

# First evidence of *Mespilus germanica* L. (medlar) in Roman Switzerland

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**Abstract** The *Mespilus* (medlar) fruit tree, non-native in Europe, is generally believed to have been introduced to central Europe during the Roman occupation of the region. Archaeobotanical remains of medlar are generally rare, resulting in a patchy knowledge of its early distribution. We here report the earliest finds of *Mespilus* seeds of the 2nd century A.D. in Switzerland, which were discovered in the Roman *vicus* of Tasgetium in Eschenz. We summarize the archaeobotanical evidence of *Mespilus* fruit stones in central Europe during Roman times, which indicate a wide geographical distribution of *Mespilus*. In addition, we give an overview of Roman sources about the use of medlar fruit and glance at medieval evidence.

**Keywords** Archaeobotany · *Vicus* of Tasgetium · Lake Constance region · Waterlogged · Historical sources · Fruit cultivation

## Introduction

*Mespilus germanica* L. (medlar) is a white flowered shrub or small tree of the rose family and related to apples and pears (family: Rosaceae, subfamily: Maloideae, genus: *Mespilus*) (Schmeil 1996). The green–brown and softly

hairy fruit usually contain five stony seeds (Fig. 1). After the first hard frost, the fruit must be stored in a dry cool place until the flesh, which is initially still hard, green and tart, softens and changes colour to a light brown, a process called bletting. It then becomes suitable for consumption. The pulp then has a distinctive slightly sour flavour and can be consumed directly, processed as a preserve or used for bakery (Baird and Thieret 1989; Knörzer and Gerlach 1999b).

*Mespilus* originated in southwest Asia (Lauber and Wagner 2001, p. 558; Baird and Thieret 1989, p. 330) or in southeast Europe (Schmeil 1996, p. 247; Lauber and Wagner 2001, p. 558). Although one possible specimen of *Mespilus* charcoal from the pre-Roman period was found in France (Durand 1991) cited in Ruas and in Marinval (Ruas 1996, Table 4 and footnote 2 on p. 105; Marinval 1999, p. 64), it is generally assumed that *Mespilus* was first introduced to central Europe by the Romans (Knörzer and Gerlach 1999a, p. 96; Willerding 1996, p. 15; Marinval 1999, p. 50). Archaeobotanical finds of *Mespilus* seeds occur with the Roman occupation in France, and north of the Alps as in the lower Rhine valley in Germany (Knörzer 1987). In Roman Britain there is evidence of *Mespilus* in the 2nd century A.D. (Baird and Thieret 1989, p. 346).

In the Middle Ages, both archaeobotanical finds (de Hingh and Bakels 1996; Rippmann and Neumeister-Taroni 2000, pp. 179, 181; Brombacher 1999) and historical sources show the popularity of *Mespilus* (citations of historical sources in Knörzer and Gerlach 1999b, p. 111; Baird and Thieret 1989, p. 346, Dickson 1994, p. 68; Hellmund 2007, p. 194). It was a common fruit tree in central European gardens for centuries. Today it is rare in central Europe and hence in southern Germany and northern Switzerland (Baird and Thieret 1989, p. 354; Knörzer and Gerlach 1999b, p. 111; Sebald et al. 1992), but

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**Fig. 1** Modern fruits of *Mespilus germanica* (medlar), photo by B. Pollmann

one can still find single trees in private orchards, botanical gardens and arboreta (for example, Albisbodenhof Baumschule, northeastern Switzerland), monastery gardens (for example, Kloster Schöntal, southern Germany) or in palace grounds (for example, Schloss Schwetzingen, southern Germany).

So far, little is known about the early distribution of *Mespilus* in central Europe. As Roman sources are only

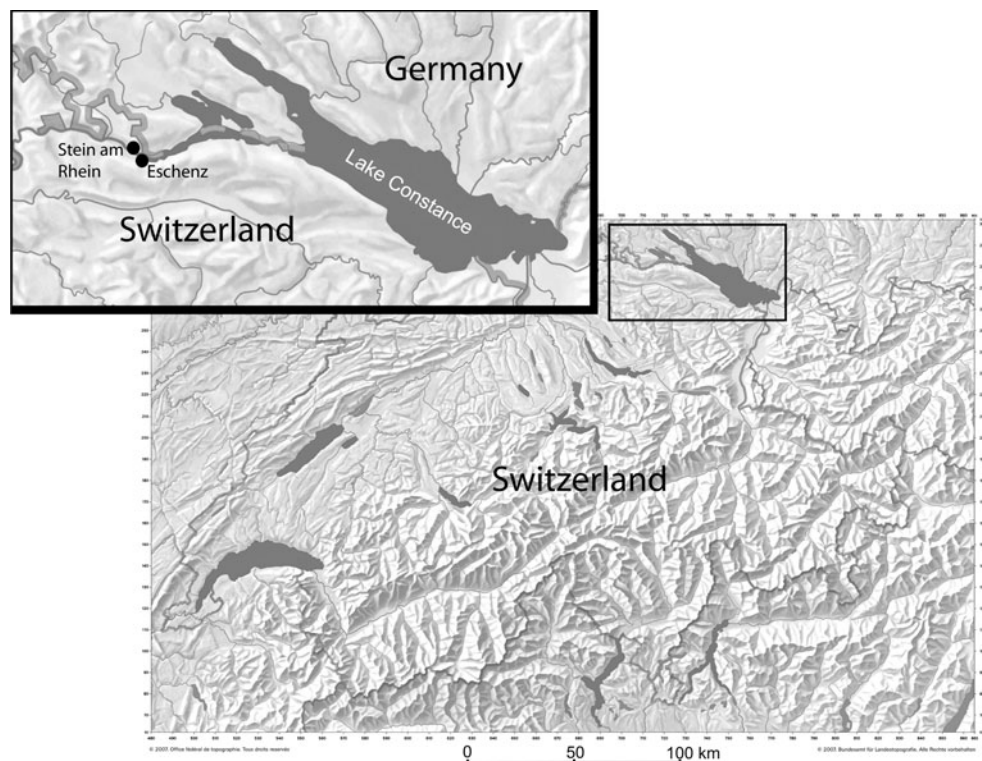
available for the southern parts of the continent (see discussion), we must rely on archaeobotanical evidence to reconstruct the distribution of *Mespilus* beyond that area. This paper presents seeds of *Mespilus* discovered in the Roman *vicus* of Tasgetium in Eschenz, Switzerland. It represents the earliest evidence of its kind in Switzerland and thus contributes valuable information on the history of *Mespilus* cultivation in central Europe.

## Materials and methods

The Roman *vicus* of Tasgetium, now Eschenz, Switzerland, was situated on the south bank of the Rhine where the river leaves Lake Constance (Bodensee) to the west (Fig. 2). The *vicus*, a small Roman civil settlement, was located on important trade routes that followed and crossed the Rhine at that point. The wooden piles of a bridge found in the river were dated by dendrochronology to the second half of the 1st to the 3rd centuries A.D. (Brem 1997). In addition, many of the excavated settlement structures were preserved in a waterlogged state. This allowed a dendrochronological dating of the *vicus* to between the beginning of the 1st century and the end of the 3rd century A.D.

Wooden structures like drains, sewers, cesspits and basins contained numerous organic artefacts (Jauch 1997) as well as ecofacts in an excellent waterlogged state of preservation. In excavations carried out during the years 1999 and 2000 (Brem et al. 1999), seeds of *Mespilus*

**Fig. 2** Map of Switzerland with a detailed view of the Lake Constance region showing the locations of the *vicus* of Tasgetium (Eschenz) and the town of Stein am Rhein, © 2007 Bundesamt für Landestopografie



*germanica* were found in an archaeobotanical sample from a wooden basin containing rubbish and faeces of the Roman inhabitants. The sample was taken close to the stone foundations of a building of as yet undetermined function (ESM Fig. 1). The basin is dated by dendrochronology to the second half of the 1st century A.D., with the most recent contents assigned to the second half of the 2nd century A.D. or later by numismatics.

Sediment samples from the excavation in Eschenz (excavation number 1999.010) containing plant remains were stored in airtight boxes at temperatures between 10 and 15°C for up to 2 years. The archaeobotanical material was extracted using semi-flotation with the wash-over method (Hosch and Zibulski 2003; Tolar et al. 2009). Sieves with mesh sizes of 4, 1 and 0.35 mm were used. In cases where many wood chips were present in the samples, a sieve with a mesh size of 8 mm was used additionally to separate large objects. After sieving, the 8 and 4 mm fractions were checked completely. The 1 and 0.35 mm fractions were randomly subsampled and then analysed under a stereomicroscope with 6 to 40× magnification. The seeds and fruits were separated and identified with help of the seed reference collection of the Institute for Prehistory and Archaeological Science of the University of Basel as well as special literature for seed and plant identification (Cappers et al. 2006). The *Mespilus* seeds and seed fragments were found in the 8 and 4 mm fractions of soil sample no. 33 with an original total volume of 10.5 l. Both the 8 mm fraction (2 l) and the 4 mm fraction (1.85 l) were checked completely.

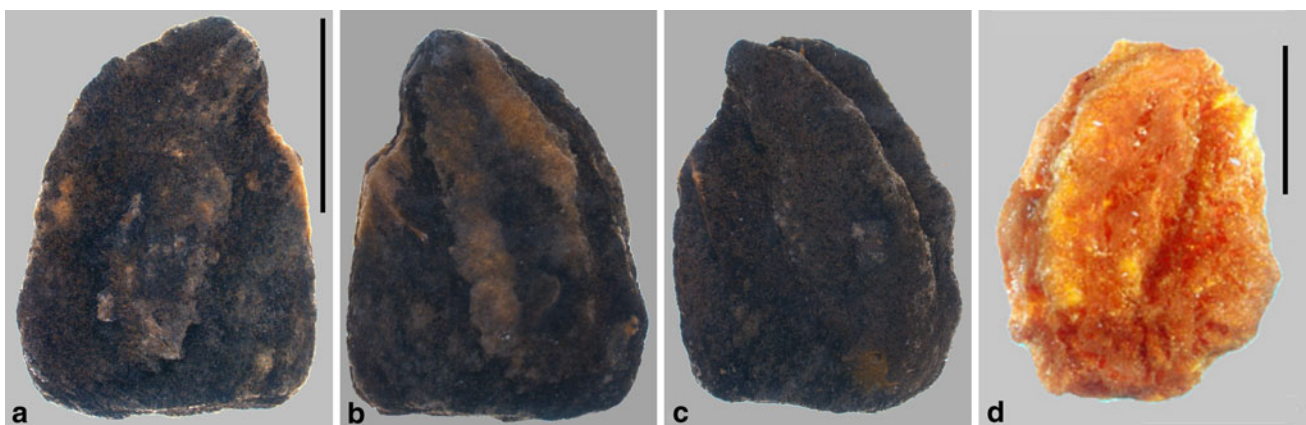
## Results

In total, 19 seeds and three seed fragments of *Mespilus* were identified (Figs. 3, 4). Due to the waterlogged

conditions beneath the ground water table, the subfossil seeds are very well preserved. They are brownish to black in colour, in contrast to the characteristic red or orange colour of modern seeds (Fig. 3). In a lateral view, the seeds are almost triangular in shape, sometimes reminiscent of a sector from an irregular disk. The slightly arched dorsal edge is broad and often characterised by a central V-shaped groove (Fig. 3c). The lateral sides show ridges of different thickness. The ventral side is typically characterised by a small ridge. The surfaces of the seeds are irregularly corrugated and hence seem porous. A finely meshed cell structure can be recognized in some areas of the seed surfaces. The measurements of all recovered seeds are listed in Table 1.

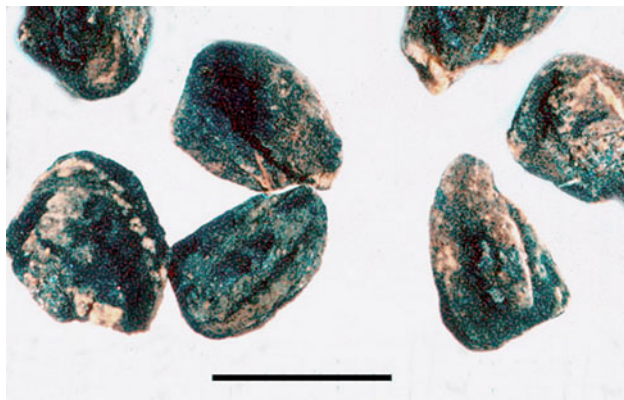
Following the criteria of Schibler and Jacomet (1996), the content of the basin is interpreted as representing mainly kitchen waste. Characteristic remains that occur in original latrine contents are a large amount of mineralised aggregations, small seeds of fig and strawberry, deformed and partially digested fish bones. In contrast, bigger fruit stones and nut shells, and other rubbish like broken pots etc. would have been absent or very rare in latrine deposits. The large number of fruit stones of plum, damson, cherry and especially peach, many nut shells (also large parts of walnut shells) and the few mineralised botanical remains, as well as bigger ceramic fragments, suggest that during the final stage the basin was not used exclusively as a latrine but mainly for the deposition of waste.

Beside the *Mespilus* seeds, remains of numerous wild and cultivated taxa were identified at the site (Table 2). The great majority of the plant remains were preserved waterlogged, with some charred and mineralised specimens among them. Quite remarkable is the large number of fruit stones, which have already been the subject of morphometric and ancient DNA studies (Pollmann et al. 2005).



**Fig. 3** Waterlogged Roman *Mespilus germanica* seed from Eschenz (2nd century A.D.); **a, b** opposite lateral sides of the same seed; **c** a second specimen, lateral view; **d** modern *Mespilus* seed with characteristic orange to red colour; scale bar = 5 mm; photos by B. Pollmann





**Fig. 4** Assemblage of waterlogged Roman *Mespilus* seeds from Eschenz (2nd century A.D.), photo by [www.archaeologie.tg.ch](http://www.archaeologie.tg.ch)

**Table 1** Dimensions of the *Mespilus* seeds found at the *vicus* of Tasgetium, Eschenz, CH

No.	Length (mm)	Breadth (mm)
1	8.2	4.8
2	9.1	7.2
3	9.4	6.9
4	10.2	6.8
5	9	7
6	8.9	6.6
7	10	7.1
8	9.8	8
9	11.4	6.5
10	10.2	7.5
11	9.6	6.9
12	8.5	6.5
13	10.3	7.8
14	10	9
15	10	7
16	10	7.6
17	10	7.8
18	9.6	7
19	10.5	6.8
Mean	9.7	7.1
Median	10.0	7.0
S.D.	0.8	0.8

## Discussion

In general, finds of *Mespilus* are rare in Roman contexts in central and western Europe (Table 3). *Mespilus* occurs in various archaeological contexts; it was found in a funerary context in France, outside the Roman city walls of Colonia Claudia Ara Agrippinensium, and in an urban context in Troyes and Reims in France and in smaller civil

**Table 2** List of cultivated food plants and probably collected wild fruits that were found in Eschenz/Tasgetium (Pollmann 2003; Feigenwinter 1997)

Cereals	
<i>Avena</i> sp. (grain)	Oat (grass)
<i>Hordeum vulgare</i> L. (grain)	Barley
<i>Panicum miliaceum</i> L. (grain, chaff)	Broomcorn millet
<i>Triticum dicoccon</i> Schr. (chaff)	Emmer
<i>Triticum monococcon</i> L. (chaff)	Einkorn
<i>Triticum spelta</i> L. (grain, chaff)	Spelt
Cerealia (grain)	Cereals
Pulses	
<i>Lens culinaris</i> Med.	Lentil
cf <i>Pisum sativum</i> L.	Probably pea
<i>Vicia faba</i> L.	Broad bean
Fruits and nuts	
<i>Corylus avellana</i> L.	Hazelnut
<i>Cucumis sativus</i> L.	Cucumber
<i>Cucumis</i> cf <i>melo</i> L.	Probably melon
<i>Ficus carica</i> L.	Fig
<i>Fragaria vesca</i> L.	Strawberry
<i>Juglans regia</i> L.	Walnut
<i>Juniperus communis</i> L.	Common juniper
<i>Malus/Pyrus</i>	Apple/pear
<i>Mespilus germanica</i> L.	Medlar
<i>Prunus avium</i> L., <i>P. avium/cerasus</i>	Cherry
<i>Prunus domestica</i> L.	Plum
<i>Prunus insititia</i> L.	Damson
<i>Prunus persica</i> (L.) Batsch	Peach
<i>Prunus spinosa</i> L.	Sloe
<i>Pyrus communis</i> L. em. Gaertn.	Pear
<i>Rosa</i> sp.	Rose/rose hip
<i>Rubus fruticosus</i> L.	Blackberry
<i>Rubus idaeus</i> L.	Raspberry
<i>Sambucus nigra/racemosa</i>	Elder
<i>Vitis vinifera</i> L.	Vine grape
Other cultivated plants	
<i>Anethum graveolens</i> L.	Dill
<i>Apium graveolens</i> L.	Celery
<i>Beta vulgaris</i> L.	Beet
<i>Brassica</i> sp.	Cabbage spp.
<i>Coriandrum sativum</i> L.	Coriander
<i>Linum usitatissimum</i> L.	Flax
<i>Papaver somniferum</i> L.	Opium poppy
<i>Satureja hortensis</i> L.	Summer savory

settlements as in the *vicus* of Nidderau-Heldenbergen or in the rural site at Novy-Chevrières. They show that the fruits were used not only in the Mediterranean parts of the Roman Empire, as known from written sources, but also in

**Table 3** Archaeobotanical evidence of *Mespilus* in Roman central and western Europe

Country	Dating	Archaeological site	Archaeological context	Reference
France	50 B.C.–A.D. 200 A.D. 40–100	La Vayssière (Larzac plateau, Aveyron)	Graves, funerary	Marinval (1993, 2004)
		Moterfil 2, Corseul	Small Gallo-Roman town, district of craftsmen	Ruas (1990)
	1st to early 3rd century A.D.	Saint-Romain-de-Jalionas (Isère)	Off-site, near a Roman villa	Bouby (2010)
		Novy-Chervièrès	Rural site	Zech-Matteme (2010)
		Les Ilettes, Annecy-le-Vieux	Urban	Lundström-Baudais (1991)
	2nd to 3rd century A.D.	Troyes	Urban	Zech-Matteme, pers. comm.
	3rd century A.D.	Reims	Urban	Zech-Matteme, pers. comm.
	3rd century A.D.	Parc Saint Georges, Lyon	Urban	Bouby (2010); Verot-Bourrely et al. (2010)
	End of the 4th to first half of 5th century A.D. “Roman period”	La Roquette, Cavillargues (Gard)	Rural site	Bouby (2010)
		Kattenburg	Civil settlement, outskirts of Roman town	Knörzer (1987)
Germany	1st half of 2nd century A.D.	Nidderau-Heldenbergen	<i>Vicus</i> , civil settlement	Baas (1982); Kreuz (1995)
		Not specified	Presence of medlar mentioned in context of history of Roman horticulture in the Rhine valley	Knörzer and Gerlach (1999a)
	Not specified	Not specified	Presence of medlar mentioned in context of Roman horticulture in Roman provinces in Central Europe	Willerding (1996)
Great Britain	2nd century A.D.	Silchester	Town, civil settlement	Baird and Thieret (1989); Dickson (1994)
Switzerland	2nd half of 2nd century A.D.	Eschenz	<i>Vicus</i> , civil settlement	This paper

the northern provinces. Now the finds in Eschenz also establish the use of *Mespilus* in Roman Switzerland.

To increase our knowledge about the processing, use and importance of *Mespilus* in Roman times we can use both the archaeobotanical information and the historical sources in which Roman customs and uses of *Mespilus* are reported for southern Europe. Since carbonised *Mespilus* seeds as well as remains of apples, dates, olives etc. are found in Roman cremation burials, it is assumed that the fruit held some cultural meaning connected with fertility, life after death and immortality (Ruas 1996, p. 99). In contrast, the finds in Eschenz suggest a use in the kitchen because they were found mixed with other discarded fruit remains. However, the occurrence of *Mespilus* in kitchen waste does not permit us to safely conclude what it was used for. It is most likely that it was used for consumption, but a medical application can also not be excluded.

Historical sources contain various pieces of information on the use of *mespilus* in ancient times. In antiquity, three types of *mespilus* were known, all of them mentioned by Pliny the Elder (Pliny, nat. hist. 15, 84): the anhedonian *mespilus* (“*mespilus anhedon*”) (Ovid, M VII 232), the setanian *mespilus* (“*μεσπιλη σητανιος*”) (Theophrastus, III, 12, 5), and the Gallic *mespilus* (“*Gallicus vocant*”, Pliny, nat. hist. 15, 84). Various authors such as Pliny the Elder, Palladius and Dioscorides describe the appearance and characteristics of *mespilus* (Magerstedt 1861). However, just one of these seems to be identical to modern *Mespilus germanica* L. Starting with the description of *mespilus* cultivation by Palladius we may assume that the fruit called *mespilus* in Roman texts is identical with the botanical *M. germanica* L. (André 1998) from the 5th century A.D. onwards. Pliny the Elder states that *mespilus* was not cultivated in Italy in the times of Cato (2nd century B.C.) (Pliny, nat. hist. 15, 84). Columella, a Roman author of the 1st century A.D., did not mention *mespilus* in his work *Liber de arboribus* (Baird and Thieret 1989), where he provides plentiful information about other fruit trees. Neither did Apicius recommend recipes for the consumption of *mespilus* (Maier 1991).

Other written sources do however provide information about the use of *mespilus* in the 1st century A.D. in the Mediterranean. For instance Palladius writes that the fruits of *mespilus* were preserved in honey since the 1st century A.D. (Pall. agric. 4, 10, 22). Dioscorides (1st century A.D.) mentions the astringent effect of *mespilus*, which can cause constipation (Diosc. I 170). In the 2nd century A.D. the prominent Roman physician Galen reported on different uses of *mespilus* against somatic discomfort and pain (Grant 2000). This latter historical source is more or less contemporary with the finds in Eschenz.

Beside its use, there is the question whether medlar was grown locally or imported when finds occur in Roman

contexts. In the case of *Mespilus* in Eschenz, at the end of the 2nd century A.D., both scenarios are possible. The reported status of horticulture in the Rhine valley by Pliny the Elder makes it likely that *Mespilus* could also have been locally cultivated. From Pliny the Elder we know that cherries were grown by the river Rhine (Pliny, nat. hist. 15, 103). Local horticulture north of the Alps must also be assumed for various fruit trees like apple, pear and plum in the 2nd century A.D., because the huge amounts of archaeobotanical evidence suggest local cultivation rather than just the import of fruits (Jacomet et al. 2006). Since *Mespilus* grows very well in regions north of the Alps and a three year old tree already produces a good yield, it is probable that medlar was cultivated locally. Kreuz (1995, p. 70) also assumes that *Mespilus* was a locally cultivated fruit like 14 other fruit taxa in Roman gardens in the Hessen region, Germany. In contrast, other fruits that were found in Eschenz were imports, such as figs, and we cannot exclude that *Mespilus* was also imported to the *vicus* of Tasgetium. This is especially since we have found *Mespilus* seeds in just one single sediment sample up to now, but it has not been found all over the settlement in different archaeobotanical samples. For final proof, wood of *Mespilus* needs to be found in situ. Pollen evidence is usually a good indicator for local cultivation, too. In the case of *Mespilus*, however, the pollen cannot be identified to the species level (Beug 2004).

In contrast to the Roman period, the finds of *Mespilus* are quite frequent in the following centuries. The popularity of medlar in the centuries following antiquity is verifiable by written sources and many medieval and modern finds of *M. germanica* seeds. Just a few examples of finds from the 7th century onwards give an impression that *Mespilus* was a favourite fruit plant in these times (De Hingh and Bakels 1996; Brombacher 1999; Rippmann and Neumeister-Taroni 2000, pp. 179, 181; Dickson 1994; Kučan 1998, p. 251; Brinkkemper and Vermeeren 1998; Karg 2008; Knörzner and Gerlach 1999b; Troubleyn et al. 2009). In addition to written sources, images on paintings or textiles may indicate the use of *Mespilus* fruit or plants, thus *Mespilus* is shown on a tapestry of the 16th century A.D. (Baird and Thieret 1989, p. 350).

Interestingly, from a regional perspective, fruit stones of *Mespilus* were found in a cesspit in Stein am Rhein, a small town about 1.5 km to the west of the Roman *vicus* of Tasgetium dating to about A.D. 1300 (Fig. 2; Brombacher and Klee 2006, p. 159). The question is whether there was a continuity of *Mespilus* cultivation in the mild climate of Lake Constance and the Rhine valley from Roman to medieval and early modern times. This is of special interest because even today the region of Lake Constance is well known for its fruit cultivation, especially for apples (Hammerl et al. 2005, p. 30; [www.fructus.ch](http://www.fructus.ch)). The hypothesis of this tradition going back

to Roman times needs to be verified by further archaeobotanical work and a survey of the recent distribution of *Mespilus* in the region of Lake Constance.

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## References

- André J (1998) Essen und Trinken im alten Rom. Reclam, Stuttgart
- Baas J (1982) Kultur- und Nutzpflanzen aus römischen Siedlungsgruben in Nidderau-Heldenbergen (Mainz-Kinzig-Kreis). Saalbg Jahrb 38:110–119
- Baird JR, Thieret JW (1989) The medlar (*Mespilus germanica*, Rosaceae) from antiquity to obscurity. Econ Bot 43:328–372
- Beug H-J (2004) Leitfaden der Pollenbestimmung für Mitteleuropa und angrenzende Gebiete. Pfeil, München
- Bouby L (2010) Agriculture dans le bassin du Rhône, du Bronze final à l'Antiquité. Agrobiodiversité, économie, cultures. EHESS, Dissertation, University of Toulouse le Mirail
- Brem H (1997) Leben mit der Grenze: die römische Zeit im Thurgau. Archäol Schweiz 20:80–83
- Brem H, Steiner D, Kesselring R (1999) Neues aus Tasgetium. Archäol Schweiz 22:123–134
- Brinkkemper O, Vermeeren C (1998) Mediterrane rijst en oosterse kruidnagels. Botanisch onderzoek van twee beermonsters. [Mediterranean rice and oriental cloves. Archaeobotanical research of two cespit samples]. In: Barwasser M, Smit M (eds) Acht eeuwen tussen twee stegen. Archeologisch, historisch en bouwhistorisch onderzoek in Kampen. Stichting Archeologie IJssel/Vechtstreek, Kampen, pp 145–153
- Brombacher C (1999) Die Pflanzenfunde aus den Latrinen. In: Bünteli K, Gamper R, Lehmann P (eds) Das Kloster Allerheiligen in Schaffhausen. Zum 950. Jahr seiner Gründung am 22. November 1049. (Schaffhauser Archäologie 4) Baudepartement des Kantons Schaffhausen. Kantonsarchäologie, Schaffhausen, pp 221–228
- Brombacher C, Klee M (2006) Archäobotanische Reste. In: Bünteli K (ed) Das Bürgerasyl in Stein am Rhein—Geschichte eines mittelalterlichen Spitals. (Schaffhauser Archäologie 7) Baudepartement des Kantons Schaffhausen. Kantonsarchäologie, Schaffhausen, pp 151–161
- Cappers R, Bekker RM, Jans JEA (2006) Digitale Zadenatlas van Nederland (Digital seed atlas of the Netherlands), (Groningen Archaeological Studies 4) Barkhuis Publishing & Groningen University Library, Groningen
- De Hingh AE, Bakels CC (1996) Palaeobotanical evidence for social difference? The example of the early medieval domain of Serris-Les Ruelles, France. Veget Hist Archaeobot 5:117–120
- Dickson C (1994) Macroscopic fossils of garden plants from British Roman and Medieval deposits. In: Moe D, Dickson JH, Jorgensen PM (eds) Garden history: Garden plants, species, forms and varieties from Pompeii to 1800. Symposium held at the European University Centre for Cultural Heritage, Ravello, June 1991, vol. PACT 42:47–72
- Durand A (1991) Paysages, terroirs et peuplement dans les campagnes du Bas-Languedoc (Xe–XIIe siècle). Université de Paris I Panthéon-Sorbonne, Paris
- Feigenwinter F (1997) Die Pflanzenfunde aus der Latrine. In: Jauch V (ed) Eschenz—Tasgetium. Römische Abwasserkanäle und Latrinen. (Archäologie im Thurgau 5) Amt für Archäologie des Kantons Thurgau, Frauenfeld, pp 21–28
- Grant M (2000) Galen on food and diet. Routledge, London
- Hammerl M, Jacoby H, Naumann S, Paas D, Trötschler P (2005) Pro UNESCO-Kulturlandschaft Bodensee, Ein gemeinsames Impulspapier. Bodensee-Stiftung & Umweltrat Bodensee, Radolfzell
- Hellmund M (2007) Pflanzenfunde aus der “Luthergrube”. In: Meller H, Schlenker B (eds) Luther in Mansfeld—Forschungen am Elternhaus des Reformators. (Archäologie in Sachsen-Anhalt 6, Sonderband) Landesamt für Denkmalpflege und Archäologie Sachsen-Anhalt, Halle, pp 189–202
- Hosch S, Zibulski P (2003) The influence of inconsistent wet-sieving procedures on the macroremains concentration in waterlogged sediments. J Archaeol Sci 30:849–857
- Jacomot S, Petrucci-Bavaud M, Kühn M (2006) Samen und Früchte. In: Schucany C (ed) Die römische Villa von Biberist-Spitalhof/SO (Grabungen 1982, 1983, 1986–1989). (Untersuchungen im Wirtschaftsteil und Überlegungen zum Umland, Ausgrabungen und Forschungen 4) BAG Verlag, Solothurn, pp 579–624/877–916
- Jauch V (1997) Eschenz—Tasgetium. Römische Abwasserkanäle und Latrinen. (Archäologie im Thurgau 5) Amt für Archäologie des Kantons Thurgau, Frauenfeld
- Karg S (2008) Diversität der Nutzpflanzen im Mittelalter Nordeuropas. Archäologische Informationen 31:97–102
- Knörzer K-H (1987) Geschichte der synanthropen Vegetation von Köln. Kölner Jahrb für Vor- und Frühgesch 20:271–388
- Knörzer K-H, Gerlach R (1999a) Der Wandel der Landwirtschaft unter dem Einfluss Roms. In: Knörzer K-H, Gerlach R, Meurers-Balke J et al (eds) PflanzenSpuren. Archäobotanik im Rheinland: Agrarlandschaft und Nutzpflanzen im Wandel der Zeiten. (Materialien zur Bodendenkmalpflege im Rheinland 10) Rheinland Verlag, Köln, pp 93–103
- Knörzer K-H, Gerlach R (1999b) Die Blüte der mittelalterlichen Landwirtschaft. In: Knörzer K-H, Gerlach R, Meurers-Balke J, Kalis AJ, Tegtmeier U, Becker WD, Jürgens A (eds) PflanzenSpuren. Archäobotanik im Rheinland: Agrarlandschaft und Nutzpflanzen im Wandel der Zeiten. (Materialien zur Bodendenkmalpflege im Rheinland 10) Rheinland Verlag, Köln, pp 109–118
- Kreuz A (1995) Landwirtschaft und ihre ökologischen Grundlagen in den Jahrhunderten um Christi Geburt: zum Stand der naturwissenschaftlichen Untersuchungen in Hessen. Berichte der Kommission für Archäologische Landesforschung in Hessen 3(1994/1995):59–91
- Kučan D (1998) Zur Ernährungsgeschichte des Spätmittelalters und der frühen Neuzeit in Oldenburg anhand der botanischen Untersuchungen der Altstadtgrabungen. Probleme der Küstenforschung im südlichen Nordseegebiet 25:243–279
- Lauber K, Wagner G (2001) Flora Helvetica, 3rd edn. Haupt, Bern
- Lundström-Baudais K (1991) Les macrorestes végétaux de deux puits des IIe–IIIe siècle à Annecy-le-Vieux, Les Ilettes. In: Vivian R (ed) Paléoenvironnement Holocène et Archéologie dans les Alpes du Nord et leur piémont. Comité des Travaux Historiques et Scientifiques, Paris, pp 109–113
- Magerstedt AF (1861) Die Mispel. In: Magerstedt AF (ed) Bilder aus der römischen Landwirtschaft. Für Archäologen und wissenschaftlich gebildete Landwirte nach den Quellen bearbeitet, vol 4. Die Obstbaumzucht der Römer. Saendig Reprint Verlag, Hans R. Wohlwend, Vaduz (Reprint von: Sonderhausen 1861), pp 160–161
- Maier R (ed) (1991) Das römische Kochbuch des Apicius—vollständige zweisprachige Ausgabe. Reclam, Stuttgart
- Marinval P (1993) Etude carpologique d'offrandes alimentaires végétales dans les sépultures gallo-romaines: réflexions préliminaires. In: Monde des morts, monde des vivants en Gaule rurale.

- Actes du Colloque ARCHAEA/AGER (Orléans, 7–9. févr. 1992). Orléans, pp 45–65
- Marinval P (1999) Les fruits et leurs usages au travers des restes archéologiques: en France, de la Préhistoire à l'Antiquité. In: Chauvet M (ed) Le patrimoine fruitier. Hier, aujourd'hui, demain. Actes de colloque de La Ferté Bernard (Sarthe), 16–17 octobre 1998. AFCEV, Paris, pp 53–64
- Marinval P (2004) Offrandes alimentaires d'origine végétale en contexte funéraire gallo-romain. In: Baray L (ed) Archéologie des pratiques funéraires. Approches critiques. (Collection Bibracte 9) Centre archéologique européen, Glux-en-Glenne, pp 197–206
- Pollmann B (2003) Archäobotanische Makrorestanalysen und molekulararchäologische Untersuchungen an botanischen Funden aus dem römischen *vicus* Tasgetium (Eschenz/Kanton Thurgau/CH). Universität Basel, Diplomarbeit
- Pollmann B, Jacomet S, Schlumbaum A (2005) Morphological and genetic studies of waterlogged *Prunus* species from the Roman *vicus* Tasgetium (Eschenz, Switzerland). *J Archaeol Sci* 32:1,471–1,480
- Rippmann D, Neumeister-Taroni B (eds) (2000) Gesellschaft und Ernährung um 1000. Eine Archäologie des Essens. Alimenterium, Vevey
- Ruas M-P (1990) Recherches carpologiques dans le Massif armoricain du Mésolithique au bas Moyen Age. Mémoire de DEA, EHESS, Paris
- Ruas M-P (1996) Eléments pour une histoire de la fructiculture en France: données archéobotaniques de l'antiquité au XVIIe siècle. In: Colardelle M (ed) L'homme et la nature au Moyen Age. Actes du Ve congrès international d'archéologie médiévale (Grenoble). Errance, Paris, pp 92–105
- Schibler J, Jacomet S (1996) Pflanzenreste und Tierknochen aus Latrinengruben: Fäkalienreste, Küchen- und Speiseabfälle oder Abraum? In: Historisches Museum Basel (ed) Fundgruben – Stille Örtchen ausgeschöpft. Historisches Museum Basel, Basel, pp 75–76
- Schmeil O (1996) Schmeil-Fitschen: Flora von Deutschland und angrenzender Länder. Quelle & Meyer, Wiesbaden
- Sebald O, Seybold S, Philippi G (1992) Die Farn- und Blütenpflanzen Baden-Württembergs vol 3. Ulmer, Stuttgart
- Tolar T, Jacomet S, Velušček A, Čufar K (2009) Recovery techniques for waterlogged archaeological sediments: a comparison of different treatment methods for samples from Neolithic lake shore settlements. *Veget Hist Archaeobot* 19:53–67
- Troubleyn L, Kinnaer F, Eryvnc A, Beeckmans L, Caluwé D, Cooremans B, De Buysers F, Deforce K, Desender K, Lentacker A, Moens J, Van Bulck G, Van Dijk M, Van Neer W, Wouters W (2009) Consumption patterns and living conditions inside Het Steen, the late medieval prison of Malines (Mechelen, Belgium). *J Archaeol Low Ctries* 1–2:5–47
- Verot-Bourrelly A, Argant J, Bouby L, Latour-Argant C, Martin S (2010) Evolution d'un paysage de confluences de la Protohistoire à l'époque gallo-romaine: géomorphologie et paléoenvironnement du site Parc Saint-Georges à Lyon (69-France). *Quaternaire* 21:413–423
- Willerding U (1996) Zur Agrarproduktion von der jüngeren vorrömischen Eisenzeit bis ins frühe Mittelalter. *Historicum, Linz-Puchenu, pp* 10–20
- Zech-Matterne V (2010) Le développement de la fructiculture en Gaule du Nord, à l'époque romaine. In: Ouzoulias P, Tranoy L (eds) Comment les Gaules devinrent romaines, Actes du colloque international, September 2007. La Découverte, Paris, pp 255–266