economically independent one from each other; therefore, grains were stored in different sectors of the building.

Concerning Building VIII, it was not used for crop cleaning and crop processing, as Building IX and room A472. Moreover, archaeological data shows that cooking pots were mainly found together with two large necked jars. There are no crop processing evidences from the archaeological and botanical studies. This building attracts attention because 20 pips of grape were found on the upper floor. It is probable that grape was dried on the upper floor. But why are there only 20 pips? Late summer is the period when grape is collected, but probably the village was fired earlier, therefore, grape had been already eaten, and people were waiting for a new grape harvest.

6.2. Future outlooks

In terms of future analyses, internal structure of starch granules of cereal grain fragments generated by various food processing could be examined using SEM in order to explore the possible processing treatments of the fragmented grains recovered from VIB2 period at Arslantepe. Moreover, I suggest to recover organic residues from pottery in order to find out biomarkers specific for barley in order to have a clear idea about barley role in the Early Bronze Age at Arslantepe because the whole greater Mesopotamia is full of evidence of the use of barley for beer. Residues analysis of the vessels will allow us to prove the evidence of brewery at Arslantepe if calcium oxalate will be identified. In addition, it will be interesting to make a general observation of all studied samples of this period to provide a better representation of the functional roles of the different buildings on the village VIB2 period at Arslantepe.

The destruction of the village of VI B2 period and the burial of crops due to fallen walls and roofs have resulted in a slow burning that caused a high level of preservation of macro-botanical materials. The exceptional state of preservation is evidenced by the conservation of numerous diagnostic morphological features in the seeds/fruits.

Two residential units (Building IX and Building VIII) and an isolated room (A472) from the destructed village have provided new data on food distribution, storage and use. This study shows that barley, emmer, naked wheat, pea, chickpea, lentil, and grape were major plant ingredients for food at Arslantepe. Barley was one of the most important cultivated cereals as well as emmer. Pea was the dominant pulse crop, but the role of legumes within the village is not so clear.

As regards to household economy, Building IX inhabitants were mainly specialized in cereal cultivation because barley, emmer and einkorn were the main species found there. This building was used for crop processing, storing and food consumption. In contrast, Building VIII was not a place where crop-processing of cereal grains had been practiced. The most interesting fact is that 20 grape pips were found on the second floor of the building what was not common for other studied structures. For example, the isolated room A472 has a big variety of plants like barley, emmer, einkorn, but, only in this building, a large number of pulses have been found. Probably people inhabiting this room liked cultivating pulses; moreover, this case demonstrates that the owners of this house were not only specialized in pulse cultivation as they also cultivated cereals. As wells as Building IX, room A 472 was a place where crop processing, storing and food consumption was occurring.

The abundance of crops indicates that the domestic units contained quantities of staple used for the subsistence of the family components in agreement with what found by previous archaeobotanical work carried out in other buildings of the village (e.g. Piccione et al., 2015). The agriculture was probably family based, with each household cultivating, harvesting, processing and storing a large variety of crops, with a diet based on cereals and at times legumes. The stored crops are always clean, well processed, with very rare rachis fragments and weeds. Moreover, different crops are often stored separately, indicating an advanced agriculture system. For example, pit K416 was a place where only emmer was stored and the raised area A179 was a place where only barley has been recovered.

The archaeobotanical evidence is also useful for dating the fire that destroyed the settlement: the abundance of crops indicates that it took place not long after the harvesting season. The general overwhelming presence of hulled barley on hulled wheats is not enough to exactly date the fire. Barley is in fact not only harvested some weeks before wheat, in late spring/early summer, but it is also a more resistant crop, easier to grow than wheat. This could also be the reason of the higher amount of the less palatable cereal, and not just the fact that wheat had not yet harvested before the conflagration. The second crop in abundance is emmer, the hulled wheat more productive than einkorn.

This research requires more studies because Arslantepe is an amazing place where archaeobotany will find out answers to many other questions. During this research, I have faced another question regarding bulgur production which requires new studies because there is no scientific support if people produced bulgur or not on the village of VIB2 period at Arslantepe.

Appendix 1. Lists of taxa and their numbers. All studied contexts.

Taxa/context		A170						Total
Taxa/sample number		478/3	480/3	1004	1005	1007	1008	
Sediment weight	kg	7		5	5	5	5	
Hordeum vulgare L.	n	24	24	51	8	6	91	204
	g	0.26	0.16	0.19			0.5	1.11
	est	20	13	15			39	87
	total	44	37	66	8	6	130	291
Triticum dicoccon	n	4,579	4,516	2,348	205	108	4,394	16,150
	g	23.45	22.45	10.16	0.84	0.42	45.4	102.72
	est	1,503	1,439	651	54	27	2,910	6,584
	total	6,082	5,955	2,999	259	135	7,304	22,734
Spicklet forks of *T. dicoccon*	n			1				1
Paired caryopses of T.dicoccon	n			30			16	46
Triticum monococcum	n	420	537	346	20	9	1,125	2,457
	g	5.64	0.77	0.61	0.07	0.05	1.52	8.66
	est	504	47	54	6	4	136	751
	total	624	584	400	26	13	1,261	2,908
Spicklet forks of *T. monococcum*	n							
Triticum aestivum/durum	n	32	22	35	1		105	195
	g							
	est							
Triticum sp.	n	104	17	26		3	36	186
	g	32.03	20.45	12.43	0.89	1.1	5.53	72.43
Galium sp.	n	1						1
Cereals - undifferentiated	g	31.43	3.99					35.42

Appendix 1a. A list of taxa and their numbers. A170

Taxa/context		A175																			Total
Taxa/sample number		356	357	358	359	360	361	362	363	364	365	366	379	380	381	382	383	384	385	387	
Sediment weight	kg	8	8	10	10	11	7	12	11	11	12	5	1	1	1	1	1	12	9	12	
Hordeum vulgare	n			2	1	1				2	2	2	2	1					1		14
	g													0.05							
	est													4							4
	total			2	1	1				2	2	2	2	5					1		18
Triticum aestivum/durum	n													2							2
	g													0.05							
	est													3							3
	total													5							5
Triticum monococcum	n				1																1
Triticum sp.	n									1											1
Galium sp.	n															1					1
Cicer arietinum	n																				
	g															0.02					
	est															1					1
Vitis vinifera	n																			1	1
Cereals – undifferentiated	g													0.1							
Legumes - undifferentiated	g																			0.03	
Indeterminable	g													0.08			0.03	0.02	0.01	0.01	

Appendix 1b. A list of taxa and their numbers. A175

Taxa/context		A179	
Taxa/sample number		525	Total
Sediment weight	kg	6	
Hordeum vulgare	n	522	522
	g	7.62	
	est	595	595
	total	4,511*	4,511

*Subsamplimg: (595x4)+(522 x4)=2380+2088=4468 + 43(those seeds were in a small box inside the big sample) = 4511

Appendix 1c. Results obtained from a raised area, A179, in the room A170

Taxa/context		A108	
Taxa/sample number		862	Total
Sediment weight	Kg	X	
Hordeum vulgare	N	1	1
Vicia/Lathyrus	N	1	1

Appendix 1d. A list of taxa and their numbers. A108

Taxa/context		A177									
Taxa/sample number		499/1	499/2	499/3	499/4	499/5	499/6	499/7	499/8	499/9	500/1
Sediment weight	kg	1	1	1	1	1	11	7	9	6	1
Hordeum vulgare	n	90	2,257	496	173	10	558	304	295	315	226
	g	1.02	5.21	3.34	1.19	0.12	2.98	1.21		0.05	0.75
	est	80	407	261	93	9	233	94		3	59
	total	170	2,664	757	266	19	791	398	295	318	285
Triticum dicoccon	n							3	1		1
	g										
	est										
	total							3	1		1
Triticum monococcum	n			1					2		
	g										
	est										
	total			1					2		
Triticum aestivum/durum	n								2		
Triticum sp.	g										
Cicer arietinum	n										
Lens culinaris	n										
Vitis vinifera sp.	n										
Rosa sp.	n										
Ranunculus arvensis	n									2	
Rapharus raphanistrum	n										
Galium sp.	n								1		
Indeterminable	n									1	

Taxa/context		A177										
Taxa/sample number		500/2	500/3	500/4	500/5	500/6	502/1	502/2	502/3	502/4	502/5	502/6
Sediment weight	kg	10	10	13	1	1	1	1	1	9	11	12
Hordeum vulgare	n	1,012	299	302	663	35	35	13	136	16	98	151
	g	3.4			3.9	0.38	0.31	0.04	1.31	0.07		0.43
	est	266			305	30	24	3	102	5		34
	total	1,278	299	302	968	65	59	16	238	21	98	185
Triticum dicoccon	n	1	1	1				1	3		1	15
	g											
	est											
	total	1	1	1				1	3		1	15
Triticum monococcum	n			1								
	g											
	est											
	total			1								
Triticum aestivum/durum	n				2			1			1	
Triticum sp.	g											
Cicer arietinum	n											
Lens culinaris	n			1								
Vitis vinifera	n											1
Rosa sp.	n										2	
Ranunculus arvensis	n											
Rapharus raphanistrum	n											
Galium sp.	n											
Indeterminable									1			

Taxa/context		A177									
Taxa/sample number		503/1	503/2	503/4	503/5	503/6	503/7	503/8	503/9	503/10	Total
Sediment weight	kg	1	1	1	1	2	8	10	13	8	
Hordeum vulgare	n	65	3	109	12	392	17	20	32	219	8,353
	g	0.35		1.26	0.11	0.15		0.14	0.19	1.33	
	est	27		98	9	12		11	15	104	2,284
	total	92	3	207	21	404	17	21	47	323	10,627
Triticum dicoccon	n			7			4			60	99
	g				0.05						
	est				3						3
	total			7	3		4			60	102
Triticum monococcum	n			2						5	11
	g							0.04	0.03		
	est							4	3		7
	total			2				4	3	5	18
Triticum aestivum/durum	n		6		7		5	11	24		59
Triticum sp.	g										
Cicer arietinum	n										
Lens culinaris	n							0.05	0.14		
Vitis vinifera	n				1						1
Rosa sp.	n										
Ranunculus arvensis	n										
Raphanus raphanistrum	n				6.5				4		11.5
Galium sp.	n		5								6
Indeterminable	n										

Appendix 1e. A list of taxa and their numbers. A177

Taxa/context		A166													Total
Taxa/sample number		285	289	290	291	293	301	302	304	305	306	308	309	310	
Sediment weight	kg	1.5	11	4	10	5	7	11	8.5	8	13	6	6	9.5	
Hordeum vulgare	n	38	300	300	305	253	297	300	303	305	298	295	306	301	3,601
	g	0.52													
	est	41													41
	total	79	300	300	305	253	297	300	303	305	298	295	306	301	3,642
Triticum dicoccon	n		2	5	4	1	1	1	2	3		4	4	4	31
	g								0.05						
	est.								3						3
	total		2	5	4	1	1	1	5	3		4	4	4	34
Triticum aestivum/durum	n		1	1	9		6	1	7	4	7		3	6	45
Pisum sativum	n								1		1				2
Lens culinaris	n								1						1
Vitis vinifera	n								2					1	3
Rosa sp.	n											2			2

Appendix 1f. A list of taxa and their numbers. A166

Taxa/context		A200									Total
Taxa/sample number		0(?)	482/1	482/2	483/2	484/1	486/2	488	490	492	
Sediment weight	Kg	X	9	10	8	6	1	4	4	4	
Hordeum vulgare	n	3	107	290	305	232	290	7	5	306	1,545
	g		0.17	0.07		0.12					
	est		13	5		9					27
	total	3	120	295	305	241	290	7	5	306	1,572
Triticum dicoccon	n		2	2	1	1	2			3	11
Triticum aestivum/durum	n		11	11			11			7	40

Appendix 1g. A list of taxa and their numbers. A 200

Taxa/context		A153	
Taxa/sample number		260	Total
Sediment weight	kg	1	
Hordeum vulgare	n	1	1
	g	0.05	
	est	4	1
	total	5	5
Triticum aestivum	n	2	2
Indeterminable	n	1	1

Appendix 1h. A list of taxa and their numbers. A 153

Taxa/context		A167										Total
Taxa/sample number		312	313	314	315	316	504/1	504/2	504/3	504/4	504/5	
Sediment weight	kg	1	1	1	1	1	3	2	2	5	5	
Hordeum vulgare	n	132	73	157	156	1	199		121	420	133	1,392
	g	0.67	0.63	0.71	0.72				0.51	1.03	0.36	
	est	52	49	55	56				40	80	28	360
	total	184	122	212	212	1	199		161	500	161	1,752
Triticum dicoccon	n	4		2	7		1	1	4	6	9	34
	g	0.22								0.05	0.17	
	est	14								3	11	28
	total	18		2	7		1	1	4	9	20	62
Triticum monococcum	n									1	1	2
Triticum aestivum/durum	n	24	1	18	10		3		3	9	26	94
Triticum sp.	n				2					4	3	9
	g				0.27				0.07			
Vitis vinifera	n				1							1
Indeterminable	n								3		10	13

Appendix 1i. A list of taxa and their numbers. A167

Taxa/context		A274		Total
Sediment weight		2	2	
Taxa/sample number		727/3	727/6	
Hordeum vulgare	n	102	88	190
Triticum dicoccon	n		18	18
Triticum monococcum	n		1	1
Triticum aestivum/durum	n		18	18
Pisum sativum	n		1	1
Vitis vinifera	n			
	g		0.16	
	est		20	20

Appendix 1j. A list of taxa and their numbers. A274

Taxa/context		A324	
Taxa/sample number		730	Total
Sediment weight		2	
Hordeum vulgare	n	101	101

Appendix 1k. A list of taxa and their numbers. A324

Taxa/context		K 416		Total
Taxa/sample number		710/4	711	
Sediment weight		2	2	4
Triticum dicoccon	n	97	100	197
	g	0.08		
	est	5		5
	total	102	100	202

Appendix 1l. A list of taxa and their numbers. K416

Taxa/context		A472											
Taxa/sample number		350/7	354/4	656/1	656/3	657	659/2	659/3	660/2	661	662/1	663/1	665/3
Sediment weight				9	8	10	6	9	15	12	4	10	10
Hordeum vulgare	n	2	2	13	12	8	16	3	103	354	3	11	
	g			0.06						0.12			0.2
	est			5						9			16
	total	2	2	18	12	8	16	3	103	363	3	11	16
Triticum dicoccon	n			235		171	261	187	121	26	57	1	180
	g			0.12			0.08	0.07		0.1	0.47		2.71
	est			8			5	4		6	30		173
	total			243		171	266	191	121	32	87	1	353
Paired caryopses of *T. dicoccon*	n												1
Spikelet forks of *T. dicoccon*	n			22			15		4		8		
Triticum monococcum	n			52		32	38	17	27	6	15	3	50
	g							0.03					0.15
	est							3					13
	total			52		32	38	20	27	6	15	3	63
Spikelet forks of *T. monococcum*	n			7			9		3		7		
Triticum aestivum/durum	n										1	1	1
Triticum sp.	g												
Pisum sativum	n	43	336.5	93.5	87.5	21.5	72.5	57.5	16.5	1	51	66	
	g	0.24	2.21	0.17	0.19							0.49	1.14
	est	6	52	4	4							12	47.5
	total	49	388.5	97.5	91.5	21.5	72.5	57.5	16.5	1	51	78	
Cicer arietinum	n	20	11		3.5							0.5	
	g												47.5
	est												6
	total	20	11		3.5							0.5	
Lens culinaris	n		3								1		
Lathyrus sativus	n		1										6
Vicia/Lathyrus	n	1	12		1			1			1	3	
Vitis vinifera	n	1											
Rosa sp.	n	1										10	2
	g												1
	est												121
	total	1										10	0.12
Galium sp.	n			1					2				12
Cereals - undifferentiated	g												133
Legumes – undifferentiated	g	1.25	3.41	0.38	0.3		0.34				0.31	0.48	

Taxa/context		A472											
Taxa/sample number		665/1	665/2	665/3	665/4	665/5	665/6	666/2	667/1	667/3	670/1	671/4	672/1
Sediment weight		8	8	9	12	10	9	8	9	9	10	9	9
Hordeum vulgare	n	5	95				322		334	1	1	2,590	
	g			0.2								4.44	
	est			16								347	
	total	5	95	16			322		334	1	1	2,937	
Triticum dicoccon	n		264	180			38		95	24		117	21
	g			2.71						0.08			0.1
	est			173						5			6
	total		264	353			38		95	29		117	27
Paired caryopses of *T.dicoccon*	n			1			2						
Spicklet forks of *T. dicoccon*	n												
Triticum monococcum	n	2	39	50			21		19	6		3	2
	g			0.15									
	est			13									
	total	2	39	63			21		19	6		3	2
Spicklet forks of *T. monococcum*	n												
Triticum aestivum/durum	n			1								15	
Triticum sp.	g			1.14									
Pisum sativum	n	52	138	47.5	45.5	51		122.5		178.5	2	76.5	212
	g	0.22			0.4			0.09		0.82			1.6
	est	5			9			2		19			38
	total	57	138	47.5	54.5	51		124.5		197.5	2	76.5	250
Cicer arietinum	n	1	6.5	6	3		17.5	23	12	60.5	297.5	541	1
	g		0.45					0.04			0.08		
	est		14					1			6		
	total	1	20.5	6	3		17.5	24	12	60.5	303.5	541	1
Lens culinaris	n				2							3	
Lathyrus sativus	n												
Vicia/Lathyrus	n	3	3	2	6			1		1		3	2
Vitis vinifera	n			1									
Rosa sp.	n		10	121						1			
	g			0.12									
	est			12									
	total		10	133						1			
Galium sp.	n												
Cereals – undifferentiated	g												
Legumes – undifferentiated	g		0.21					0.51					0.44

Taxa/context		A472											
Taxa/sample number		672/2	672/5	678/2	683/1	683/2	686/1	686/3	688	691/3	692	696/2	697/1
Sediment weight		9	8	10	3	2	7	8	6	8	8	5	9
Hordeum vulgare	n	162	184	102	16	4	17	45	304	10	28	6	4
	g	1.38	1.58	0.17	0.07		0.18		0.03		0.05		
	est	108	123	13	5		14		2		4		
	total	270	307	115	21	4	31	45	306	10	32	6	4
Triticum dicoccon	n	18	8	76	59	103	153	90	100	78	233	98	13
	g		0.03	0.04	0.14	0.34	1.02		0.11	0.09	0.15		0.09
	est		2	3	9	22	65		7	6	10		6
	total	18	10	79	68	125	218	90	107	84	243	98	19
Paired caryopses of *T.dicoccon*	n	1											
Spicklet forks of *T. dicoccon*	n				29	2				1	42	7	
Triticum monococcum	n	3	2	16	16	17	54	12	29	18	57	1	2
	g				0.03		0.19		0.03				
	est				3		17		3				
	total	3	2	16	19	17	71	12	32	18	57	1	2
Spicklet forks of *T. monococcum*	n				15						40		
Triticum aestivum/durum	n			1			1	1			1		
	g												
	est												
Triticum sp.	g				0.17		1.08						
Pisum sativum	n	157.5	150.5		27	30.5	10.5	11	1.5	45	55	63	48
	g	0.34	1.37		0.23	0.09	0.13			0.15	1.06	0.11	0.13
	est	8	32		5	2	3			4	25	3	3
	total	165.5	182.5		32	32.5	13.5	11	1.5	49	80	66	51
Cicer arietinum	n	210	141.5	18.5						1	2	1	50
	g	0.89	0.6										
	est	28	2										
	total	238	143.5	18.5						1	2	1	50
Lens culinaris	n												
Lathyrus sativus	n												
Vicia/Lathyrus	n	2	4								1		
Vitis vinifera	n				1								
Rosa sp.	n												
	g												
	est												
	total												
Galium sp.	n												
Cereals – undifferentiated	g						0.46						
Legumes – undifferentiated	g	2.8	0.13						0.07				

Taxa/context		A472				
Taxa/sample number		697/2	698	1e	sn	Total
Sediment weight		10	6			
Hordeum vulgare	n		6		2	4,775
	g			0.18	0.02	8.48
	est			14	2	662
	total		6	14	4	5,437
Triticum dicoccon	n		218		69	3,373
	g		0.45	0.42	0.2	7.84
	est		29	27	13	502
	total		247	27	82	3,875
Paired caryopses of *T.dicoccon*	n					5
Spicklet forks of *T. dicoccon*	n		48		15	193
Triticum monococcum	n		43		19	660
	g		0.04			0.54
	est		4			49
	total		47		19	709
Spicklet forks of *T. monococcum*	n		34		4	119
Triticum aestivum/durum	n					23
Triticum sp.	g					2.39
Pisum sativum	n	50	60.5		15.5	2,591
	g		0.67			10.71
	est		16			252
	total	50	76.5		15.5	2,843
Cicer arietinum	n				0.5	1,447.5
	g					2.06
	est					11
	total				0.5	1,507.5
Lens culinaris	n					9
Lathyrus sativus	n					1
Vicia/Lathyrus	n					47
Vitis vinifera	n				0.5	3.5
Rosa sp.	n					143
	g					
	est					12
	total					155
Galium sp.	n					3
Cereals – undifferentiated	g					
Legumes – undifferentiated	g				0.13	

Appendix 1m. A list of taxa and their numbers. A472

Appendix 2. Ubiquity

Number of samples

	A166	A274	A177	A167	A472	A200	A170	A324	A153	A108	A175	A179	K416		Ubiquity
	13	2	30	10	40	9	6	1	1	1	19	1	2	135	
Hordeum vulgare	13	2	30	9	35	9	6	1	1	1	9	1		117	87 %
Triticum dicoccon	11 *	1	14	8	31	6	6						2	77	57 %
Triticum aestivum/durum	10	1	9	8	9	4	5		1		1			48	36 %
Triticum monococcum		1	7	2	31		6				1			48	36 %
Pisum sativum	2	1			36									39	29 %
Cicer arietinum			1		24						1			26	19 %
Lens culinaris	1		3		4									8	6%
Lathyrus sativus					1									1	1%
Vicia/Lathyrus					17					1				18	13 %
Vitis vinifera	2	1	2	1	4						1			11	8%
Rosa sp.	1		1		5									7	5%
Galium sp.			1		2		1				1			5	4%
Ranunculus arvensis			1											1	1%
Rapharus raphanistrum			1											1	1%

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