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First archaeobotanical contribution to the history of food production and agriculture at Aghmat (Morocco) between the 11th and the 17th c.

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Abstract

Aghmat, medieval city of the Haouz region (Marrakech), is described by textual sources as a
prosperous commercial city, surrounded by fertile lands. Located at the foot of the High Atlas, at the
opening of the Ourika valley, it benefited from a geographical situation favourable to the development
of an important irrigated agriculture. However, Aghmat was hit by the great crisis that struck Morocco
at the end of the 14th and during the 15th c., and was abandoned. It is only in the course of the 16th c.
that the locality found a new dynamism, while knowing a deep spatial, demographic and economic
reorganization. Indeed, Aghmat seems to take at this period the shape of a dispersed habitat, entirely
dedicated to a new agricultural development.

Since 2005, the extensive excavation of the medieval urban centre and of its levels of abandonment
makes it possible to locally approach this transitional period between two socio-economic systems.
Thus arises the question of the agricultural evolutions and of the role played by the various socio-
economic components on lands management. The recent creation of an archaeobotanical program that
includes both carpological and anthracological analysis seems to be the most promising way to
document these questions. Based on nearly fifty archaeological samples extracted from varied contexts
(hearths, dumps, plantation pits), dated between the 11th and the 17th c., this work allows proposing a
first review on cultivated/gathered plants.

Keywords: plant production; terroirs; Middle Ages; modern period; Maghreb; Islamic archaeology

1. Introduction

The medieval and Islamic North African city of Aghmat (Morocco), which was abandoned in the course of the 14th century AD, is today a 100 hectare area of ruins, buried under fields of olive trees and barley, on the location of the rural market town of Ghmat, 30 km south of Marrakech (fig. 1). Situated at the foot of the northern slope of the High Atlas mountain range, from which it has drawn its abundant water resources throughout its existence, the city of Aghmat was first mentioned in Arabic textual sources between the end of the 9th century and the middle of the 10th century AD: geographers based in the major Islamic capitals (Cairo, Kairouan, Cordoba) described it then as a prosperous city that helped to relay trans-Saharan trade to the Mediterranean basin, but above all as a major agricultural centre in the western Maghreb (Al-Bakri 1911; Al-Idrisi 1866; Al-Yaqubi 1892; Ibn Hawqal 1938). This position as the granary of Morocco has not been denied for several centuries, to the extent that it has survived the disappearance of the medieval city: today the polycentric village of Ghmat enjoys a national reputation as the best nursery in the Moroccan kingdom, supplying ornamental and fruit plants of all kinds to a very large number of hotels, public parks and buildings, and private villas throughout the country (Héritier-Salama 2019).



Fig. 1: Location and general view of the archaeological site of Aghmat (Mission Archéologique d'Aghmat)

Since 2005, the Archaeological Mission of Aghmat¹ aims to study, protect and enhance this vast archaeological site in an exceptional state of preservation. To date, the programme has focused on the extensive excavation (approximately 3,000m²) of the city's monumental area, where the Great Mosque and its ablution fountain (called *qubba*), the public baths (*hammam*), an elite residence (possibly the palace) and a wealthy residential area (of inner garden houses also called *riads*) are located (fig. 2). While the earliest phases of occupation (at least the 10th century) are still poorly documented, the main phase of development of this district seems to date back from the 11th-12th centuries, which coincides with the time when the city became the ephemeral (c.1056-1070) capital of the Almoravid Empire. Then, the site experienced a strong urban dynamism where the buildings were constantly restored or even rebuilt (Fili, Messier 2015), until the city was rather abruptly abandoned by its elites (mid-14th century) and reoccupied by populations who gradually ruralized its activities and economic balance (15th-16th c.) in an architectural landscape that was inexorably deteriorating (Héritier-Salama *et al.* 2016). The monumental district of the city was finally totally abandoned and gradually disappeared in a scenery that had evolved into a space fully devoted to agriculture, which it has remained until today. Since 2016, the MAA has developed a line of research dedicated to palaeoenvironments, in both a natural and agricultural perspective², based on the study of seeds and wood charcoals remains.

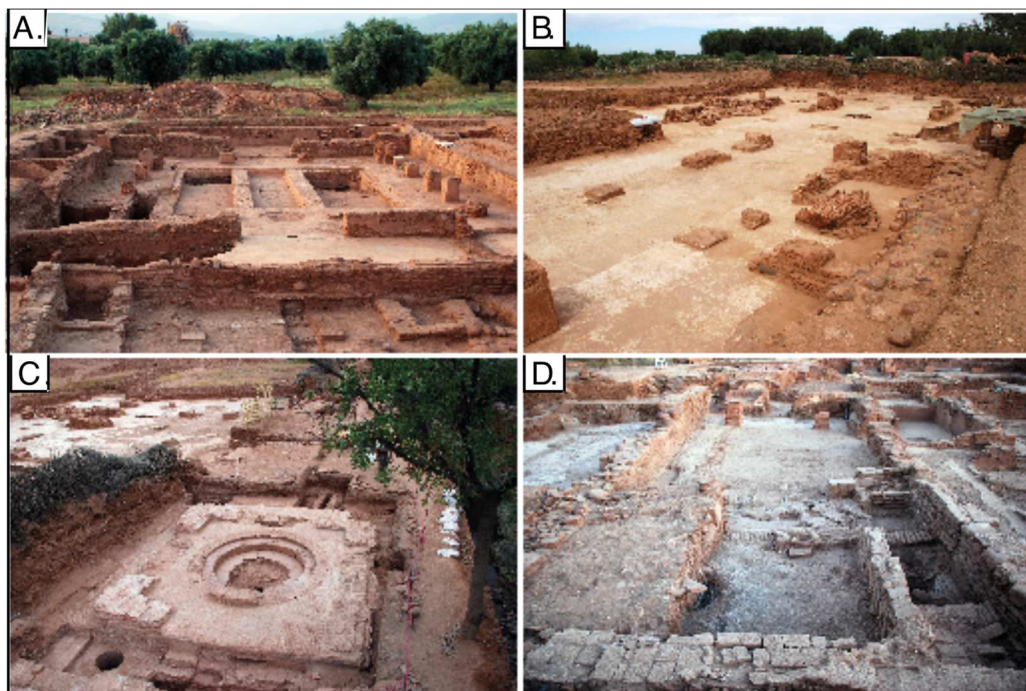


Fig. 2: A. Palatial garden; B. Great Mosque; C. Ablution fountain (*qubba*); D. House (Mission Archéologique d'Aghmat)

¹ Programme co-supervisors: Ronald Messier (MTSU, USA), Abdallah Fili (Chouaib Doukkali University, Morocco), Chloé Capel (CNRS, France).

² Under the supervision of Jérôme Ros (CNRS, UMR5554, ISEM, France) and Violaine Héritier-Salama (Paris Nanterre University, France).

In this paper, we will present the first results of the archaeobotanical analysis, providing the very first archaeological data on food plants and agriculture in this region of Morocco. Although the data are still preliminary, they appear to be worth discussing, regarding the scarcity of available archaeobotanical data on medieval Morocco (tab. 1), especially in the south of the country, where only the settlements of Îgîlîz and Sijilmasa had been studied so far (Ruas 2018).

Site	Chronology	Status	Type of contexts	Reference
Al Basra	9th-12th c.	City	Potter's kilns, dumps, housing floors	Pollock 1986; Mahoney 2004
Aghmat	10th-17th c.	City, Reoccupation of the city	Hearths, charcoal/ash levels, traffic levels, dumps, garden soil	Ros, Badri unpublished
Asilah	11th-13th c.	Rural	Housing floors	Ros, Badri 2020
Badis	9th-15th c.	Port city	Concentration of ashes in an inhabited space	Pollock 1986
Îgîlîz	10th-15th c.	Rural fortress	Habitats, fireplaces, ovens, latrines, garbage dumps	Ruas <i>et al.</i> 2011, 2016a
Lixus	8th-14th c.	Reoccupation of a city	Dumps	Grau Almero <i>et al.</i> 2001, 2010; Perez Jorda 2005
Nakûr	9th-11th c.	City	Pit filling	Pollock 1986
Qsar es-seghir	12th-15th c.	Port city, Fortress	Oven, manures	Pollock 1986
Rirha	9th-14th c.	Occasional reoccupation of a city	Dumps, domestic and artisanal ovens/kilns	Ruas <i>et al.</i> 2016b
Sijilmasa	7th-12th c.	City	Habitat floors, ovens, dumps	Mahoney unpublished
Volubilis	8th-11th c.	City	Storage and activities areas	Fuller 2002, 2004; Fuller, Pelling 2018

Tab. 1: Corpus of medieval and modern archaeological sites with carpological studies in Morocco (adapted from Ruas 2018)

2. Material and methods

The archaeological team carried out sampling during the various excavation campaigns. During the 2016 and 2019 campaigns, a total of 137 samples were inventoried and sieved on fine meshes (0.5mm) directly on the site, representing 806.75 litres of raw sediment. The samples are issued from a variety of contexts: hearths and hearths discharges, charcoal/ash levels, traffic levels, dumps, garden soils. Depending on the context of origin, the initial volume of the samples was variable, ranging from 0.2 to 10 litres. Originally, we intended a complete analysis of the samples by 2021, but due to the COVID-19 pandemic, we only had access to the ones stored at the ISEM laboratory (Montpellier, France). For this reason, in this paper, the presented results are issued from the complete study of 17 samples for seed remains, of 11 samples for wood charcoal remains, and 30 other carpological samples were studied in a preliminary way (first identifications, evaluation of abundance).

The extraction of seed remains was carried out at the carpological platform of the UMR5554 (ISEM, Montpellier) under a Nikon SMZ 645 binocular (magnification x 0.8 to x 5). A sorting with the naked eye was not sufficient to see all the remains, nor to observe the diagnostic characteristics sought at the time of the determination, in particular for the remains of fine fractions. For carpology, as the determinations were made following an anatomical comparison, we used a reference collection of fresh and archaeological seeds as well as the following publications: Cappers *et al.* 2006; Jacomet 2006 and Rameau *et al.* 2008. For anthracological analysis, specific recognition was done using a reflection microscope, with the help of reference atlases (Jacquot 1955; Jacquot *et al.* 1973; Schweingruber 1990; Vernet *et al.* 2001) and the reference collection of the team "Dynamique de la biodiversité, anthropo-écologie" (ISEM, UMR 5554). The analyses were performed on an Olympus BH2-UMA reflection microscope, with black/white background and x100, x200 and x500 magnification.

3. Results

3.1. Carpological results

A total of 977 seed remains was collected, from 17 studied samples. Out of the 977 remains, 975 are charred and 2 mineralized. They allowed identifying 55 taxa, among which 17 are determined to the species (tab. 2, 3; fig. 3).

		Phase	11th-12th	14th-15th	15th-17th	
		Contexts	Qubba Palace	Houses Hammam	Palace Houses Basin	
		Number of samples	5	7	5	
		Volume (liters)	24,5	36,6	14,7	
TAXONS	Type of remains					Total
Cereals						
<i>Avena</i> sp.	grain	–	1	–	–	1
	grain fg.	2	1	–	–	3
cf. <i>Avena</i>	grain fg.	1	–	–	–	1
<i>Hordeum vulgare</i>	grain	11	14	9	–	34
	grain fg.	14	15	24	–	53
	spikelet	–	1	–	–	1
	rachis segment	11	3	17	–	31
	lemma fg.	–	–	1	–	1
<i>Triticum aestivum/turgidum</i>	grain	5	9	2	–	16
	grain fg.	5	13	–	–	18
	rachis segment	4	2	4	–	10
<i>Triticum</i> sp.	fg. sem	–	–	3	–	3
<i>Triticum type mono/dico/spelta</i>	sem.	–	–	1	–	1
<i>Panicum miliaceum</i>	sem.	–	–	5	–	5
<i>Cerealia</i>	fg. sem	41	6	–	–	47
	rachis segment	1	–	–	–	1
Gathered/cultivated fruits						
<i>Ficus carica</i>	seed	202	–	5	–	207
	seed fg.	42	–	7	–	49
<i>Juglans regia</i>	shell fg.	–	1	–	–	1
<i>Olea europaea</i>	stone	–	–	2	–	2
	stone fg.	–	78	4	–	82
Type <i>Olea europaea</i>	stone fg.	3	–	1	–	4
<i>Olea/Ziziphus</i>	stone fg.	–	15	6	–	21
<i>Phoenix dactylifera</i>	seed	–	–	1	–	1
	seed fg.	–	1	–	–	1
<i>Prunus persica</i>	stone	–	–	1	–	1
<i>Punica granatum</i>	seed	2	–	1	–	3
	seed fg.	5	–	3	–	8
<i>Rubus fruticosus</i> agg.	stone	5	–	1	–	6
<i>Rubus fruticosus/idaeus</i>	stone	1	–	–	–	1
<i>Rubus idaeus</i>	stone	1	–	–	–	1
<i>Rubus cf. idaeus</i>	stone	1	–	–	–	1
<i>Vitis vinifera</i>	pip	14	7	2	–	23
	pip fg.	61	–	4	–	65
	pedicel	–	1	1	–	2
<i>Ziziphus</i> spp.	stone	–	–	1	–	1
	stone fg.	–	1	13	–	14
Oleaginous/textile plant						
<i>Linum usitatissimum</i>	seed	2	1	1	–	4
Pulses						
<i>Fabaceae</i>	seed	3	1	1	–	5
	seed fg.	13	–	–	–	13
Total number of cultivated plants identified remains		450	171	115	–	742
Total number of identified remains		546	191	240	–	977
coprolite		–	1	–	–	1

Tab. 2: List and quantification of cultivated/gathered plants carpological remains (fg. = fragment)

	Phase	11th-12th	14th-15th	15th-17th	
	Contexts	Qubba Palace	Houses Hammam	Palace Houses Basin	
	Number of samples	5	7	5	
	Volume (liters)	24,5	36,6	14,7	
TAXA	Type of remains				Total
CHARRED REMAINS					
Wild plants					
Anthemis cotula	seed	—	—	1	1
Avena cf. fatua	glume fg.	—	—	1	1
	lemma base	—	—	2	2
	pedicel	—	—	3	3
Avena sp.	husk fg.	1	1	26	28
Brassicaceae	tegument fg.	—	—	8	8
Bromus sp.	seed fg.	—	—	1	1
Carex/Rumex	seed	1	—	—	1
Caryophyllaceae	seed	1	—	—	1
	seed fg.	2	—	—	2
Chenopodiaceae	fruit	1	—	—	1
	seed	1	—	—	1
Chenopodium murale	seed	1	2	1	4
Chenopodium sp.	seed	2	—	1	3
	seed fg.	1	—	—	1
Fabaceae	seed	2	—	—	2
	seed fg.	1	—	—	1
Galium sp.	seed	1	1	1	3
Lolium multiflorum/perenne/rigidum	seed	—	1	—	1
Lolium sp.	seed	18	1	15	34
	seed fg.	1	—	11	12
	spikelet	—	11	—	11
cf. Lysimachia	seed	1	—	—	1
Malva sp.	seed	—	—	12	12
Medicago sp.	seed	1	1	13	15
	seed fg.	—	—	3	3
Medicago/Trifolium	seed	1	—	—	1
Phalaris sp.	seed	—	1	1	2
Plantago sp.	seed	—	—	2	2
Poaceae	seed	13	—	1	14
	seed fg.	27	—	2	29
	stalk fg.	2	—	—	2
	root fg.	1	—	—	1
Portulaca oleracea	seed	1	—	—	1
Rosaceae	epidermal spine	2	—	1	3
Rumex sp.	seed	9	—	5	14
	fg. sem	—	—	2	2
Scrophulariaceae	seed	1	—	—	1
Sherardia arvensis	seed	1	—	—	1
Sherardia sp.	seed	1	—	2	3
Silene sp.	seed	1	—	7	8
Solanum sp.	seed	—	—	1	1
cf. Vicia	seed	—	1	—	1
MINERALIZED REMAINS					
Wild plants					
Buglossoides arvensis	seed	—	—	2	2
Total number of wild plants identified remains		96	20	125	241
Total number of identified remains		546	191	240	977

124

125 Tab. 3: List and quantification of wild plants carpological remains (fg. = fragment)

126

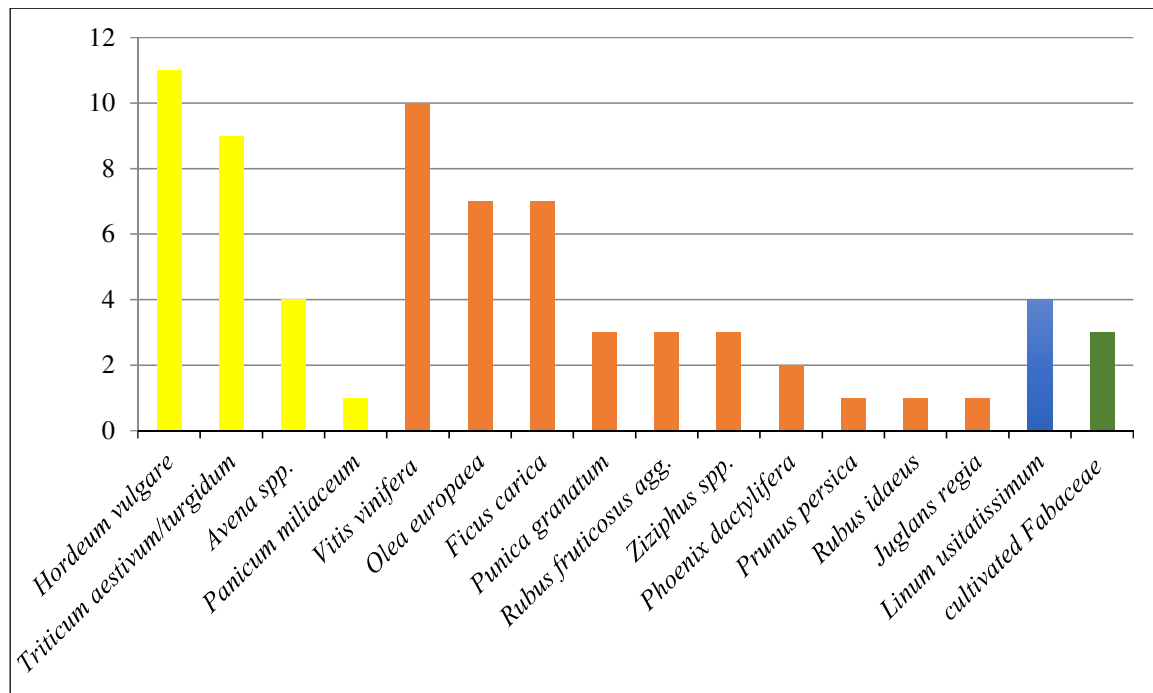


Fig. 3: Ubiquity of the cultivated taxa in the carpological samples (total of studied samples: 17) (in yellow: cereals; in orange: fruits; in blue: textile/oleaginous plants; in green: pulses)

3.1.1. Cereals

A total of 226 cereal remains have been encountered in the studied samples (23% of the total number of remains), allowing the identification of at least 5 cereals: hulled barley (*Hordeum vulgare*), naked wheat (*Triticum aestivum/turgidum*), common millet (*Panicum miliaceum*), a wild or cultivated oat (*Avena* spp.) and a possible hulled wheat (*Triticum* type *monococcum/dicoccum/spelta*). The majority of the remains correspond to caryopsis (180 remains), although hulled barley and naked wheat were also found as rachis segments (46 remains). The poor preservation of naked wheat rachis segments did not allow a more precise identification (hexaploid or tetraploid type). Among the discovered cereals, hulled barley is the most frequent and abundant, followed by naked wheat (fig. 3). The status, wild or cultivated, of the oat is still to explore, although several remains (lemma bases) discovered in one sample were identified as possible common wild oat (*Avena* cf. *fatua*). Common millet is also present but only in one sample, dated from the last occupation phase of the site.

3.1.2. Fruits

With 494 remains, fruit species is the plant category delivering the most remains. On the 14 identified taxa, we recognized the presence of grape (*Vitis vinifera*), fig (*Ficus carica*), olive (*Olea europaea*), walnut (*Juglans regia*), date palm (*Phoenix dactylifera*), peach (*Prunus persica*), pomegranate (*Punica granatum*), blackberry (*Rubus fruticosus* agg.), raspberry (*Rubus idaeus*) and jujube (*Ziziphus* spp.). Grape, fig and olive are both the most frequent and abundant fruit taxa in the samples, while the other taxa are identified by less remains and tend to appear more sporadically (1 to 3 contexts) (fig. 3). We

observe that grape is just as frequently noted in the studied samples than hulled barley and naked wheat.

3.1.3. Pulses and oleaginous/textile plant

About 18 remains issued from 3 stratigraphic units have been identified as pulses remains (Fabaceae, 2% of the total number of remains). Although their size and general shape presume their cultivated nature, due to the disappearance of the diagnostic anatomical features, we were not able to identify them, not even to the genus. Flax (*Linum usitatissimum*) is also identified by 4 remains in 4 stratigraphic units (less than 1% of the total number of remains) (fig. 3).

3.1.4. Wild plants

A total of 241 wild plant remains have been collected in the studied samples (25% of the total number of remains), allowing the determination of 31 taxa among which 5 are identified to the species: stinking chamomile (*Anthemis cotula*), nettle-leaved goosefoot (*Chenopodium murale*), duckweed (*Portulaca oleracea*), blue field-madder (*Sherardia arvensis*) and field gromwell (*Buglossoides arvensis*). Most of the discovered taxa are annual species, belonging to the Poaceae, Amaranthaceae or Fabaceae family, those identified to the species being considered as common crop weeds (Jauzein 1995). The taxa identified to the species tend to generally be observed in rich, dry soils. Nettle-leaved goosefoot and duckweed are considered as spring crops weeds, while blue field-madder is considered as a winter crops weed (Jauzein 1995).

3.2. Overview of future carpological results

In order to evaluate the potential of other samples, a rapid evaluation was carried out on 30 of them that were available at the ISEM laboratory (Montpellier, France) (tab. 4). This assessment aimed to identify the main cultivated/gathered taxa present, and to evaluate their abundance.

It appears that, in these samples, the recorded taxonomic diversity is similar to that identified in the fully studied assemblages. Hulled barley and naked wheat are the most frequent and abundant cereals, present as grains and rachis segments, the latter appearing more abundantly and frequently in the samples from the last phase of occupation. Oats are identified by grains in all phases of occupation, although their status remains indeterminable (cultivated, wild). Common millet is identified only in the last phase of occupation. The diversity of fruit trees remains relatively stable throughout the period under consideration, although their relative importance seems to vary by phase and according to the studied context. The case of the olive tree is particularly interesting because, although it is quite frequent in all 3 phases of occupation, it seems to be particularly abundant in certain samples issued from a planting pit in one of the garden of the elite habitat (palace). Some fruits, such as peach, walnut and date, only appear anecdotally in the samples. Flax is present throughout the studied chronology, but is never encountered in significant quantities. Legumes/pulses are rare in the assemblages;

however, some seeds identified as possible alfalfa (*Medicago* cf. *sativa*) were encountered in a late sample. Their determination needs to be confirmed by further study.

	Phase Contexts Number of samples	11th-12th Qubba - Palace Gardens 10	14th-15th Houses - Hammam Gardens 10	15th-17th Houses - Basins Reoccupation in Mosque 10
TAXONS	Type of remains			
Cereals				
<i>Avena</i> sp.	grain + grain fg.	2 / X	3 / X	4 / X
<i>Hordeum vulgare</i>	grain + grain fg.	8 / XXX	8 / XX	8 / XX
	rachis seg.	5 / X	5 / X	5 / XX
<i>Panicum miliaceum</i>	grain + grain fg.	–	–	3 / XX
<i>Triticum aestivum/turgidum</i>	grain + grain fg.	8 / XXX	6 / XX	6 / XX
	rachis seg.	3 / X	2 / X	2 / X
Gathered/cultivated fruits				
<i>Ficus carica</i>	seed + fg.	6 / XX	2 / X	2 / X
<i>Juglans regia</i>	shell fg.	–	1 / X	–
<i>Olea europaea</i>	stone + fg.	5 / XX	8 / XX	5 / X
<i>Phoenix dactylifera</i>	seed + fg.	–	2 / X	2 / X
<i>Prunus persica</i>	stone + fg.	–	–	1 / X
<i>Rubus fruticosus</i>	stone + fg.	2 / X	–	1 / X
<i>Punica granatum</i>	seed + fg.	4 / X	1 / X	1 / X
<i>Vitis vinifera</i>	pip + fg.	8 / XXX	5 / X	5 / X
<i>Ziziphus</i> spp.	stone + fg.	–	2 / X	1 / X
Oleaginous/textile plant				
<i>Linum usitatissimum</i>	seed + fg.	2 / X	4 / X	1 / X
Cultivated Fabaceae				
Fabaceae (big seeds)	seed + fg.	–	2 / X	3 / X
<i>Medicago</i> cf. <i>sativa</i>	seed + fg.	–	–	1 / X

Tab. 4: Evaluated ubiquity and abundance of cultivated/gathered taxa in 30 carpological samples (for each taxa, the number before the X/XX/XXX is the number of samples in which the taxa was observed; X = 1 to 10 remains, XX = 10 to 50, XXX = more than 50)

3.3. Preliminary anthracological results

The first anthracological results come from the study of isolated wood charcoal fragments, collected during the 2017 and 2018 missions in order to perform radiocarbon dating. As the reliability of the anthracological approach depends partly on the quantity of coals studied/identified (at least 100-150 per sample or SU depending on the context) (Chabal 1997), the results presented below should only be considered as qualitative contributions, without quantitative value, allowing to address for the first time in Aghmat the question of exploited wood resources.

In the framework of our study, 29 charcoal fragments issued from 11 SU were identified (tab. 5). They allow us to record a diversity of 14 taxa: evergreen oak (*Quercus coccifera/ilex*), filaria/buckthorn (*Phillyrea/Rhamnus*), poplar (*Populus* sp.), ash (*Fraxinus* sp.), juniper/berbera thuja (*Juniperus/Tetraclinis articulata*), a leguminous tree (cf. Fabaceae), a monocotyledon (*Monocotyledon*), olive (*Olea europaea*), pomegranate (*Punica granatum*) and fig (*Ficus* sp.) trees, as

well as two *Prunus*, one of them being identified as a cultivated one (almond or peach tree, *Prunus* type *dulcis/persica*).

Phase Contexts Number of samples	11th-12th Qubba 1	14th-17th Souk 11	
TAXONS			Total
cf. Fabaceae	1	–	1
Fabaceae/ <i>Ficus</i>	1	–	1
<i>Ficus</i> sp.	5	–	5
<i>Fraxinus</i> sp.	1	2	3
<i>Juniperus/Tetraclinis</i>	1	–	1
Monocotyledon	4	–	4
<i>Olea europaea</i>	–	3	3
<i>Phillyrea/Rhamnus</i>	–	1	1
<i>Populus</i> sp.	–	1	1
<i>Prunus</i> type <i>dulcis/persica</i>	–	1	1
<i>Prunus</i> sp.	2	–	2
<i>Punica granatum</i>	1	–	1
<i>Quercus coccifera/ilex</i>	2	3	5
Total number of remains	18	11	29

Tab. 5: Identification and quantification of wood charcoal remains

4. Discussion

Although the archaeobotanical results remain preliminary, the discovery of such a wide diversity of exploited taxa, in both seed and wood charcoals remains, authorizes a first discussion on past plants and environments exploited at Aghmat between the 11th and the 17th c.

4.1. Exploited terroirs: a mosaic landscape

As soon as the medieval city emerges, the richness of its agriculture is praised by numerous medieval texts that provide a relatively homogenous picture of the terroirs associated with the town. They mention the co-existence of two main great terroirs: an irrigated one in the plains, and a rain-fed one in the mountains, that included pastures (Al-Yaqûbî 1892; Ibn Hawqal 1938; Al-Idrîsî 1866). The recurrent description of abundant gardens, both on the outskirts of the city and within the city, underlines the importance of local horticulture and arboriculture. A large date palm grove and orchards are also mentioned (Al-Bakrî 1911; Al-Idrîsî 1866; Ibn al-Khatîb 1983).

Indeed, despite the preliminary and exploratory nature of the archaeobotanical study, several environments seem to have been exploited: a rather open and dry plant cover (*filaria*/buckthorn), the river borders (poplar), perhaps of the nearby Ourika river, as well as cultivated areas, that certainly included irrigated orchards (for pomegranate, date palm, maybe also almond/peach tree, grapevine, olive tree, fig tree), gardens and/or crop fields (cereals, pulses, flax). Although an important date palm

grove is mentioned by textual sources, no charcoal of this species has been discovered so far, only a few seeds. If the fruits of this local production were indeed common and consumed by the population of the site, the scarcity of discovered remains might be related to waste management, that did not favour the charring of the seeds, or to taphonomical issues (significant fragmentation, intense carbonization preventing the identification of the rest?). Regarding evergreen oak, ash and walnut tree, discovered in the studied charcoals remains and as shell fragment (walnut), their origin must be questioned, since they do not grow nowadays in the plain of Aghmat: were they « naturally » present near the site during medieval and modern times, in cool stations in the case of ash, or in garden for the walnut tree? Or are the identified remains issued from imported wood and fruits, perhaps from the mountain terroir located on the slopes of the High Atlas? To favour one or the other of these hypotheses, it will be necessary to develop the anthracological approach, by questioning the frequency, abundance and role of these taxa in the food and fuel economy of the site, and by documenting the contexts in which they are identified. Finally, the case of flax must be considered. Indeed, the plant, not mentioned as being part of the local agricultural landscape by textual sources, is identified as seeds in several samples issued from the different phases of occupation. In the case of a local production, its culture certainly required a controlled irrigation, also necessary to treat its fibers.

4.2. Agricultural activities and food habits

With the exception of Al-Idrīsī who mentions the existence of mills dedicated to flour production on the banks of the river (Al-Idrīsī 1866), there are very few descriptions of the daily-life agricultural activities led at Aghmat in medieval or modern texts. In this regard, archaeobotanical remains are the main source of information.

Cereals are one of the main plant category in the carpological samples, both in terms of abundance and frequency. Given the heterogenous nature of the samples, it is impossible to affirm that the identified weeds (stinking chamomile, nettle-leaved goosefoot, duckweed, blue field-madder, field gromwell) come from the same field as those on which the cereals were grown on, and therefore to argue about the agrarian practices specific to each cereal (seeding season, cutting height, farming regime). The recurrence of hulled barley and naked wheat indicates widespread use of these grains in the site's food economy. The composition of the samples (mainly grains, few rachis segments, weed seeds) suggests that the cereals were processed somewhere else, and that « clean » to « semi-clean » products were transported to the heart of the city. The registered fruits remains correspond to charred consumption waste (pips, seeds, stone, no entire fruits, no fruit flesh), encountered in domestic hearths as well as in the hammam hearths. The role of the flax discovered in the site, whether for food, oil or textile production, is not clearly defined at the moment.

Among the few agricultural activities described by textual sources, one of them, considered as important, has not been brought to light by our study so far. Indeed, ancient authors have described the production and use/consumption at Aghmat of the argan tree (leaves, wood, fruits) (Al-Bakri 1911).

Argan fruits were collected, used as fodder for cattle, more precisely goats (Al-Zuhri). The nuts rejected by these animals were then roasted and crushed with a hand grinder to make a paste, which was pressed to extract a large amount of pure oil (Al-Zuhri). This oil was considered as a staple food in the daily-life of the inhabitant during medieval and modern times: it was used for cooking, to fry the doughnuts sold at Aghmat's souk, for lighting and even in the pharmacopoeia and cosmetics of the Masmud women (Ibn al-Baytar, 1990). These testimonies on the argan tree raise questions. The plant, now absent from the Ourika plain, was considered as an important element in the daily life of the Masmoudies, and several authors agree on the presence of the argan tree in the surroundings of Aghmat. But so far, no carpological or anthracological remains of this species have been identified in the studied archaeobotanical samples, while being abundant in the archaeobotanical samples of Îgîlîz, medieval settlement contemporary of Aghmat's earliest phase (11th-12th c.) and located in the Anti-Atlas (Ruas *et al.* 2011, 2016). Its absence at Aghmat could be explained by the small number of studied samples, by the type or location of sampled contexts, or by the location where argan fruits were processed, if the generated waste was discharged and/or charred outside the excavation area.

4.3. Rise and fall of a city: what consequences on agriculture?

Between the 11th century and the 17th c., Aghmat underwent several major changes: consecrated as the capital of the Almoravid dynasty between 1057 AD and 1062 AD, Aghmat becomes at the beginning of the 12th century a great commercial centre, engaged in intense trade with Sudan while developing economic relations with the Iberian Peninsula and the Mediterranean world. This situation came to an end a century after, when the Merinids took Marrakech in 1269 AD, putting an end to the Almohad domination in western Maghreb. Aghmat thus became a second-rate city and, with the arrival of the Saadians in 1554 AD, emptied of its population, thus becoming a deserted city, gradually ruralizing its activities and economic balance. Such a complex history raises the question of how these great historical socio-economic dynamics found an echo in the plant economy of the site.

The earliest textual sources praise, as mentioned before, the great diversity of exploited landscapes (crops, gardens, orchards, date palm grove) and the richness of local plants productions, that included numerous fruits (pomegranate, pears, grapes, carobs, apples, quinces, apricots, sour cherries, bitter oranges, mulberries), and vegetables (fava beans, aubergines, gourds, turnips, cabbages). In the 14th century, Ibn al-Khatîb, who visited the city, describes it as on the brink of its decline, mentioning grapevine, fig and olive trees, while evoking the harmful effect of the social and political troubles on crops. In the 16th century and later, several travellers such as Leo Africanus (1980), Marmòl (1667) or Richardson (1860), describe a devastated but still fertile land, where grapevine and olive trees are still cultivated, in association with vast crop fields, probably cereals.

Based on archaeobotanical data, so far, we do not observe any type of main changes or evolutions in the exploited taxa, nor in the practices. Through all the documented phases, we identify a common agro-horticultural fund over the entire period, the staple productions being hulled barley, naked wheat,

grape, olives and figs, their frequency and abundance varying depending on the context. Nonetheless, the presence in some samples from the 15th-16th c. of common millet, generally more associated with rural contexts and peasant populations, of numerous barley rachis, and of a possible alfalfa, might be an indicator of the ruralisation of this part of the city. This hypothesis will have to be confirmed by the study of a more complete corpus of samples. Concerning the exploited/consumed fruits, we do not observe a loss of diversity, the same taxa being present in the earliest and latest samples of the site. If some fruits (peach, walnut, raspberry) are present only during one phase of occupation, we consider it as due to the weakness of the corpus studied at the moment, and not as a sign of changes in the agricultural practices.

4.4. Aghmat and its contemporaries: first comparison

So far, the available carpological data for medieval and modern Morocco remain limited, with only 11 studied sites in the whole country (fig. 4). The comparison between the different sites suffer from several difficulties, inherent to: their unequal status (urban, rural, commercial, religious) and their strong geographical disparity (north, south, coast, plain, mountain); the corpus of samples (diversity of sampled contexts, quantity of studied samples, original volume of sampled sediment); and finally, to the study protocol that was applied (proper sieving and extracting method, quantification of the remains). For this reason, it is important to keep in mind that the comparison we propose is preliminary, simply aiming to contextualize the archaeobotanical data of Aghmat on a larger scale.

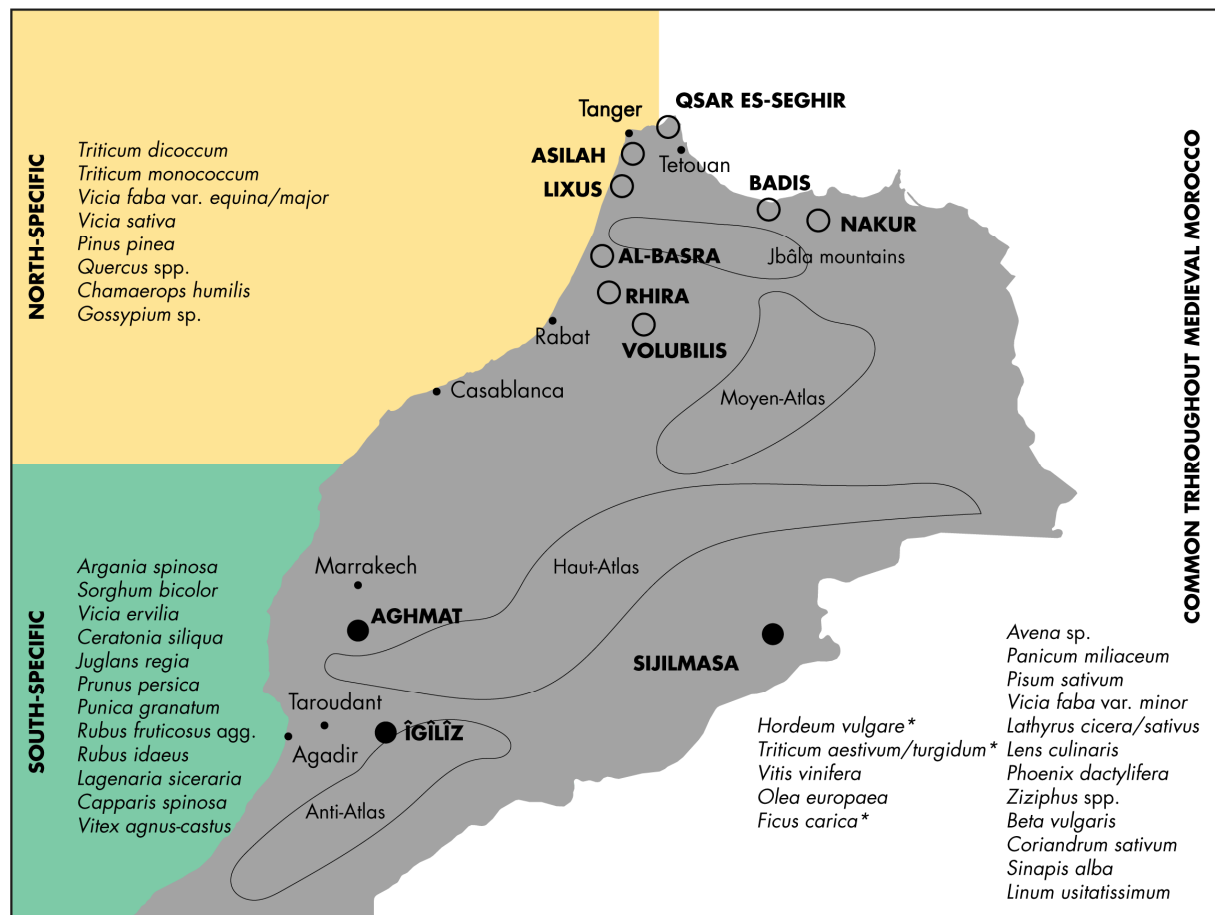


Fig. 4: Cultivated/gathered plants identified by carpological remains in medieval and modern Morocco (compilation established after Ruas 2018, Ros and Badri 2020 and Ros unpublished) (black dots = southern sites, great dot with black outline = northern sites; the asterisk indicates that the plant is present in all sites)

Among the staple crops, some are common to the entire studied area, regardless of the location or status of the sites, particularly cereals (naked wheat, hulled barley), legumes (peas, fava beans, lentils), and some fruit trees (olive and fig trees, grape vine). These staple productions are also common to the major part of the medieval western Mediterranean (for ex. Ruas 2005; Peña-Chocarro *et al.* 2019). Some of the secondary agro-horticultural crops are found in both northern and southern Morocco, such as common millet, flax, date palms and jujube trees, but not in every site. Others are, for the moment, only identified in the north (einkorn, emmer, common vetch, stone pine, cotton) or south (sorghum, pomegranate, peach, walnut, carob, argan, bitter vetch, bottle gourd, caper, vitex) (fig. 4). This greater diversity identified in the south might be caused by a source effect, Îgilîz being a site with an important quantity of studied samples, and, more importantly, a wider diversity of contexts, which favour a better representation of different plant categories and types of remains.

It is interesting to note that, according to this first comparison, Aghmat has more productions in common with the sites located in the far north of Morocco than with the "neighbouring" site of Îgilîz, which stands out for the prominent role played by the argan tree, and to a lesser extent by the sorghum, in its agro-horticultural production (Ruas *et al.* 2011, 2016b). This significant difference in

production highlighted by the carpological studies could have been interpreted as resulting from a sort of environmental or even socio-economic limit, the Îgîlîz area being in a zone dominated by the argan grove, whereas Aghmat and the Ourika valley correspond to a predominantly olive-growing area, which is manifested by the important presence of olives in the archaeobotanical assemblages of the site. But, as mentioned earlier, the reality of Aghmat is more ambivalent, with textual sources mentioning the role played by argan oil in the domestic dietary practices of the medieval populations of the zone. This strong difference between the carpological assemblages of Îgîlîz and those of Aghmat could be explained by the existence of different practices, or by a production of argan oil in Aghmat taking place in areas/neighbourhoods not yet documented by archaeology.

5. Conclusions

The first archaeobotanical results allowed highlighting the staple productions of the medieval and modern agriculture of Aghmat. If barley, wheat, grapevine, olive and fig trees are common productions during the whole studied period, the status, role and management (terroirs, irrigation practice) of secondary exploited taxa, such as millet, flax, pomegrenate, date palm, remain to be investigated. The presence of certain taxa (ash, evergreen oak, walnut, raspberry) in the archaeobotanical samples will also have to be discussed, in order to determine if they are proof of the exploitation of a second terroir, located in the nearby mountains, or of the existence of these taxa in the plain. Although the site knows major socio-economic changes, the evolution of the agricultural spectrum (diversification or, on the contrary, agricultural specialization) between the 11th and the 17th c. are yet to be enlightened (development of millet crops, artificial meadows, on-site cereal processing?).

The archaeobotanical potential of the site was confirmed by our approach. The next few years will see the complete studies of the remaining samples, and the implementation of systematic sampling during future field phases. The obtained archaeobotanical data, once placed in their chronological and spatial context, within each sector of the site, will allow a more detailed documentation of the plants, practices, and terroirs exploited, according to the status of the inhabitants of Aghmat. To complete this approach, a CNRS project intitled « AGrosystèmes Historiques du Maroc: Adaptations, Transformations - L'exemple de la région du Haouz » has been initiated in 2020, combining an isotopic approach, aimed at highlighting the practices linked to manuring and irrigation of certain species (hulled barley, naked wheat, grapevine, olive tree), and a research on the past diversity of the grapes and olives exploited at Aghmat, thanks to geometric morphometrics applied to the pips and stones collected in our samples (Terral *et al.* 2004, 2010). The archaeobotanical approach carried out in this paper was thus a first step towards a better knowledge of the agricultural practices of this still little known region.

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