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ORIGINAL ARTICLE

Archaeobotanical research at the medieval fortified site of Îgîlîz (Anti-Atlas, Morocco) with particular reference to the exploitation of the argan tree

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Abstract The analysis of botanical macro-remains (seeds, fruits and wood) from the fortress site of Îgîlîz, situated in the Anti-Atlas mountain range of southern Morocco, provides a first glimpse of the plant economy of a medieval rural community in this part of North Africa. Considered as the original stronghold of the religious community led by Ibn Tûmart, the founder of the Almohad dynasty, the site was occupied from the 10th to the 13th century A.D. The crop assemblage identified from ashy contexts in a central grouping of buildings (the *qasba*) comprises barley (*Hordeum vulgare*), sorghum (*Sorghum* sp., earliest occurrence known so far from Morocco), wheat (*Triticum* sp.) and a pulse (*Lathyrus sativus/cicera*). Several arboreal fruit species are also identified: fig (*Ficus carica*), almond (*Prunus dulcis*), date palm (*Phoenix dactylifera*), grapevine (*Vitis vinifera*) and argan (*Argania spinosa*). The latter, predominant in the archaeobotanical record in the form of both fruit and wood remains, is of particular interest as it is the first time that this species, endemic to south-western Morocco and of prime economic interest regionally, has been identified from an archaeological context. In the past, as today, the argan tree seems to have played a major role in village economies as a source of wood for fuel and construction, fodder for livestock and food in the form of an edible oil, extracted from the oleaginous seeds. This article focuses on present and past uses of *Argania spinosa* as well as on the ecology and morpho-anatomy of this emblematic species.

Keywords *Argania spinosa* · Almohad · Middle ages · Morocco · Rural fortress

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Introduction

Archaeobotanical research in Morocco has until now focused on the north-western part of the country with studies at sites such as the Neolithic cave of Kaf Thaht El Ghar (Ballouche and Marinval 2003) and the Roman settlements of Lixus (Grau Almero et al. 2001; Pérez Jordà 2005), Rhira (Figueiral and Heinz 2009 unpublished report) and Volubilis (with some Islamic levels) (Fuller and Stevens 2009). To this we can add ethnobotanical work initiated in the Jbâla Mountains in 1997 (Peña-Chocarro et al. 2000; Ibáñez et al. 2002; Zapata et al. 2003a, b).

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In the southern part of Morocco only a few studies of pollen have been done so far, from marine sediments off the shore at Cape Ghir (McGregor et al. 2009) (Fig. 1).

Here the preliminary archaeobotanical results from the Islamic levels of the fortress settlement Îgîlîz in south-western Morocco are presented. The site is located on the top of the Jebel Îgîlîz, 1,350 m a.s.l., in the Anti-Atlas range, around 60 km to the south-east of the modern city of Taroudant (Fig. 2).

The geographic region of interest, situated between 750 and 1,600 m a.s.l., includes the valley bottom where the modern village of Maganounne is located along the Assif Arghane river, the mountain of Îgîlîz (Jebel Îgîlîz) and the village territory of Tifigit. General climatic conditions in the area are considered as arid to semi-arid. However, orographic lifting plays an important role in the local amount of precipitation (Knippertz et al. 2003, p. 76). Thus, from the Souss plain (Agadir) until the Anti-Atlas range (Igherm), the annual rainfall varies between 150 and 250 mm, while it can reach 400–600 mm per year in the Atlas range. The present vegetation belongs to the Mediterranean-Saharan transition (infra- and thermo-Mediterranean) consisting of steppic shrublands mostly dominated by the endemic species *Argania spinosa*. The northern slopes are covered by scrub vegetation with *Artemisia inculta* as the major component, characteristic of bioclimates with an annual rainfall of around 200–300 mm (Msanda et al. 2002). Present local landscapes have been formed both by environmental factors (climate, soil, altitude etc.) and the impact of human land use for at least the

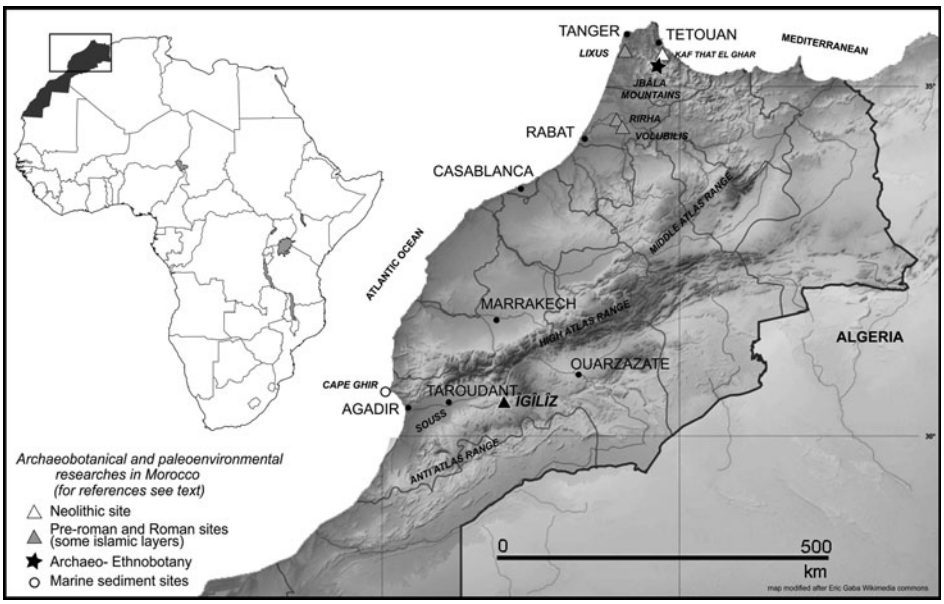


Fig. 1 Map of the northern and pre-Saharan Morocco showing the location of sites with archaeobotanical and palaeoenvironmental studies mentioned in the text (map modified after Wikimedia Commons Eric Garba)

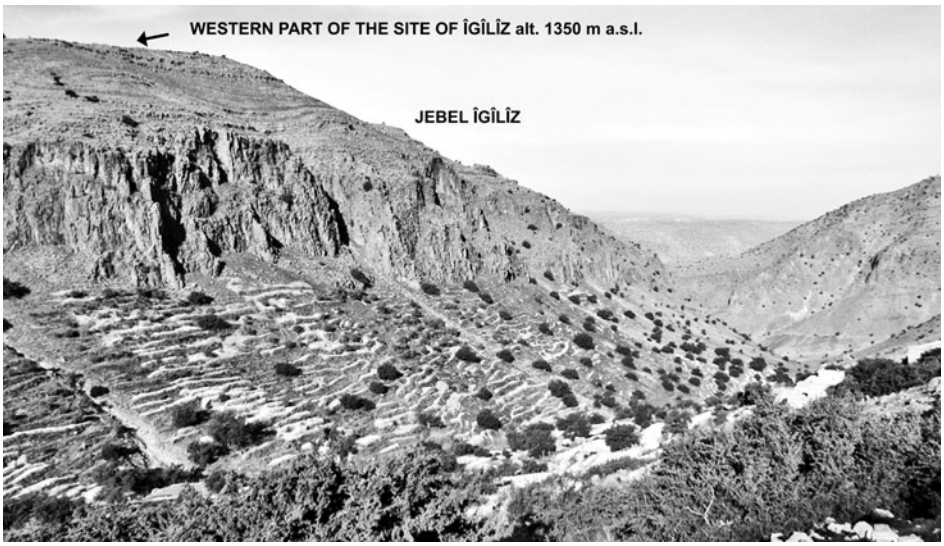


Fig. 2 The site of Îgîlîz seen from the modern village of Tifigit. In the valley are cultivation terraces with barley (*Hordeum vulgare*) and almond (*Prunus dulcis*) (photograph Ruas April 2010)

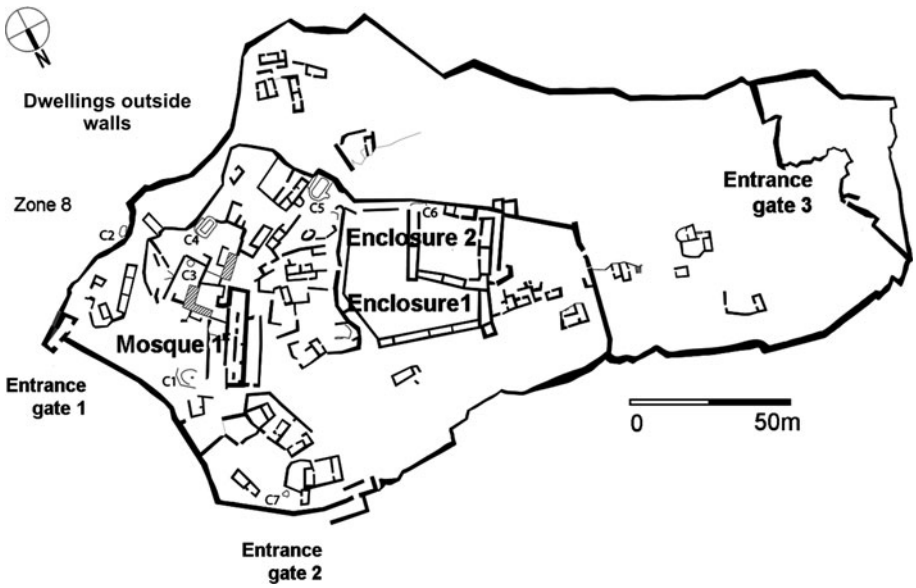


Fig. 3 Plan of the central jebel, site of Îgîlîz (topography: S. Walid Ismaïl; CAD: C. Touihri)

last 1,300 years and in particular through overgrazing by sheep and goats (McGregor et al. 2009).

Our study is part of a French-Moroccan research program directed by A. Ettahiri, A. Fili and J.-P. Van Staëvel and initiated in 2004 in order to understand the human occupation of the Souss Valley and the Atlas range during the Middle Ages and early modern times. Archaeological excavation was preceded by the study of Islamic written sources as well as surveys aimed at locating major sites. Among other sites the survey identified Îgîlîz as a particularly important locality in Medieval Morocco as it is considered to be the birthplace of Ibn Tûmart (born in 1078 or 1079, died in 1130; Van Staëvel and Fili 2006). This legendary figure, of Berber origin, proclaimed himself Mahdi—that is spiritual guide—in 1121. With his brothers of faith he founded the Almohad Dynasty that, succeeding the Almoravids, would come to dominate large parts of North Africa and Moorish Spain for almost 150 years in the 12th and 13th centuries (A.D. 1121–1269). The fortified settlement of Îgîlîz thus constitutes the almost mythical place of origin and first stronghold of the rigorist and revolutionary Muslim community led by Ibn Tûmart (Van Staëvel and Fili 2006).

The archaeobotanical study at Îgîlîz, initiated in 2009, is the first to produce results from this part of Morocco even though several medieval sites have already been excavated in the Souss region. Through the analysis of wood and seed remains, it spreads light on farming and breeding practices as well as on the exploitation of plant resources and the history of landscapes in this mountainous area still inhabited by Berber Arghen tribes. Moreover, the present village of Tifigit, which is located at the foot of the mountain on which Îgîlîz is situated, offers an excellent opportunity for ethnographic observation of non-mechanized agricultural activities and plant use: dry-framing of cereals and pulses, irrigated horticulture, argan exploitation, use of straw and chaff in the adobe walls, grinding, foddering, domestic cooking etc. Besides archaeobotanical sampling on the site, part of the fieldwork was thus spent making observations of current practices in and around the village, useful for comparing and sometimes understanding the results obtained from the medieval settlement.

From this comparison between past and present arise numerous questions concerning the origin and evolution of

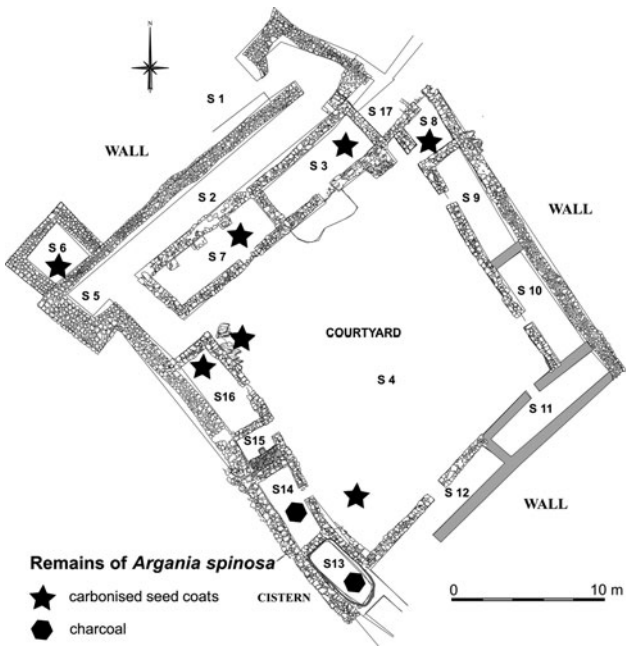


Fig. 4 Plan of the *qasba* (enclosure 2) with position of the argan tree seeds and charcoal mentioned in the text. *S* space (topography: S. Walid Ismaïl; plan and CAD modified: F. Renel, C. Touihri, A. Zizouni)

crop assemblages and agricultural practices in this part of the Anti-Atlas range. Was agriculture practiced in irrigated gardens or in dry-farming systems, for example on terraces, during the medieval period? Which cultivated plants were present during the 11th and 12th century? Were they of local origin or introduced? Did the argan tree play as prominent a role in medieval economies as it does today?

The site

Îgîlîz, surrounded by a large fortification wall, was an extended and well-organized settlement with several distinctive areas included a mosque (Fig. 3). One entire group of buildings excavated in 2009 (the *qasba* = enclosure 2) is limited on three sides (North, East and South) by walls forming a closed residential area. Several rooms, generally rectangular in shape, abut on these walls and open up towards the interior into a large courtyard measuring 29 × 25 m. The *qasba* includes a cistern and a small bathroom that add a touch of comfort to the whole. A long corridor giving access to a large building, used both for habitation and reception purposes, constitutes the western wing of the block. Except for room 3, where an earlier occupation has been detected, the whole building complex seems to have been occupied during one single period that was probably relatively short despite the imposing remains. The whole structure is abandoned after this phase. Abundant ceramic material that seals the destruction levels belongs mainly to this period of abandonment. Certain rooms show signs of intense fire events (Fig. 4). Hearths and burned levels offered favourable conditions for the preservation of charred plant remains (wood and seed assemblages). Besides the abundant carbonised remains, the arid conditions of the sediments have also allowed the preservation of desiccated construction wood. A dried-out cess-pit also provided mineralised seeds and fruits.

Excavations have revealed two phases of construction. Four absolute ^{14}C carbon dates obtained on charcoal and seed remains indicate a main occupational period during the 11th and 12th centuries A.D. Three of these dates are given in Table 1 and relate to the age of the sorghum caryopsis and of the argan tree remains (charcoal and seed). The charcoal fragments of *Argania spinosa* provide somewhat older dates than the seeds. As they come from the destruction layer caused by burning of the roof of the cistern, this somewhat older date could be explained by the use of old wood for the building of the roof.

Materials and methods

The dry and aerobic conditions of archaeological contexts excluded the presence of waterlogged plant material. Sampling thus favoured burnt layers and combustion structures where carbonised remains could be found. In 2009, almost all of the excavated contexts in the *qasba* (enclosure 2; rooms, cistern) yielded charred wood or seeds from the destruction layers caused by fire or from the ashes of the hearths. In total 50 samples of sediment were obtained from 28 stratigraphic units in the central residence. The extraction of botanical remains from sediment samples was rendered somewhat difficult by the lack of running water, but thanks to water from a collective well, we managed to treat 180.85 l of sediment by manual flotation on two sieves (mesh size 2 and 0.3 mm). 38 samples turned out to be positive for seed remains.

Charred wood pieces were chosen randomly from a dozen contexts at the site and identified.

In 2010, more sampling was carried out in the sector surrounding cave 2, in several buildings and in the mosque. This area provided more hearths with abundant remains of carbonised seeds, fruits and wood, desiccated wood

Table 1 Results of AMS ^{14}C dating of charcoal and carbonised seeds from Îgîlîz

Lab.-code	Sample/context	Material dated	^{14}C date	Cal A.D. (2σ)	Century (A.D.)
UBA-13364	UB2 (US4352)/layer burnt from first house	Charred caryopsis of *Sorghum*	948 ± 19	1025–1059 1066–1072 1075–1155	11th–12th
UBA-13365	UB3 (US4352)/layer burnt from first house	Charred caryopsis of *Hordeum vulgare*	942 ± 27	899–919 950–956 961–1025	10th–11th
UBA-13366	UB4 (US4810)/ hearth	Charred seed of *Argania spinosa*	968 ± 27	1018–1059 1065–1072 1075–1155	11th–12th
UBA-13367	UB5 (US41329)/ burnt destruction filling cistern	Charcoal of *Argania spinosa*	1050 ± 26	899–1018 950–956 961–1025	10th–11th

Table 2 Taxa identified from carbonised seeds and wood from enclosure 2 (*qasba*); SU = stratigraphic units, S = spaces

Taxa		Spaces						Frequency SU = 28	Frequency S = 7	Wood
		3	4	6	7	8	9	16			
Cereals											
Hordeum vulgare	caryopsis	X			X			X	7	3	
cf. *Triticum*	caryopsis	X				X			3	2	
Sorghum sp.	caryopsis, spikelet, rachis, stem	X						X	10	2	
Cerealia	caryopsis	X		X		X			3	3	
Pulses											
Lathyrus cicera/sativus	seed	X							1	1	
Fruits											
Argania spinosa	seed, sclerified testa	X	X	X	X	X	X		19	6	X
Ficus/Ficus type	nutlet	X				X		X	5	3	
Phoenix dactylifera	seed	X							1	1	
Prunus dulcis	endocarp fragment			X					1	1	
Vitis vinifera	seed, pedicel	X	X	X	X	X		X	12	6	
Wild plants											
Amaranthus sp.	seed	X			X			X	10	3	
Amaranthac./Chenopodiac.	seed	X			X				2	2	
cf. *Anagallis*	seed	X				X			3	2	
Anthemis type	achene	X							3	1	
Asperula/Galium	achene	X		X	X	X			6	4	
Asphodelus sp.	seed				X				1	1	
Asteraceae	achene				X				2	1	
Avena sp./*sterilis* type	caryopsis, lemma base, awn	X			X				7	2	
Barbarea type	seed	X							1	1	
Boraginaceae	achene					X			1	1	
Brassicaceae	seed	X							3	1	
cf. *Calendula*	achene	X							1	1	
Centaurea type	achene				X				1	1	
Chenopodium sp.	seed				X				1	1	
Chrysanthemum sp.	achene	X							2	1	
Coronilla type	seed	X							1	1	
Cupressus/Juniperus	charcoal										X
Echium sp.	achene	X							1	1	
Fabaceae, large seed	seed	X							2	1	
Fabaceae	seed	X			X				4	2	
Geranium type	mericarp				X				1	1	
Lamiaceae	achene	X				X			3	2	
Lathyrus/Vicia	seed	X			X				2	2	
cf. *Lithospermum*	achene	X			X				3	2	
cf. *Lolium* type *rigidum*	caryopsis				X				1	1	
Malva sp.	mericarp	X	X	X	X	X		X	14	6	
Medicago sp.	seed	X		X				X	3	3	
Paniceae	caryopsis	X				X			3	2	
Papaver sp.	seed	X							1	1	
Plantago sp.	seed	X			X	X			9	3	
cf. *Phalaris*	caryopsis	X							2	1	
cf. *Phleum*	caryopsis	X							1	1	
cf. *Poa*	caryopsis	X							1	1	
Poaceae type 1	caryopsis	X		X	X				9	3	
Poaceae type 2	caryopsis	X							1	1	
Populus sp.	charcoal										X
Reseda type *odorata*	seed				X				1	1	
Rumex sp.	nutlet	X							1	1	
cf. *Scorpiurus*	seed	X							1	1	
Sherardia sp.	achene	X		X					2	2	
cf. *Solanum*	seed	X							1	1	
Trifolium sp.	seed	X		X					4	2	
Silene gallica type	seed	X				X			5	2	
Valerianella dentata type	seed	X							1	1	
Vicia type	seed			X					1	1	

(probably the roof of the mosque) as well as mineralized seeds mixed with occasional fish bones from the fill of a domestic cesspit. According to the ceramic typology (^{14}C dating in process), the occupation of this sector can be dated to the same period as the *qasba* (11th to 13th centuries A.D.).

Results

Even though the precise sorting and quantification of the plant remains from Îgîlîz is still in progress the first analysis of the plant remains has allowed the identification of 53 cultivated and wild taxa. Charred remains and the

occurrences (or constancy) of charred seed and fruit taxa extracted in enclosure 2 in 2009 are indicated in Table 2. Almost all seed and fruit remains come from hearths in houses or activity areas or from burnt layers resulting from the destruction of certain rooms of the *qasba* by fire. In these contexts remains of construction wood (joists, beams, roof elements) are particularly abundant, more so than seeds and fruits.

Hordeum vulgare (barley) and *Sorghum* sp. (sorghum) are the most common cereals in the stratigraphic units of the *qasba* even though they are attested in relatively few archaeological contexts. Remains of *Sorghum* consist of hulled grains as well as fragments from the panicle and the stem. In space 3, the remains are locally very abundant and appear as a concentration of panicle fragments and grains (>300 grains). They probably correspond to the residues of storage carbonised during the burning of the house that previously occupied this space. *Triticum* sp. (wheat) is less frequent and the bad preservation state of the caryopses (often fragmented or corroded) limits their identification to that of a probable free-threshing wheat species. No glumes of *Hordeum* or *Triticum* were found. *Avena* (oat) was present in the form of grains and floret bases. While the status (wild or cultivated) of the former cannot be established, the latter could be identified as wild oat (*Avena* cf. *sterilis*) and subsequently all the *Avena* remains were assimilated in this category. One single pulse (*Lathyrus sativus/cicera*) was attested from only one context. No legumes, spices or fibre plants have been identified from Îgîlîz so far.

Among the five fruits and nuts identified, fig (*Ficus carica*), almond (*Prunus dulcis*) and date palm (*Phoenix dactylifera*) are sporadically recorded. Grape vine (*Vitis vinifera*) and especially the argan tree (*Argania spinosa*)

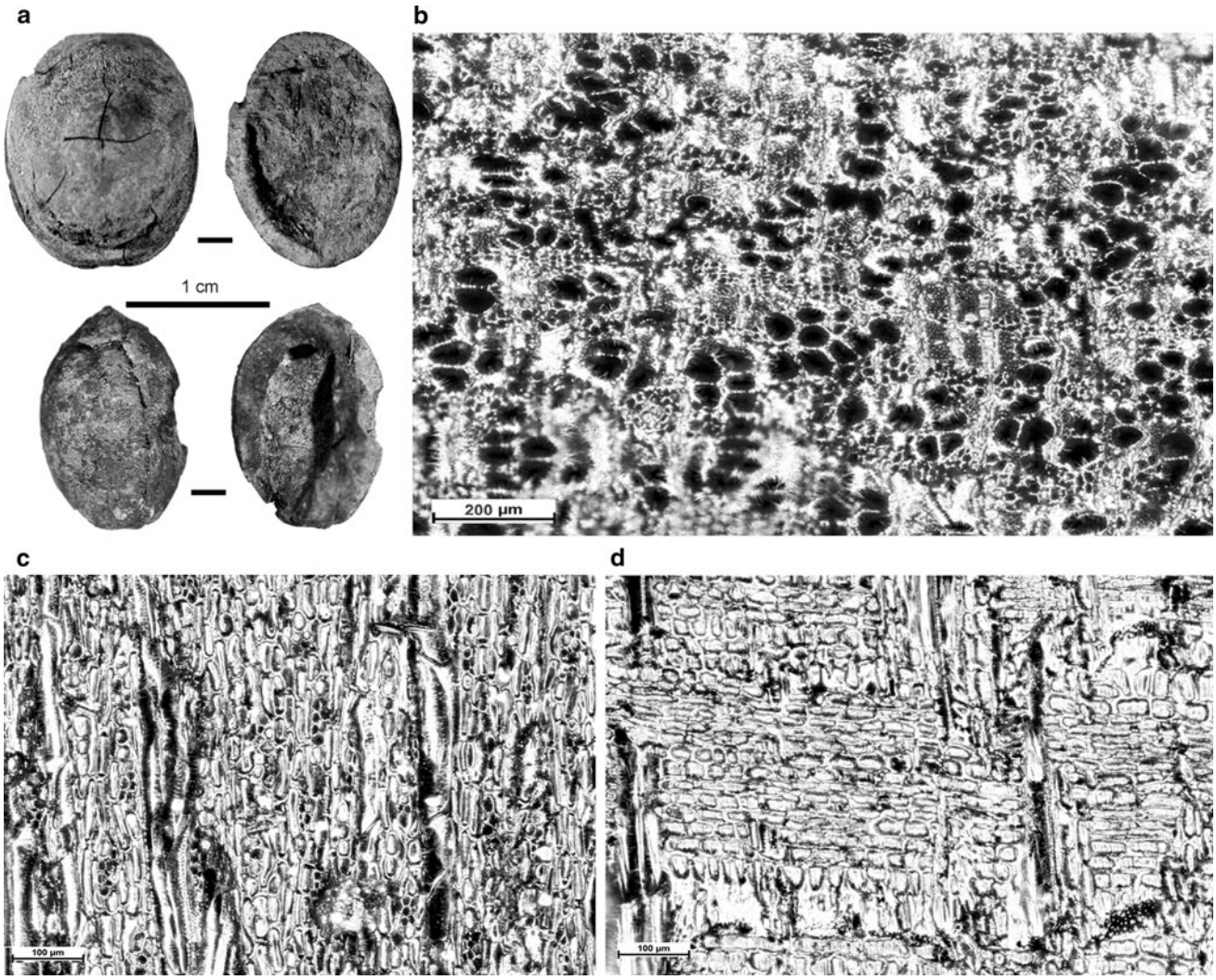


Fig. 5 Archaeobotanical remains of *Argania spinosa* from medieval Îgîlîz; **a** charred and fragmented seed coats (testas), dorsal and internal views (photographs Ruas 2010); **b–d** charred wood in transversal (**b**), longitudinal tangential (**c**) and longitudinal radial (**d**) sections (photographs Tengberg 2010)

are more frequent. The latter species is attested by abundant fragments of sclerified testa ("kernels") and wood. As discussed below, this tree species could have played an important economic role in the life and activities of the medieval population.

Other plants are wild taxa that have not yet been identified precisely as they need to be matched with a seed reference collection of the local flora that is at present being constituted. The highest diversity is observed in the assemblage from space 3 together occurring with the concentration of sorghum. While several taxa from the Poaceae can be distinguished (*Avena* cf. *sterilis*, cf. *Phalaris*, cf. *Poa*, cf. *Phleum*, Paniceae), the most frequently encountered wild taxon in the *qasba* is *Malva* followed by *Asperula/Galium*. The occurrence of seeds from *Amaranthus*, *Plantago* and a Poaceae "type 1" is lower but locally significant.

Charcoal pieces of three tree taxa were identified. Wood of *Populus* sp. (poplar) is present in the destruction levels of a plastered cistern (space 13). This hygrophilous tree would not have grown in the immediate, dry and stony surroundings of the site but must have been brought from a nearby *wadi* or from the valley bottom where the presence of water allows the development of gallery forests. A few fragments belonging to coniferous wood, either *Juniperus* (juniper) or *Cupressus* (cypress) are identified from room 2 in the *qasba*. Several species from these two genera are indigenous to southern Morocco but do not grow in the surroundings of the site today. Further analysis will hopefully tell us if coniferous wood is common in the site and thus perhaps of local origin or if its presence is sporadic and rather results from an occasional importation.

As for the seeds, by far the most frequently attested ligneous species is *Argania spinosa*. Argan wood is present in almost all contexts that have been tested, whether resulting from the accidental burning of construction elements (destruction layers) or the use of wood as a fuel in hearths and ovens. Even though this preliminary analysis is not representative for the wood use at the site, it shows that the tree was not only exploited for its fruits during medieval times and that it was probably an important element of surrounding plant formations as it is still today.

Finally, some charred faunal remains were also found in the samples and present a particular interest for our understanding of storage conditions. Fragments (head, pronotum, abdomen) from adult individuals of a weevil (*Sitophilus* sp.) were identified from the sorghum concentration in space 3. The genus *Sitophilus* comprises several phytophagous species of which some are pests feeding exclusively on grain (for example *S. granarius*). Several small rodent coprolites (maybe from mice) were found in the same concentration of cereals.

As far as we know, sorghum and the argan tree are here identified archaeobotanically for the first time in Morocco. *Argania spinosa* is by far the most frequently attested species at the site, present in almost all of the excavated areas. It is found in different forms according to the archaeological contexts. Numerous fragmented seeds are recorded from domestic contexts in association with pottery, grindstones and hearths. Carbonised and desiccated construction elements are present in rooms that were destroyed by fire. In hearths charred argan wood appears again, this time as a result of its use as fuel (Fig. 4).

The archaeological charred seeds and wood of *Argania spinosa*

All the charred remains of argan fruits consist of fragments of the thick woody seed coat or testa that surround the oily endosperm. In some cases these seed coats have broken up into halves and resemble nut shells (Fig. 5a). Two different fruit types—spindle-shaped and a squatter ovoid—were observed in the archaeological remains as well as on modern trees. The base and the apex are obtuse; carbonisation seems not to affect the general morphology and anatomical structure of the testa. When charred, they still

Table 3 Size measurements of recent and archaeological specimens of *Argania spinosa*

Specimen	Length (mm)	Breadth (mm)	L/B ratio
Recent uncharred berries (Tifigit, Morocco 2009)			
Fruit with dried flesh, n = 7			
	27	21	1.29
	27.8	21.1	1.32
	23.1	16	1.44
Acuminate apex	32.9	17.9	1.84
	24.3	19.1	1.27
	26.5	18	1.47
	25	17.8	1.40
min	23.1	16	1.27
max	32.9	21.1	1.84
Entire seeds, n= 5			
	23	15.9	1.45
	21.9	14.3	1.53
	19.9	15	1.33
	18.9	15.9	1.19
	19	14	1.36
min	18.9	14	1.19
max	23	15.9	1.53
Seeds with stocky (a) and long-shape (b) outline			
a	17.9	13	1.38
b	25	13	1.92
Charred fossil testa halves, n = 9 (Îgîlîz, Tifigit, High Middle ages)			
Sample z4 sp8			
n = 2	16.3	10	1.63
	15.3	8	1.91
Sample z4 sp8 su02			
n = 7	16	uncomplete	
	20	uncomplete	
	16	12	1.33
	16	11	1.45
	uncomplete	14	
	16	9	1.78
	12	8.9	1.35
min	12	8	1.33
max	20	14	1.91

Fig. 6 The Argan tree (*Argania spinosa*); **a** Cultivated tree in irrigated garden; **b** Trunk with characteristic "snake-skin" bark; **c** Flowering branch with terminal spine; **d**–**e** Spindle-shaped and broadly ovoid fruits (photographs Ruas/Tengberg, Tifigit, April–May 2009)

preserve their ovoid outline with a regular convex dorsal shape and a smooth outer surface. In the interior an oval cavity is left where the endosperm was originally lodged. The suture line of two halves is formed by a flat and more or less broad edge all around the seminal cavity (breadth of the edge is 1–2 mm for the carbonized seeds).

Size measurements of recent fruit and seeds and of carbonized fossil testas are indicated in Table 3. However, fossil specimens are too few to obtain meaningful averages of the size indices. Minimum and maximum length and breath of nine carbonised halves are L (12–20 mm) and B (8–14 mm) with an index value L/B (1.33–1.91) and for five entire recent seeds L (18.9–23 mm) and B (14–15.9 mm) with an index value L/B (1.19–1.53). The smaller and narrower size of the archaeological testas compared to recent seeds is probably due to the effect of carbonisation but this has to be proven by experimentation.

Argania spinosa wood is diffuse-porous with a dendritic arrangement of vessel elements in the transversal section (Fig. 5b). The axial parenchyma forms tangential bands and is composed of multicellular strands. Wooden rays are 1–3 cells wide and of heterocellular composition (Fig. 5c–d longitudinal sections).

The huge importance—ecological, economic and cultural—of the argan tree at the present-day in south-western Morocco is well studied by botanists, agronomists and ethnologists (Charrouf and Guillaume 1999; Msanda et al. 2005; Simenel et al. 2009) but the history of its exploitation and its use during ancient times has still to be investigated. Our identification of wood and seeds at medieval Îgîlîz can be considered as a starting point for this research.

Description of the species

Argania spinosa (Sapotaceae) is a shrub or medium height tree with spiny branches and a characteristic "snake-skin"-like bark. In favourable conditions the tree can live for more than 100 years and then develops a tortuous growth. Several generations of small yellow monoecious flowers succeed each other in 1 year, some being contemporaneous

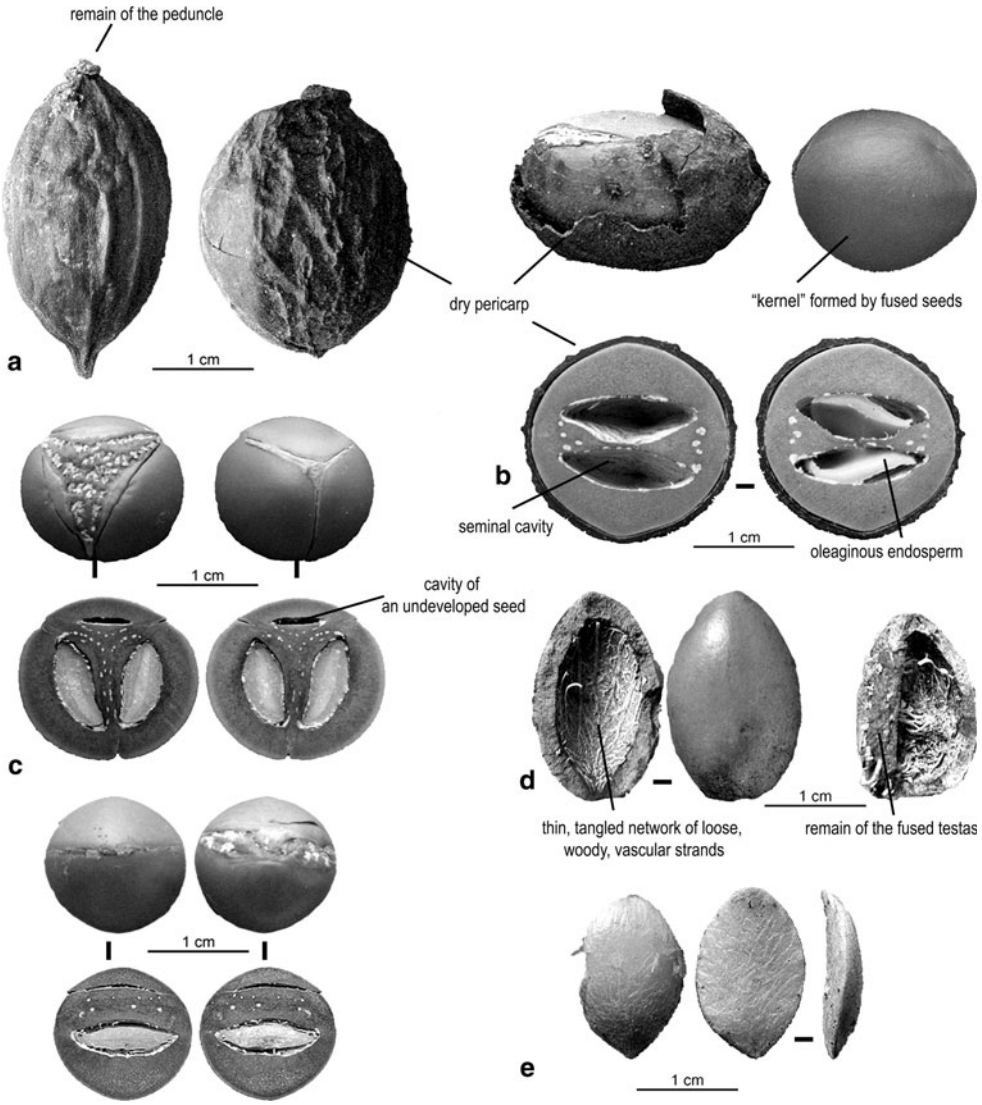


Fig. 7 Modern fruits and seeds from *Argania spinosa*; **a** Spindle-shaped and ovoid dry berries; **b** Dry berry, "kernel" and cross-section of the kernel formed by the fusion of two seeds with sclerified testas; **c** cross-sections of kernels with three and two seeds respectively fused together; **d** sclerified halves of the "kernel" after crushing; **e** two dehusked seeds (specimens collected at Tifigit, Morocco in May 2009, alt. 1,000–1,200 m a.s.l.; cross-sections prepared by M. Lemoine, CNRS UMR 7209, Paris, photographs Ruas 2010)

with the fruits resulting from earlier flowerings (Fig. 6a–f). Some trees produce fruits every year, some every second year and yet others over a period of more than 3 years (Bani-Aameur 2001).

The fruits (2–4 cm) are fleshy berries that are spindle-shaped or broadly ovoid in outline, somewhat resembling big olives of which some have a more or less pronounced acuminate apex (Figs. 6e–f, 7a). They turn bright yellow when ripe then brown when dry. Each fruit encloses one to four seeds characterised by a well-developed and sclerified testa (false kernel) (Fennane et al. 1999; El Alaoui 2006) (Fig. 7b–c). When several seeds are present their testas are fused and they appear as a unique kernel with several internal seminal cavities Thus they can easily be mistaken for the stone of a drupe. The white oleaginous endosperm of each seed includes several embryos (polyembryonic). The seeds are dehusked by crushing the "kernels", sometimes leaving a more or less regular portion of the fused testas (Fig. 7d–e).

Ecology and present-day natural distribution

The argan tree, a thermophilous species endemic to southwestern Morocco and widely distributed from sea level up to 1,300–1,500 m a.s.l., forms woodlands that are particularly well-developed in the plains of Essaouira and Souss near the Atlantic coast (Fig. 8a). In the surroundings of Îgîlîz the species reaches its easternmost limit of natural extension and forms open to very open woodlands and shrublands together with *Euphorbium officinarum* on slopes exposed towards the south and the south-west (Msanda et al. 2002) (Fig. 8b–d)

As a xerophyte it supports semi-arid to arid conditions and is able to flower and bear fruit even when the annual rainfall

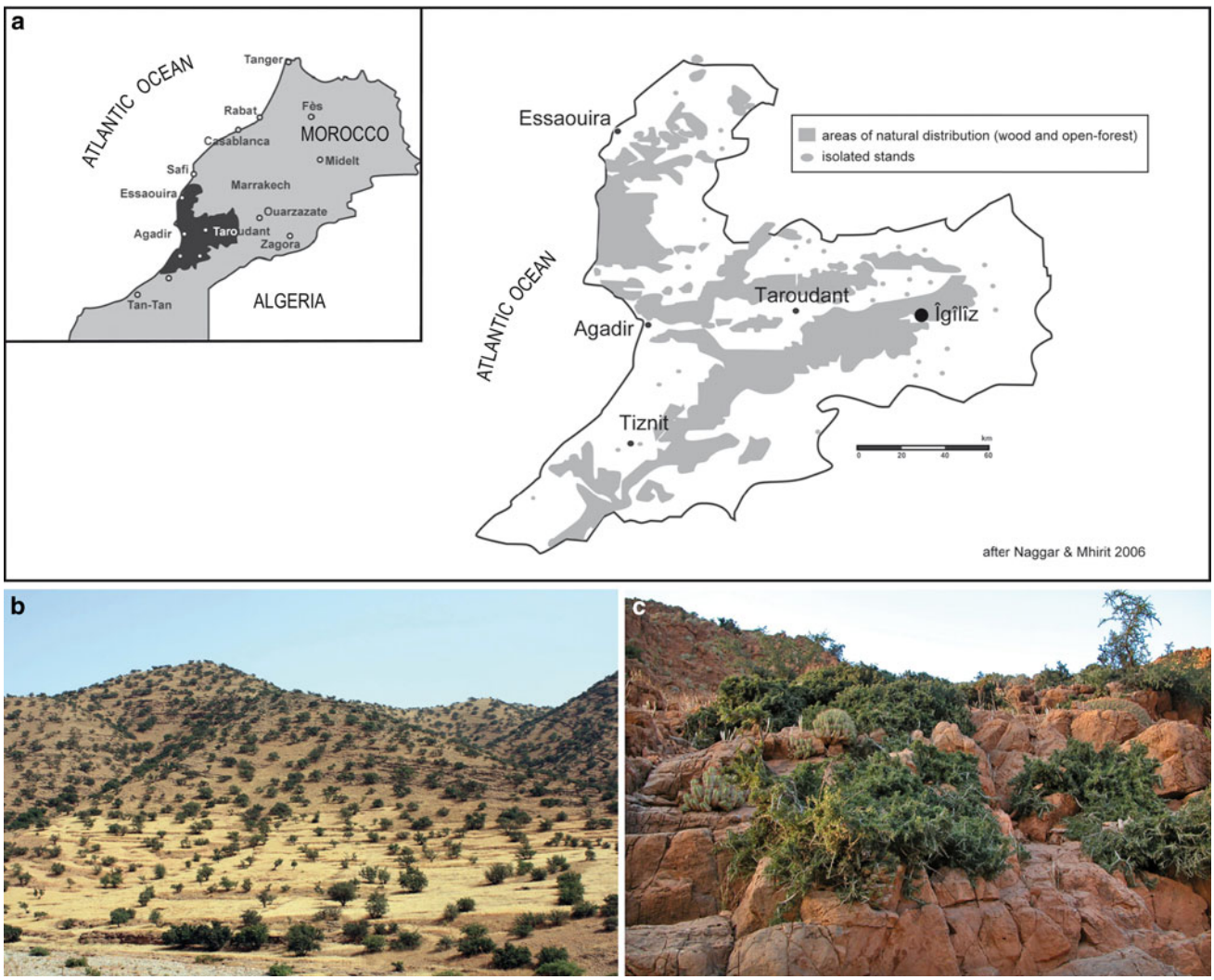


Fig. 8 Ecology and habitat of *Argania spinosa* in the area of Tifigit, Anti-Atlas, Morocco; **a** distribution of the species in south-western Morocco; **b** open shrubland with *Argania spinosa* (foothills of the Anti-Atlas range, alt. 800–1,000 m a.s.l.); **c** xerophytic formation with browsed *Argania spinosa* and *Euphorbia officinarum* (Tifigit, 1,200 m a.s.l.) (photographs Ruas/Tengberg, April–May 2009)

does not exceed 100 mm. An element of thermo- and infra-Mediterranean formations, the argan tree is normally associated with species such as the wild olive (*Olea* sp.) and the carob tree (*Ceratonia siliqua*). However, in reality, all the woodlands that can be observed in these areas today are the result of a long history of agro-pastoral activities in which the argan tree plays a major role (McGregor et al. 2009).

The growth form of the argan tree is very variable according to local conditions and a diversity of forms could be observed around Tifigit. When managed and protected, for example for oil production or for shade inside the village, trees can become very large with well-developed crowns. On the contrary, when heavily browsed or pruned for fodder and fuel they are reduced to stunted small trees and shrubs spreading on the rocky soil (Fig. 8d).

Uses of *Argania spinosa* at Tifigit—Ethnobotany

The exploitation of the argan tree seems rather to belong to a strategy of foraging than to one of cultivation. The slopes of the mountain pasturelands are covered with wild growing forms of the tree. However a few specimens are cultivated in the irrigated terraces gardens of Tifigit, together with other fruit trees (*Prunus dulcis*, *Phoenix dactylifera*, *Punica granatum*, *Pyrus communis*, *Ficus carica*, *Ceratonia siliqua*), legumes, aromatics and some medicinal plants (Fig. 6b).

For the present inhabitants of the mountains the argan tree is an important resource in domestic and subsistence activities. Its leaves and fleshy fruits constitute an important source of fodder for livestock, mainly goats, sheep and equids. While certain trees are protected from browsing through an intricate system of landholding and management, others are of free use for feeding and woodcutting; practices that result in zones of particularly reduced and stunted trees (Fig. 8a, d). A highly appreciated product of the argan tree, that has gained much commercial value in recent years, is the edible oil extracted through the grinding of the internal part of the roasted seeds. At Tifigit, it seems that the main methods used for acquiring argan fruits for oil production is to collect fallen fruit from the soil around protected trees or gather them either from dung or from where they have been spat out by goats (Fig. 9). The by-products resulting from the oil processing are also used: the crushed endosperms as a fodder and the hard seed coats as a source of fuel. More generally, in the area of its exploitation, the oil constitutes the major source of vegetable fat in traditional diets but also has cosmetic and ritual uses (Bellakdar 1997; Charrouf and Guillaume 1999). Finally, in Tifigit and the other villages of its area, the hard argan wood finds many uses: in construction, for manufacturing various utilitarian objects and as an appreciated fuel. The spiny branches are sometimes used as fencing around gardens and fields (Fig. 10a–e).

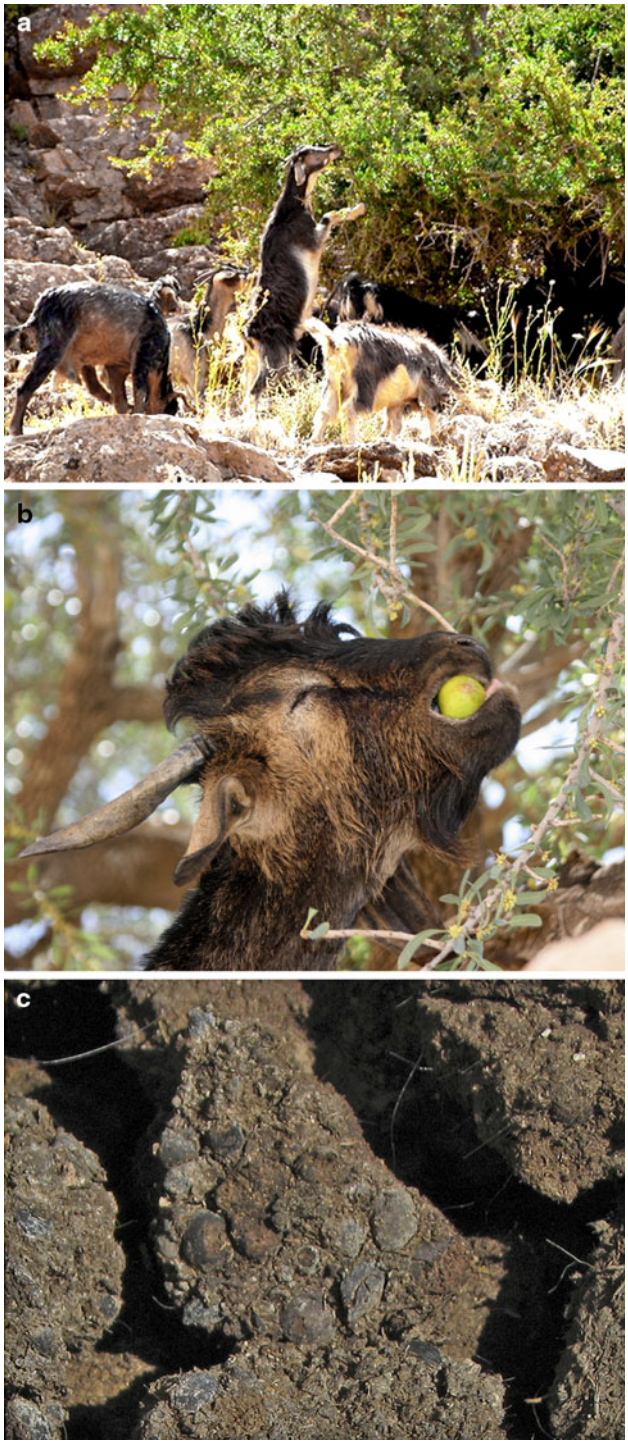


Fig. 9 Argan fruit and pastoralism: browsing and dung. **a**, **b** browsing and feeding (Tifigit, photograph Tengberg April–May 2009); **c** detail of argan fruit kernels in dung (Tifigit, photograph Ruas April 2010)

Evidence of argan from Islamic medieval texts

A compilation of medieval and later texts written by Arabic scientists or travellers informs us about the consumption of argan oil in Morocco through history. The oldest mention

Fig. 10 Uses of Argan tree at Tifigit; **a** joist of roof; **b** date palm (*left*) and argan tree (*right*) timber as beams; **c** spiny branches for fencing; **d** packsaddle frame of argan wood (mule); **e** argan twigs as domestic fuel (Tifigit, photographs Ruas/Tengberg, April–May 2009)

dates to the 11th century and comes from al-Bakrî, a geographer and historian who originated from Moorish Spain. According to the texts, the extraction of the oil followed the same procedure that still applies today (Rocher 1926). The fallen ripe berries were collected from the ground (during September according to al-Idrîsî). The fresh or dried berries were then fed to animals (Al Idrisi specifies that these were goats) that consumed the fleshy pericarp before spitting out the kernels. A close relationship between goat breeding and oil production does thus seem to have also existed in the past. The kernels were collected from the floors of animal pens or stables and roasted in a pan. The grinding was done with a manual rotating grindstone and resulted in the extraction of a thin and transparent oil (al-Bakrî: 357-359; al-Zuhrî: 8; Ibn al-Baytâr: 112; al-Idrîsî: 231; Marmol: 6, Fig. 11). This edible oil is said to have been consumed together with boiled meat by people from the Haha tribe (Léon l'Africain: 96; Marmól: 17) as well as

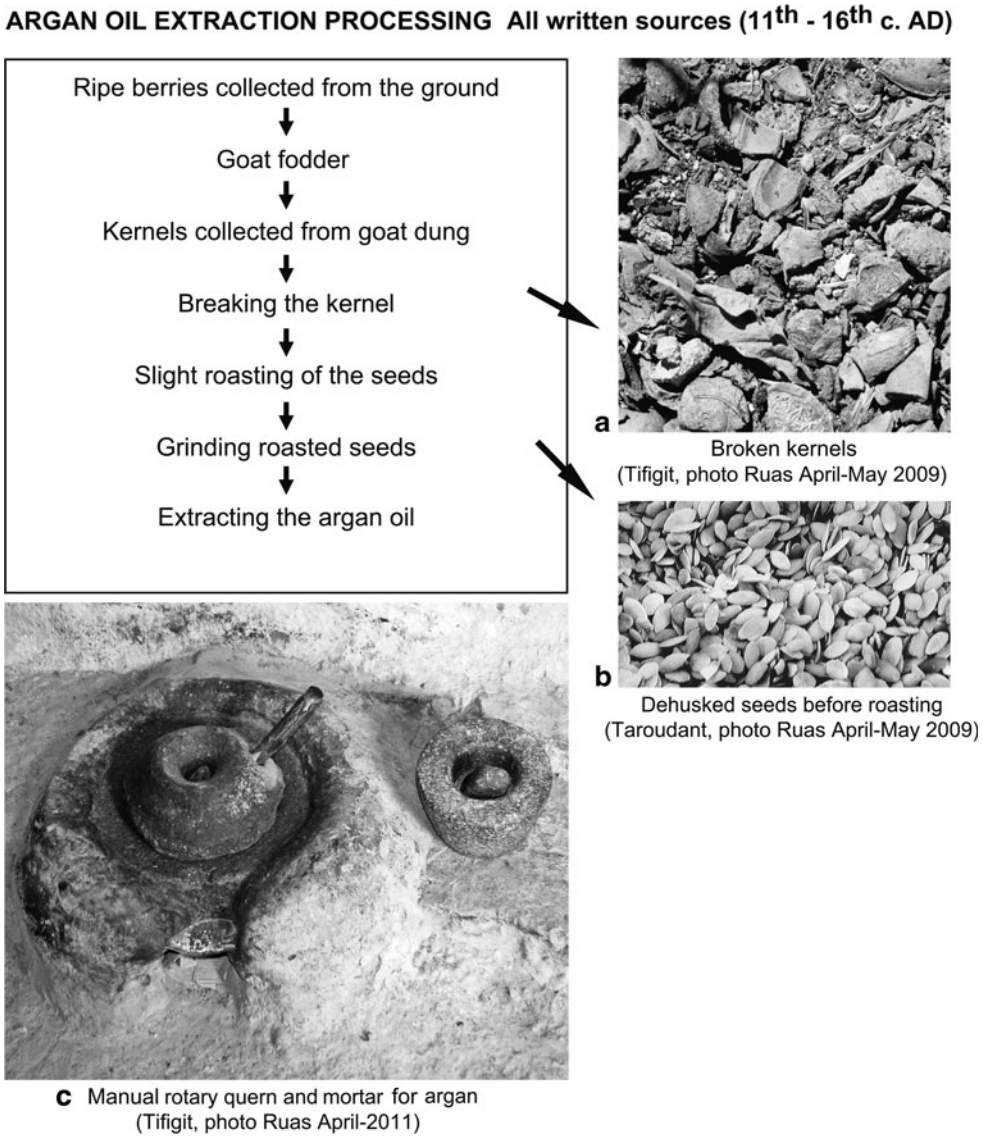


Fig. 11 Simplified outline of the production of argan oil after medieval and modern texts (*sources*: al-Bakri 11th c.; al-Zuhri mid-12th c.; Idrisi mid-12th c.; Ibn al-Baytâr 13th c.; Marmól 16th c.). Illustrations from present-day oil production at Tifigit, Morocco: **a** refuse of fragmented kernels (seed testas) after breaking; **b** oily endosperms ready for grinding; **c** domestic rotary quern used for the extraction of oil

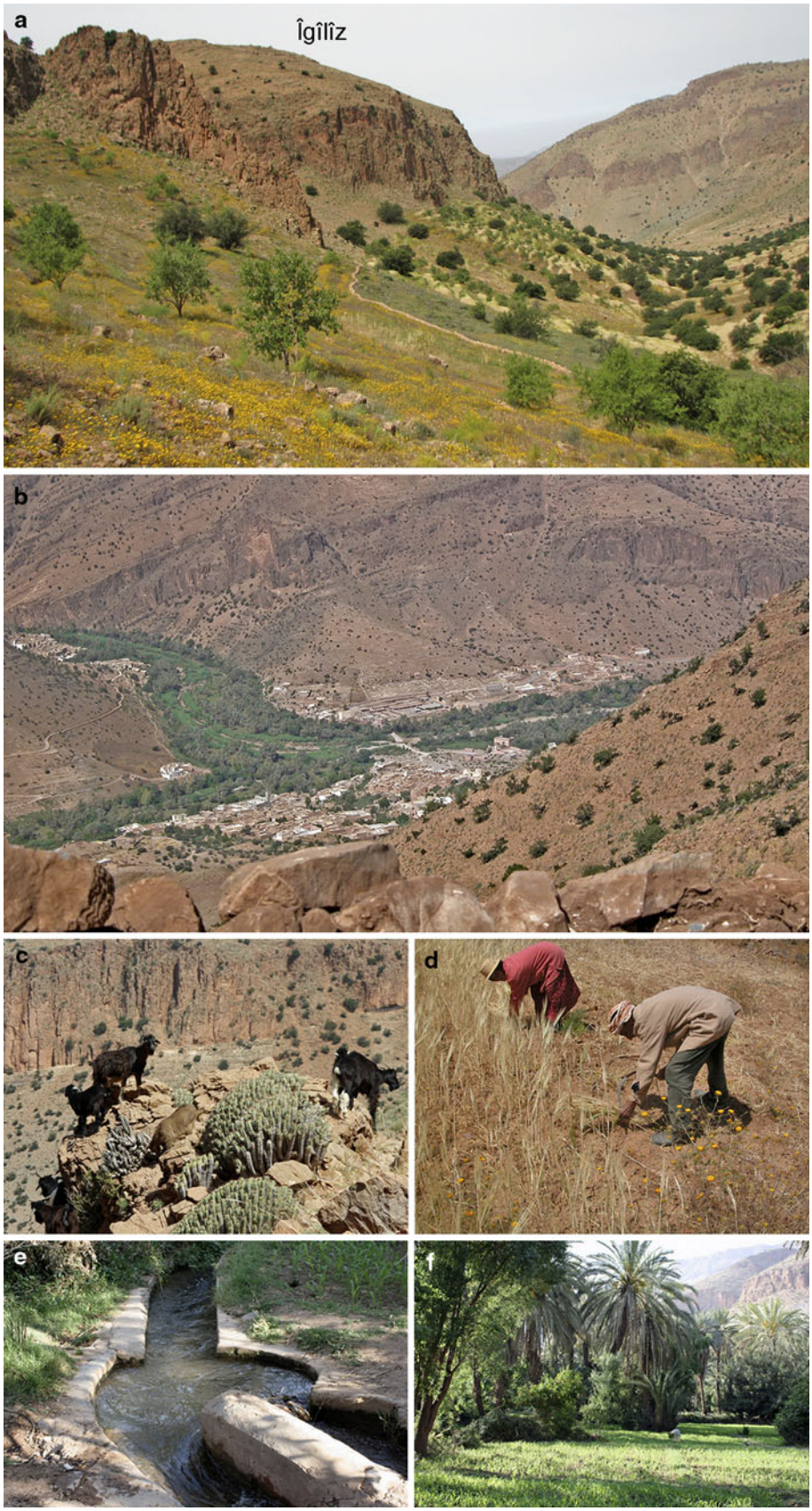
being used for cooking fritters (Al-Idrîsî: 231). Al- Bakrî also gives several indications for medical preparations using argan oil (al- Bakrî: 162). Women of the High Atlas put the oil on their hair as a cosmetic (Al-Idrîsî: 231). Finally, it could also be used as a burning substance in lamps (Al-Idrîsî: 231).

The Souss plain area was an important centre of argan oil production and trade. During the high Middle Ages, the oil was exported from the region to Marrakech (al-Zuhrî: 118) and in the late Middle Ages its governors offered argan oil as a prestigious gift to kings (Ibn Khaldoun 6: 356) In modern times, the extraction of argan oil has become a specific economic activity of the Haha tribe (Marmól, t. 2, 17).

Conclusion

This first archaeobotanical study conducted at medieval Îgîlîz reveals a diversified plant spectrum composed principally of nine crops: three cereals, one pulse and five fruit species.

Among these, the fruits and the wood of the argan tree played a major economic role in the daily activities of the inhabitants, for example the numerous occurrences of seed fragments suggest that its oil was used as a fat staple. The argan tree still constitutes an important resource for food, wood and fodder for the present-day populations of Tifigit and the other villages in the surroundings. One of the future aims of the archaeobotanical study at Îgîlîz will be to


a
Îgîlîz
b
c
d
e
f

◄ **Fig. 12** **a**, **b** Present-day landscapes: farming on the slope terraces (Tifigit, alt. 1,200 m a.s.l.) and in the wadi (village of Magannoune, Assif Arghane, alt. 758 m a.s.l.); **c** Mountain arid pastureland; **d** Manual harvest of *Hordeum vulgare* (terrace cultivation); **e**, **f** Irrigation system in the wadi; **f** mixed cropping in date palm garden (photographs Ruas/Tengberg, April–May 2009)

evaluate the wild, cultivated or domestic status of this species.

In a wider perspective further research will focus on the understanding of farming and breeding practices in a mountainous environment during Islamic medieval times and try to contribute to the history of the management strategy of landscapes (Fig. 12). Questions of particular interest will thus be the location and nature of cultivation (presence of terrace cultivation, irrigation?), the territories used for pastoral activities and foraging, the relation between Jebel Îgîlîz and the valley bottom where oasis agriculture is practiced today, as well as the settlement's involvement in regional trade and exchange networks.

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