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CHAPTER 7: PLANT ECONOMY AND ENVIRONMENT

INTRODUCTION: CURRENT STATUS, AIMS OF RESEARCH

Up to now archaeobotanical research has been conducted on various Roman settlements in the Alsace / F and the North of Switzerland. Only few of these settlements have been the subject of a large systematic sampling and analysing program. Among the well-studied sites are the Roman vici of Oberwinterthur[1] and Eschenz[2], the pre-legionary and legionary camp phases in Vindonissa[3], the colonia in Augst[4] and the Roman villa in Biberist[5]. And so the current status of Roman archaeobotany in the area is more than average[6]. Yet the representation of plant macro remains is strongly dependent on the conditions of preservation. The majority of investigated sites are located in dry deposits[7], where plant macro remains can only preserve through charring or mineralisation[8]. Only few archaeological sites are situated under the current water table[9]. The latter enables the preservation of not carbonised (plus / minus unaltered) vegetative material through waterlogging of the soil. This often results in the recovery of an abundance of organic remains. Given that the majority of archaeological structures in the Roman civil settlement of Oedenburg / Biesheim-

1 C. Jacquat, Römerzeitliche Pflanzenfunde aus Oberwinterthur (Kanton Zürich, Schweiz). In: J. Rychener / P. Albertin, Beiträge zum römischen VITUDURUM – Oberwintherthur 2. Ber. Zürcher Denkmalpflege, Monogr. 2 (Zürich 1986) 241-264. – M. Kühn pers. comm.

2 F. Feigenwinter, Die Pflanzenfunde aus der Latrine. In: V. Jauch (ed.), Eschenz – Tasgetium. Römische Abwasserkanäle und Latrinen. Arch. Thurgau 5, 1997, 21-28. – B. Pollmann, Archäobotanische Makrorestanalysen und molekulararchäologische Untersu-chungen an botanischen Funden aus dem römischen vicus Tasgetium (Eschenz, Kanton Thurgau / CH) [Master Thesis, University of Basel].

3 S. Jacomet, Und zum Dessert Granatapfel – Ergebnisse der archäobotanischen Untersuchungen. In: A. Hagendorn / H. W. Doppler / A. Huber / H. Hüster Plogmann / S. Jacomet / C. Meyer-Freuler / B. Pfäffli / J. Schibler, Zur Frühzeit von Vindonissa. Auswertung der Holzbauten der Grabung Windsich-Breite 1996-1998, 1. Veröff. Ges. Pro Vindonissa XVIII (Brugg 2003) 173 ff.

4 M. Dick, Verkohlte Samen und Früchte aus zwei holzkohlereichen Schichten von Augst (Augusta Rauricorum; Forum und Insula 23). Jahresber. Augst u. Kaiseraugst 10, 1998, 347-350. – S. Jacomet / M. Bavaud, Verkohlte Pflanzenreste aus dem Bereich des Grabmonumentes (Rundbau) beim Osttor von Augusta Raurica: Ergebnisse der Nachgrabungen von 1991. Jahresber. Augst u. Kaiseraugst 13, 1992, 103-111. – M. Petrucci-Bavaud, Pflanzliche Speisebeigaben in den Brandgräbern. In: C. Haeffelé (ed.), Die römischen Gräber an der Rheinstrasse 46 des Nordwestgräberfeldes von Augusta Raurica, Jahresber. Augst u. Kaiseraugst 18, 1996, 253-259. – M. Petrucci-Bavaud, Archäobotanische Untersuchungen im Bereich der Herdstelle im Raum B6 und von Gruben in Raum B11. In: H. Sütterlin (ed.), Kastelen 2. Die älteren Steinbauten in den Insulae 1 und 2 von Augusta Raurica. Forsch. Augst 22 (Augst 1999) 165-184. – M. Petrucci-Bavaud, Archäobotanische Untersuchungen von ausgewählten Befunden in der Insula 1. In: Sütterlin 1999 (op. cit.). – S. Jacomet, Ein römerzeitlicher verkohlter Getreidevorrat aus dem 3. Jahrhundert n. Chr. von Augusta Raurica (Kaiseraugst AG, Grabung »Adler«, 1990.05). Jahresber. Augst u. Kaiseraugst 21, 2000, 225-230. – S. Jacomet / M. Petrucci-Bavaud, Archäobotanische Untersuchung der Kulturschichten der Holzbauperiode. In: P.-A. Schwarz (ed.), Die prähistorischen Siedlungsreste und die frühkaiserzeitlichen Holzbauten auf dem Kastelenplateau. Die Ergebnisse der Grabungen 1991-1995.51 sowie 1979-1980.55 und 1980.53 im Areal der Insulae 1, 2, 5 und 6 von Augusta Raurica. Forsch. Augst 21 (Augst 2004) 241-299.

5 S. Jacomet / M. Petrucci-Bavaud / M. Kühn, Samen und Früchte. In: C. Schucany (ed.), Die römische Villa von Biberist-Spitalhof/SO (Grabungen 1982, 1983, 1986-1989). Untersuchungen im Wirtschaftsteil und Überlegungen zum Umland. Ausgr. u. Forsch. 4 (Remshalden 2006) 579-624 / 877-916 (Tabellen).

6 See S. Jacomet / C. Brombacher, Geschichte der Flora in der Regio Basiliensis seit 7500 Jahren: Ergebnisse von Untersuchungen pflanzlicher Makroreste aus archäologischen Ausgrabungen. Mitt. Naturforsch. Ges. beider Basel 11, 2009, 27-106 and the literature cited.

7 Desiccation of plant remains is not possible in our climate, for an overview of conditions of preservation we refer to S. Jacomet / A. Kreuz, Archäobotanik. Aufgaben, Methoden und Ergebnisse vegetations- und agrargeschichtlicher Forschungen (Stuttgart 1999) 57 ff.

8 Conditions of preservation are discussed below.

9 e. g. the Roman vici in Eschenz and Oberwinterthur, or – on other sites – deposits in wells.

Kunheim (Alsace, Dép. Haut-Rhin 68, France) are located under the current water table and that more than 300 samples from 87 structures are studied, its investigation is an extremely important contribution to the Roman archaeobotanical research for the provinces north of the Alps[10].
The main objectives of our investigation are 1) to determine the plant spectrum available to the inhabitants of Roman Oedenburg; 2) to contribute to the interpretation of the archaeological structures through the botanical composition of the samples. Based on the plant spectrum we aimed to reconstruct the natural environment of the settlement[11], to detect chronological and/or spatial trends across the settlement as well as to highlight aspects of agriculture, trade and other cultural activities.

MATERIAL AND METHODS

Origin and date of the samples

The archaeobotanical investigation includes the analyses of the Roman-period structures in the civil settlement excavated between 1999 and 2005. The studied samples originate from the three main areas of excavation. They will be referred to as follows (**fig. 7.1**):
– »Civil East« (**tab. 1a**).
– »Temple complex« (**tab. 1b**).
– »Surroundings of the temple complex« (**tab. 1c**).

– »Civil east« (**fig. 7.1**): refers to the excavated area of field BK 04. In this area two successive phases are distinguished. Phase 1 is dated from the second decennium AD to the end of the 1st cent. AD. This phase is contemporary with and linked to the military occupation. The archaeology is characterised by various pits located in a humid area in between natural palaeochannels; no evidence of living quarters has been found within this area of excavation. Phase II is connected to a reorganisation of the area. It is »marked« by the construction of a new road track. This new road was lined with large public buildings and living quarters. The latter are connected to the activities of river crossing and the receiving of travellers. Phase II ends around the beginning of the 3rd cent. AD.
– »Temple complex« (**fig. 7.1**): this refers to the complex of cultic buildings where different types of offerings were deposited; this area of excavation is situated southeast of Altkirch in a marshy area which is bordered by a small stream, the Riedgraben, to the west. The complex, excavated by the team of the University of Basel, starts chronologically at the beginning of the 1st decennium AD and develops steadily; numerous offerings and architectural repairs are established, until the mid-3rd cent. AD (for details, see Chapter 2, particularly **fig. 2.22; 2.46; 2.65; 2.89; 2.117**).
– »Surroundings of the temple complex« (**fig. 7.1**): this refers to the area to the north of the Temple complex. At the beginning of its occupation, between 10 and 60 AD and contemporary with the military occupation of the camps, the area is marked by civilian facilities: including the establishment of wharves

[10] Funding was obtained from the EUCOR Learning and Teaching Mobility (ELTEM) project of the University of Basel. An additional grant was obtained from the Freiwillige Akademische Gesellschaft, Basel (Switzerland).

[11] The reconstruction of the natural environment was dealt with in L. Wick / A. Schlumbaum, Die natürliche Vegetation. In: M. Reddé (ed.), Oedenburg I. Les camps militaires julio-claudiens. Monographien RGZM 79, 1 (Mainz 2009) 37-43.

along the Riedgraben, of roads, and of living quarters. In a second phase, no later than the beginning of the 2nd cent. AD, a profane extension of the sanctuary is installed for the use of pilgrims: this includes baths, basins and wells. At least one temple (F) was built outside the precincts of the Temple complex. The area appears to be abandoned during the course of the 4th cent. AD.

Besides the three main fields of excavation discussed in this chapter, samples from two other locations within the civil settlement are included. For our main analysis, we have allocated these samples to one of the other areas of excavation as the number of studied samples in these two locations is too low for spatial comparison. The first two samples originate from a well in the area BK 02-05-02 »Civil South« (**fig. 7.1**). This part of the civil settlement was excavated in 2002[12] and lies immediately to the south of »Civil East«. It concerns an area of artisan activity. Due to safety hazards and time restrictions the well is not excavated entirely and therefore its contextual evidence is not clear. Dendrochronological study dates it to the 1st cent. AD. The results of this pit are integrated in the analysis of the area Civil East (**tab. 1a**).

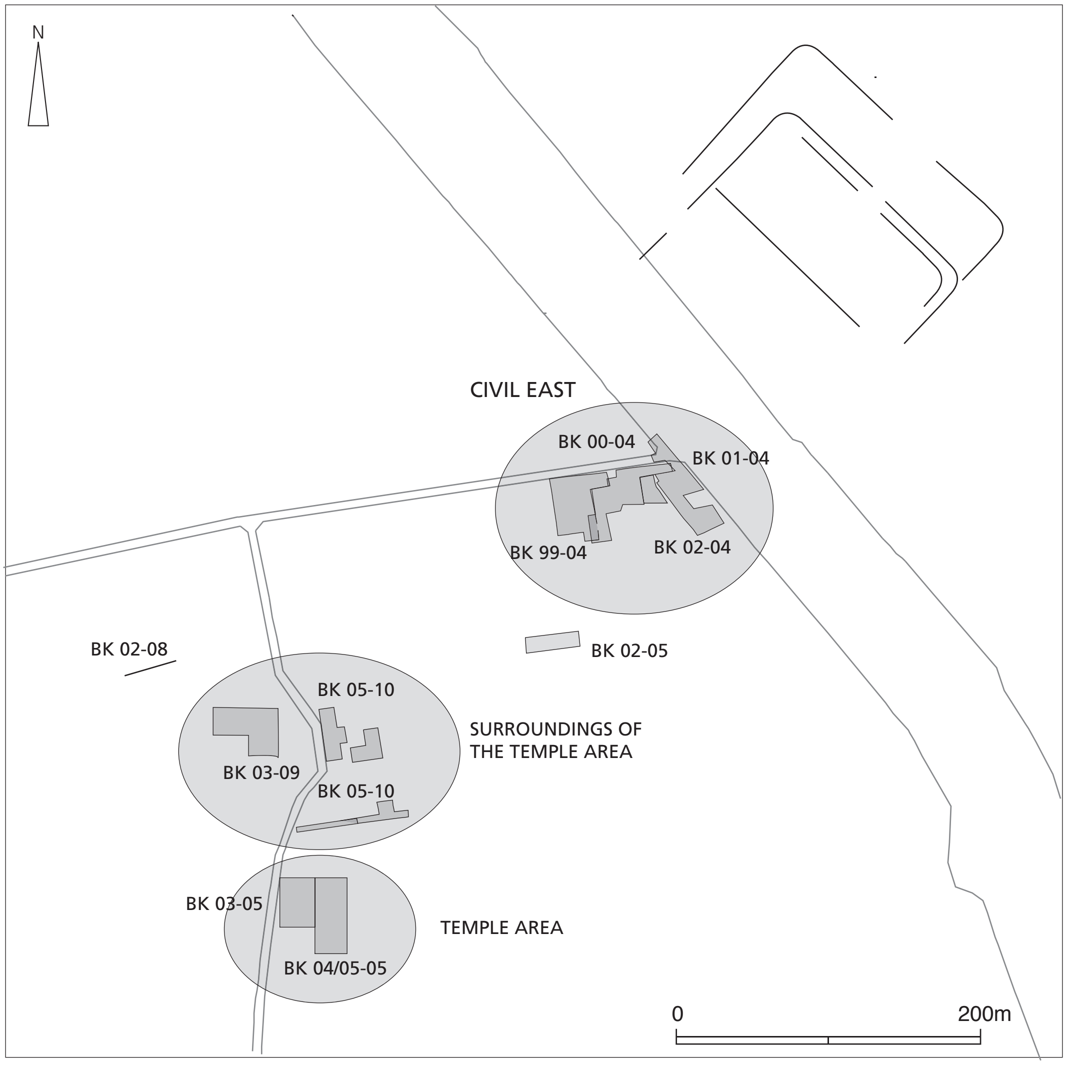

Fig. 7.1 Map of the Roman settlement indicating the fields of excavation (after M. Reddé et al. 2005 [footnote 39] fig. 8).

[12] Excavations in the area Civil South were directed by C. Schucany and P.-A. Schwarz (Universität Basel).

Civil East		Structure	Preservation	Samples studied	Volume (ml)
1st cent. AD (Horizon 1)	Pit	BK 99-04-01	W	9	47000
		BK 99-04-86	W	3	19000
		BK 00/01-04-24	W	34	232000
		BK 01-04-02	W	2	8000
		BK 01-04-08	W	1	7000
		BK 01-04-14	W	1	5500
		BK 01-04-15	W	1	13000
		BK 01-04-25	W	4	58000
		BK 01-04-27	W	7	41000
		BK 01-04-33	W	1	16000
		BK 01-04-73	W	4	33000
	Total pits 1st cent. AD (N)	11		67	479500
	Layer	BK 01-04-50	W	14	83500
		BK 01-04-71	W	2	7000
		BK 01-04-72	W	4	33000
		BK 02-04-55	W	10	97000
		BK 02-04-64	W	2	22000
		BK 02-04-65	W	1	6000
		BK 02-04-67	W	2	14000
		BK 02-04-78	W	3	26000
	Total layers 1st cent. AD (N)	8		38	288500
Total 1st cent. AD		19		107	784500
2nd cent. AD (Horizon 2)	Pit	BK 01-04-38	W	21	150000
		BK 02-04-15	W	6	30000
		BK 02-04-18	W	3	11000
		BK 02-04-42	W	3	8000
		BK 00-04-53	W	1	8000
	Total pits 2nd cent. AD (N)	5		34	207000
Total 2nd cent. AD		5		34	207000
Roman	Pit	BK 02-04-40	W	3	17000
	Trench	BK 02-04-1004	W	1	14000
Total Roman		2		6	44000
Total structures Civil East		26		143	1035500
Total structures Civil South		BK 02-05-140	W	2	16500
Total		27		145	1052000

Table 1a Overview of the studied structures in the area Civil East (BK 04).

Temple complex		Structure	Preservation	Samples studied	Volume (ml)
3/4 to 75/80 AD (Phase 1)	Layer	BK 03-05-53	W	8	49000
		BK 03-05-56	W	6	32000
		BK 04-05-32	W	3	9000
		BK 04-05-17	D	5	36000
		BK 04-05-19	D	3	22000
	Total layers 1st cent. AD (N)	5		25	148000
	Ditch	BK 04/05-05-49	W	12	65000
	Vessel	BK 05-05-180	D	1	7000
	Posthole	BK 04-05-138	W	1	6000
		BK 04-05-139	W	1	4000
	Total postholes 1st cent. AD (N)	2		2	10000
Total 3/4 to 75/80 AD (Phase 1)		9		40	230000
2nd cent. AD (Phases 2-4)	Pit	BK 05-05-160/219	D	9	140000
	Layer	BK 04-05-17	D	2	12000
		BK 04-05-19	D	1	6000
		BK 03-05-38	W	1	8000
		BK 03-05-39	W	1	5000
		BK 03-05-75	W	2	6000
		BK 04-05-02	W	1	5000
		BK 04-05-50	D	8	319000
		BK 05-05-211	D	1	9800
	Total layers 2nd cent. AD (N)	8		17	370800
	Ditch	BK 04-05-137	D	1	6000
	Vessel	BK 05-05-180	D	1	6000
	Posthole	BK 03-05-65	W	1	5500
		BK 04-05-63	D	1	6000
		BK 04-05-80	D	1	6000
		BK 04-05-83	D	1	4000
		BK 04-05-84	D	1	5000
		BK 04-05-86	D	1	8000
		BK 04-05-88	D	1	1000
		BK 04-05-123	D	1	9000
		BK 04-05-135	D	1	8000
		BK 04-05-106	D	4	16200
		BK 05-05-174	D	1	12000
	Total Postholes 2nd cent. AD (N)	11		14	80700
Total 2nd cent. AD (Phases 2-4)		22		42	603500
2nd-4th cent. AD	Ditch	BK 03-05-16	W	15	124500
Roman	Ditch	BK 04-05-12	D	1	6000
		BK 04-05-92	D	1	4000
	Total ditches Roman (N)	2		2	10000
	Layer	BK 04-05-66	D	1	4000
		BK 04-05-70	D	1	4000
	Total layers Roman (N)	2		2	8000
Total Roman		4		4	18000
Total		36		101	976000

Table 1b Overview of the studied structures in the Temple complex (BK 05).

Surroundings of the temple complex		Structure	Preservation	Samples studied	Volume (ml)
1st cent. AD	Pit	BK 03-09-29	W	1	8000
		BK 03-09-193	W	1	6000
		BK 03-09-194	W	2	12000
	Total pits 1st cent. AD (N)	3		4	26000
	Layer	BK 05-10-168	W	1	10000
		BK 03-09-212	W	1	5000
		BK 05-10-310	W	1	8000
		BK 03-09-163	W	1	20500
		BK 03-09-166	W	3	27000
	Total layers 1st cent. AD (N)	5		7	70500
Total 1st cent. AD		8		11	96500
Roman	Pit	BK 03-09-89	W	1	22500
		BK 03-09-90	W	1	4500
		BK 03-09-129	W	1	5000
		BK 05-10-161	W	1	30000
	Total pits Roman (N)	4		4	62000
	Layer	BK 03-09-67	W	1	3000
		BK 03-09-74	W	6	35000
		BK 03-09-151	W	5	32000
		BK 03-09-215	W	1	?
		BK 03-09-Son26	W	15	88000
		BK 05-10-149	W	2	40000
		BK 05-10-308	W	1	12000
	Total layers Roman (N)	7		31	210000
	Basin	BK 05-10-son19	W	13	65800
	Pot content	BK 05-10-400	W	1	14000
	Trench	BK 03-09-Son2	W	1	5000
		BK 03-09-Son5	W	1	19000
	Total Trenches Roman (N)	2		2	24000
Total Roman		15		51	375800
Total Surroundings of the temple complex		23		62	472300
Total structures BK 08		BK 02-08	W	2	13000
Total		24		64	485300

Table 1c Overview of the studied structures in the Surroundings of the temple complex (BK 09 and BK 10).

The second pair of samples originate from a machine trench (BK 08) dug for palaeohydrological investigations (**fig. 7.1**)[13]. Two samples are taken from a deposit dated to the Roman period. The results of these samples are integrated in the analysis of the Surroundings of the temple area (**tab. 1c**).

Tables 1a, 1b and **1c** give an overview of the analysed structures for each area of excavation. These tables include date, type of context, preservation, the number of analysed samples and the volume of processed sediment for each structure separately. In total 310 samples taken in 87 structures are included in the

[13] Excavations in Trench BK 08 were conducted by C. Fortuné.

present study. This coincides with 2513.3 litres of processed soil. In practice, many more soil samples have been taken, processed and partially analysed (more than 700). They involve among others samples taken within the military camp[14]. The majority of studied samples are recovered from waterlogged deposits, except for 49 samples from 24 structures taken in dry deposits in the temple complex.

As listed in **Tables 1a, 1b** and **1c**, a structure is defined through a certain »code«. The different numbers within this code refer to the field of excavation, the year of excavation and the number of the structure. For example BK 01-04-24 represents structure 24 in field 04 dug in the year 2001. In the following we use the word »structure« for a very wide range of contexts ranging from pits, postholes, layers to ditches.

Chronological framework

For the main analysis of our data, we constructed a chronological framework. This framework consists of structures belonging to the 1st cent. AD; those belonging to the 2nd cent. AD; and those which could not be dated more precisely than to the Roman period. It is likely that the majority of structures classified as »Roman« belong to the 1st and 2nd cent. AD, it can not be excluded however that they date to the 3rd cent. AD. In the areas Civil East and Surroundings of the temple complex, these time horizons (1st and 2nd cent. AD) are also used by the archaeologists. In the temple complex however, the five chronological phases distinguished by the archaeologists do not correspond entirely with our framework. In order to facilitate intra-site comparison, we therefore grouped those structures from the temple complex belonging to phase 1 with those of the 1st cent. AD; the structures belonging to phases 2 to 4 are classified with those dated to the 2nd cent. AD. As the end of phase 1 (from 3/4 AD to 75/80 AD) coincides with the abandonment of the military camp, this division seemed appropriate for comparison between the different areas of excavation. **Figure 7.2** shows the number of samples studied in each area of excavation for the different time horizons.

Methods of analysis

The majority of samples were processed in the field laboratory operated in Biesheim/F, in the near vicinity of the site[15]. Additional sieving was carried out in the laboratory of the IPAS (Institute of Prehistory and Archaeological Science) of the University of Basel. All archaeobiological samples have been processed using »semi-flotation« as described by Hosch and Zibulski[16] or »wash-over« previously described by Kenward and Hall[17] in order to separate the organic from the inorganic material. Sieves of mesh sizes 4 mm, 1 mm and 0.35 mm were used, as these have proven most appropriate for collecting the majority of organic material. In the field laboratory the inorganic fractions were sorted. The study of the organic material was carried out both in the field laboratory and in the laboratory of the IPAS in Basel/CH.

14 For details on the archaeobotanical results of the military camp see P. Vandorpe / S. Jacomet, Pflanzliche Ernährung. In: Reddé 2009 (footnote 11) 365-368.

15 The processing of samples in the field laboratory was undertaken by Fr. Ginella, Br. Andres, C. Heitz, C. Malnasi, A. Springer, J. Kissling, W. Muñoz and P. Koch.

16 S. Hosch / P. Zibulski, The influence of inconsistent wet-sieving procedures on the macroremains concentration in waterlogged sediments. Journal Arch. Scien. 30, 2003, 849-857.

17 H. K. Kenward / A. R. Hall / A. K. C. Jones, A tested set of techniques for the extraction of plant and animal macrofossils from waterlogged archaeological deposits. Scien. and Arch. 22, 1980, 3-15.

	Year	N° of samples analysed			Method	Org. fraction considered (in mm)	Quantification	Done by
		Civil East	Temple complex	Surroundings of Temple complex				
FIELD SEASON	1999	4			rapid screening	4, 1	semi-quantified	S. Jacomet / M. Klee
	2000	14			full analysis	4, 1	fully quantified	S. Jacomet / M. Klee
		3			rapid screening	4, 1	semi-quantified	S. Jacomet / M. Klee
	2001	33			rapid screening	4, 1, 0.35	semi-quantified	S. Jacomet
	2002	32			full analysis	4, 1	fully quantified	P. Vandorpe / S. Jacomet
	2003		34	38	rapid screening	4, 1	semi-quantified	P. Vandorpe
	2004		50		rapid screening	4, 1	semi-quantified	P. Vandorpe
	2005		21	21	rapid screening	4, 1	semi-quantified	P. Vandorpe
Total		86	105	59				
ADDITIONAL ANALYSIS		4			full analysis	4, 1	fully quantified	practical course for students
		12	16	1	full analysis	4, 1, 0.35	fully quantified	P. Vandorpe
		65		4	rapid screening	4, 1	semi-quantified	P. Vandorpe
Total		81	16	5				
Total samples analysed			352*					

* This number of samples differs from the total of analysed samples included in this text while some samples have been analysed twice (rapid screening and full analysis), in addition those samples that did not yield plant macrofossils are not mentioned in the current text.

Table 7.2 Overview of archaeobotanical analysis.

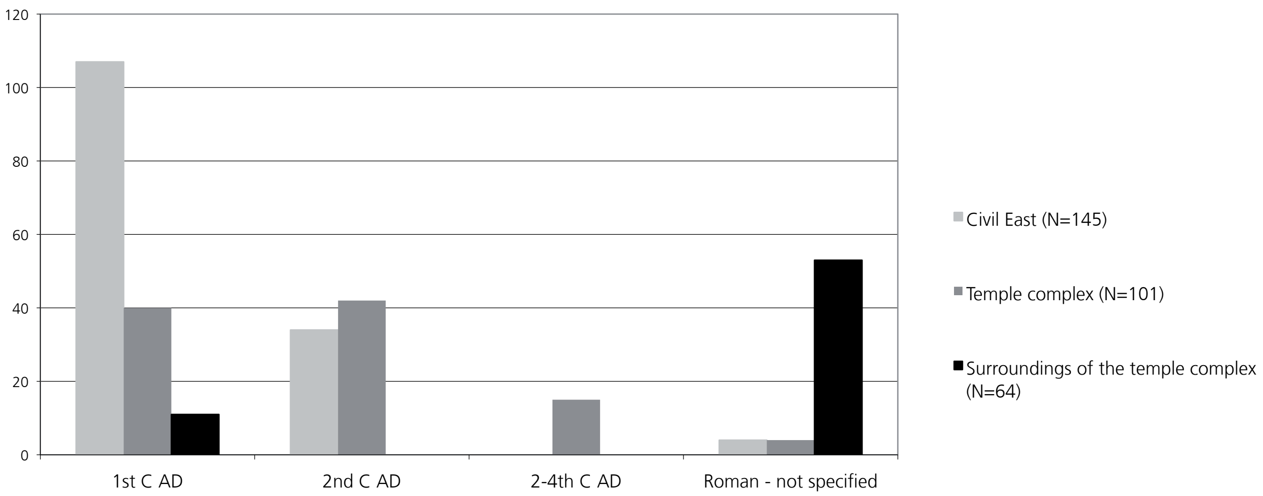

Fig. 7.2 Number of samples studied in each area of excavation for the different time horizons.

Table 2 gives an overview of the archaeobotanical analyses. The majority of the analyses have been undertaken during and as part of the fieldwork[18]. Additionally, full-quantitative analyses have been fulfilled for the study of specific questions[19]. As can be inferred from **Table 2**, the majority of samples have been analysed using rapid screening of the 4 mm and 1 mm organic fraction. We opted for rapid screening as it allowed us to consider a large amount of samples within a short period of time[20]. This method of analysis consists of screening the entire 4mm organic fraction and a subsample of the 1mm organic fraction for the presence of plant macro remains[21]. The abundance of archaeological and/or ecological material (charcoal, waterlogged wood, insects, plants etc.) is estimated by eye and recorded. The presence of plant macrofossils is registered using a binocular microscope. Their abundance is semi-quantified using a five-point-scale (1 = present, 2 = 2-10 items, 3 = 11-50 items, 4 = 51-500 items, 5 = >500 items).

Plant macrofossils were identified using a binocular microscope of the type Wild M3Z with magnification ×6.5 to ×40. The identification is completed using the modern reference collection of the IPAS. In addition, several seed atlases and publications were consulted[22]. The botanical nomenclature of wild plants follows the Flora Europaea; the nomenclature of cultural plants follows Zohary and Hopf[23].

To interpret and detect similarities/differences in the plant spectrum, we decided to work with ubiquity of species within the samples. The ubiquity of each plant taxon is calculated on the basis of presence-absence data[24]. Each type of preservation is considered separately. As waterlogged plant remains can not preserve in dry deposits, the ubiquity of waterlogged plant species is calculated only taking into account samples located in waterlogged deposits. These include 261 samples. For charred and mineralised plant remains, all deposits are considered. Hence the ubiquity of species was calculated based on 310 samples.

To interpret and detect similarities/differences between archaeological deposits (discussed below), we use the semi-quantitative recording of plant species (see appendix). This data gives a better reflection of the composition of the samples.

18 The analyses have varied a great deal according to excavation season. This is largely due to the time and budget available in every season.

19 P. Vandorpe / S. Jacomet, Comparing different pre-treatment methods for strongly compacted organic sediments prior to wet-sieving: a case study on Roman waterlogged deposits. Env. Arch. 12, 2007, 207-214. – P. Vandorpe / S. Jacomet, Remains of burnt vegetable offerings in the temple area of Roman Oedenburg (Biesheim-Kunheim, Alsace , France) – first results. In: J. Wiethold (ed.), Travaux d'archéobotanique (à la mémoire de Karen Lunstrom Baudais). Bibracte (Glux-en-Glenne in press).

20 Rapid screening is a good alternative for archaeobotanical analysis, this is already stated by Hall and Kenward for medieval plant assemblages. See A. R. Hall / H. K. Kenward, Environmental evidence from the Colonia: General Accident and Rougier Street. Arch. York 14/6, 1990, 289-434. – H. K. Kenward / A. R. Hall, Biological evidence from Anglo-Scandinavian deposits at 16-22 Coppergate. Arch.York 14/7, 1995, 435-479. – H. K. Kenward / A. R. Hall, Enhancing Bioarchaeological Interpretation Using Indicator Groups: Stable Manure as a Paradigm. Journal Arch. Scien. 24, 1997, 663-673.

21 Preceding examination of the different fractions of the samples has shown that most of the plant macrofossils (seeds and fruits) are found in the 4 mm and 1 mm fraction, only occasionally new species were found in the 0.35 mm fraction.

22 W. Beijerinck, Zadenatlas der Nederlandsche Flora (Wageningen 1947) 316. – G. Berggren, Atlas of Seeds and small fruits of Northwest-European plant species (Sweden, Norway, Denmark, East Fennoscandia and Iceland) with morphological descriptions. Part 2 Cyperaceae. Swedish Natural Science Research Council (Stockholm 1969) 68. – G. Berggren, Atlas of Seeds and small fruits of Northwest-European plant species (Sweden, Norway, Denmark, East Fennoscandia and Iceland) with morphological descriptions. Part 3 Saliacaceae – Cruciferae. Swedish Natural Science Research Council (Stockholm 1981) 260. – A.-L. Anderberg, Atlas of seeds and small fruits of Northwest-European plant species with morphological descriptions. Part 4: Resedaceae – Umbelliferae. (Uddevalla 1994) 281. – K.-H. Knörzer, Römerzeitliche Pflanzenfunde aus Neuss (Berlin 1970) 162. – K.-H. Knörzer, Römerzeitliche Pflanzenfunde aus Xanten (Köln 1981) 176. – H.-P. Stika, Römerzeitliche Pflanzenreste aus Baden-Württemberg (Stuttgart 1996) 207.

23 D. Zohary / M. Hopf, Domestication of Plants in the Old World. The origin and spread of cultivated plants in West Asia, Europe and the Nile Valley (Oxford 2000) 279.

24 As the data is recorded in many different ways (i.e. fully quantified, semi-quantified and presence-absence) we had to simplify and unify the data in order to make / allow comparisons/ conclusions.

RESULTS 1: THE PLANT SPECTRUM

Preservation

In the archaeological layers of Roman Oedenburg plant macro remains are recorded in three different states of preservation, namely through waterlogging, charring and mineralisation[25]. In total 303 different plant taxa are identified. As expected in waterlogged deposits, seeds and fruits are predominantly preserved not carbonised (un-altered). Mineralised and charred plant macro remains represent only rare admixtures in the plant assemblage (see below).

Waterlogging occurs when anaerobic conditions are created by the long-time exclusion of air due to the presence of groundwater. These conditions prohibit the decay of otherwise perishable materials. Waterlogged plant remains are recovered from all structures in the civil settlement located under the present ground water table. Of the 303 plant taxa, the large majority (N=297) are found in a waterlogged state of preservation.

Charred plant remains are preserved through the slow carbonisation under reducing conditions. They are recovered from almost all structures both in dry and waterlogged deposits in the civil settlement, though in very small amounts. Of the 303 plant taxa, 58 are found charred. They include above all edible plants.

Mineralisation occurs when plant material is converted into an inorganic substance. The main components in this process are high concentrations of phosphate, calcium and changing groundwater condition. Through decay of plant material a cavity is created, the surrounding soil acts as mould, and the original material is reproduced by the mineral infillings. Green[26] argues that mineralised plant remains are mostly recovered from cess pits and garderobes, while high concentrations of phosphate are present. Mineralised plant remains are found in a large number of structures. All are located in waterlogged deposits, especially in the area Civil East. In the temple complex no mineralised plant macro remains are recorded. Of the 303 plant taxa, 57 are preserved through mineralisation. They include primarily edible plants.

The presence of mineralised plant remains in waterlogged conditions is not widespread, or to be more precise not known[27]. Kenward and Hall[28] claim that organic decay and groundwater movement are important and necessary factors in the process of mineralisation. As a consequence in pure waterlogged deposits, mineralisation does not take place. They come to this conclusion studying the Anglo-Scandinavian Coppergate (York / GB) samples as hardly any mineralised remains are found. Carruthers[29] reports the finding of two adjacent medieval faecal deposits at Jennings Yard / GB, where one deposit yields preservation through waterlogging and no mineralised remains, the other originates from dry deposits and yielded charred and mineralised remains. Kühn[30] observes similar findings in two medieval ditches in Schloss Hallwyl / CH. This illustrates anew the theory prompted by Kenward and Hall[31]. Nevertheless, in Roman Oedenburg mineralised plant remains are found in waterlogged conditions. These mineralised remains are

[25] For an extended overview of different conditions of preservation of especially Roman plant remains, we refer to Jacomet 2003 (footnote 3) 173-229 on results of Windisch-Breite. Mineralised plant remains in particular have been largely discussed.

[26] F. J. Green, Phosphatic mineralization of seeds from archaeological sites. Journal Arch. Scien. 6, 1979, 279-284.

[27] A. Kreuz, Spätlatènezeitliche verkohlte und mineralisierte Pflanzenfunde von Hanau-Mittelbuchen. Germania 76, 1998, 865-873.

[28] Kenward / Hall 1995 (footnote 20) 435 ff.

[29] W. Carruthers, Carbonised, mineralised and waterlogged plant remains. In: J. W. Hawkes / M. J. Heaton (eds.), Jennings Yard, Windsor. Wessex Arch. Report 3, 1993, 82-90.

[30] M. Kuhn pers.comm.

[31] Kenward / Hall 1995 (footnote 20) 435 ff.

characterised by an orange to black colour and a very hard configuration. Some seeds and fruits seem to have only partially been mineralised. Experiments have shown that mineralisation can rapidly take place under favourable circumstances[32]. Hence there are several possibilities for the presence of the mineralised remains: first of all, the seeds and fruits originate from secondary deposits and thus are mineralised in a different area; secondly as the water level fluctuated severely in this area and mineralisation can be very rapid, they are likely to have formed in one of the periods where the water level was rather low.

Archaeological structures preserved in waterlogged environments are very valuable. Usually a different and much smaller spectrum of plant material is recovered from sites located in dry deposits in comparison to sites located in waterlogged deposits[33]. As Carruthers[34] affirms, the preservation of waterlogged plant assemblages, as with some mineralised plant assemblages, is unaffected by human intervention. This contrasts with charred plant assemblages, which are usually a direct result of human activity and thus often biased in their composition[35]. However, the main agent in the composition of plant assemblages remains the human selection process. It is clear that most samples represent mixtures of natural deposits and human activities.

Further the conditions of preservation have a direct influence on the representation of plant species. As cited by Van der Veen[36] »the mode of preservation is an indicative factor in the occurrence of plant species as the type of plant foods is strongly correlated to the type of preservation encountered«. This implicates that certain plant taxa only preserve through charring (e.g. garlic), others only unaltered in waterlogged deposits (e.g. bottle gourd).

The plant spectrum

In total, 303 plant taxa are identified through the study of seeds and fruits[37]. The majority of which are waterlogged (292); 57 are recovered mineralised; 58 are charred. The plant species recovered include cultivated plants[38] as well as wild plants[39]. The wild plants gathered for consumption are listed together with the cultivated plants according to their use. The wild weeds are grouped according to the actualistic grouping/principle described by Ellenberg[40]. Information on habitats was taken from Hanf[41] and Oberdorfer[42].

32 W. Carruthers, Mineralised plant remains. In: A. J. Lawson (ed.), Potterne 1982-5: Animal husbandry in later prehistoric Wiltshire. Wessex Arch. Report 17, 2000, 72-84.

33 Jacomet/Kreuz 1999 (footnote 7) 57-62. – Exceptions may be burnt destruction layers see e.g. Windisch Breite HP 2 in Jacomet 2003 (footnote 3) 173ff. or Novaesium in Knörzer 1970 (footnote 22).

34 Carruthers 2000 (footnote 32) 72-84.

35 These observations do not include events as destruction by fire, and intentional burning for offering, for basics we refer to U. Willerding, Präsenz, Erhaltung und Repräsentanz von Pflanzenresten in archäologischem Fundgut. In: W. A. van Zeist / K. Wasylikowa / K.-E. Behre (eds.), Progress in Old World Palaeoethnobotany (Rotterdam 1991) 25-51 among others.

36 M. Van der Veen / A. Livarda / A. Hill, The Archaeobotany of Roman Britain: Current State and Identification of Research Priorities. Britannia 38, 2007, 181-210.

37 To calculate the total of plant taxa, the following principles were pursued: fully identified species; plant items identified to genus when no other species from that genus are found; families when no other species or genera from that family occur; cf. identifications when no fully identified specimens are present.

38 When we talk about »cultivated plants« we mean cultivars, which are plant species genetically and morphologically different of wild plants.

39 The economic or cultural and gathered plants have been the subject of a previous publication – see P. Vandorpe/S. Jacomet in M. Reddé / H. U. Nuber / S. Jacomet / J. Schibler / C. Schucany / P.-A. Schwarz / G. Seitz / F. Ginella / M. Joly / S. Plouin / H. Hüster Plogmann / C. Petit / L. Popovitch / A. Schlumbaum / P. Vandorpe / B. Viroulet / L. Wick / J.-J. Wolf / B. Gissinger / V. Ollive / J. Pellisier, Oedenburg, une agglomération d'époque romaine sur le Rhin supérieur. Gallia 62, 2005, 252-257.

40 H. Ellenberg, Vegetation ecology of Central Europe (Cambridge 1988) 731. – H. Ellenberg, Zeigerwerte der Gefässpflanzen Mitteleuropas. Scripta geobotanica 18 (Göttingen [3]1991) 7-122.

41 M. Hanf, Ackerunkräuter Europas mit ihren Keimlingen und Samen (Ludwigshafen 1982) 496.

42 E. Oberdorfer, Pflanzen-soziologische Exkursionsflora (Stuttgart 1994) 1050.

The plant spectrum is discussed by indicating the ubiquity of species within the studied samples based on presence/absence data. In **tables 3a, 3b** and **3c** the results of these calculations are summarised. For each plant species, ubiquity percentages are measured for the total number of samples, for the different areas of excavation, for the chronological phases and for the different types of contexts.
Figures 7.3, 7.4 and **7.5** visualise the ubiquity of plant groups in the studied samples according to type of preservation.

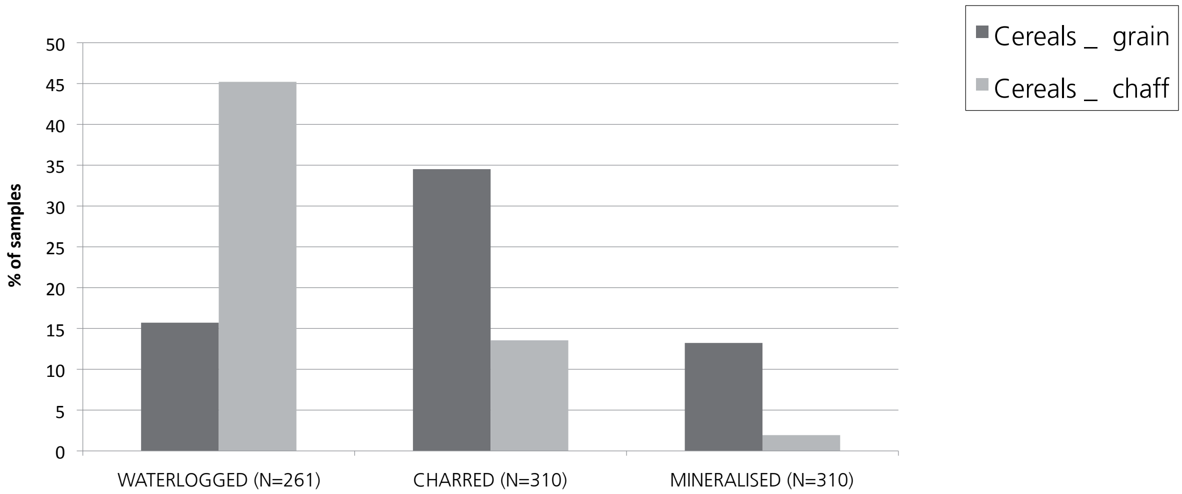

Fig. 7.3 Ubiquity of cereal grains and chaff in the studied samples according to type of preservation.

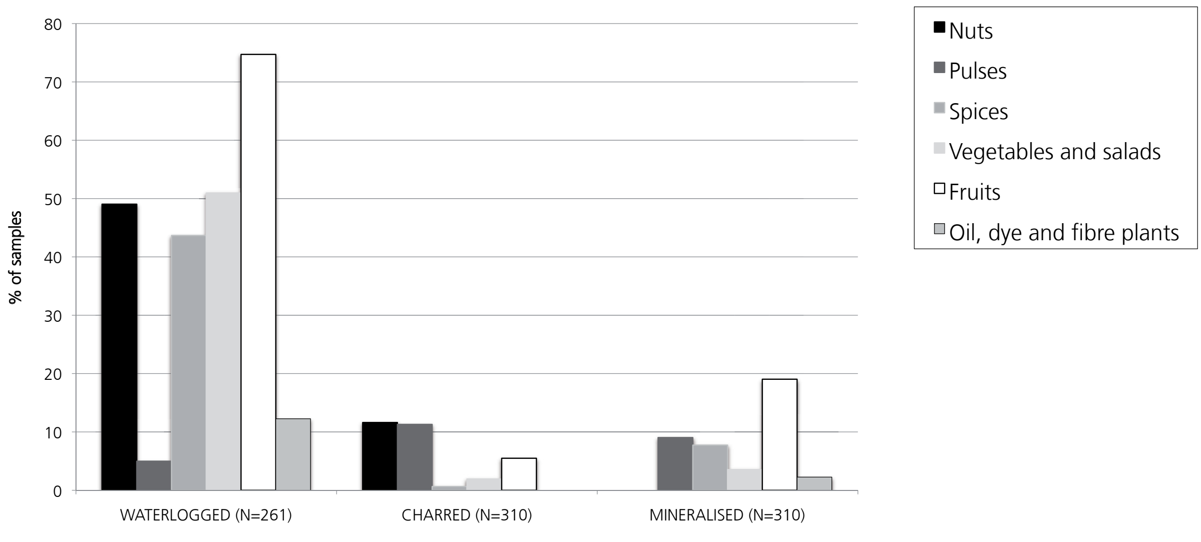

Fig. 7.4 Ubiquity of nuts, pulses, spices, vegetables and salads, fruits and oil dye and fibre plants in the studied samples according to type of preservation.

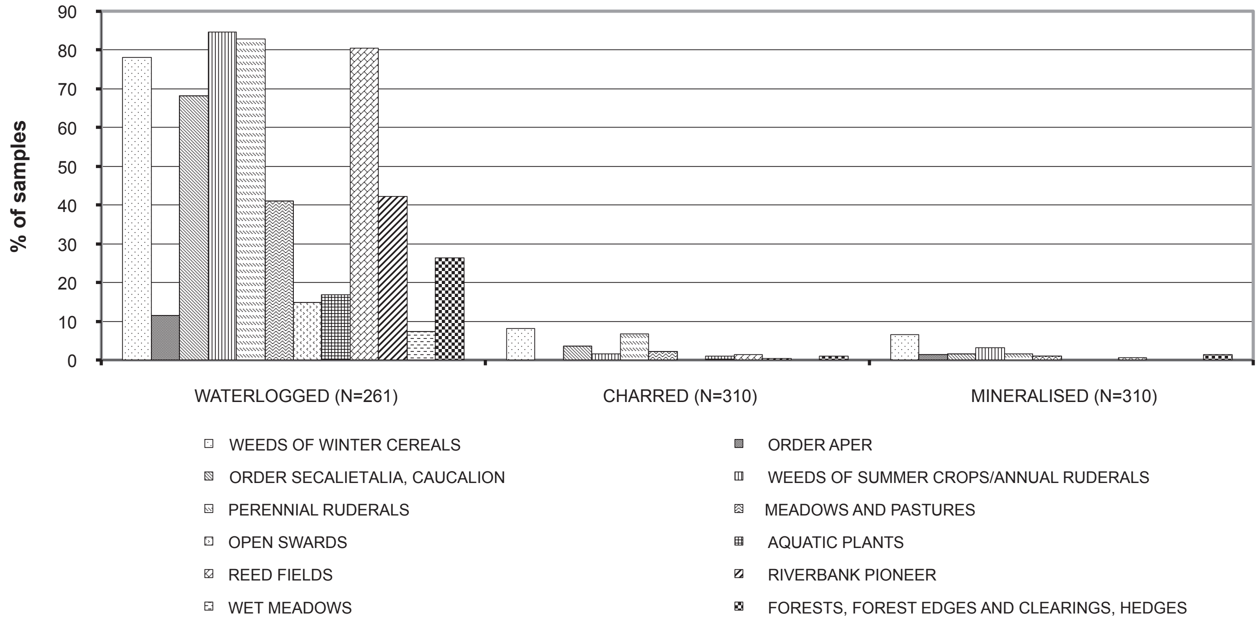

Fig. 7.5 Ubiquity of weeds groups in the samples according to type of preservation.

Cultivated and gathered plants

Nine cereal taxa are recorded, representing those cereals usually found within Roman settlements north of the Alps[43]. They include: oat (*Avena* sp.), barley (*Hordeum vulgare*), rye (*Secale cereale*), naked wheat (*Triticum aestivum/durum/turgidum*), einkorn (*Triticum monococcum*), emmer (*Triticum dicoccum*), spelt (*Triticum spelta*), broomcorn millet (*Panicum miliaceum*) and foxtail millet (*Setaria italica*). Cereals are an important part of the Roman diet. They are used to produce flower for flat bread or fermented bread and also for porridges. For each of these products, specific cereals are used and/or favoured[44].

The cereal remains are recovered in three states of preservation: waterlogged, charred and mineralised (**tab. 3a, 3b** and **3c; fig. 7.3**). The larger bulk of the cereal remains are recovered as waterlogged chaff remains (spikelet forks, glumes and rachis fragments). These are found in 45.2 % of the analysed samples. In addition waterlogged cereal testa fragments or »cereal bran« are found in large amounts[45]. As these

43 S. Jacomet / J. Schibler / C. Maise / L. Wick / S. Deschler-Erb, Mensch und Umwelt. In: L. Flutsch / U. Niffeler / F. Rossi (eds.), Römische Zeit. Die Schweiz vom Paläolithikum bis zum frühen Mittelalter 5 (Basel 2002) 21-40.

44 J. André, Essen und Trinken im alten Rom (Stuttgart 1998) 279.

45 As the identification of these bran fragments is very time-consuming, we were not able to conduct more detailed identifications than the group »cerealia«. For more detailed information on this subject we refer to C. Dickson, The identification of cereals from ancient bran fragments. Circaea 4, 1987, 95-102. – C. Dickson, Human coprolites. In: B. Bell / C. Dickson (eds.), Excavations at Warebeth (Stromness Cemetery) Broch, Orkney. Proc. Soc. Ant. Scot. 1989, 115-131. – C. Dickson, The Roman army diet in Britain and Germany. In: U. Körber-Grohne / H. Küster (eds.), Archäobotanik. Symposium der Universität Hohenheim (Stuttgart) vom 11.-16-Juli 1988 (Berlin, Stuttgart 1989) 135-154. – C. Dickson, Experimental Processing and Cooking of Emmer and Spelt Wheats and the Roman Army Diet. In: D. E. Robinson (ed.), Experimentation and Reconstruction in Environmental Archaeology (Oxford 1990) 33-39 – C. Dickson, Memoirs of a Midden Mavis. – The study of ancient diets and environments from plant remains. Glasgow Naturalist 22, 1991, 65-76.

remains are usually restricted to latrine deposits, they are recorded in no more than 15.7 % of the samples. Charred and mineralised cereal remains (grains and chaff) represent only rare admixtures in the archaeological deposits. Nevertheless, charred cereal grains and chaff were recovered in 35.5 % and 13.5 % of the samples respectively, mineralised cereal grains and chaff in 13.2 % and 1.9 % of the samples respectively.

Glume wheats (emmer*: Triticum dicoccum*, spelt*: Triticum spelta* and einkorn: *Triticum monococcum*) constitute the majority of the cereal remains. They are mainly recovered as waterlogged chaff remains (in 34.5 % of the samples). Especially the highly organic layers within palaeochannels have yielded large amounts of chaff remains. The majority of glume wheats are found in the area Civil East. The most commonly recorded glume wheat is spelt. Its waterlogged glumes are found in 24.9 % of the samples, charred in 6.5 % of the samples[46]. It is slightly more common in the 1st cent. AD than in the 2nd cent. AD. Remains of spelt are found in pits, layers and a ditch. The second most frequent glume wheat is emmer. It was found in 13 % of the samples as waterlogged chaff remains, in 5.2 % of the samples as charred chaff remains. It is more common in the 2nd cent. AD (in 17.5 % of the samples). It is found in pits and layers. The third glume wheat, einkorn is present in much smaller amounts than spelt or emmer wheat. It is part of the rare cereal taxa in Oedenburg. It was found in 3.8 % of the samples as waterlogged chaff, in 1.3 % as charred chaff. It is present in approximately the same amount of samples in the 1st and 2nd cent. AD. It occurs in pits and layers.
Barley *(Hordeum vulgare* and *Hordeum* sp.*)*[47] is mainly recovered as waterlogged rachis fragments (in 10 % of the samples) and charred grains (in 10.6 % of the samples). It is much less recurrent than emmer or spelt. The waterlogged remains are almost solely found in layers, the charred remains are spread over the layers, pits and a ditch. In comparison to the glume wheats, remains of barley occur regularly in all three excavation areas. Both broomcorn millet (*Panicum miliaceum*) and foxtail millet (*Setaria italica*) are present. They are recorded as waterlogged glumes and grains, charred grains and mineralised glumes and grains. Findings of millet originate from pits, layers, ditches and the basin, except mineralised millet remains which are found exclusively in one pit (BK 01-04-38). The distribution of broomcorn millet and foxtail millet differs; foxtail millet is recorded as a rare find (in less than 4 % of the samples) whereas broomcorn millet is one of the more common cereal species (e. g. waterlogged chaff in 29.1 % of the samples, mineralised grains in 10.3 % of the samples). Both millets are found in the 1st and 2nd cent. AD, they are more frequent in the area Civil East and the Surroundings of the temple complex than in the Temple complex.

The remaining three cereal taxa, oats, rye and naked wheat, are rare in Roman Oedenburg. Oats (*Avena* sp.) occur primarily as charred grains (in 3.2 % of the samples) and are more frequently found in pits and in

[46] A possible explanation for the larger amounts of spelt in comparison to emmer could be the state of preservation of the cereal remains. My personal experience leads me to think that a badly preserved spelt glume is more easily recognised than a badly preserved emmer or einkorn glume.

[47] We think that the majority of barley grains found in Roman Oedenburg are hulled as several charred grains were found with the glumes clearly visible. On the other hand, no clear findings of naked barley are recorded.

		Spatial			Chronology			Context					
	Total	Civil East	Temple Complex	Surroundings	1st cent. AD	2nd cent. AD	Roman-not specified	Pit	Layer	Ditch	Posthole	Basin	Pot content
N of structures	63	27	12	24	35	10	18	25	31	2	3	1	1
N of samples	261	145	52	64	155	40	66	114	103	27	3	13	1
WATERLOGGED													
CEREALS _ grain													
Avena sativa/fatua	0,4	0,7			0,6			0,9					
Cerealia – Testa	13,8	21,4		7,8	13,5	25,0	7,6	25,4	6,8				
Panicum miliaceum	1,9	3,4			1,9	5,0		4,4					
Setaria italica	0,8	1,4				5,0		1,8					
Panicum/Setaria	1,1	2,1			1,3	2,5		1,8	1,0				
CEREALS _ chaff													
Hordeum vulgare – rachis	0,8	1,4			1,3			1,8					
Hordeum sp. – rachis	10,0	6,9	1,9	23,4	10,3		15,2	3,5	20,4	3,7			
Secale cereale – rachis	1,5			6,3	0,6		4,5		3,9				
Triticum dicoccon – glume	13,0	18,6		10,9	13,5	17,5	9,1	13,2	18,4				
Triticum monococcum – glume	3,8	6,2	1,9		5,2	5,0		3,5	5,8				
Triticum spelta – glume	24,9	33,8	3,8	21,9	26,5	25,0	21,2	27,2	31,1	7,4			
Glume wheats	34,5	47,6	1,9	31,3	39,4	32,5	24,2	41,2	40,8	3,7			
Panicum miliaceum – glume	29,1	31,7	5,8	42,2	31,0	17,5	31,8	29,8	35,9	11,1		15,4	
Setaria italica – glume	3,1	3,4		4,7	3,9		3,0	3,5	3,9				
Panicum/Setaria – glume	2,3	3,4		1,6	1,9	5,0	1,5	3,5	1,0			7,7	
NUTS													
Corylus avellana	43,3	44,8	32,7	48,4	43,9	55,0	34,8	50,0	41,7	40,7		15,4	
Juglans regia	21,1	26,2	7,7	20,3	16,8	47,5	15,2	28,1	13,6	14,8		38,5	
Pinus pinea	0,4			1,6			1,5		1,0				
PULSES													
Lens culinaris	1,1	2,1			0,6	5,0		2,6					
Pisum sativum	0,8	1,4			1,3			0,9	1,0				
Vicia faba	0,4	0,7				2,5		0,9					
Fabaceae	3,4	5,5		1,6	4,5	2,5	1,5	6,1	1,9				
SPICES													
Anethum graveolens	18,0	25,5		15,6	18,7	35,0	6,1	26,3	16,5				
Apium graveolens	26,8	37,9	3,8	20,3	31,6	37,5	9,1	44,7	16,5	7,4			
Carum carvi	0,8	1,4			0,6	2,5		1,8					
Coriandrum sativum	33,7	49,0	5,8	21,9	42,6	37,5	10,6	49,1	30,1	3,7			
Foeniculum vulgare	2,3	2,8		3,1	2,6	2,5	1,5	2,6	2,9				
Origanum vulgare	0,8	1,4			0,6	2,5		1,8					
cf. *Petroselinum crispum*	0,4	0,7			0,6			0,9					
Pimpinella anisum	0,4	0,7			0,6			0,9					
cf. *Piper nigrum*	0,4	0,7				2,5		0,9					
Piper nigrum	0,8	1,4			1,3			1,8					
cf. *Ruta graveolens*	0,4	0,7			0,6			0,9					
Satureja hortensis	9,2	13,1		7,8	7,7	20,0	6,1	14,0	7,8				
VEGETABLES AND SALADS													
Amaranthus sp.	36,8	50,3	5,8	31,3	36,8	52,5	27,3	56,1	26,2	7,4		23,1	
Atriplex sp.	11,1	13,1	1,9	14,1	11,6	10,0	10,6	8,8	18,4				
Beta vulgaris	9,6	15,2	1,9	3,1	14,2	2,5	3,0	14,9	7,8				
Brassica cf. *oleracea*	1,5	2,8			2,6			0,9	2,9				
Brassica rapa/nigra	1,9	2,8		1,6		7,5	3,0	3,5	1,0				
Brassica sp.	12,3	18,6	3,8	4,7	13,5	27,5		21,9	6,8				
Brassica/Sinapis	0,8	1,4			0,6	2,5		1,8					
Daucus carota	16,5	19,3	13,5	12,5	23,2	7,5	6,1	21,9	12,6	14,8		7,7	
Lagenaria siceraria	9,6	13,1	3,8	6,3	8,4	27,5	1,5	15,8	6,8				
Pastinaca sativa	0,8	1,4			1,3				1,9				
Portulaca oleracea	5,4	8,3		3,1	5,2	12,5	1,5	10,5	1,9				
FRUITS													
Cucumis melo	1,1	1,4		1,6	0,6	5,0		1,8	1,0				
Cucumis sativus	1,1	2,1				7,5		2,6					
Cucumis melo/sativa	10,3	15,2		7,8	7,1	37,5	1,5	18,4	5,8				
Ficus carica	42,5	57,2	19,2	28,1	47,7	67,5	15,2	65,8	27,2	25,9			100
Fragaria vesca	11,5	18,6		4,7	14,2	12,5	4,5	21,1	3,9			15,4	
Malus sylvestris/domestica	2,3	4,1			3,9			5,3					
Malus/Pyrus	29,5	44,8		18,8	32,9	42,5	13,6	49,1	19,4			7,7	
Pyrus sp.	26,8	40,7	3,8	14,1	25,8	55,0	12,1	45,6	13,6	3,7		23,1	
Morus sp.	7,3	12,4		1,6	0,6	42,5	1,5	15,8	1,0				
Olea europaea	5,0	8,3		1,6	3,9	17,5		9,6	1,9				
Physalis alkekengi	25,3	36,6	13,5	9,4	29,7	27,5	13,6	45,6	7,8	18,5		7,7	
Prunus avium/cerasus	23,8	38,6		9,4	23,9	52,5	6,1	49,1	5,8				
Prunus domestica	13,0	18,6		10,9	11,0	32,5	6,1	24,6	5,8				
Prunus domestica/insititia	7,3	9,0	3,8	6,3	6,5	12,5	6,1	12,3	1,0	7,4		15,4	
Prunus insititia	8,8	15,9			9,0	22,5		18,4	1,9				
Prunus persica	15,7	20,0	15,4	6,3	15,5	35,0	4,5	22,8	8,7	22,2			
Prunus spinosa	18,0	31,0		3,1	18,7	42,5	1,5	39,5	1,9				
Prunus sp.	14,9	21,4	1,9	10,9	18,7	12,5	7,6	25,4	8,7	3,7			
Rubus caesius	23,0	33,1	9,6	10,9	24,5	40,0	9,1	43,9	3,9	14,8		15,4	
Rubus fruticosus	14,2	22,8	1,9	4,7	14,8	27,5	4,5	28,9	2,9	3,7			
Rubus idaeus	9,2	16,6			13,5	7,5		21,1					

Table 3a Ubiquity of waterlogged plant species.

	Total	Spatial			Chronology			Context					
		Civil East	Temple Complex	Surroundings	1st cent. AD	2nd cent. AD	Roman – not specified	Pit	Layer	Ditch	Posthole	Basin	Pot content
N of structures	63	27	12	24	35	10	18	25	31	2	3	1	1
N of samples	261	145	52	64	155	40	66	114	103	27	3	13	1
WATERLOGGED													
Rubus sp.	8,4	9,0	7,7	7,8	10,3	2,5	7,6	13,2	3,9	11,1			
Sambucus nigra/racemosa	39,5	27,6	73,1	39,1	32,9	47,5	50,0	35,1	26,2	96,3	33,3	61,5	100
Vitis vinifera	31,0	41,4	17,3	18,8	31,6	47,5	19,7	48,2	18,4	18,5		15,4	
OIL, DYE AND FIBRE PLANTS													
Cannabis sativa	7,3	6,2	11,5	6,3	8,4	10,0	3,0	6,1	7,8	14,8			
Carthamus tinctorius	0,4			1,6	0,6				1,0				
cf. *Isatis tinctoria*	0,4	0,7			0,6			0,9					
Linum usitatissimum	1,9	3,4			1,3	7,5		4,4					
Papaver somniferum	5,0	9,0			5,2	12,5		11,4					
WEEDS OF WINTER CEREALS													
Adonis sp.	4,6	7,6		1,6	4,5	10,0	1,5	7,9	2,9				
Agrostemma githago	40,6	49,7	7,7	46,9	44,5	42,5	30,3	48,2	44,7	11,1		15,4	
Anthemis arvensis	14,2	11,0	3,8	29,7	14,8	12,5	13,6	8,8	25,2	3,7			
Bromus arvensis Type	0,8	1,4			1,3			1,8					
Buglossoides arvensis	1,9	2,8		1,6	2,6		1,5	3,5	1,0				
Fallopia convolvulus	28,0	28,3	9,6	42,2	28,4	30,0	25,8	29,8	34,0	11,1	33,3		
Galium aparine	14,6	16,6	3,8	18,8	14,2	15,0	15,2	16,7	17,5	3,7			
Silene gallica	0,4	0,7				2,5		0,9					
Stachys annua/arvensis	0,4	0,7				2,5		0,9					
Valerianella locusta	0,4	0,7			0,6				1,0				
Valerianella rimosa	0,8	0,7		1,6	0,6		1,5	0,9	1,0				
Veronica hederifolia	0,4	0,7				2,5		0,9					
Viola tricolor	0,4	0,7			0,6			0,9					
Order Aperetalia_weeds of rather acidic/neutral soils													
Aphanes arvensis	0,4	0,7				2,5		0,9					
cf. *Bromus secalinus*	0,4	0,7			0,6				1,0				
Camelina sativa	3,4	2,8		7,8	2,6	7,5	3,0	3,5	4,9				
Centaurea cyanus	2,3	4,1			3,9			2,6	2,9				
Papaver argemone	6,1	6,9		9,4	5,8	10,0	4,5	7,9	6,8				
Papaver dubium	1,9	1,4		4,7	1,3	2,5	3,0	1,8	2,9				
Raphanus raphanistrum	0,4	0,7			0,6				1,0				
Scleranthus sp. – capsule	0,4		1,9		0,6					3,7			
Order Secalietalia, Caucalion alliance_weeds of calcareous soils													
Ajuga chamaepitys	11,1	7,6	9,6	20,3	11,6	5,0	13,6	6,1	18,4	7,4		7,7	
Bupleurum rotundifolium	0,4	0,7			0,6			0,9					
Caucalis platycarpos	16,5	13,8	11,5	26,6	18,1	12,5	15,2	12,3	25,2	11,1			
Euphorbia exigua	0,4			1,6	0,6				1,0				
Galium spurium	4,2	6,2		3,1	5,2	5,0	1,5	6,1	3,9				
Glaucium corniculatum	1,9	0,7	1,9	4,7	1,3	5,0	1,5	0,9	3,9				
Myagrum perfoliatum	41,4	44,1	40,4	35,9	52,9	25,0	24,2	53,5	33,0	37,0	33,3	7,7	100
Nigella arvensis	0,8			3,1	1,3				1,9				
Orlaya grandiflora	7,3	9,7	1,9	6,3	9,0	5,0	4,5	7,0	10,7				
Ranunculus arvensis	5,0	6,2	1,9	4,7	4,5	10,0	3,0	7,9	2,9	3,7			
Scandix pecten-veneris	0,4	0,7			0,6				1,0				
Silene cf. *dichotoma*	0,4			1,6	0,6				1,0				
Stachys annua	19,9	31,0		10,9	23,9	25,0	7,6	30,7	14,6			15,4	
Thymelaea passerina	0,8			3,1			3,0		1,9				
Torilis arvensis	0,4	0,7			0,6			0,9					
Vaccaria pyramidata	4,6	8,3			2,6	20,0		8,8	1,9				
Valerianella dentata	10,3	9,7	5,8	15,6	8,4	15,0	12,1	9,6	11,7	11,1		7,7	
WEEDS OF SUMMER CROPS AND ANNUAL RUDERALS													
Aethusa cynapium	2,7	2,8		4,7	1,9	2,5	4,5	3,5	2,9				
Anagallis arvensis/foemina	18,0	22,1	3,8	20,3	18,1	30,0	10,6	24,6	17,5	3,7			
Arenaria serpyllifolia	6,1	9,0		4,7	7,1	10,0	1,5	9,6	4,9				
Atriplex/Chenopodium	7,7	13,8			10,3	10,0		12,3	5,8				
Capsella bursa-pastoris	2,3	3,4		1,6	2,6	2,5	1,5	4,4				7,7	
Chenopodium album	59,4	64,1	36,5	67,2	62,6	55,0	54,5	63,2	59,2	44,4	66,7	61,5	
Chenopodium ficifolium	0,4	0,7			0,6				1,0				
Chenopodium foliosum	0,4	0,7				2,5		0,9					
Chenopodium hybridum	46,4	45,5	32,7	59,4	46,5	47,5	45,5	54,4	43,7	44,4		15,4	
Chenopodium murale	6,1	9,7		3,1		35,0	3,0	12,3	1,9				
Chenopodium polyspermum	1,5	1,4	1,9	1,6	1,3	2,5	1,5	1,8	1,9				
Echinochloa crus-galli	0,8	1,4			1,3			1,8					
Euphorbia helioscopia	5,0	3,4	1,9	10,9	3,9	2,5	9,1	3,5	5,8	3,7		15,4	
Euphorbia platyphyllos	0,4			1,6	0,6				1,0				
Fumaria officinalis	1,1	2,1			1,9			1,8	1,0				
Fumaria sp.	13,0	3,4	30,8	20,3	12,3	5,0	19,7	5,3	14,6	44,4	33,3		
Galeopsis bifida	1,5	1,4		3,1	1,3		3,0	0,9	2,9				
Galeopsis ladanum	0,4	0,7			0,6				1,0				
Galeopsis sp.	10,3	7,6		25,0	8,4	10,0	15,2	7,0	17,5			7,7	
Galeopsis cf speciosa	0,4			1,6	0,6				1,0				
Galeopsis tetrahit	0,8		3,8		0,6		1,5			7,4			

Table 3a Ubiquity of waterlogged plant species.

	Total	Spatial			Chronology			Context					
		Civil East	Temple Complex	Surroundings	1st cent. AD	2nd cent. AD	Roman – not specified	Pit	Layer	Ditch	Posthole	Basin	Pot content
N of structures	63	27	12	24	35	10	18	25	31	2	3	1	1
N of samples	261	145	52	64	155	40	66	114	103	27	3	13	1
WATERLOGGED													
Galeopsis ladanum/segetum	0,4			1,6	0,6				1,0				
cf. *Heliotropium europaeum*	0,4			1,6			1,5		1,0				
Heliotropium sp.	0,4	0,7			0,6			0,9					
Lamium amplexicaule/purpureum	2,3	2,8		3,1	1,3	7,5	1,5	2,6	2,9				
Malva sylvestris	3,1	4,1		3,1	1,3	10,0	3,0	5,3	1,9				
Mercurialis annua	6,5	2,1	19,2	6,3	2,6	2,5	18,2	2,6	2,9	29,6	33,3	7,7	100
Poa annua	3,1	5,5			3,2	7,5		6,1	1,0				
Polygonum lapathifolium/persicaria	37,2	46,2	15,4	34,4	45,2	25,0	25,8	43,9	38,8	11,1		30,8	
Polygonum persicaria	4,6	6,2	3,8	1,6	6,5	2,5	1,5	3,5	6,8	3,7			
Portulaca sp.	1,1	1,4		1,6	0,6	2,5	1,5	1,8	1,0				
Setaria verticillata/viridis	3,8	2,1		10,9	3,2	2,5	6,1	3,5	4,9			7,7	
Solanum nigrum	37,2	32,4	34,6	50,0	37,4	37,5	36,4	26,3	50,5	37,0		38,5	
Sonchus asper	5,7	8,3		4,7	6,5	7,5	3,0	8,8	4,9				
Sonchus asper/oleraceus	7,3	12,4		1,6	11,0	5,0		10,5	6,8				
Sonchus oleraceus	1,9	2,1		3,1	1,9	2,5	1,5	1,8	2,9				
Stachys cf. *arvensis*	0,4		1,9		0,6				1,0				
Stellaria media	40,6	51,7	11,5	39,1	49,0	27,5	28,8	46,5	43,7	11,1		38,5	
Thlaspi arvense	26,8	29,7	15,4	29,7	32,9	27,5	12,1	31,6	26,2	22,2		7,7	
Urtica urens	20,7	24,8	11,5	18,8	26,5	15,0	10,6	28,1	15,5	11,1		23,1	
Verbena officinalis	8,0	6,2		18,8	6,5	5,0	13,6	7,0	10,7			15,4	
Xanthium strumarium	1,5			6,3	0,6		4,5		3,9				
PERENNIAL RUDERALS													
Agropyron repens	0,4	0,7			0,6				1,0				
Arctium lappa	1,5	2,8				10,0		3,5					
Arctium minus	0,4	0,7				2,5		0,9					
Arctium sp.	4,6	5,5	1,9	4,7	3,9	7,5	4,5	5,3	1,9	3,7		23,1	
Bryonia dioica	1,5	2,1		1,6	1,9		1,5	2,6	1,0				
Carduus crispus	0,4	0,7				2,5		0,9					
Cerastium arvense	0,4			1,6			1,5		1,0				
Chelidonium majus	4,2	4,1	1,9	6,3	2,6	7,5	6,1	6,1	1,9	3,7			100
cf. *Chondrilla juncea*	0,4	0,7			0,6				1,0				
Cirsium sp.	9,6	12,4		10,9	11,0	7,5	7,6	11,4	11,7				
Cirsium/Carduus	9,6	9,7	7,7	10,9	12,3	5,0	6,1	9,6	10,7	7,4		7,7	
Conium maculatum	6,9	2,8		21,9	1,9	7,5	18,2	3,5	2,9			84,6	
Convolvulus arvensis	0,4	0,7			0,6			0,9					
Cruciata laevipes	0,4	0,7			0,6			0,9					
Dipsacus cf. *fullonum*	0,4	0,7			0,6				1,0				
Fallopia dumetorum	0,4	0,7			0,6			0,9					
Hyoscyamus niger	14,9	11,0	13,5	25,0	14,8	12,5	16,7	13,2	18,4	18,5			
Lactuca serriola	0,4			1,6	0,6				1,0				
Lamium album	1,9	2,1		3,1		7,5	3,0	2,6	1,9				
Lapsana communis	7,3	7,6	1,9	10,9	7,7	7,5	6,1	8,8	8,7				
cf. *Marrubium vulgare*	0,4	0,7			0,6			0,9					
Onopordum acanthium	2,3	2,8		3,1	3,9			2,6	2,9				
Plantago major	10,0	10,3	1,9	15,6	9,7	7,5	12,1	11,4	6,8	3,7		38,5	
Poa compressa	1,5	2,8			1,9	2,5		3,5					
Polygonum aviculare	32,2	34,5	15,4	40,6	32,3	30,0	33,3	29,8	35,0	22,2		61,5	
Potentilla anserina	4,2	5,5		4,7	4,5	2,5	4,5	7,0	2,9				
Ranunculus repens	36,0	27,6	51,9	42,2	36,1	17,5	47,0	26,3	38,8	59,3		61,5	
Reseda sp.	0,4	0,7			0,6			0,9					
Rumex conglomeratus – perianth	4,6	6,2		4,7	5,2	2,5	4,5	4,4	4,9			15,4	
Rumex crispus – tubercle	2,3	2,8		3,1	3,2		1,5	2,6	2,9				
Rumex obtusifolius – perianth	1,5	1,4		3,1	1,3		3,0	0,9	2,9				
Rumex obtusifolius	51,7	57,9	19,2	64,1	56,1	37,5	50,0	57,9	58,3	18,5		30,8	
Sambucus ebulus	23,0	15,9	44,2	21,9	22,6	12,5	30,3	16,7	22,3	55,6	33,3	15,4	
Saponaria cf. *officinalis*	0,4	0,7			0,6			0,9					
Silene alba	1,5	2,8			1,3	5,0		2,6	1,0				
Urtica dioica	16,5	18,6	1,9	23,4	18,1	10,0	16,7	21,9	11,7	3,7		38,5	
MEADOWS AND PASTURES													
Achillea millefolium	1,1	2,1			1,9			2,6					
Agrostis sp.	1,9	3,4			2,6	2,5		4,4					
Ajuga reptans	7,7	9,0	9,6	3,1	12,3		1,5	4,4	12,6	3,7	33,3		
Anthriscus sp.	0,4	0,7			0,6				1,0				
Bromus cf. *commutatus*	0,8	1,4			1,3			1,8					
Bromus hordeaceus	0,8	1,4			1,3			1,8					
Centaurea cf. *jacea*	0,4	0,7			0,6			0,9					
Centaurea sp.	10,3	11,7	5,8	10,9	13,5	5,0	6,1	11,4	11,7	3,7		7,7	
Cichorium intybus	2,7	2,8		4,7	3,2		3,0	2,6	2,9			7,7	
Cirsium/Centaurea	2,3	3,4		1,6	2,6	5,0		2,6	2,9				
cf. *Cynosurus* sp.	0,4	0,7			0,6			0,9					
Dactylis glomerata	0,4	0,7			0,6			0,9					
Deschampsia caespitosa	1,1	2,1			1,9			2,6					

Table 3a Ubiquity of waterlogged plant species.

	Total	Spatial			Chronology			Context					
		Civil East	Temple Complex	Surroundings	1st cent. AD	2nd cent. AD	Roman – not specified	Pit	Layer	Ditch	Posthole	Basin	Pot content
N of structures	63	27	12	24	35	10	18	25	31	2	3	1	1
N of samples	261	145	52	64	155	40	66	114	103	27	3	13	1
WATERLOGGED													
Dianthus cf. *armeria*	0,4	0,7			0,6			0,9					
Festuca rubra/ovina	0,4	0,7			0,6			0,9					
Festuca/Lolium	1,1	2,1			1,3	2,5		2,6					
Holcus lanatus	0,8	1,4			1,3			1,8					
Leontodon autumnalis	0,8	0,7		1,6	1,3			0,9	1,0				
Leontodon sp.	0,4	0,7			0,6			0,9					
Leucanthemum vulgare	4,2	4,1		7,8	4,5	5,0	3,0	4,4	5,8				
Lolium perenne	0,4	0,7			0,6			0,9					
Nardus stricta	0,4	0,7			0,6			0,9					
Plantago lanceolata	1,9	2,8		1,6	2,6	2,5		2,6	1,9				
Plantago media	2,3	3,4		1,6	3,9			4,4	1,0				
Poa pratensis	0,8	1,4			1,3			1,8					
Poa pratensis Type	0,4	0,7				2,5		0,9					
Poa pratensis/trivialis	0,4	0,7			0,6				1,0				
Potentilla erecta	0,8	1,4			1,3			1,8					
Prunella vulgaris	21,5	22,1	7,7	31,3	24,5	12,5	19,7	21,9	25,2	7,4		23,1	
Ranunculus acris	5,4	6,9	1,9	4,7	5,2	10,0	3,0	7,0	4,9			7,7	
Rhinanthus sp.	4,6	5,5		6,3	5,2	2,5	4,5	6,1	3,9			7,7	
Rumex acetosa – perianth	0,4	0,7			0,6			0,9					
Rumex acetosella	0,4	0,7			0,6			0,9					
Scabiosa sp.	0,8			3,1	0,6		1,5		1,0			7,7	
Silene vulgaris	1,1	2,1			0,6	5,0		2,6					
Taraxacum officinale	2,7	3,4		3,1	1,9	5,0	3,0	3,5	1,9			7,7	
Trifolium pratense	1,5	2,8			1,9	2,5		3,5					
Trifolium sp. – chalice	9,2	12,4		9,4	10,3	7,5	7,6	10,5	11,7				
Open swards													
Acinos arvensis	0,8	1,4			0,6	2,5		0,9	1,0				
Ajuga genevensis	1,5	2,1		1,6	2,6			0,9	2,9				
Artemisia campestris	0,4	0,7				2,5		0,9					
Centaurea scabiosa	0,4	0,7			0,6			0,9					
Dianthus sp.	0,4	0,7			0,6			0,9					
Euphorbia cf. *seguieriana*	1,9	3,4			3,2				4,9				
Euphrasia/Odontites	0,8	1,4			1,3			0,9	1,0				
Gentiana cruciata	0,4	0,7			0,6			0,9					
Medicago lupulina	3,8	4,1	1,9	4,7	5,2		3,0	4,4	4,9				
Medicago minima – pod	6,9	11,0		3,1	10,3	2,5	1,5	9,6	5,8			7,7	
Odontites sp.	0,4	0,7			0,6			0,9					
cf. *Petrorhagia prolifera*	0,4			1,6			1,5		1,0				
Prunella grandiflora	0,4	0,7			0,6			0,9					
Scabiosa columbaria	0,8	0,7	1,9		0,6	2,5		0,9	1,0				
Stachys recta	0,4	0,7			0,6				1,0				
Teucrium botrys	0,4	0,7			0,6				1,0				
Teucrium cf. *chamaedrys*	1,1			4,7			4,5	0,9	1,9				
Teucrium montanum	0,8	1,4				5,0		1,8					
Trifolium cf. *campestre* – chalice	0,4	0,7			0,6			0,9					
Aquatic plants													
Ceratophyllum cf. *submersum*	3,1			12,5			12,1	0,9				53,8	
Lemna sp.	1,5	2,1		1,6	1,9		1,5	0,9	1,9			7,7	
Polygonum cf. *amphibium*	0,4	0,7			0,6				1,0				
Potamogeton sp.	7,7	2,1	17,3	12,5	3,2	2,5	21,2	0,9	7,8	22,2		38,5	
Sparganium sp.	11,1	1,4	26,9	20,3	3,9	2,5	33,3	1,8	7,8	33,3		76,9	
Zannichellia palustris	0,8			3,1	0,6		1,5		1,9				
Reed fields													
Alisma plantago-aquatica	10,3	8,3		23,4	9,0	2,5	18,2	7,0	9,7			69,2	
Carex sp.	71,3	71,7	65,4	75,0	76,1	67,5	62,1	71,1	75,7	55,6	66,7	76,9	
Cicuta virosa	0,4			1,6			1,5					7,7	
Eleocharis palustris	33,7	37,9	26,9	29,7	42,6	30,0	15,2	36,8	40,8	11,1			100
Galium cf. *palustre*	1,1	2,1			1,3	2,5		2,6					
Galium palustre	0,4	0,7			0,6				1,0				
Glyceria sp.	3,4	0,7		12,5	1,3		10,6	0,9	3,9			30,8	
Hippuris vulgaris	1,1	2,1			1,9				2,9				
Iris cf. *pseudacorus*	0,4		1,9		0,6					3,7			
Juncus sp.	4,6	7,6		1,6	6,5	5,0		8,8	1,9				
Lycopus europaeus	9,2	4,1	5,8	23,4	6,5	2,5	19,7	4,4	9,7	7,4		53,8	
Mentha arvensis/aquatica	5,7	7,6		6,3	7,1	7,5	1,5	8,8	3,9			7,7	

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		Spatial			Chronology			Context					
	Total	Civil East	Temple Complex	Surroundings	1^{st} cent. AD	2^{nd} cent. AD	Roman – not specified	Pit	Layer	Ditch	Posthole	Basin	Pot content
N of structures	63	27	12	24	35	10	18	25	31	2	3	1	1
N of samples	261	145	52	64	155	40	66	114	103	27	3	13	1
WATERLOGGED													
Nasturtium officinale	8,0	2,8		26,6	3,2	2,5	22,7	4,4	3,9			92,3	
Oenanthe fistulosa	14,2	15,2	13,5	12,5	17,4	12,5	7,6	13,2	13,6	18,5		23,1	
Poa palustris	0,4	0,7			0,6			0,9					
Rorippa amphibia	0,4	0,7			0,6				1,0				
Rumex cf. *aquaticus/hydrolapatum*	0,4	0,7			0,6				1,0				
Riverbank plants (pioneer)													
Alnus glutinosa – veg. part	0,4	0,7			0,6				1,0				
Alnus sp. – veg. Part	0,8	1,4			1,3			0,9	1,0				
Bidens tripartita	1,9		1,9	6,3	1,3		4,5		2,9			15,4	
Cyperus flavescens	0,4	0,7			0,6			0,9					
Cyperus fuscus	2,7	3,4		3,1	3,2	5,0		3,5	2,9				
Cyperus sp.	0,4			1,6	0,6				1,0				
Myosoton aquaticum	2,3	3,4		1,6	2,6	2,5	1,5	4,4	1,0				
Polygonum hydropiper	14,6	14,5	15,4	14,1	18,1	5,0	12,1	5,3	22,3	18,5		30,8	
Polygonum hydropiper/mite	19,5	16,6	17,3	28,1	15,5	12,5	33,3	7,0	28,2	22,2		61,5	
Polygonum lapathifolium	10,0	15,9	1,9	3,1	12,3	12,5	3,0	14,9	7,8	3,7			
Polygonum minus	4,2	4,8		6,3	4,5	2,5	4,5	1,8	7,8			7,7	
Polygonum mite/minus	1,1	1,4	1,9		1,3		1,5		1,9	3,7			
Ranunculus flammula	0,4	0,7			0,6			0,9					
Ranunculus sardous	3,8	4,8	1,9	3,1	4,5	5,0	1,5	3,5	5,8				
Ranunculus sceleratus	10,3	3,4	9,6	26,6	5,2	7,5	24,2	3,5	9,7	14,8		69,2	
Teucrium cf. *scordium*	1,1	2,1			1,9				2,9				
Wet meadows													
cf. *Euphorbia palustris*	0,8	1,4			1,3			0,9	1,0				
Filipendula ulmaria	1,1	2,1			1,3	2,5		1,8	1,0				
Linum catharticum	1,9	2,8		1,6	2,6	2,5		2,6	1,9				
Lychnis flos-cuculi	4,6	3,4	1,9	9,4	5,2		6,1	3,5	6,8	3,7			
Scirpus sylvaticus	0,8	1,4			1,3			1,8					
Stachys officinalis	0,4	0,7			0,6			0,9					
Forests, forest edges and clearings, hedges													
Abies alba – needle	4,6	4,1	3,8	6,3	5,8	2,5	3,0	3,5	5,8	7,4			
Acer sp. – veg. part	0,4			1,6			1,5	0,9					
Arctium cf. *nemorosum*	0,4			1,6			1,5		1,0				
Betula pendula – veg. part	0,4			1,6			1,5		1,0				
Cornus sanguinea	1,1	1,4		1,6	1,3		1,5	1,8	1,0				
Crataegus sp.	1,9	1,4		4,7	1,3		4,5	0,9	3,9				
Humulus lupulus	1,9		5,8	3,1	1,9		3,0	0,9	1,0	11,1			
Quercus sp. – veg. part	3,1	1,4		9,4	3,9		3,0	1,8	5,8				
Rosa sp.	9,2	15,2	1,9	1,6	7,1	32,5		18,4	2,9				
Solanum cf. *dulcamara*	3,1	3,4	3,8	1,6	3,9	2,5	1,5	1,8	4,9	3,7			
Stellaria cf. *nemorum*	0,8	1,4			1,3			0,9	1,0				
Torilis cf. *japonica*	0,4			1,6			1,5		1,0				
Valeriana cf. *tripteris*	0,4	0,7			0,6			0,9					
Viburnum lantana	0,8	0,7		1,6	0,6		1,5	1,8					
Viburnum opulus	0,8	1,4			0,6		1,5	0,9	1,0				
Calamintha menthifolia	1,1	1,4	1,9		1,3		1,5	0,9	1,0	3,7			
Galium verum	0,4	0,7			0,6			0,9					
Hypericum perforatum	2,3	3,4		1,6	1,3	7,5	1,5	4,4	1,0				
Saponaria cf. *ocymoides*	0,4	0,7			0,6			0,9					
Silene nutans	0,4	0,7			0,6			0,9					
Thalictrum minus	0,8	0,7		1,6	0,6		1,5		1,9				

Table 3a Ubiquity of waterlogged plant species.

		Spatial			Chronology			Context					
	Total	Civil East	Temple Complex	Surroundings	1st cent. AD	2nd cent. AD	Roman – not specified	Pit	Layer	Ditch	Posthole	Basin	Pot content
N of structures	87	27	36	24	38	27	22	26	39	5	13	1	3
N of samples	310	145	101	64	164	76	70	123	125	30	16	13	3
CHARRED													
CEREALS _ grain													
Avena sp.	3,2	4,1	1,0	4,7	5,5	1,3		4,9	3,2				
Hordeum vulgare	10,6	9,0	15,8	6,3	7,3	21,1	7,1	14,6	10,4	6,7			
Hordeum sp.	5,8	6,2	2,0	10,9	7,9	2,6	4,3	10,6	4,0				
Secale cereale	0,6		2,0			2,6		1,6					
Triticum aestivum	1,0	0,7		3,1	1,2		1,4	2,4					
Triticum aestivum/durum/turgidum	5,5	1,4	8,9	9,4	1,8	13,2	5,7	8,9	4,0			7,7	
Triticum dicoccon	0,6	0,7		1,6	1,2			0,8	0,8				
Triticum spelta	0,3			1,6			1,4		0,8				
Triticum sp.	6,5	4,1	6,9	10,9	5,5	9,2	5,7	8,1	8,0				
Cerealia no Paniceae	19,4	16,6	24,8	17,2	15,9	31,6	14,3	26,8	16,8	10,0	18,8		
Panicum miliaceum	6,1	4,1	6,9	9,4	5,5	10,5	2,9	8,1	7,2				
Setaria italica	2,6	2,1	3,0	3,1	2,4	5,3		3,3	3,2				
Panicum/Setaria	0,3	0,7				1,3		0,8					
CEREALS _ chaff													
Hordeum vulgare – rachis	1,6	2,1	1,0	1,6	1,8	1,3	1,4	1,6	2,4				
Hordeum sp. – rachis	1,6	1,4		4,7	2,4	1,3		3,3	0,8				
Secale cereale – rachis	0,3			1,6			1,4	0,8					
Triticum aestivum – rachis	0,3			1,6			1,4	0,8					
Triticum dicoccon – glume	5,2	11,0			5,5	7,9	1,4	11,4	1,6				
Triticum monococcum – glume	1,3	2,8			2,4			0,8	2,4				
Triticum spelta – glume	6,5	11,7		4,7	8,5	6,6	1,4	13,0	3,2				
Glume wheat	3,5	4,8		6,3	4,3	2,6	2,9	7,3	1,6				
NUTS													
Corylus avellana	8,7	4,1	20,8		6,1	19,7	2,9	6,5	11,2	3,3	25,0		
Juglans regia	2,9	1,4	6,9			10,5	1,4	3,3	4,0				
Pinus pinea	3,9		11,9		0,6	14,5		6,5	2,4				33,3
PULSES													
Lathyrus sp.	0,6		2,0			2,6			1,6				
Lens culinaris	3,9	3,4	5,9	1,6	1,8	10,5	1,4	6,5	3,2				
Pisum sativum	0,6	0,7	1,0		0,6	1,3		0,8	0,8				
Vicia faba	3,2	3,4	3,0	3,1	1,8	7,9	1,4	4,9	2,4	3,3			
Vicia/Lathyrus	0,3	0,7				1,3		0,8					
Fabaceae	6,1	0,7	14,9	4,7	3,0	15,8	2,9	4,9	8,0	3,3	12,5		
SPICES													
Apium graveolens	0,3			1,6	0,6				0,8				
Satureja hortensis	0,3			1,6			1,4		0,8				
VEGETABLES AND SALADS													
Allium sativum	0,3		1,0			1,3			0,8				
cf. *Allium sativum*	0,3		1,0			1,3		0,8					
Atriplex sp.	0,3		1,0				1,4		0,8				
Brassica sp.	1,0			4,7	1,2		1,4		2,4				
FRUITS													
Ficus carica – fruitflesh	3,9		11,9			15,8		6,5	3,2				
Phoenix dactylifera	2,3		6,9			9,2		4,9	0,8				
Prunus domestica/insititia	0,3			1,6	0,6				0,8				
Prunus persica	0,3		1,0			1,3			0,8				
Sambucus nigra/racemosa	4,8		14,9			19,7		0,8	11,2				
Vitis vinifera	2,6	0,7	6,9		1,2	7,9		3,3	2,4	3,3			
WEEDS OF WINTER CEREALS													
Galium aparine	3,9	2,1	2,0	10,9	4,9	1,3	4,3	4,9	4,0	3,3			
Veronica hederifolia	1,6		5,0			6,6		1,6	2,4				
Order Secalietalia, Caucalion alliance_weeds of calcareous soils													
Avena fatua	0,3	0,7			0,6				0,8				
Caucalis platycarpos	0,3			1,6	0,6				0,8				
Galium spurium	1,0	2,1			1,2	1,3		1,6	0,8				
Galium cf. *spurium*	1,0		3,0			3,9			2,4				
Glaucium corniculatum	0,3			1,6	0,6				0,8				
Myagrum perfoliatum	0,6		1,0	1,6	0,6	1,3			1,6				
Vicia cf. *angustifolia*	0,3	0,7			0,6				0,8				
WEEDS OF SUMMER CROPS AND ANNUAL RUDERALS													
Chenopodium album	0,6		2,0			2,6			0,8		6,3		
Chenopodium polyspermum	0,3	0,7				1,3		0,8					
Galeospis ladanum/segetum	0,3			1,6	0,6				0,8				
cf. *Solanum nigrum*	0,3			1,6	0,6				0,8				
Thlaspi arvense	0,3	0,7			0,6				0,8				

Table 3b Ubiquity of charred plant species.

	Total	Spatial			Chronology			Context					
	Total	Civil East	Temple Complex	Surroundings	1st cent. AD	2nd cent. AD	Roman – not specified	Pit	Layer	Ditch	Posthole	Basin	Pot content
N of structures	87	27	36	24	38	27	22	26	39	5	13	1	3
N of samples	310	145	101	64	164	76	70	123	125	30	16	13	3
CHARRED													
PERENNIAL RUDERALS													
Cruciata laevipes	0,3		1,0			1,3			0,8				
Rumex obtusifolius	6,5	3,4	9,9	7,8	4,3	11,8	5,7	6,5	8,8	3,3			
Silene alba	0,3		1,0			1,3			0,8				
MEADOWS AND PASTURES													
Centaurea sp.	0,3	0,7			0,6				0,8				
Festuca/Lolium	0,6	1,4			0,6	1,3		1,6					
Galium boreale	0,3		1,0			1,3			0,8				
Plantago lanceolata	0,3	0,7				1,3		0,8					
Plantago media	0,3		1,0				1,4			3,3			
Trifolium sp.	0,3	0,7					1,4	0,8					
Aquatic plants													
Sparganium sp.	1,0		3,0			3,9		0,8	1,6				
Reed fields													
cf. *Alisma plantago-aquatica*	0,3	0,7				1,3		0,8					
Carex sp. tricarpellate	0,6	0,7		1,6	0,6	1,3		1,6					
Galium cf. *palustre*	0,3	0,7			0,6				0,8				
Riverbank plants (pioneer)													
Teucrium scordium	0,3	0,7			0,6				0,8				
Forests, forest edges and clearings, hedges													
Abies alba – needle	0,3	0,7					1,4	0,8					
Galium verum	0,3	0,7				1,3		0,8					
cf. *Humulus lupulus*	0,3			1,6	0,6				0,8				

Table 3b Ubiquity of charred plant species.

	Total	Spatial			Chronology			Context					
	Total	Civil East	Temple Complex	Surroundings	1st cent. AD	2nd cent. AD	Roman – not specified	Pit	Layer	Ditch	Posthole	Basin	Pot content
N of structures	87	27	36	24	38	27	22	26	39	5	13	1	3
N of samples	310	145	101	64	164	76	70	123	125	30	16	13	3
MINERALISED													
CEREALS _ grain													
Avena sp.	0,3	0,7				1,3		0,8					
cf. *Avena*	0,6			3,1			2,9		1,6				
Hordeum vulgare	1,3	2,8			0,6	3,9		3,3					
Triticum spelta	0,3	0,7				1,3		0,8					
Triticum sp.	0,6	1,4				2,6		1,6					
Panicum miliaceum	10,3	20,7		3,1	9,8	18,4	2,9	24,4	1,6				
Setaria italica	1,0	2,1				3,9		2,4					
Panicum/Setaria	1,0	2,1			0,6	2,6		2,4					
Cerealia ohne Hirsen	3,2	6,9			3,0	6,6		7,3	0,8				
CEREALS _ chaff													
Hordeum vulgare – rachis	0,3	0,7			0,6			0,8					
Triticum spelta – spikelet fork	0,3	0,7			0,6			0,8					
Cerealia – ear	0,3	0,7				1,3		0,8					
Cerealia – glume	0,6	1,4				2,6		1,6					
Panicum miliaceum – glume	0,3	0,7				1,3		0,8					
Setaria italica – glume	0,3	0,7				1,3		0,8					
Panicum/Setaria – glume	0,3	0,7				1,3		0,8					
PULSES													
Lens culinaris	8,4	15,9		4,7	4,9	19,7	4,3	18,7	2,4				
Pisum sativum	0,3	0,7			0,6			0,8					
Vicia faba	5,8	10,3		4,7	2,4	14,5	4,3	12,2	2,4				
Fabaceae – fruitflesh	2,6	5,5			1,2	7,9		6,5					
Fabaceae	0,3	0,7			0,6			0,8					
FRUITS													
Cucumis melo	0,6	1,4				2,6		1,6					

Table 3c Ubiquity of mineralised plant species.

		Spatial			Chronology			Context					
	Total	Civil East	Temple Complex	Surroundings	1st cent. AD	2nd cent. AD	Roman – not specified	Pit	Layer	Ditch	Posthole	Basin	Pot content
N of structures	87	27	36	24	38	27	22	26	39	5	13	1	3
N of samples	310	145	101	64	164	76	70	123	125	30	16	13	3
Cucumis melo/sativa	4,8	9,0		3,1	1,2	14,5	2,9	10,6	1,6				
Ficus carica	7,1	12,4		6,3	7,9	6,6	5,7	14,6	3,2				
Fragaria vesca	1,0	2,1			1,2	1,3		2,4					
Malus sylvestris/domestica	3,2	6,9			3,7	5,3		8,1					
Pyrus sp.	0,3	0,7			0,6			0,8					
Malus/Pyrus	7,7	15,2		3,1	7,3	13,2	2,9	17,9	1,6				
Morus sp.	0,6	1,4				2,6		1,6					
MINERALISED													
Physalis alkekengi	0,6	1,4			0,6	1,3		1,6					
Prunus sp. – fragment	0,6	0,7		1,6	0,6		1,4	0,8	0,8				
Rubus caesius	1,0	2,1			0,6	2,6		2,4					
Rubus sp. – inner	0,3	0,7			0,6			0,8					
Sambucus nigra/racemosa	1,0	2,1			1,2	1,3		2,4					
Vitis vinifera	13,2	26,9		3,1	12,8	23,7	2,9	31,7	1,6				
SPICES													
Anethum graveolens	4,5	8,3		3,1	2,4	10,5	2,9	9,8	1,6				
Apium graveolens	3,5	7,6			3,7	6,6		8,9					
Carum carvi	0,6	1,4				2,6		1,6					
Coriandrum sativum	3,2	6,9			1,8	9,2		8,1					
Foeniculum vulgare	0,6	1,4				2,6		1,6					
Nigella cf *sativa*	0,6	1,4				2,6		1,6					
VEGETABLES AND SALADS													
Atriplex sp.	0,3	0,7				1,3		0,8					
Beta vulgaris	1,0	2,1			1,2	1,3		2,4					
Brassica sp.	0,3	0,7				1,3		0,8					
Daucus carota	1,6	3,4			1,8	2,6		4,1					
Lagenaria siceraria	1,3	2,8				5,3		3,3					
OIL AND FIBRE PLANTS													
Linum usitatissimum	1,6	3,4				6,6		4,1					
Papaver somniferum	1,3	2,8			1,2	2,6		3,3					
WEEDS OF WINTER CEREALS													
Agrostemma githago	2,3	4,8			1,2	6,6		5,7					
Buglossoides arvensis	0,3	0,7			0,6			0,8					
Fallopia convolvulus	0,3	0,7				1,3		0,8					
Galium aparine	2,6	5,5			2,4	5,3		6,5					
cf. *Veronica hederifolia*	0,3	0,7				1,3		0,8					
Order Aperetalia_weeds of rather acidic/neutral soils													
Camelina sativa	1,3	2,8			1,2	2,6		3,3					
Order Secalietalia, Caucalion alliance_weeds of calcareous soils													
Caucalis platycarpos	1,0	2,1			1,8			2,4					
Galium spurium	0,3	0,7			0,6			0,8					
Vaccaria pyramidata	0,3	0,7				1,3		0,8					
WEEDS OF SUMMER CROPS AND ANNUAL RUDERALS													
Galeopsis cf. *speciosa*	0,3	0,7				1,3		0,8					
Polygonum lapathifolium/persicaria	0,3	0,7				1,3		0,8					
Solanum nigrum	1,6	3,4				6,6		4,1					
Sonchus oleraceus	0,3	0,7				1,3		0,8					
Stellaria media	0,3	0,7			0,6			0,8					
Thlaspi arvense	0,6	1,4			1,2			1,6					
PERENNIAL RUDERALS													
Arctium sp.	0,3	0,7			0,6			0,8					
Convolvulus arvensis	0,3	0,7				1,3		0,8					
Hyoscyamus niger	0,6	1,4			1,2			1,6					
Lapsana communis	0,3	0,7			0,6			0,8					
MEADOWS AND PASTURES													
Centaurea sp.	0,3	0,7			0,6			0,8					
Rhinanthus sp.	0,3	0,7				1,3		0,8					
Scabiosa sp.	0,6	1,4			1,2			1,6					
Reed fields													
Carex sp.	0,3	0,7			0,6			0,8					
Galium palustre	0,3	0,7				1,3		0,8					
Forests, forest edges and clearings, hedges													
Rosa sp.	1,0	2,1			1,2	1,3		2,4					
cf *Seseli libanotis*	0,3	0,7				1,3		0,8					

Table 3c Ubiquity of mineralised plant species.

the 1st cent. AD. Rye (*Secale cereale*) constitutes a very small part of the cereal remains. It is mainly found as waterlogged chaff fragments (in 1.5 % of the samples) in the organic layers bordering the palaeochannels in the area surrounding the temple complex. In the temple complex, waterlogged remains and few charred grains of rye are recorded (in 0.3 % of the samples). Naked wheat (*Triticum aestivum / durum / turgidum*) is mainly found as charred grains (in 5.5 % of the samples). Single finds of charred and waterlogged rachis however are recovered too (possibly hexaploid type). Naked wheats are most common in pits and in the 2nd cent. AD. The majority of grains are recovered from the structures associated with offering practices in the temple complex.

On the whole, cereal remains are very common in Roman Oedenburg. They were found in all areas of excavation and mainly recovered from pits and layers. The most frequently found cereals are broomcorn millet, spelt, emmer and barley. The minor or major importance of individual cereal species on archaeological sites is hard to determine as different issues affect their representation: type of context, no storage facilities are found in the excavated areas; type of deposit, by-products from crop processing and other waste material; and conditions of preservation. All cereal taxa are attested in the 1st and 2nd cent. AD. No clear chronological differences in the dispersal of the cereal species could be discerned. However, the spatial distribution of cereal taxa across the site is diverse. We remark that einkorn and emmer are not present in the Surroundings of the temple complex and the temple complex respectively, rye on the other hand was not found in the area Civil East.

Lentil (*Lens culinaris*), common pea (*Pisum sativum*), broad bean (*Vicia Faba*) and sweet pea (*Lathyrus* sp.) represent the pulses (**tab. 3a, 3b** and **3c; fig. 7.4**). Pulses are primarily recovered as mineralised seeds / fruits (in 9 % of the samples), in addition smaller amounts of charred (in 11.3 % of the samples) and waterlogged remains (in 5 % of the samples) are found. Pulses are mainly found in the area Civil East (waterlogged and mineralised) and the Temple complex (charred). The majority is recovered from pits, only few originate from layers. Lentil and broad bean are most recurrent, common pea is much less frequent. Lentil, broad bean and common pea were found in both the 1st and 2nd cent. AD structures. Sweet pea is rare and recovered from a single structure in the temple complex dated to the 2nd cent. AD (BK 04-05-50). Pulses are an important part of the Roman diet because of their high protein content. In contrast to many of the archaeological plant remains, pulses are better preserved when charring and / or mineralisation is attested. This applies also for Roman Oedenburg where pulses are generally underrepresented.

Walnut (*Juglans regia*), hazelnut (*Corylus avellana*) and stone pine nut (*Pinus pinea*) represent the nuts (**tab. 3a, 3b**). All three were recovered charred (in 11.6 % of the samples) and waterlogged (in 49 % of the samples) (**fig. 7.4**). Hazelnut shells are most frequently found, waterlogged they occur in 43.3 % of the samples, charred in 8.7 % of the samples. They are recovered from all areas of excavation. Their distribution across the samples is homogenous, which means that they occur in the same percentages of samples from the 1st and 2nd cent. AD, in all types of structures and in all areas of excavations. Hazelnut is a wild plant which grows as a shrub in forests and along forest edges, its nuts are gathered for consumption.
Remains of walnut are slightly less frequent than hazelnut, waterlogged in 21.1 % of the samples, charred in 2.9 % of the samples. Walnut shells are recorded in all areas of excavation and are clearly more frequent in the 2nd cent. AD (waterlogged in 47.5 % of the samples, charred in 10.5 % of the samples). Except for postholes they are recorded in all types of contexts.
The third nut species, stone pine nut, is very rare among the botanical findings. One single waterlogged nut is found. It represents the only find of stone pine outside the temple complex. Within the temple complex,

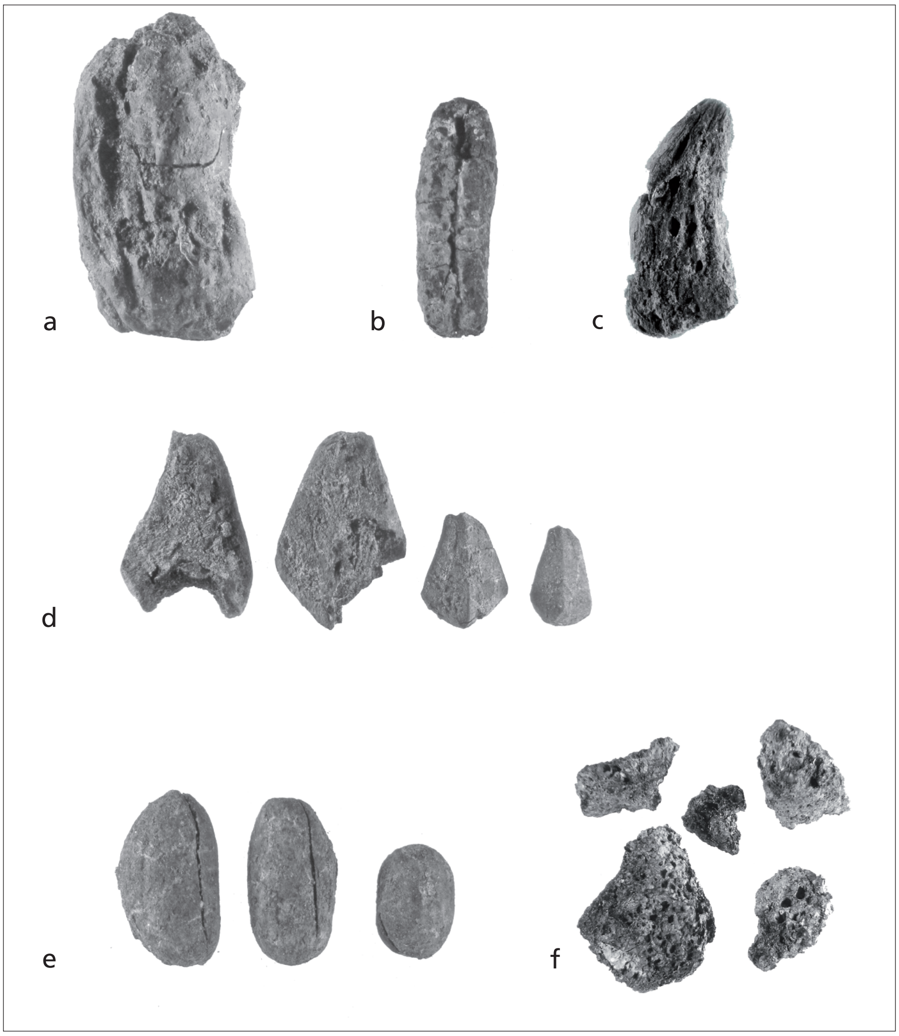

Fig. 7.6 a-b *Phoenix dactylifera* (fruit and stone); **c** *Allium sativum* (clove); **d-e** *Pinus pinea* (scales and nuts); **f** *Ficus carica (*fragments of fruitflesh). Scale 5 mm.
Photograph made by G. Haldimann, © IPNA Basel University.

charred remains of stone pine have been recorded in larger quantities (in 3.8 % of the samples)[48]. Nut fragments, scales and a cone fragment of stone pine are among the findings in two structures related to sacred practices (BK 04-05-50 and BK 05-05-160/219) (**fig. 7.6**). Stone pine remains undoubtedly represent imported goods as climatic conditions impede their growth north of the Alps. Although stone pine nuts are mentioned in many recipes by *Apicius*[49], they do represent rare imports[50]. Roman findings of stone pine north of the Alps are almost always in sacrificial contexts (in temples or in incineration graves) (see below). Spices are represented by 12 different species (**tab. 3a, 3b** and **3c**). Nine spices could be identified with certainty, three species are plausible identifications. Seeds and fruits of spices are mainly recovered as

48 Vandorpe / Jacomet in press (footnote 19).
49 André 1998 (footnote 44) 72 f.
50 C. Bakels / S. Jacomet, Access to luxury foods in Central Europe during the Roman period: the archaeobotanical evidence. In: M. van der Veen (ed.), Luxury foods. World Arch. 34/3, 2003, 542-557.

waterlogged items (in 43.7 % of the samples), charred and mineralised seeds are not so common (in 0.6 % and 7.7 % of the samples respectively) (fig. 7.4). The majority of findings derive from pit contexts.

Coriander (*Coriandrum sativum*), celery (*Apium graveolens*) and dill (*Anethum graveolens*) are the most regularly found (waterlogged in respectively 33.7, 26.8 and 18 % of the samples) and most abundantly present spices. Dill and coriander are found in waterlogged and mineralised condition, celery is additionally found as charred seeds. Summer savory (*Satureja hortensis*) and fennel (*Foeniculum vulgare*) are less common. However, summer savory is present in 9.2 % of the samples as waterlogged seeds, in 0.3 % as charred seeds. Fennel seeds are found in 2.3 % of the samples as waterlogged remains, mineralised in less than 1 % of the samples. The remaining spices are present in less than 1 % of the studied samples. They are often represented by a single find and are recovered from pit contexts solely. Caraway (*Carum carvi*) is recorded as mineralised (in 0.6 % of the samples) and waterlogged seeds (in 0.8 % of the samples). It is found both in the 1st and 2nd cent. AD. Oregano *(Origanum vulgare)* is recorded as waterlogged seeds (in 0.8 % of the samples) and equally present in the 1st cent. AD and 2nd cent. AD. For parsley (cf. *Petroselinum crispum*), aniseed[51] (*Pimpinella anisum*) and common rue (cf. *Ruta graveolens*), one waterlogged seed each is identified. These findings originate from two pits in the area Civil East and date to the 1st cent. AD. Parsley, aniseed[52] and common rue were introduced by the Romans. All of them are rarely found in the archaeological record north of the Alps. Although, they were very common spices in ancient Rome.

Pepper (*Piper nigrum*) is recorded in two pits in the area Civil East. One is dated to the 1st cent. AD (BK 01-04-24), the other to the 2nd cent. AD (BK 02-04-15). It both involves single findings of waterlogged peppercorns. Pepper represents a luxury good and is imported from India. Archaeological findings of pepper north of the Alps are rare[53].

Black cumin (*Nigella* cf. *sativa*) is found in a pit-structure (BK 01-04-38) dated to the 2nd cent. AD in the area Civil East. It involves two mineralised seeds (fig. 7.7). Black cumin is used as a condiment; it is also known as a healing herb in southern Europe and the Near East[54]. Besides, it is native in the Mediterranean and represents an imported food plant.

Spices are an important component of the Roman diet. Historical sources very often refer to the lavish use of spices in Roman cooking[55]. The majority of the spices are introduced into this region with the start of the Roman period and are probably cultivated locally towards the end of the 1st cent. AD. The spatial distribution of spices across the civil settlement is remarkable. Almost all spices are recovered from the area Civil East. In the Surroundings of the temple complex and in the Temple complex itself five respectively two spices are found. It is likely that the representation of spices is related to the type of context from which they were recovered.

Vegetables and salads are represented by at least ten species (tab. 3a, 3b and 3c). They include amaranth (*Amaranthus* sp.), orache (*Atriplex* sp.), beet (*Beta vulgaris*), cabbage (*Brassica* cf. *oleracea*, *Brassica rapa / nigra*, *Brassica* sp.), cabbage / mustard (*Brassica / Sinapis*), carrot (*Daucus carota*), bottle gourd (*Lagenaria siceraria*),

51 The findings of aniseed have been discussed in a previous publication, see Vandorpe / Jacomet 2005 (footnote 39) 255 f.

52 A recent publication mentions the findings of pollen of aniseed in a well in Waldgirmes (G). They represent the only other find of aniseed north of the Alps, see A. Stobbe, Ein römischer Brunnen im freien Germanien. Archäologie in Deutschland 2/2009, 28-29.

53 For more details about the pepper find see Vandorpe / Jacomet 2005 (footnote 39) 255 f. – Jacomet / Brombacher 2009 (footnote 6) 27-106.

54 A. Heiss / K. Oeggl, The oldest evidence of Nigella damascena L. (Ranunculaceae) and its possible introduction to central Europe. Veg. Hist. Arch. 14, 2005, 562-570.

55 André 1998 (footnote 44) 279 f.

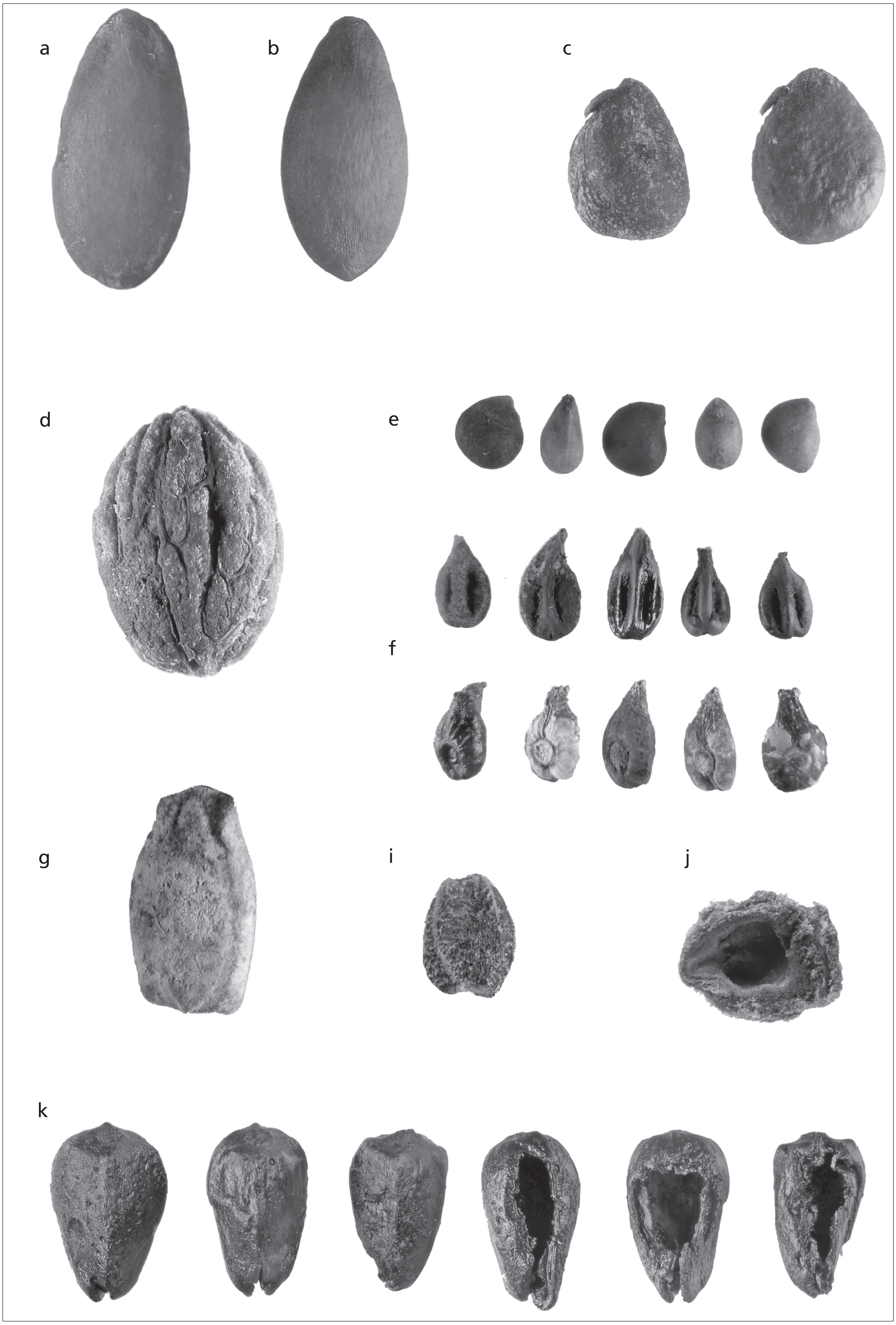

Fig. 7.7 **a** *Cucumis melo*; **b** *Cucumis sativus*; **c** *Morus nigra*; **d** *Olea europaea*; **e** *Ficus carica*; **f** *Vitis vinifera*; **g** *Lagenaria siceraria*; **i** *Nigella* cf. *sativa*; **j** *Beta vulgaris*; **k** *Carthamus tinctorius*. Scale 2 mm. Photograph made by G. Haldimann, © IPNA Basel University.

parsnip (*Pastinaca sativa*), little hogweed (*Portulaca oleracea*) and garlic (*Allium sativum*)[56]. Usually finds of vegetables and salads succeed relatively rare in archaeological deposits while they are harvested before the seeds mature. The leaves or roots which are consumed do not succeed. However, vegetables comprise a large part of the economic plant remains in Roman Oedenburg. They are mainly found as waterlogged seeds (in 51 % of the samples), mineralised and charred seeds represent only rare findings (**fig. 7.4**).

Amaranth is the most common leaf vegetable. It is present in 36.8 % of the samples. It is found in all areas of excavation; it is slightly more common in the 2nd cent. AD and above all recovered from pits.

Other widespread leaf vegetables include orache (in 11.1 % of the samples), little hogweed (in 5.4 % of the samples) and cabbage (in more than 10 % of the samples). Cabbage/mustard seeds are present in less than 1 % of the samples and recorded in two pits, dated to the 1st cent. AD and 2nd cent. AD.

Besides leaf vegetables, three root vegetables are represented. They include carrot, beet and parsnip. Most numerous are the findings of carrot. It occurs in 16.5 % of the samples and is more common in the 1st C AD, it was found in different types of contexts and in all parts of the settlement. Findings of beet fruits and occasionally seeds are equally frequent (**fig. 7.7**). They appear in 9.6 % of the samples. They are more common in the 1st cent. AD and are recovered from pits as well as layers. A third root vegetable is parsnip. Parsnip represents a very rare find. It is recorded in a 1st cent. AD layer (BK 02-04-55) in the area Civil East.

Another rare find includes two charred cloves of garlic (**fig. 7.6**). They originate from a layer in the temple complex dated to the 2nd cent. AD. Garlic, in general, is hardly ever found on archaeological sites due to its potential to be preserved[57]. It is only preserved as a charred clove.

Finally, waterlogged seeds, two stalks, parts of the fruit wall and mineralised seeds of bottle gourd are recovered. Seeds of bottle gourd are recovered from 9.6 % of the samples, they are more common in the 2nd cent. AD and found in pits as well as layers (**fig. 7.7**). Remarkable are the findings of parts of the stalk and the apical half of a bottle gourd in two different structures[58]. Bottle gourd is rarely found on archaeological sites due to its potential to be preserved. In contrast to garlic, it is found in waterlogged conditions only.

The vegetables and salads are generally well represented throughout the whole site. However larger quantities were found in the area Civil East and in the Surroundings of the Temple complex.

The largest group of cultural plants are undoubtfully the fruits. 20 species have been identified of which 19 are waterlogged, 11 are charred and 6 are mineralised (**tab. 3a, 3b** and **3c**). The majority are recovered as waterlogged remains (in 78.2 % of the samples), mineralised (in 18.7 % of the samples) and charred (in 5.4 % of the samples) remains are less frequent (**fig. 7.4**). Fruits are mainly recorded in pits, however they do occur in all other types of contexts. The most regularly found fruits are (in order of abundance): fig (*Ficus carica*) (**fig. 7.6**), elderberry (*Sambucus nigra/racemosa*), grapevine (*Vitis vinifera*) (**fig. 7.7**), apple/pear (*Malus/Pyrus*), winter cherry (*Physalis alkekengi*), cherry (*Prunus avium/cerasus*), dewberry (*Rubus caesius*), blackthorn (*Prunus spinosa*) and peach (*Prunus persica*). Rarely found species (present in less than 10 % of the samples) include date (*Phoenix dactylifera*) (**fig. 7.6**), mulberry (*Morus nigra*) (**fig. 7.7**), olive (*Olea europaea*) (**fig. 7.7**), melon (*Cucumis melo*) (**fig. 7.7**), cucumber (*Cucumis sativus*) (**fig. 7.7**) and plums (*Prunus domestica/insititia*).

[56] Amaranth, orache, cabbage/mustard, carrot, parsnip and little hogweed are also known as wild plants or weeds. As they are known in the Roman cuisine and they were found in contexts dominated by food plants, we classified them within this group.

[57] Jacomet/Brombacher 2009 (footnote 6) 27-106.

[58] Vandorpe/Jacomet 2005 (footnote 39) 254 f.

The fruit species can be divided into three subgroups, namely 1) indigenous fruits gathered in their natural habitat, 2) imported fruits and 3) fruits introduced by the Romans and grown locally. It is often difficult to determine to which of the subgroups (2) or (3) fruits belong. It is clear that many fruits were introduced into the area by the Romans, it is not clear however if local cultivation was practiced and when this first began. From traditional archaeobotanical analyses only, it is hardly possible to establish whether fruits originate from local cultivation or represent imported goods (see below).
The gathered fruits include woodland strawberry (*Fragaria vesca*), winter cherry, blackthorn, dewberry, blackberry (*Rubus fruticosus*), red raspberry (*Rubus idaeus*) and elderberry. From the gathered fruits, winter cherry is not so common. It is not always seen as a food plant, in Roman Oedenburg however it was found as mineralised seeds in latrine deposits, which is an indication for its consumption. The fruits introduced by the Romans and possibly cultivated locally include fig, melon, cucumber, peach, cherry, plum, black mulberry, apple/pear and grape. Fruits that were definitively imported while can not grow in the area because of climatic reasons comprise date and olive.
All fruits except date are found both in the 1st and the 2nd cent. AD. Date, a fruit often associated with sacred practices, was exclusively found in charred state in the temple area in two structures dated to the 2nd cent. AD. Most fruit species are found throughout the three areas of the civil settlement, with the temple complex yielding the lowest variety and numbers of fruit remains.

Oil, fibre and dye plants are not abundant in Roman Biesheim and when found then only in small numbers (**tab. 3a, 3b** and **3c; fig. 7.4**). Hemp (*Cannabis sativa*), flax (*Linum usitatissimum*) and poppy (*Papaver somniferum*) are plausible oil and fibre plants[59]. They are mainly recovered as waterlogged seeds, only few mineralised remains are recorded.
Hemp seeds are most common and present in 7.3 % of the samples, of which 8.4 % is dated to the 1st C AD and 10 % in the 2nd cent. AD. They are more common in layers than in pits. Hemp is evenly distributed over the different excavation areas.
Flax seeds are not common (waterlogged in 1.9 % of the samples, mineralised in 1.6 % of the samples), they are more frequent in the 2nd cent. AD and originate from pits only in the area Civil East.
Poppy is again more common, it occurs in 5 % of the samples as a waterlogged seed, in 1.3 % of the samples as a mineralised seed. It has been noted in pits in the area Civil East only and is more frequent in the 2nd cent. AD. Because only small quantities of poppy were recovered, it is very likely that it had not been cultivated for its oil extraction but had rather been used as a spice or for medicinal purposes[60].
Findings of dye plants are rare in Roman Oedenburg. Two possible dye plants are identified, it concerns dyers woad (cf. *Isatis tinctoria*) and safflower (*Carthamus tinctorius*). Of dyers woad, a single waterlogged seed is recorded. Its identification is uncertain. It was found in a pit (BK 01-04-24) in the area Civil East and dating to the 1st cent. AD. Dyers woad is known as a source of blue dye. The blue pigment is extracted from its leaves. Dyers woad is a plant favouring nutrient rich, alkaline soils. It is very common in dry warm areas like the Upper Rhine region, along roads but also in dry calcareous grassland. As several plant species favouring dry calcareous grassland are found within this pit, it is more likely to assume that it reached the

[59] It is likely that gold of pleasure (*Camelina sativa*) also belongs to the oil and fibre plants, however only small amounts were recovered. Note that the plants mentioned here could also have been used for other purposes than to extract oil or fibres.

[60] André 1998 (footnote 44) 162 f.

settlement as part of the grassland vegetation. Therefore we think its presence in Roman Oedenburg is not connected to dyeing practices[61].

In contrast to the single seed of dyers woad, seeds of safflower (*Carthamus tinctorius*) are found in large quantities in a single structure (**fig. 7.7**). They originate from one layer (BK 03-09-74) in the Surroundings of the Temple complex. It is dated to the 1st cent. AD. All safflower seeds are waterlogged and very well preserved; the majority of the seeds are found complete with just a small hole on the side (**fig. 7.7**). Oberdorfer[62] mentions the cultivation of safflower for oil extraction or for birdseeds in the lowlands of the river Rhine. It is also known as a source of red and yellow dyes which can be extracted from its flowers. Findings of safflower seeds are exceptional and very rare in the archaeobotanical record (see below).

Arable and ruderal weed flora

By far the largest group of wild plants are the weeds of cultivated fields. They include 75 taxa. These arable weeds reached the civil settlement most likely as part of the harvested crops. Within the arable weed flora we can, on an actualistic basis, distinguish between weeds of winter cereals and weeds of summer crops. We have classified the annual ruderal vegetation with the weeds of summer crops, as their natural habitats are overlapping and thus difficult to keep apart. In addition we discuss the perennial ruderal vegetation.

Weeds of winter cereals (Secalietea)

The weeds of winter cereals or Secalietea are represented by 40 different plant species (**tab. 3a, 3b** and **7.3c**), of which 38 taxa were preserved through waterlogging, eight through charring and nine through mineralisation. Considering the variety of plant taxa, the weeds of winter cereals represent one of the largest groups of plant taxa recovered. In addition they constitute a large part of the plant assemblage. Waterlogged remains of weeds of winter cereals are found in 78.2 % of the samples, charred in 8.1 % of the samples, mineralised in 6.5 % of the samples (**fig. 7.5**).

The most commonly found weeds of winter cereal are muskweed (*Myagrum perfoliatum*) (**fig. 7.8**) and corn cockle (*Agrostemma githago*) (**fig. 7.8**). They are both present in more than 40 % of the samples. Other species present in more then 10 % of the samples include black-bindweed (*Fallopia convolvulus*), annual hedge nettle (*Stachys annua*), carrot bur parsley (*Caucalis platycarpos*), cleavers (*Galium aparine*), corn chamomile (*Anthemis arvensis*), yellow bugle (*Ajuga chamaepitys*) and narrow fruit corn salad (*Valerianella dentata*). The remaining species are found in less than 8 % of the samples.

Within the Secalietea, species belonging to two sub-groups are well represented. They consist of the Order Secalietalia Alliance Caucalion and the Order Aperetalia.

Of special interest are the 19 weeds belonging to the order of the Secalietalia, the Alliance Caucalion. They are found very frequently in the studied samples (waterlogged in 68.2 % of the samples, charred in 3.5 % of the samples, mineralised in 1.6 % of the samples). The commonest of these taxa in Roman Oedenburg are (in order of abundance): muskweed (*Myagrum perfoliatum*), annual hedge nettle (*Stachys annua*), carrot bur

[61] For more information on dyers woad see V. Zech-Matterne / L. Leconte, New archaeobotanical finds of Isatis tinctoria L. (woad) from Iron Age Gaul and a discussion of the importance of woad in ancient time. Veg. Hist. Arch. 2009, published online.

[62] Oberdorfer 1994 (footnote 42) 1050 f.

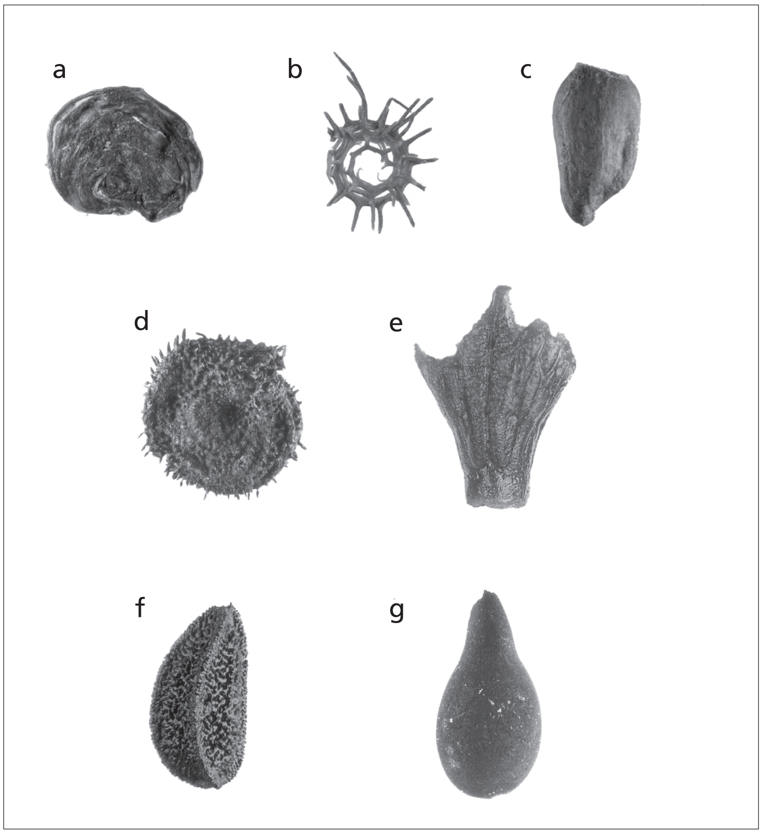

Fig. 7.8 **a** *Medicago lupulina*; **b** *Medicago minima*; **c** *Centaurea cyanus*; **d** *Agrostemma githago*; **e** *Myagrum perfoliatum*; **f** *Nigella arvensis*; **g** *Thymelaea passerina*. Scale 1 mm. Photograph made by G. Haldimann, © IPNA Basel University.

parsley (*Caucalis platycarpos*), yellow bugle (*Ajuga chamaepitys*), white lace flower (*Orlaya grandiflora*), narrowfruit cornsalad (*Valerianella dentata*), false cleavers (*Galium spurium*) and corn buttercup (*Ranunculus arvensis*). Less common are cow soapwort (*Vaccaria hispanica*) and red horned poppy (*Glaucium corniculatum*). And rare are findings of devil-in-a-bush (*Nigella arvensis*) (**fig. 7.8**), spurge flax (*Thymelaea passerina*) (**fig. 7.8**), field hedge parsley (*Torilis arvensis*), shepherd's needle (*Scandix pecten-veneris*), thorow-wax (*Bupleurum rotundifolium*), dwarf spurge (*Euphorbia exigua*), a possible forking catchfly (*Silene* cf. *dichotoma*), wild oat (*Avena fatua*) and a possible garden vetch (*Vicia* cf. *angustifolia*). All of these are native in the Mediterranean area (except for forking catchfly (*Silene dichotoma*) which is native in Eastern Europe). The phytosociological group of the Caucalion alliance is characterised by thermophilic plant species growing on calcareous soils. Most of these plant species flower relatively early, as a result they are very prominent in winter cereals. Today the large majority of these plant species are rarely found. Nonetheless they were growing in the near vicinity of the settlement before the beginning of the industrial maize agriculture.

The remaining 20 weeds of winter cereals represent different habitats and are generally more common in Roman plant assemblages. The majority grows on sandy loam soils. Corn cockle (*Agrostemma githago*) is by far the best represented. It is a plant favouring nutrient rich soils, along with garden cornflower (*Centaurea cyanus*) (**fig. 7.8**), parsley piert (*Aphanes arvensis*) and cleavers (*Galium aparine*). The latter is likewise an indicator for nitrogen. The second most frequently found taxon is black-bindweed (*Fallopia convolvulus*). It is one of the most commonly found species within cereal fields and is characteristic of more acidic soils. Other cereal weeds, characteristic of slightly acidic to highly acidic soils, include respectively corn gromwell (*Buglossoides arvensis*), corn chamomile (*Anthemis arvensis*) and wild radish (*Raphanus raphanistrum*). Broad-fruited cornsalad (*Valerianella rimosa*), lamb's lettuce (*Valerianella locusta*) and common catchfly (*Silene gallica*) are weeds favouring dry and open areas. Lastly for this group, we identified weeds preferring to grow on soils free of lime such as blindeye (*Papaver dubium*), prickly poppy (*Papaver argemone*) and johnny jump up (*Viola tricolor*). Within these 20 weed species, eight can be classified to the order of the Aperetalia. They represent weeds of rather acidic-neutral soils or lime-deficient soils.

Weeds of winter cereals are present in the three studied areas of excavation. The majority are found in the area Civil East and the Surroundings of the temple complex. They are more common in pits and layers. Their distribution is similar in the 1st and 2nd cent. AD.

Weeds of summer crops and annual ruderals

The weeds of summer crops and annual ruderals comprise 35 taxa (35 waterlogged, 6 mineralised and 4 charred), of which four identifications are only tentative (**tab. 3a, 3b** and **3c**). Quantitatively they represent a large part of the plant remains. Waterlogged remains are found in 84.7 % of the samples, charred in 1.6 % of the samples, mineralised in 3.2 % of the samples (**fig. 7.5**).
Annual ruderals are classified together with the weeds of summer crops as their habitats are related. Many of the weeds classified in this category are today found between cultivated plants as leaf vegetables and summer cereals. However they also occur on waste and disturbed land, along roadsides and riverbanks. It is also plausible that many of these plant taxa have grown in the near vicinity of the structures in which they were found.
Almost all weeds of summer crops and annual ruderals found in the civil settlement of Oedenburg favour nutrient-rich sandy and loamy soils. Several plant taxa preferring soils rich in nitrogen were recovered; they represent the most frequently found plant taxa within this group. They comprise (in order of abundance) fat-hen (*Chenopodium album*), maple-leaved goosefoot (*Chenopodium hybridum*), common chickweed (*Stellaria media*), field pennycress (*Thlaspi arvense*) and black nightshade (*Solanum nigrum*). In addition plant taxa with a preference for calcareous soils were found, these include thyme-leaved sandwort (*Arenaria serpyllifolia*), broad-leaved spurge (*Euphorbia platyphyllos*), blue pimpernel (*Anagallis arvensis/foemina*) and fool's parsley (*Aethusa cynapium*). Several plants growing in dry respectively humid environments were found; vervain (*Verbena officinalis*) and high mallow (*Malva sylvestris*) favour dry land; sun spurge (*Euphorbia helioscopia*), common fumitory (*Fumaria officinalis*) and rough cocklebur (*Xanthium strumarium*) favour humid soils. Weeds of summer crops were found in all three excavated areas. However, the majority comes from the area Civil East and the Surroundings of the temple complex.

Perennial ruderal vegetation

Plants representing the perennial ruderal vegetation consisted of 33 different species of which three are tentative identifications (**tab. 3a, 3b** and **3c**). All 33 species were found as waterlogged seeds or fruits, three as charred and four as mineralised seed/fruit. Waterlogged remains are found in 82.8 % of the samples, charred in 6.8 % of the samples, mineralised in 1.6 % of the samples (**fig. 7.5**). They originate from all types of contexts. Except for a few species, the perennial ruderals represent only a small part of the plant remains. Their natural habitat includes wasteland, disturbed grounds, alongside roads etc. Nevertheless some of the perennial ruderals can equally be found as part of cultivated fields and/or garden cultivation. The majority of plant species classified under ruderal vegetation are likely to have grown in the immediate surroundings of the structures/layers in which they were found.
As for the weeds of summer crops and the annual ruderals, general habitat characteristics of the perennial ruderal vegetation are: nutrient rich soils (indicators for nutrients are round-leaved dock [*Rumex obtusifolius*] and curled dock [*Rumex crispus*]), mainly growing on sand and loam (e.g. knotweed [*Polygonum aviculare*]), some growing on clayey soils (e.g. creeping buttercup [*Ranunculus repens*]). Plants recovered favouring humid environments are swallow wort (*Chelidonium majus*) and silverweed (*Potentilla anserina*).

A small group of perennial ruderals typical for dry environments comprise henbane (*Hyoscyamus niger*), scotch thistle (*Onopordum acanthium*), skeletonweed (*Chondrilla juncea*), wild lettuce (*Lactuca serriola*), soapwort (*Saponaria officinalis*) and a possible white horehound (*Marrubium vulgare*). The latter three represent single items. Today, these plant species can still be found in the surroundings of the site.
Perennial ruderals were found throughout the three excavated areas of the civil settlement, however the largest variety originates from the area Civil East.

Grassland vegetation

The grassland vegetation recorded in the civil settlement includes 51 plant species (50 waterlogged, 3 mineralised and 6 charred) of which 4 doubtful identifications (**tab. 3a, 3b** and **3c**). Even though the number of plant taxa is high, this group of plants only represents a very small part of the plant assemblage. Of more than half of the plant taxa, only a single item was found. Waterlogged remains of grassland plant taxa are found in 41 % of the samples, charred in 2.3 % of the samples, mineralised in 1 % of the samples (**fig. 7.5**).
Within the grassland vegetation, we can distinguish between plant species growing in cultivated meadows and pastures (24 plant taxa) (Molinia-Arrhenatheretea class) and others growing on open swards (19 plant taxa) (Festuco-Brometea class).
Cultivated meadows and pastures are characterised by nutrientrich soils with a high nitrogen content and good irrigation. Self-heal (*Prunella vulgaris*) is the most frequently found species (in 21.5 % of the samples) followed by knapweed (*Centaurea* sp.), common bugle (*Ajuga reptans*), meadow buttercup (*Ranunculis acris*) and oxeye daisy (*Leucanthemum vulgare*).
Open swards are characterised by soils poor in nutrients. In the plant assemblage we have evidence for poor calcareous swards and open swards of sandy and rocky ground. From the latter only five plant species are found representing mainly single items. The vegetation of calcareous grassland is slightly better represented. The most frequently found species are yellow trefoil (*Medicago lupulina*) (**fig. 7.8**) and bur medick (*Medicago minima*) (**fig. 7.8**). In the Upper Rhine region, natural drainage conditions, as sandy soils with a lower substrate of gravel, supply very dry soil conditions throughout the year[63]. The latter enables the sub Mediterranean grassland vegetation as found in Roman Oedenburg.
Most of the grassland plant species are sporadically found in all types of contexts, particularly in the area Civil East. The majority of grassland species in samples include few remains. It is likely that they reached the settlement adhering to human clothing and/or animal fur (e.g. the pod remains of yellow trefoil). However, samples from one 1st cent. AD pit (BK 99-04-01, and to a lesser extent in pit BK 01-04-24 and layer BK 02-04-55) in the area Civil East, have produced a large amount and variety of plant taxa growing in meadows, pastures and swards. These plant assemblages are exceptional in their composition in comparison to the other studied samples. It is likely that the deposits in Pit BK 99-04-01 derive from animal dung and/or fodder (see below).

[63] M. Moor, Einführung in die Vegetationskunde der Umgebung Basels in 30 Exkursionen. Lehrmittelverlag des Kantons Basel-Stadt (Basel 1962) 464.

Forest, forest edges and clearings

The vegetation of forests, forest edges, forest clearings and hedges is represented by 23 plant species[64] (21 waterlogged, 3 charred, 2 mineralised) (**tab. 3a, 3b** and **3c**). Waterlogged remains are found in 26.4 % of the samples, charred in 1 % of the samples, mineralised in 1.3 % of the samples (**fig. 7.5**). Most findings are dated to the 1st cent. AD, only few species are recorded in the 2nd cent. AD. On the whole they are present in small amounts, commonest are wild rose (*Rosa* sp.) and fir needles (*Abies alba*). The majority of the woodland species indicate the presence of floodplain forest such as common hops (*Humulus lupulus*) and guelder rose (*Viburnum opulus*) among others. The remaining woodland plants indicate the presence of dryer woodland with species as woodland calamint (*Calamintha menthifolia*) and common St. Johnswort (*Hypericum perforatum*). Some of the species grow near the excavated areas, others like fir (*Abies alba*) were most probably introduced from further distances like the Vosges mountains (about 40 km away).
In Roman Oedenburg, a whole range of plants growing in forests and forest edges are gathered for consumption. They have been mentioned above with the nuts and fruits (see above). They constitute the largest amount of woodland vegetation.

Aquatic, reeds and riverbank vegetation

Plants favouring wet environments are very frequent in Roman Oedenburg. A large part of the civil settlement was located in lower marshland. Consequently these plant taxa are most likely representing the local vegetation. 42 different plant species are found (42 waterlogged, 5 charred and 2 mineralised) (**tab. 3a, 3b** and **3c**). We distinguished between four habitats: plants growing in water, in reeds, on riverbanks and on wet meadows. However, these habitats can not be separated very strictly from one another, single species can easily grow in several of these four habitats.
Six aquatic plants are recorded. Waterlogged they are present in 16.9 % of the samples, charred in 1 % of the samples (**fig. 7.5**). They indicate rooted water plant communities with stagnant and/or slowly flowing water and are characteristic of nutrient rich and alkaline soils. Tropical hornwort (*Ceratophyllum* cf. *submersum*) and horned pondweed (*Zannichellia palustris*), both plants are today rarely found, point to the presence of muddy water. Many aquatics recovered originate from 1st cent. AD layers in the area Civil East. As discussed above, this area of the civil settlement was largely affected by flooding of the Rhine in the 1st cent. AD. Nonetheless, aquatic plants were also abundant in the ditches of the temple complex, particularly pondweed (*Potamogeton* sp.) and bur-reed (*Sparganium* sp.).
A second well represented wet environment is reed fields. Eighteen plant species are recorded. They represent a large part of the plant assemblage and are found throughout the whole civil settlement in all types of contexts. They are recorded in 80.5 % of the samples as waterlogged remains, 1.3 % as charred remains and 0.6 % as mineralised remains (**fig. 7.5**). As for the aquatic plants, the reed fields are characterized by nutrient rich and alkaline soils. We note the presence of tubular water-dropwort (*Oenanthe fistulosa*), a very rare plant today. It is present in 14.2 % of the studied samples, in all types of contexts except for postholes. It is a pioneering plant, thermophilic and grows in areas with changing water conditions. Findings of other currently rare plants include cowbane (*Cicuta virosa*) and great yellow cress (*Rorippa amphibia*). The majority

[64] These 23 plant taxa do not include the gathered food plants.

of the reed field taxa originate from the area Civil East and the Surroundings of the temple complex which is to be expected as these areas are prone to flooding of the Rhine.

A third group comprises the riverbank vegetation. Twelve plant species were recovered, some of which are very common, others rare. They are recorded in 42.1 % of the samples as waterlogged remains and in 0.3 % as charred remains (**fig. 7.5**). They are generally more abundant in layers, ditches than in pits. The riverbanks are characterised by nutrient rich and alkaline soils, rich in humus. Several plants are a sign for the presence of floodplains (e. g. water chickweed (*Myosoton aquaticum*) and common alder (*Alnus glutinosa*)). Among the rare plant species are threelobe beggarticks (*Bidens tripartita*) and water germander (*Teucrium scordium*). Threelobe beggarticks favours riverside environments but can also be found within the arable weed flora indicating wet patches within the fields. Water germander, today rarely found, is another plant species favouring very wet and flooded areas. The majority of the riverbank taxa are found in the area Civil East and the surroundings of the temple complex.

A last group in this category, are those plants growing in wet meadows. They include six plant species. They are recorded in 7.3 % of the samples as waterlogged remains (**fig. 7.5**). Apart from ragged robin (*Lychnis flos-cuculi*) (present in 4.2 % of the samples), they are not very common and present in less than 2 % of the samples. In addition, ragged robin also occurs in improved grassland. Therefore it is very plausible that the plant species found comprise isolated plants and do not indicate the presence of a wet meadow in the near vicinity.

RESULTS 2: CHARACTERISTICS OF PLANT ASSEMBLAGES WITHIN AREAS AND STRUCTURES

In the following chapter, we will discuss the contexts in which plant remains are found. As the three areas of excavation are very different in character, we decided to discuss the types of contexts for each area separately. Within each area, contexts are grouped according to type, preservation and plant assemblage. The following observations are based on the semi-quantitative dataset of plant macro remains[65].

Civil East

The area Civil East is characterised by its location adjacent to the military camp and its position under the current water level (**fig. 7.1; 7.9**). Hence, all studied samples originate from waterlogged sediments. Two time horizons have been defined within this area. They coincide with the 1st (Horizon 1) and 2nd cent. AD (Horizon 2). Samples are taken in pits and layers solely. In total, 145 samples from 27 structures are studied (**tab. 1a**). Samples which did not yield a significant assemblage of plant macro remains are not or only shortly mentioned in the text.

Layers in waterlogged sediments

Organic layers are dug in eight different locations of the excavated area. In total, 35 samples are recovered. They comprise of mainly waterlogged plant material, charred and mineralised remains are only rarely found.

65 Tables comprising the semi-quantitative recording are included in the appendix. In this table each sample is listed separately.

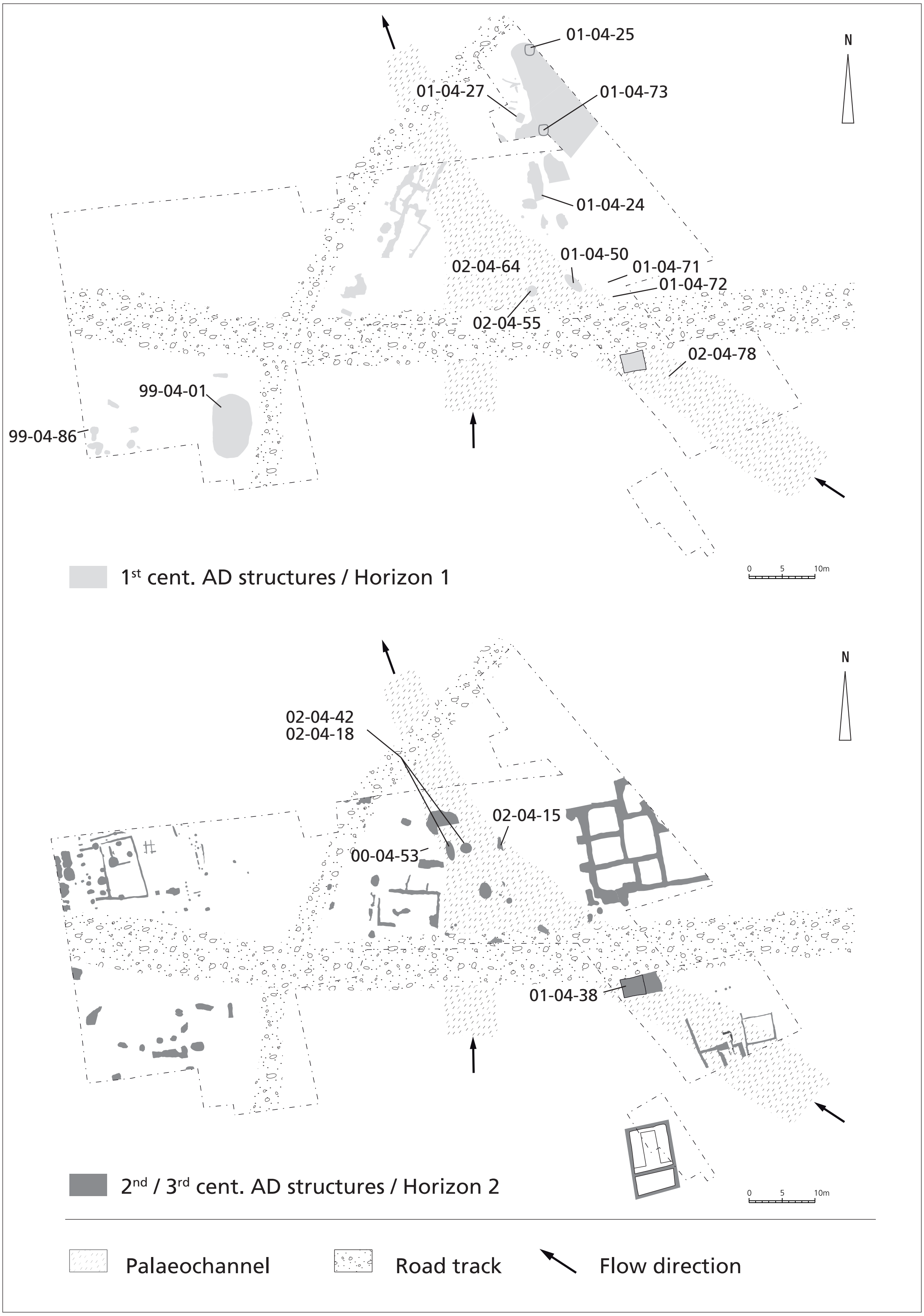

Fig. 7.9 Map of the area Civil East indicating those studied structures rich in plant macro remains.

They all date to the 1st cent. AD. Based on their composition of plant macro remains, we distinguish two types of layers.

– A first type consists of layers poor in plant macro remains (BK 01-04-50, BK 01-04-71 and BK 01-04-72) (**fig. 7.9**)[66]. Only few remains of cultivated plants are found. Cereal chaff fragments of mainly glume wheat, some spices (coriander and celery), some fig seeds and a single peach stone are recovered. Wild plant taxa include arable weeds and ruderal weeds as well as those growing on riverbanks and in reed fields. Only few charred and no mineralised remains are found. Characteristic for these layers is their neatly positioned grid of interlacing twigs. These twigs are mainly from willow (*Salix* sp.), poplar (*Populus* sp.) and alder (*Alnus* sp.), all of which are typical for floodplain forests and grow in the near vicinity of the river Rhine. Alder is also known for its qualities as a construction wood in wet environments[67]. Most of the recorded plant macro remains derive from natural deposits. They are indicators of the local environment. This would have been a moist area with soils rich in nitrogen, and open water nearby.

– A second type consists of layers rich in plant macro remains (BK 02-04-55, BK 02-04-64, BK 02-04-78) (**fig. 7.9**). The assemblage of waterlogged seeds and fruits is much more diverse and plentiful. The major difference to the first type of layers lies in the representation of cultivated and gathered plants. Large amounts of cereal chaff fragments (of spelt, emmer, einkorn and broomcorn millet) and small-seeded food plants are registered. They include spices, fruits and vegetables. In particular, remains of coriander, celery, amaranth, apple/pear, fig and grapevine are abundant. Large fruit stones are only rarely registered. The assemblage of wild plant taxa is in comparison to the first type of layers also more plentiful and diverse. It comprises primarily ruderal plants and weeds of winter cereal; especially weeds of the Caucalion alliance are recorded in large quantities. In addition plants growing on riverbanks and in reed fields are abundant. Charred plant remains, in particular charred chaff fragments, are found. No mineralised plant macro remains are registered.
In BK 02-04-55 we recorded cereal testa fragments and single findings of olive, bottle gourd and mulberry. In the bottom layers of BK 02-04-55 we recorded remains of grassland vegetation. The latter are very scarcely found in Roman Oedenburg, and almost exclusively found within one pit (BK 99-04-01; see below). Characteristic for these layers (except BK 02-04-78) are, besides the waterlogged twigs and branches, the many fragments of wood debris. These fragments of wood debris often represent unfinished artefacts, waste of construction material and partially burnt fragments. The wood species are much more varied and other than the species mentioned above. Remains of silver fir (*Abies alba*), Norway spruce (*Picea abies*), maple (*Acer* sp.), hazelnut (*Corylus avellana*), oak (*Quercus* sp.), birch (*Betula* sp.) and common beech (*Fagus sylvatica*) are found[68]. In addition, ceramics, bone fragments and remains of metal working (e.g. slag) are found in this area.
In contrast to the first type of layers, the deposits in layers BK 02-04-55 and BK 02-04-64 represent a mixture of human and natural deposits. Both of these layers include a variety of waste products.

66 Two other layers are recorded as poor in plant macro remains (BK 02-04-65 and BK 02-04-67). Their sample composition is different. They do not contain twigs and branches; BK 02-04-65 yielded hardly any plant macro remains; in BK 02-04-67 the majority consists of charred cereal grains and chaff. Both of their plant assemblage are not very significant and most likely represent settlement noise.

67 See chapter 8.

68 See chapter 8.

Pits in waterlogged sediments

Hundred and six samples from nineteen pits are studied. Most pits are multiply sampled. Of these pits, twelve are dated to the 1st cent. AD, five to the 2nd cent. AD, one is not more precisely dated than »Roman period«. On the whole, the amount of macro plant remains recovered from these eighteen pits is very variable. In the following we distinguish five types of pits based on their content of plant macro remains.

– A first type of pits includes those with a poor representation of plant macro remains (BK 01-04-08, BK 01-04-14, BK 01-04-15, BK 01-04-02, BK 01-04-33, BK 02-04-18, BK 02-04-40, BK 02-04-42). They consist of waterlogged remains mainly, in addition some charred cereal grain and very few or no mineralised remains are recorded. The waterlogged remains comprise small numbers of wild plant taxa. They represent ruderal vegetation and reed fields. Remains of edible plants are rare; they include hazelnut shell, glumes of millet and elderberries. Two of these pits showed a somewhat more diverse plant spectrum. It consists of pit BK 02-04-42 which has yielded seeds of fig and grapevine; and BK 01-04-02 which yielded more edible plants in the bottom layers of the pit (US 07).
All of these pits are described by the archaeologists as refuse pits. It is very likely that the plant remains recovered from these pits do not originate from the primary fill of the pit, but rather from a secondary deposit of waste material. As indicators for human deposits are slight, we consider them as settlement noise (see below). Furthermore, remains of the local vegetation which was moist and nutrient rich, are found.

– A second type of pits comprises only one pit (BK 99-04-01) (**fig. 7.9**). It is characterised by a rich assemblage of plant macro remains of mainly wild weeds. All studied samples originate from the lowest layer of this pit and yielded very compact waterlogged organic material in which many culms were found. Charred and mineralised plant material is nearly absent. Waterlogged seeds and fruits on the contrary are abundant. The large majority of the seeds and fruits represent wild weeds; edible plants form only a minor part. The latter comprise above all cereal chaff remains (barley, spelt and broomcorn millet), vegetables (carrot, cabbage and bottle gourd) and spices (coriander, celery and summer savory). No fruits are recorded. The spectrum of wild weeds is very diverse. Cereal weeds, ruderal plants and weeds of reed fields and riverbanks are recorded. However, in comparison to all plant assemblages recovered in Roman Oedenburg its richness in plant species growing in meadows, pastures and open swards is unique. Therefore, the plant assemblage of this pit is of much interest. First of all, almost exclusively wild weeds are recovered; and second the sample composition before sieving was very characteristic and exclusive in Oedenburg. The samples were very compacted, composed of organic material only, homogenous in their composition and lots of large vegetative remains as stems were visible. These different features suggest that we are dealing here with the remains of stable manure and/or litter (see below). Similar deposits were identified in two wells in the Roman fort of Welzheim (G)[69].

– A third type of pits is characterised by a rich and diverse assemblage of plant macro remains of mainly edible plant species. It involves five pits dated to the 1st cent. AD (BK 01-04-86, BK 01-04-24, BK 01-04-27, BK 01-04-73, BK 02-04-140) and two dated to the 2nd cent. AD (BK 01-04-38, BK 01-04-53) (**fig. 7.9**).

[69] U. Körber-Grohne / U. Piening, Die Pflanzenreste aus dem Ostkastell von Welzheim mit besonderer Berücksichtigung der Graslandpflanzen. In: U. Körber-Grohne / M. Kokabi / U. Piening / D. Planck (eds.), Flora und Fauna im Ostkastell von Welzheim. Forschungen und Berichte zur Vor- und Frühgeschichte in Baden-Württemberg 14 (Stuttgart 1983) 17-88.

These pits yielded a large quantity of organic vegetative material composed of mainly waterlogged remains. Mineralised remains are present. Charred remains were rather scarce and contain almost exclusively cereal grains and chaff. For all pits, remains of economic plants constitute a large part of the plant assemblage. Characteristic of all these plant assemblages is the abundance of small-seeded food plants (both waterlogged and mineralised). They include cereals (millet), spices (coriander, celery), vegetables (amaranth and beet), and many fruits (figs, wild strawberry, apple/pear, cape gooseberry, grapevine). Large fruit stones of mainly cherry and plum are attested too. Cereal chaff is recovered from all pits, cereal testae are recovered from four of the pits. Pulses are not common among the findings. Findings of wild weeds include species of the arable weed flora and the ruderal vegetation. In particular findings of corn cockle are abundant. Other wild plants indicating the local wet environment are scarce.
Within this group two pits need further consideration while they were extremely rich in plant macro remains. The first pit (BK 01-04-24) is large and quadrangular in shape and dated to the 1st cent. AD. The studied samples originate from each layer from top to bottom. Single findings of aniseed and pepper are registered. Many food plants are recorded. Towards the bottom layers more cereal chaff and weeds of winter cereal are recorded; grassland species (which is rather unusual) and more wetland species are registered. In these bottom layers we discern similarities with the plant assemblage of the fill of pit BK 99-04-01, belonging to our »type two« pit. The second pit (BK 01-04-38) is quadrangular and of a very regular shape (3.5 m × 2.8 m). Wooden planks constructed on wooden posts were found at the bottom of this pit. It has been interpreted as a possible cellar and is dated to the 2nd cent. AD. The fill of this pit is extremely rich in plant macro remains. In comparison to other pits, many »exotic« plant species are found. These »exotics« include olive, melon/cucumber, bottle gourd and mulberry. Besides, a variety and abundance of mineralised remains were recorded. These are above all edible plants, including large amounts of pulses (mainly broad bean and other unidentified Fabaceae) and very rare plant taxa as e.g. the spice black cumin.
We conclude that the plant assemblage recovered from the third type of pits is dominated by the presence of human waste material. It is clear that the fills of these pits represent waste material of many different origins. Clear indicators for the presence of faecal remains are found, too (see below). Whether these deposits represent primary or secondary deposits is hard to identify. Nonetheless, it is clear that waste materials other than faecal material are also discarded in the pits.

– A fourth type is characterised by a rich assemblage of plant macro remains of cultivated and wild plants. It includes one pit (BK 02-04-15) which dates to the 2nd cent. AD (**fig. 7.9**). Contrary to the third type of pits, no evidence of faecal remains is found and many indicators of the local wet environment are found. The plant assemblage of this pit is composed of waterlogged remains only. Cereal chaff of mainly glume wheat is abundant as are nuts (walnut), grapevine and vegetables. In addition there are findings of olive stones and a single peppercorn. Wild weeds include weeds of winter cereal, summer crops and ruderal vegetation. From the archaeobotanical analysis we conclude that most of the plant remains made their way into this deposit as refuse material. It is unlikely that any latrine deposits were dumped. This structure should be interpreted as a refuse pit, where waste of cultural activity was deposited (cooking, crop processing among others). The local environment was wet and eutrophic. Many of the recorded food products were imported from the Mediterranean region.

– A fifth type includes one pit (BK 01-04-25) (**fig. 7.9**). It is characterised by a plant assemblage of mainly cereal remains and wild weeds. Contrary to the third and fourth type of pits, hardly any remains of fruits are discovered. Other edible plants are equally scarce. The majority of plant macro remains consists of waterlogged seeds and fruits of ruderal plants and plants of the arable weed flora. No clear indications to the nature of the deposit are discernable. This pit is likely to be used as a refuse pit for crop processing debris.

Conclusion

Based on the plant macro remains, we conclude that the area Civil East is one of intense human activity. From the archaeological evidence it is hard to distinguish whether the plant assemblages derive from primary or secondary deposited material. Nonetheless it is clear that a wide range of waste products from cultural activity are dumped at some point in the pits and layers in this area. On the one hand the local population needed to get rid of their rubbish, on the other hand they possibly tried to stabilize and manage the marshland by throwing waste in the course of the palaeochannels (layers). The latter is also suggested by the many twigs and branches recovered from these layers.
The plant spectrum recovered in the area Civil East ascertains that the local population had access to a very wide range of food plants. Comparing the semi-quantitative data of plant macro remains from 1st cent. AD structures with those from the 2nd cent. AD structures, we can observe changes towards the 2nd cent. AD. Imported food plants as e.g. melon, cucumber, olive and mulberry represent rare findings in the 1st cent. AD; in the 2nd cent. AD they are much more numerous (see below). Thus after the abandonment of the military camp around 70 AD the influence of Roman culture is still perceptible. Or is it a consequence of the beginnings of local cultivation of certain food plants (see below) ?

Temple complex

In the temple complex, a hundred and one samples from 30 structures are studied (**tab. 1b; fig. 7.1; 7.7**). The studied samples originate from dry as well as waterlogged sediments. Chronologically they can be attributed to five different phases. In this overview we have only included those contexts which have yielded plant macro remains.

Contexts in waterlogged sediments

Within the waterlogged sediments, two ditches and several layers have been sampled. The ditches form an important part of the temple complex. One represents the enclosing ditch of the temple area (BK 04-05-49), the other presumably functioned as a drainage channel (BK 03-05-16). Layers and the contents of ditches are discussed together as similarities between deposits are observed.
The majority of contexts belongs to Phase 1 (3/4 to 75/80 AD) (layers BK 03-05-53, BK 03-05-56 and BK 04-05-32; ditch BK 04-05-49), two layers to Phase 2 (75/80 AD to 120 AD) (BK 03-05-75, BK 04-05-02), and a ditch to Phases 3 to 5 (from 120 AD onwards) (BK 03-05-16) (see chapter 2). Based on the composition and abundance of plant macro remains, we discern different deposits.

– A first group of contexts is characterised by a low density but large variety of plant macro remains including cultivated plants. Such a botanical sample composition can be observed in layers BK 03-05-53, BK 04-05-32, BK 03-05-75, BK 04-05-02 and the ditch BK 04-05-49 (**fig. 7.10**). The majority of plant remains is preserved through waterlogging, in addition few charred remains are recorded. The plant assemblage is composed of

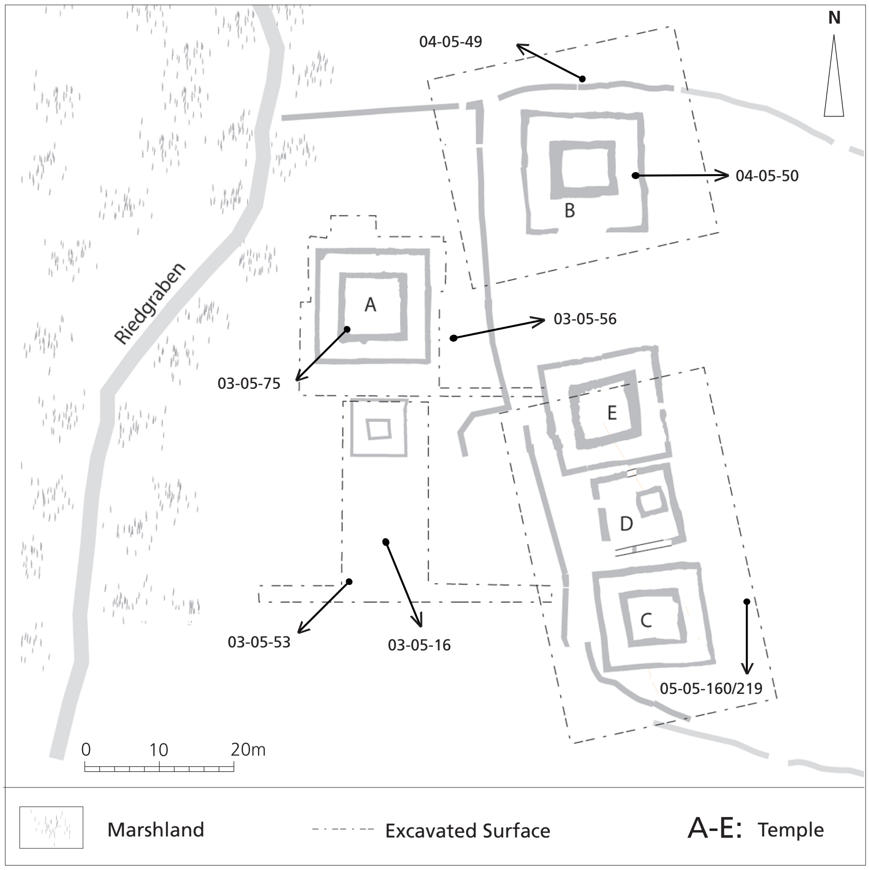

Fig. 7.10 Map of the Temple complex indicating those studied structures rich in plant macro remains (after C. Schucany / P.-A. Schwarz in chapter 2, **fig 2.1**).

small numbers of wild weeds and economic plants. The greater part of the useful and/or edible plants are fruits (fig, pear, peach, elderberry and grapevine) and hazelnut. The wild weeds include cereal weeds and plants representing ruderal vegetation and reed fields. In BK 03-05-53 and BK 03-05-75 one seed of a bottle gourd was found respectively; in BK 04-05-49 few remains of walnut and cereal (chaff fragments of millet and glume wheat) were recorded[70]. In BK 03-05-75 less fruits were recorded.

We conclude that a wide range of well-preserved plants were found in these deposits, originating from human activity and the local vegetation. In comparison to waterlogged deposits in the other areas of excavation, only small numbers of plant macro remains are recorded; especially food plants are scarce. This could indicate that this area of the settlement was only frequented for special occasions and not for disposal of debris.

[70] Towards the bottom of the ditch more waterlogged organic material is preserved, resulting in a more diverse spectrum of plants in the lowest layers, e. g. cereal remains and cultural plants originate from the lower levels only. The difference between the upper and the lower part of the fill of the ditch has to be interpreted as a consequence of conditions of preservation, a tendency which is also observed in the pollen spectrum of the ditch (L.Wick pers. Comm.).

– A second group of deposits is characterised by a low density of plant macro remains including gathered plants and wild weeds. These deposits are observed in the filling of the drainage ditch (BK 03-05-16) (**fig. 7.10**; **2.68**). The fill of the ditch is characterised by its dark colour and high organic content. Both the upper and lower layer has been intensively sampled. The plant remains represent what was growing in and around the ditch. A wide range of aquatic and riverbank plants gives away the marshy nature of the area. It is very likely that the ditch was filled with water most of the time. The small numbers of above all gathered edible plants (hazelnut, elderberry, winter-cherry) and cereal weeds could indicate that some human waste material ended up in the ditch. It represents most likely secondary deposits. According to the small number of waste material, the ditch must have been kept fairly clean.

– A third group of deposits includes those very poor in plant macro remains. They include the layer BK 03-05-56 (**fig. 7.10**) and postholes BK 04-05-138 and BK 04-05-139 belonging to Phase 1, posthole BK 03-05-65 dated to Phase 2 and the layers BK 03-05-38 and BK 03-05-39 belonging to Phase 3. All studied samples have yielded very few plant macro remains originating from natural deposits of the local vegetation.

Contexts in dry sediments

In the dry sediments there is a clear distinction between those contexts rich and those poor in plant macro remains[71].

– Contexts poor in plant macro remains include two layers (BK 04-05-17, BK 04-05-19) and ten postholes (BK 04-05-63, BK 04-05-80, BK 04-05-83, BK 04-05-84, BK 04-05-86, BK 04-05-88, BK 04-05-106, BK 04-05-123, BK 04-05-135, BK 05-05-174) both belonging to Phases 1 and 2 (1st and 2nd cent. AD). All of these contexts are located on a gravel terrace. The composition of the samples is very similar. Only few charred plant macro remains have been recovered. They include primarily cereal grains, hazelnut shell and a few wild weeds. The plant assemblage is too small to make any inferences; they most likely represent settlement noise, no area of particular use could be defined.
Three other deposits were also poor in plant macro remains. All of these were related to sacrificial practices and include a deposit of arms (BK 05-05-211) and the contents of two ceramic vessels (BK 05-05-180 US35 and 48). The few charred plant remains represent secondary deposits and are not connected to offering. In BK 05-05-180 US 35 one fragment of stone pine nut, fruit flesh of fig and some fragments of unidentified fruit flesh were found. Although the remainder are typical for vegetable offerings in Roman times, no traces of fire are observed within this area. It is likely that they derive from surrounding structures.

– Contexts rich in plant macro remains include one layer (BK 04-05-50) belonging to Phase 3 (120 AD to 130/140 AD) and one pit (BK 05-05-160/219) belonging to Phase 4 (130/140 AD to 160/170 AD) (**fig. 7.10**; **fig. 2.95 to 2.109**). Both contexts are characterised by their dark ashy nature. Charcoal, charred fruit flesh and/or charred processed food are predominant in the samples. In addition charred seeds and fruits of mainly cultivated plants are recovered. They comprise cereal grains (naked wheat and barley), pulses (lentil,

[71] Five contexts are not considered as they yielded hardly any plant macro remains. These are BK 04-05-137, BK 04-05-92, BK 04-05-12, BK 04-05-66, BK 04-05-70.

pea and broad bean), nuts (stone pine nut, walnut and hazelnut), fruits (fig, date, peach and grape) and a clove of garlic (**fig. 7.6**). Hardly any wild plants are found. The plant assemblages recovered from these two contexts are unique in Roman Oedenburg. They represent primary deposits. From the plant macro remains, it is clear that both represent the remains of vegetable offerings (see below).

Conclusion

In comparison to the other areas of excavation, most of the samples from the temple complex are poor in plant macro remains both in waterlogged and dry sediments. It is likely that they derive from settlement noise and do not represent intentional human deposition. As plant remains are scarce, inferences about chronological changes within the temple complex are not possible.

The only exceptions to these conclusions are the two contexts rich in charred plant macro remains. It is clear that these contexts are both related to sacrificial practices. Their plant assemblages are the result of intentional fire. The sacrificial nature of the pit (BK 05-05-160/219) was visible from the start due to the abundance of small ceramic vessels (89 were recovered), the large chunks of charcoal and the large fragments of charred processed food within its deposits. It is confirmed that the remains in the pit evolve from a single event. The nature of the layer (BK 04-05-50) is only discovered after archaeobotanical analysis of its content. The plant macro remains in this layer have possibly accumulated over time[72]. From our analysis, it becomes clear that some food plants were exclusively used for sacrificial practices. Findings of date, garlic and stone pine[73] are restricted to the temple complex.

Surroundings of the temple complex

The area »Surroundings of the temple complex« is defined as the area immediately to the North of the temple complex (**fig. 7.1; 7.8**). Here, sixty two samples from 23 structures were studied (**tab. 7.1c**). They include pits, layers in and around palaeochannels, as well as a large quadrangular basin. All are located in waterlogged deposits. Few structures are dated to the 1st cent. AD, the majority no more detailed than »Roman period – not specified«.

Waterlogged layers

Based on the composition of plant remains, we differentiate between three types of layers.

– A first type of layers is characterised by a rich assemblage of plant macro remains of mainly cereal chaff and wild weeds. Three layers located in the western part of the excavated area have yielded such an assemblage. They include a floor level (BK 03-09-166), a wattle structure (BK 03-09-163) and a trial trench through a palaeochannel (BK 03-09-Son26) (**fig. 7.11**). The first two are dated in the 1st cent. AD, the latter is not precisely dated. Their plant assemblages are dominated by waterlogged plant macro remains, charred and mineralised remains are absent. Cereal remains and wild weeds stand out in the samples.

[72] See chapter 2.

[73] A single stone pine nut was found in the area Surrounding the temple complex.

In layers BK 03-09-166 and BK 03-09-163 glumed grains of broomcorn millet, followed by rachis fragments of barley and other unidentified cereals are predominant. Other seeds and fruits are scarce. They include cereal weeds, ruderal plants, riverbank plants and meadow plants.

In layer BK 03-09-Son26 rachis fragments of barley and rye followed by glumed grains of millet are recorded. Few fragments of glume wheat chaff are found. Weeds of winter cereals are abundant, with an extremely high number of corn cockle (*Agrostemma githago*), carrot bur parsley (*Caucalis platycarpos*) and corn chamomile seeds (*Anthemis arvensis*).

It is clear that the layers in and around the palaeochannels are used to dispose of waste material as has been observed in the area Civil East. Particularly the disposal of cereal waste products is observed in these layers. In comparison to the area Civil East where glume wheat is abundant, we remark here the presence of other cereal species (rye, barley and millet). Also significant is the abundance of very well preserved millet grains. In such large amounts millet grains were only registered in a 2nd cent. AD pit in the area Civil East. In the present floor layer, it is likely that we are dealing with some kind of storage facilities. However, no other indications are found for this hypothesis.

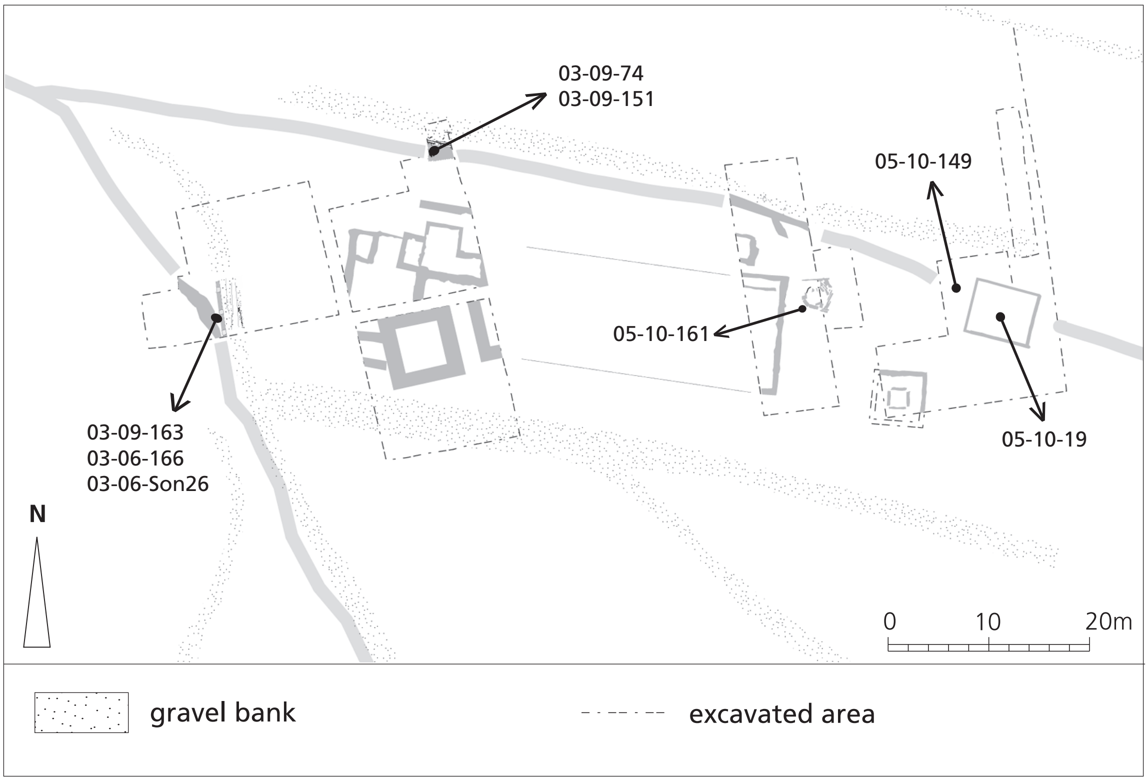

Fig. 7.11 Map of the Surroundings of the temple complex indicating those studied structures rich in plant macro remains.

– A second type of layers is characterised by a rich assemblage of above all cultivated plants. Three layers are dated to the 1st cent. AD (BK 03-09-74, BK 03-09-212, BK 05-10-310), the remaining could not be dated precisely (BK 03-09-151, BK 10-05-149) (**fig. 7.11**). The waterlogged plant macro remains, mainly seeds, are plentiful and very diverse in these layers. They compile an extensive list of species of which the economic plants form the largest share. The edible and/or useful plants include nuts, vegetables, spices and fruits, especially small-seeded food plants are present. Waterlogged cereals are not so common, only few chaff fragments of millet and spelt are documented. Then again cereal weeds are very numerous. By far the most frequent are the weeds of winter cereals from the Caucalion alliance. Other wild weeds include ruderal plants and less abundant are plants preferring riverbank and reed field environments, forests or meadows.
In BK 03-09-74, we note the presence of many »exotic« plants remains (olive, melon/cucumber and seeds and the nearly complete fruit of a bottle gourd). Remarkably is also the finding of safflower seeds (*Carthamus tinctorius*). Charred plant macro remains are plentiful. The plant assemblage in this layer is comparable to the extremely rich plant assemblages recovered from pits in the area Civil East.
In BK 03-09-151plant macro remains represent almost exclusively edible plants. We note the abundance of waterlogged cereal bran fragments as well as mineralised remains of millet, lentil, broad bean and grape. Except for some ruderals and plants favouring humid environments, wild weeds are scarce.
In BK 05-10-149 we remark the presence of a single waterlogged stone pine nut. It represents the only waterlogged find of stone pine in Roman Oedenburg.
Edible and/or useful plants made up for the majority of the seeds and fruits in this type of layers. It is clear that a mixture of waste products is discarded of in this area.

– A last group of layers is poor in the representation of plant macro remains. They are layers BK 05-10-308, BK 03-09-67 and BK 05-10-168. It is thought that most of the plant remains derive from natural deposits of its immediate surroundings.

Pits in waterlogged sediments

Eight samples from seven pits are analysed. They include three pits dated to the 1st cent. AD (BK 03-09-29, BK 03-09-193, BK 03-09-194) and four which are not more precisely dated than Roman period (BK 03-09-89, BK 03-09-90, BK 03-09-129, BK 05-10-161). On the whole, the studied samples from these pits do not yield a significant plant assemblage. They are very poor in plant remains, the latter included waterlogged as well as charred remains. These charred remains are mainly single findings of cereal chaff and grains.
In pit BK 03-09-194 a slightly more diverse spectrum was recorded, with some spices and cereal weeds. The plant assemblage recovered from pit BK 03-09-129 is also more abundant and diverse. It includes few waterlogged cereal chaff remains, some fruits (fig, grapevine and mulberry) and some ruderal plants.
One pit represents a monumental stone well (BK 05-10-161). Due to safety hazards the well could not be excavated entirely. It is thought to be related to sacrificial practices. Its plant assemblage is dominated by waterlogged remains of above all aquatic and ruderal plants. Economic plants are rather scarce, only waterlogged hazelnut shell and charred cereal grain are recorded. It is clear that the studied plant spectrum does not indicate any sacrificial practices but derives from the immediate surroundings of the well and secondary deposits of waste.

Basin

Several samples taken in a trial trench (BK 05-10-Son19) within a large quadrangular basin were studied (**fig. 7.11**). The basin itself is constructed in the 1st cent. AD. The side walls consist of very large wooden planks of oak. The samples taken in the fill of the basin are mainly of very dark organic material (like peat). Lots of very thin vegetative material is recovered. Plant macro remains are not abundant and include mainly aquatic plants and plants favouring wet environments. The aquatic plants indicate the presence of standing or slowly flowing water. As aquatic plants are found throughout the whole trial trench, it is thought that the basin was always more or less filled with water. In addition to the aquatic plants, ruderal plants are found and some economic plants especially towards the bottom of the basin. The majority of plant remains represent the vegetation within and in the near vicinity of the basin. Indication to the function of this basin could not be detected through the study of its plant macro remains.

Trench 08

Two samples taken in Roman layers in Trench 08 were studied (**fig. 7.1**). The plant assemblage recovered from these deposits is similar to those found in pits and cultural layers in the area Civil East. They are mainly composed of waterlogged plant macro remains; no mineralised or charred remains were recovered. The presence of grapevine and peach confirms its date in the Roman period.

Conclusion

The area »Surroundings of the temple complex« includes a large variety of contexts of which the coherence and chronology is not entirely clear. As in the area Civil East, we observe the practice of waste disposal within palaeochannels. The samples from pits are rather poor in plant macro remains. The plant spectrum is varied, although different to the other areas of excavation (see below). The plant assemblages of some contexts are very rich. In this area of excavation, no evidence of sacrificial practices is found through the study of plant macro remains.

DISCUSSION

Interpretation of archaeobotanical assemblages

Deposition of plant remains within archaeological structures is of two natures. It can be thanatocoenoses that is it is formed in the course of its deposition and consists of plants of different origins. Or else it can be palaeo-biocoenoses, where plant species grow together at the place of deposition or they are collectively brought to their place of deposition (e. g. cultivated plants and weeds)[74]. In Roman Oedenburg the majority

[74] Willerding 1991 (footnote 35) 25-51.

of plant assemblages are thanatocoenoses. They represent a mixture of different deposits. These include human as well as natural origins.
In the following we aim to define the origin of the plant remains within the archaeological deposits.

Waste disposal

The majority of plant macro remains recovered in the Roman-period structures is part of waste products from human activity. These waste products range from kitchen refuse to crop processing debris to faecal material. As discussed above, it is clear that pits and palaeochannels are used to dispose of waste. Based on the occurrence of plant taxa/parts, preservation and abundance of seeds/fruits, we distinguish different types of deposits. Our observations are based on the groups made by Hellwig[75] for the interpretation of archaeological plant assemblages.

– A first type of deposit is faecal remains. Within these deposits, we find mainly those parts of plants that are used for consumption and consequently survive the digestion process. The latter has a strong influence on the representation of plant taxa. Due to the digestion process a whole range of food plants is not or scarcely attested in faecal deposits. They include those plants of which only the leaves and roots are consumed (e.g. salads and vegetables).
In Roman Oedenburg we define faecal material by the presence of a large abundance of cereal bran fragments, stone cells of pear, pericarp of apple/pear, small-seeded food plants and compacted organic concretions. The plant macro remains within these faecal deposits are waterlogged as well as mineralised. Cereal bran fragments are the remains of cereal grains which have passed through the intestinal tract. The small-seeded food plants include mainly fruits (e.g. fig, wild strawberry), spices (e.g. celery, coriander) and millet grains. The compacted organic concretions are often mineralised. In its texture small seeds of edible plants and cereal bran fragments can be observed. They possibly represent parts of human coprolites[76]. In addition to plant macro remains, faecal deposits often yield large amounts of fly pupae and other small zoological remains (see chapter 9).
Samples including latrine deposits are mainly identified in pits in the area Civil East (1^{st} cent. AD (BK 01-04-86, BK 01-04-24, BK 01-04-27, BK 01-04-73, BK 02-04-140); 2^{nd} cent. AD (BK 01-04-38, BK 01-04-53)) and in two layers in the Surroundings of the temple complex (BK 03-09-74 and BK 03-09-151). Whether these present primary or secondary deposits is hard to tell from the plant macro remains. It is clear however that those contexts containing latrine waste are used for other kinds of waste disposal, too. The plant assemblage of such contexts including latrine deposits, have yielded the richest and most diverse spectrum of edible plants.

– A second type of deposit indicates the presence of kitchen refuse. This group is characterised by the presence of charcoal, charred cereal grains and charred wild weeds, additionally larger fruit stones (e.g. peach, plum etc.) and nutshells are usually found[77]. Besides kitchen refuse, we classify these plant remains

[75] M. Hellwig, Botanischer Beitrag zur Funktionsanalyse an mittelalterlichen Feuchtsedimenten aus Braunschweig. Nachr. Niedersachsen Urgesch. 58, 1989, 267-271.

[76] Such concretions were also frequently attested in a latrine deposit in Eschenz; see Feigenwinter 1997 (footnote 2) 21-28.

[77] Hellwig 1989 (footnote 76) 267-271.

in Roman Oedenburg under »settlement noise«, indicating the vicinity of living quarters and thus cultural activity. These deposits include only small quantities of plant macro remains. This type of deposit is identified in the majority of structures in the three areas of excavation.

– A third type of deposit is characterised by the presence of many arable weeds and cereal chaff. Hellwig[78] questions their origin as remains of crop processing and suggests that these could have originated from faecal remains especially due to presence of the larger arable weeds as corn cockle and cornflower. In Oedenburg however it is clear that the assemblages of cereal chaff and arable weeds represent part of crop processing activities as hardly any other indicators for faecal material are found within these assemblages. In addition arable weeds are often introduced to settlement areas with the harvest[79]. These types of deposits are predominantly recovered from organic layers in and at the edges of palaeochannels (e.g. BK 02-04-55, BK 02-04-78, BK 03-09-163, BK 03-09-166, BK 03-09-Son26). In the area Civil East, the cereals include mainly glume wheat. In the Surroundings of the temple complex, rachis fragments of barley and glumes of broomcorn millet dominate in the samples. From the contextual evidence it is not clear whether or not these cereal remains represent local crop processing activity or are deposited for other reasons (wetland management – see below).

– A fourth type of deposit includes above all ruderal plants or wild plants growing in gardens[80]. In Oedenburg, we add plants favouring wet environments as riverbanks and reeds to this deposit. This fourth group of plants are not of any use but mainly represent the local environment. Within the waterlogged layers in the area Civil East and the Surroundings of the temple complex, a large part of the plant assemblage derives from the local vegetation. This environment was largely influenced by human occupation (the ruderal vegetation is well-represented) and the presence of water.

– A fifth type of plant assemblage in Roman Oedenburg is composed of almost exclusively wild plant taxa. One pit structure (BK 99-04-01) in the area Civil East is composed almost uniformly of such deposits. Its content is characterised by very compacted organic material including a lot of straw-like plant material. It is thought that they derive from cereals; however, the identification of the stems was not taken any further yet, therefore they may also originate from wild grasses. The seeds and fruits in the deposit include mainly plants growing in cultivated meadow and pasture communities, in addition to many other wild plant taxa. In particular reed fields (e.g. sedges) are well-represented. Of the plant taxa, not only seeds and/or fruits were found but also other vegetative parts as chalices, pods and perianths etc. Their preservation was outstanding. Usually remains of the grassland vegetation reach settlement areas as part of hay or dung. One possible interpretation for this fifth type of deposits is that it originates from animal dung. However, a close inspection of the unsieved material does not confirm this[81]. In addition no mineralised plant remains are recorded. Another hypothesis could be that they derive from hay or bedding from stables – maybe mixed with dung – which is more plausible[82]. Archaeobotanical examination of two well deposits in the Roman fort East of Welzheim provided a similar plant assemblage where grassland taxa dominate the assemblage.

[78] Hellwig 1989 (footnote 76) 267-271.
[79] Jacomet/Kreuz 1999 (footnote 7) 76ff.
[80] Hellwig 1989 (footnote 76) 267-271.
[81] M. Kühn pers. comm.
[82] Future detailed inspection (e.g. a thin section) of these sediments could possibly add to the understanding of this deposit.

In addition, this deposit fits well in the indicator group[83] defined by Kenward and Hall[84] for the identification of stable manure in archaeological deposits. According to them, stable manure is characterised by a high organic content, straw-like plant material, characteristic decomposer insects, hay-meadow plants and insects, cereal remains, twigs and leaves among others. Considering these indicators and the results of the Welzheim deposit, we suggest we are dealing with stable manure which contained a mix of bedding and hay. It could have originated from horse stables which must have existed with the presence of the military.

Wetland management

The Roman settlement of Oedenburg was installed at the beginning of the 1st cent. AD in the alluvial plains of the river Rhine. At that time, the landscape was composed of many palaeochannels crossing the settlement area, small islands and river terraces[85]. Large parts of the civil settlement are thus located in marshland where water was a constant threat. In the plant spectrum, this is particularly discernible in the area Civil East. It is thought that in this area of excavation, brushwood matting was deposited in order to drain this marshland area [86]. Periods of heavy rainfall during the excavation seasons have shown that these brushwood matting are very effective to walk on and to keep ones feet dry. Evidence of brushwood matting was found in the organic layers. As discussed, two types of organic layers are excavated (see above). The first type is characterised by the presence of many twigs and branches, few other plant macro remains; the second type is characterised by the presence of twigs, branches, debris of woodworking and many other plant macro remains. They include large amounts of cereal chaff and cereal weeds among other plant macro remains. Cereal weeds are normally introduced to the settlement as part of the harvest. On the one hand it is plausible that activity related to cereal processing has taken place in this area; it is also possible that remains of crop processing activity are brought to this area to serve for drainage purposes[87]. On the other hand the cereal chaff fragments and arable weeds could also be part of an accumulation of general waste disposal. The dumping of waste material in rivers or watercourses is known from the Roman *vicus* in Solothurn Vigier[88] and the Roman town at Xanten[89]. Besides drainage purposes, the deposition of waste material could have served to level the underground for the installation of a new floor. During the excavation season of 2009 in the vicus of Eschenz/Tasgetium/CH, such foundations filled with waste and cereal by-products were found[90].

[83] Kenward/Hall 1997 (footnote 20) 665f.: »An indicator group is thus a colleczion of recordable data of any kind which when occurring together, can be accepted as evidence of some past state or activity«.

[84] Kenward/Hall 1997 (footnote 20) 663ff.

[85] See Reddé 2007 (footnote 11).

[86] see chapter 5.

[87] In this context, the presence of cereal rachis fragments and arable weeds in the palaeochannels in the area to the East of Altkirch (see 7.3.5.3.1) can be explained as drainage material.

[88] S. Jacomet / C. Wagner / K. Wacker Feigenwinter / N. Felice / H. Albrecht, Samen und Früchte aus vorrömischen, römerzeitlichen und mittelalterlichen Ablagerungen in der Altstadt von Solothurn (Schweiz), Areale Vigier und Klosterplatz. Unpublished manuscript, 1993.

[89] Knörzer 1981 (footnote 22) 176.

[90] S. Jacomet pers. comm., results of the archaeobiological field course 2009 organised by the IPNA (University of Basel).

The temple complex and its vicinities

In the temple complex, the majority of samples have yielded few plant macro remains. We have interpreted these remains as part of the local vegetation and as indicators of adjoining living quarters. We did not record the intentional deposition of large amounts of waste material as observed in other parts of the civil settlement. We did however record intentional deposition of plant remains as part of sacrificial practices.
Based on contextual evidence (location within temple complex) and plant assemblage, we identified the remains of vegetable offerings in a hearth and a pit[91]. Vegetable offerings are characterised through plants that are not usually in contact with fire for their consumption. In addition stone pine, date, fig, cereal and pulses among others are very frequently found as part of Roman vegetable offerings in sacred areas such as temples[92] and graves[93]. The plant assemblage from the offering pit and hearth in Oedenburg is characterised by large fragments of charred fruit flesh and/or charred processed food. The charred processed food probably derives from bread and/or pastry. Parts of the charred fruit flesh could be identified as date and fig. The remaining vegetable remains include seeds and fruits of cultivated plants which are typical for Roman offerings. An evaluation of fourteen archaeobotanical studies undertaken in sacrificial contexts in the Roman Empire has shown that the list of offering plants in Oedenburg is extensive in comparison to the majority of sites[94]. This is mainly due to the recovering techniques used at the temple sites[95]. From this evaluation we infer that stone pine, date and fig are most frequently found as part of vegetable offerings. Nuts other than stone pine, cereals and pulses are recovered when soil samples are processed. It is therefore thought that they represent an equally important part of the offerings and that the predominance of stone pine, date and fig at most of the other sites can be explained by a bias created through the method of collection of plant macro remains. In general, we conclude that the vegetable offerings recovered in Oedenburg are similar to the findings in other sacrificial sites in the Roman Empire. Furthermore, we note that plants used for offering are similar or even identical throughout the Roman Empire regardless of the location of the site[96].
In Roman Oedenburg, we note the absence of date and almost absence of stone pine outside the temple complex. Only one single waterlogged nut of stone pine is found within the extensively studied and well preserved archaeological layers of the civil settlement. Date and stone pine represent imported food plants as climatic conditions prohibit their growth north of the Alps. Other imported food plants from

[91] These findings have been the subject of two previous publications; Vandorpe/Jacomet in press (footnote 19). – F. Ginella / H. Hüster Plogmann / P. Vandorpe, »… und sie huldigten den Göttern«. Reste von Tieren und Pflanzen aus dem gallo-römischen Tempelbezirk Oedenburg/Biesheim-Kunheim (Haut-Rhin, F). In: D. Castella/M.-F. Meylan Krause (eds.), Topographie sacrée et rituels, Le cas d'Aventicum, capitale des Helvètes, Actes du colloque international d'Avenches, 2-4 novembre 2006. Antiqua 43, 2008, 304-308.

[92] D. E. Robinson, Domestic burnt offerings and sacrifices at Roman and pre-Roman Pompeii, Italy. Veg. Hist. Arch. 11, 2002, 93-99. – B. Zach, Vegetable offerings on the Roman sacrificial site in Mainz, Germany – short report on the first results. Veg. Hist. and Arch. 11, 2002, 101-106. – J.-C. Béal, Le sanctuaire des basaltes à Alba-La-Romaine (Ardeche) et ses offrandes. In: C. Goudineau / I. Fauduet / G. Coulon (eds.), Les sanctuaires de tradition indigène en Gaule Romaine (Paris 1994) 161-168.

[93] L. Bouby / P. Marinval, Fruits and seeds from Roman cremations in Limagne (Massif Central) and the spatial variability of plant offerings in France. Journal Arch. Scien. 31, 2004, 77-86. – M. Petrucci-Bavaud / S. Jacomet, Zur Interpretation von Nahrungsbeigaben in römerzeitlichen Brandgräbern. Ethn.-Arch. Zeitschr. 38, 1997, 567-593. – M. Petrucci-Bavaud / A. Schlumbaum / S. Jacomet, Samen, Früchte und Fertigprodukte. In: D. Hintermann (ed.), Der Südfriedhof von Vindonissa. Archäologische und naturwissenschaftliche Untersuchungen im römerzeitlichen Gräberfeld Windisch-Dägerli. Veröffentlichungen der Gesellschaft Pro Vindonissa 17 (Brugg 2000) 151-159.

[94] Vandorpe/Jacomet in press (footnote 19).

[95] The majority of the other findings are hand collected and have thus yielded less remains.

[96] Robinson 2002 (footnote 93) 93-99.

the Mediterranean and further afield have been identified and recorded throughout all areas of the civil settlement. As a result of these findings, we assume that date and stone pine are in Oedenburg exclusively used for sacrificial purposes and not for daily consumption.
In the surroundings of the temple complex, no indications of sacrificial acts could be identified through study of the plant remains. The single nut of stone pine was found within a drainage channel (BK 05-10-149) filled with human waste material. Stone pine nuts and scales are often found as part of Roman sacred contexts on archaeological sites north of the Alps[97]. And although they were an important component of Roman cooking, findings of stone pine in other types of contexts are rare,. One exception to this are the findings of stone pine nuts in the kitchen of the Roman villa in Worb/CH[98].

Summary

The majority of plant assemblages recovered in the civil settlement derives from a mixture of deposits. The inhabitants disposed of their waste materials in both watercourses and pits. There is no clear pattern recorded. In the majority of pit structures, we are dealing with secondary deposits. Waste material in the watercourses is twofold; some palaeochannels are used to discard debris, others are filled with cleaning by-products and/or rubbish to serve as isolation material or drainage purposes. It is likely that we only have primary fills in two contexts in the temple complex. They are a clear sign of sacrifical events.

Local cultivation and/or import of food plants

Before the arrival of the Romans, the diet of the local population in the Upper Rhine region is rather monotonous. It is mainly based on vegetable food with cereals and pulses composing the main part of the diet[99]. Furthermore wild fruits, hazelnuts and spices are gathered[100]. With the arrival of the Romans, many new products are introduced and imported, this results in a richer and much more diverse diet[101]. In addition, the cultivation of fruit trees, the gardening of vegetables and spices and the development of wine growing is initiated[102]. The change in nutritional pattern in comparison to the Late Iron Age is very apparent in Roman Oedenburg. The newly introduced food plants include nuts, spices, fruits, vegetables etc. Some are introduced and subsequently cultivated locally, others are imported. It remains vague when

97 For an overview of the findings of stone pine see in the first place M. E. Kislev, Pinus pinea in agriculture, culture and cult. In: H. Küster (ed.), Der prähistorische Mensch und seine Umwelt. Festschr. für Udelgard Körber-Grohne (Stuttgart 1988) 73-79. – And furthermore: G. Willcox, Exotic plants from Roman water-logged sites in London. Journal Arch. Scien. 4, 1977, 269-282. – Bakels/Jacomet 2003 (footnote 50) 542-557. – Bouby/Marinval 2004 (footnote 94) 77-86.

98 C. Brombacher, Archäobotanische Untersuchungen. In: M. Ramstein (ed.), Worb-Sunnhalde; Ein römischer Gutshof im 3. Jahrhundert (Bern 1998) 105-108.

99 S. Jacomet / C. Jaquat / M. Winter / L. Wick, Umwelt, Ackerbau und Sammelwirtschaft. In: F. Müller / G. Kaenel / G. Lüscher (eds.), Eisenzeit. Die Schweiz vom Paläolithikum bis zum frühen Mittelalter 4 (Basel 1999) 98-115. – K.-H. Knörzer / R. Gerlach, Geschichte der Nahrungs- und Nutzpflanzen im Rheinland. In: K.-H. Knörzer / R. Gerlach / J. Meurers-Balke / A. J. Kalis / U. Tegtmeier / W. D. Becker / A. Jürgens (eds.), PflanzenSpuren. Archäobotanik im Rheinland: Agrarlandschaft und Nutzpflanzen im Wandel der Zeiten. Materialien zur Bodendenkmalpflege im Rheinland 10 (Köln 1999) 67-127.

100 There are hints in the archaeobotanical record that local cultivation of »exotic« food plants initiated in the Iron Age; see comments in Jacomet/Brombacher 2009 (footnote 6) 27-106

101 Jacomet et al. 2002 (footnote 43) 21-40. – Bakels/Jacomet 2003 (footnote 50) 542-557

102 J. Wiethold, How to trace the »Romanisation« of central Gaule by archaeobotanical analysis? Some considerations on new archaeobotanical results from France Centre-Est. In: Actualité de la Recherche en Histoire et Archéologie agraire (ed.), Actes du colloque international AGER V, septembre 2000 (Besançon 2003) 269-282.

local cultivation of newly introduced food plants first started and if they ever were cultivated locally. It is clear that, at least during the military occupation of the site, a large supply of vegetable foods was needed to feed the inhabitants. Even after the abandonment of the military camp in the 1st cent. AD, Roman Oedenburg remained an important centre as proven by its large surface and its many public buildings.

To prove local cultivation of food plants based on archaeobotanical macro remain data only is hardly feasible. Hints can be provided by the study of off-site pollen cores. However, there are many methodological problems. The issue of identifying a »consumer or producer site« has been food for discussion among many authors[103]. Several explanatory models were developed in order to interpret archaeological plant assemblages. M. Jones[104] developed a model to understand the patterning in charred seed assemblages in order to define whether the recovered seed assemblage represents a producer or a consumer site. Producer sites being defined through grain-rich assemblages, consumer sites through weed- and chaff-rich assemblages. This model has been questioned ever since it appeared. A recent re-analysis of the issue by van der Veen and G. Jones[105] has demonstrated that a distinction between these two types of settlements can not be made purely on the basis of the content of charred seed assemblages. It rather represents an indicator of the scale of production and consumption. In addition, it was stressed that species composition, taphonomic issues and context in which the assemblage was found should have been considered in the model. We touch upon this issue to state that opinions differ when interpreting archaeobotanical data in order to find out about local production.

Besides the archaeobotanical record, Jacomet[106] compiled information about contextual evidence which is indicative of local cultivation, to interpret the plant assemblage of a Roman villa in Biberist/CH. Yet, none of the archaeological markers apply for Roman Oedenburg; there is no evidence of tools used for cultivation; neither dry kilns nor storage facilities were found. Only the archaeobotanical indicators are relevant, namely: 1) the presence of different stages of cereal processing; 2) the presence of imported food plants, they point to trading which implies a surplus production; 3) the predominance of a plant (pointing to specialisation); and 4) findings of non-consumable parts of food plants such as straw[107].

Based on the above-mentioned archaeobotanical indicators, we infer that cereals were cultivated locally in Roman Oedenburg[108]. Findings of cereal remains are common in Roman Oedenburg. Of the nine different cereal taxa recorded in Oedenburg, four are very common, in particular their chaff remains. They include spelt, emmer, barley and broomcorn millet. Waterlogged chaff remains – accompanied by a variety of arable weeds – constitute the main bulk of the cereal remains. As for the chaff remains, those of free-threshing wheat are very rarely found within settlement areas[109], also in Oedenburg. Chaff remains of hulled cereals are more regularly found within settlements[110]. Charred cereal grains are rare. Waterlogged cereal testae are numerous among the findings.

103 For an overview see M. van der Veen / G. E. M. Jones, A re-analysis of agricultural production and consumption: implications for understanding the British Iron Age. Veg. Hist. Arch. 15, 2006, 217-228.

104 M. K. Jones, Archaeobotany beyond Subsistence Reconstruction. In: G. Barker / C. Gamble (eds.), Beyond domestication in prehistoric Europe (London 1985) 107-128.

105 van der Veen/Jones 2006 (footnote 104) 217-228.

106 Jacomet/Petrucci-Bavaud/Kühn 2006 (footnote 5) 579-624.877-916 (Tables)

107 The latter was identified in pit BK 99-04-01 in the area Civil East.

108 While very few Roman sites have been archaeobotanically analysed in the direct surroundings of Oedenburg, we can obviously not exclude that the provisions of the civil and military settlement were supplied by other rural sites instead of cultivated by the inhabitants of Oedenburg.

109 Upon threshing grains of naked wheats are released. Threshing of cereals is mainly undertaken outside the settlement areas.

110 Glume wheats are often transported and stored in the spikelets to prevent infestation of the grains. Dehusking of the grains belongs to the daily activities.

An additional strong hint on local cereal cultivation gives the the analysis of two pollen profiles (one originating from the Temple complex, the other from a nearby palaeochannel »Riedgraben«). These indicate an open landscape with arboreal pollen not exceeding 20 to 30 % from the beginning of the Roman period onwards; the development of the herbaceous vegetation is at the expense of the woodland[111] and an increasing abundance of cereal pollen (over 5 %) and grassland pollen is recorded. The pollen data visibly expose the anthropogenic influence on the landscape at the beginning of the Roman period.

Agricultural practices

In the following we try to shed a light on local agricultural practices based on the arable weed flora and the grassland vegetation. We discuss these in function of the location and / or soil types used for cultivation. We classified the arable weeds into weeds growing within the winter cereals and weeds growing within summer crops. A strict border between both does not exist[112]. In addition, it is not possible to differentiate between the weeds growing within summer cereals and those growing within garden cultivation plots[113]. From our data, it is apparent that mixtures of ecological types were exploited; they are a good reflection of the immediate surroundings of the settlement.

Summer crops / gardens

The weeds of summer crops (or crops requiring hoeing) recorded in the archaeological layers reflect the exploitation of several soil types for growing the crops (see above; **tab. 3a, 3b** and **3c**). The presence of nutrient-rich sandy and loamy soils is attested by findings of e. g. sun spurge (*Euphorbia helioscopia*) and field pennycress (*Thlaspi arvense*); the presence of calcareous soils by thyme-leaved sandwort (*Arenaria serpyllifolia*) and blue pimpernel (*Anagallis arvensis / foemina*). Findings of e. g. fat hen (*Chenopodium album*) and black nightshade (*Solanum nigrum*) indicate a high nitrogen content of the soil which could be an indication of manuring. Findings of humid sun spurge (*Euphorbia helioscopia*) and common fumitory (*Fumaria officinalis*) possibly indicate that even relatively moist environments were cultivated.
The garden plots in which a mixture of pulses, vegetables and spices were grown, must have been located in the settlement area. In our samples, remains of pulses are not common; vegetables and spices on the contrary are abundant. Pulses certainly played a major role in the diet. Their under-representation is likely to be caused by issues of preservation[114]. Among the vegetables and spices we count above all amaranth,

[111] C. Petit / O. Girardclos / V. Ollive / M. Reddé, Milieux humides et aménagements anthropiques dans la plaine du Rhin: Le site romain d'Oedenburg (Haut-Rhin). In VII^e Colloque AGER, Silva et Saltus en Gaule romaine. Dynamique et gestion des forêts et des zones rurales marginales, in press.

[112] S. Jacomet / C. Wagner / N. Felice / B. Füzesi / H. Albrecht, Verkohlte pflanzliche Makroreste aus Grabungen in Augst und Kaiseraugst. Kultur- und Wildpflanzenfunde als Informationsquellen über die Römerzeit. Jahresber. Augst u. Kaiseraugst 9, 1988, 271-310.

[113] Oberdorfer 1994 (footnote 42) 1050.

[114] Preservation of pulses in waterlogged sediments is rare. This has been observed by several authors, e. g. S. Jacomet / C. Brombacher / M. Dick, Archäobotanik am Zürichsee. Ackerbau, Sammelwirtschaft und Umwelt von neolithischen und bronzezeitlichen Seeufersiedlungen im Raum Zürich. Ergebnisse von Untersuchungen pflanzlicher Makroreste der Jahre 1979-1988 (Zürich 1989) 124 f.

cabbages, carrot, dill, coriander and celery. For most vegetables and salads (e.g. amaranth) it is the leaves or roots which are meant for consumption. Plants are only then allowed to flower to recover their seeds. Consequently, one could interpret the occurrence of seeds as an indication of cultivation. This is in contrast to many of the spices where the seeds possess the aromatic flavour and are used for consumption and are thus very regular findings in archaeobotanical assemblages.

In Oedenburg there is evidence for both summer and winter cereals. Spelt is a winter cereal; broomcorn millet is a summer cereal. Barley and emmer can be cultivated as summer or winter cereal. From the cereal remains and arable weeds, there is no clear indication whether winter cereals were more important than summer cereals. In addition, samples containing e.g. winter cereals usually contained a mix of arable weeds, likewise for the summer cereals. On top, the weeds of summer crops are often found in plant assemblages rich in vegetables and salads, which demonstrate that they may originate from garden cultivation as well as cereal fields.

Winter cereals

The weeds of winter cereals recorded in the archaeological layers belong to several ecological types (see above; **tab. 3a, 3b** and **3c**). They reflect the use of a variety of soils for cereal cultivation. Like the summer crops, nutrient-rich soils of sand and loam (proven through the recovery of corn cockle (*Agrostemma githago*) and garden cornflower (*Centaurea cyanus*) among others), soils high in nitrogen (e.g. cleavers (*Galium aparine*)) but also the more acidic soils poor in nutrients (indicated by the weeds belonging to the Order of the Aperetalia) were used for crop cultivation.

Of special interest are the weeds of winter cereals belonging to the Order of the Secalietalia, Caucalion alliance. The majority of these weeds, favouring a dry warm climate and calcareous soils, are native in the Mediterranean. Up till now it is unclear how they diffused north of the Alps, some say they were introduced with the arrival of the Romans[115]. However recent findings have demonstrated that part of these Caucalion taxa was already present north of the Alps before the arrival of the Romans[116]. This issue is particularly important when considering the origin of the cereals. It is known that during the Roman period cereals were traded over long distances[117]. Thus, it is plausible that arable weeds were introduced into the area as part of cereal import from the Mediterranean area. There are only few Caucalion weeds found in Oedenburg that did not occur before the Roman period. They comprise muskweed (*Myagrum perfoliatum*), corn buttercup (*Ranunculus arvensis*), thorow-wax (*Bupleurum rotundifolium*) and devil-in-a-bush (*Nigella arvensis*). In order to find an answer to the question of cereal import, we verified the context and sample composition in which these four plant taxa were found.

Thorow-wax represents a single find in the 1st cent. AD structure BK 99-04-01 in the area Civil East. It is part of a plant assemblage dominated by wild weeds originating from meadows and pastures and from cultivated fields. Chaff remains of millet and glume wheat represent the most important cultivated plants.

115 J. Wiethold, Archäobotanische Aspekte der Romanisierung in Südwestdeutschland. Bemerkungen zur Unkrautflora römerzeitlicher Dinkeläcker. In: A. Müller-Karpe / H. Brandt / H. Jöns / D. Krausse / A. Wigg (eds.), Studien zur Archäologie der Kelten, Römer und Germanen in Mittel- und Westeuropa. Festschrift A. Haffner. Internationale Archäologie. Studia Honoraria 4 (Rahden/Westf. 1998) 531-551.

116 Jacomet / Brombacher 2009 (footnote 6) 27-106. – T. Märkle, Macroremains from a late Iron age well in Schaeffersheim. In: J. Wiethold (ed.), Travaux d'Archéobotanique (à la mémoire de Karen Lundstrom-Baudais). Bibracte, Glux-en-Glenne, in press.

117 A. Kreuz, Landwirtschaft im Umbruch? Archäobotanische Untersuchungen zu den Jahrhunderten um Christi Geburt in Hessen und Mainfranken. Ber. RGK 85, 2004, 97-292, 9 Tafeln.

Single findings of devil-in-a-bush are found in two 1st cent. AD layers in the Surroundings of the temple area (BK 09-03-74 and BK 10-05-310). They both represent layers of waste material where cereals are not dominating the samples, other economic plants are plentiful. We remark that one of these layers (BK 09-03-74) includes a very exotic plant spectrum with many imported food plants (see above). In addition, there are indications that this layer contains an imported seed transport (see below).
Corn buttercup is slightly more frequent in the samples (in 13 samples or 5 %) although in small amounts. It is found in one sample from the 1st cent. AD layer BK 09-03-74 in the Surroundings of the temple area. In the temple area it is found in a 1st cent. AD ditch (BK 03-05-49). In the area Civil East, it is found in two 1st cent. AD pits (BK 99-04-01 and BK 01-04-24) and two 2nd cent. AD pits (BK 01-04-38 and BK 02-04-15). In all (except for BK 99-04-01) many imported food plants are found, in addition few of these samples include large amount of millet and spelt wheat chaff.
Muskweed is by far the most frequent taxon of the Caucalion alliance in our samples. Muskweed is mainly known as a weed of winter cereal but can also occur as a ruderal plant[118]. Siliques of muskweed are robust and slightly lignified, which facilitates their preservation in waterlogged contexts. The apical parts of the silique of muskweed were found in more than 40 % of the samples as a waterlogged remain, in 0.6 % as a charred remain. It is found in all types of contexts and in all areas of excavation. There is no clear pattern in its distribution in the samples. It occurs in very rich plant assemblages dominated by cultivated food plants as well as in very poor plant assemblages where hardly any economic plants are attested. Its presence is remarkably higher in the 1st cent. AD (52.9 % of the samples) than in the 2nd cent. AD (25 % of the samples)[119]. In addition the 2nd cent. AD findings often represent a single item. The earliest findings of muskweed in Roman Oedenburg originate from a layer in the Temple complex which is dated 3/4 AD (BK 03-05-53) based on dendrochronology. Within this layer we also have evidence for bottle gourd. Unfortunately, in the other areas of excavation, no structures could be dated this early.
As established, muskweed is very frequent in Roman Oedenburg but hardly ever found on other Roman sites North of the Alps. One possible reason for its absence on Roman archaeological sites could be due to its difficulty of identification. Only four other Roman findings of muskweed are known to us. They represent more recent findings. Kreuz[120] mentions the find of a single waterlogged silique of muskweed in Gross-Gerau / D. Matterne[121] reports the finding of muskweed in cereal grain stocks at the site »Larry« in Liéhon, Moselle / F. Wiethold[122] found muskweed in a well dated around 200 AD in Kaiserslautern-Otterbach / D. Finally, muskweed was identified in a layer of destruction in the excavation Insula 27 in Augst[123]. Today muskweed is rarely found and its repartition is restricted to the South of Europe.
To state that muskweed arrived in Alsace as part of cereal grain transport from the Mediterranean area – based on our findings alone – is however doubtful. First of all, siliques of muskweed are not easily recognised. For the un-trained eye they pose a problem of identification. Secondly, the archaeobotanical dataset of the pre-Roman times in Alsace is scarce. In general while very few archaeobotanical studies have taken place so far. Thirdly, long-distance relations with the Mediterranean area were established long before the Roman occupation north of the Alps. These contacts are mainly confirmed through findings of imported artefacts on Iron Age sites. About import of plants in the Iron Age there exists very few information[124]. One example

118 Oberdorfer 1994 (footnote 42) 1050.
119 See also Jacomet / Brombacher 2009 (footnote 6) 27-106.
120 Kreuz 2004 (footnote 117) 97-292.
121 V. Matterne, Étude carpologique d'un stock de grains gallo-romain découvert sur le site de Liéhon »Larry« (Moselle). Unpublished manuscript, 2005, 3.
122 J. Wiethold pers. comm.
123 Own research
124 See A. Livarda / M. Van der Veen, Social access and dispersal of condiments in North-West Europe from the Roman to the medieval period. Veg. Hist. Arch. 17, 2008, 201-209. – And the annotations in Jacomet / Brombacher 2009 (footnote 6) 27-106.

is the Iron Age salt mining site of Bad Nauheim/D, where plant species thought to be introduced by the Romans were recorded. These plants (e. g. coriander) were found together with other imported handicraft products. Accordingly, it is suggested that plants native in the Mediterranean could already have been introduced during the Iron Age[125]. It is however clear that an increase comes with the Roman expansion[126]. In the case of muskweed: we can not prove nor exclude the hypothesis that muskweed first reached the site as part of imported cereal stocks from the Mediterranean area. Its ubiquity is very high in Roman Oedenburg. It may well have diffused into the area with the sowing of the imported cereal grains. As a consequence, the large majority of the muskweed siliques found in Oedenburg derive from locally grown plants after a primary introduction into the area. The presence of the calcareous gravel terraces in the near vicinity of the site yields a good substitute to its natural habitat in Southern Europe. To conclude, a clear answer to this question is impossible without the ideal context, that is preferably a sunken ship wreck packed with cereal stocks as was found in the Netherlands[127].

Grassland management

Macro plant remains representing grassland vegetation are rare in Oedenburg. They represent single findings in most of the samples. Yet in the area Civil East, one pit context (BK 99-04-01) yielded more than average. Samples from this pit are dominated by wild plant taxa and in particular the grassland vegetation. **Table 4** summarises the recorded grassland species in this pit. The origin of these deposits is difficult to detect. As stated above we assume we have the remains of stable manure or bedding which implies these deposit can contain straw and/or hay. We have at least 24 plant taxa growing in cultivated meadows and pastures. The most commonly found ones are self-heal (*Prunella vulgaris*), clover (*Trifolium* sp.) and rattle (*Rhinanthus* sp.). We have also evidence of six species favouring poor calcareous swards. Although, they are much less frequent in the samples. In addition, pollen analysis confirms that the landscape was already open at the beginning of the Roman period. Not only is there an increase in cereal pollen, the percentage of grassland pollen is equally high.

Assuming that we are dealing with deposits of hay or what is left of it, we explored the flowering times of the different grassland taxa in order to find out about the time of cutting of the meadows for hay. In **Table 4** the blooming time of each taxon is indicated. This shows that flowering of the taxa takes place between May and September/October. This suggests that the meadows were cut in late summer as seed-ripening of the majority of these taxa was then possibly fullfilled. The hay was then used as fodder or as bedding in stables[128]. Mowing of the meadows is a known practice in Roman times. It has been established in several Roman settlements[129]. It is thought the fields were grazed and manured until early summer. After that they were kept free of animals to preserve the meadow until mowing times.

125 A. Kreuz, Unerwartete Pflanzenfunde aus der keltischen Saline in Bad Nauheim. Hessen Arch. 2002, 66-68. – Jacomet/Brombacher 2009 (footnote 6) 27-106.

126 Livarda/van der Veen 2008 (footnote 124) 201-209. – Jacomet/Brombacher 2009 (footnote 6) 27-106.

127 J. P. Pals / T. Hakbijl, Weed and insect infestation of a grain cargo in a ship at the Roman fort of Laurium in Woerden (Province of Zuid-Holland). Review of Palaeobotany and Palynology 73, 1992, 287-300. – J. K. Haalebos, Ein römisches Getreideschiff in Woerden (NL). Jahrb. RGZM 43, 1996, 475. 487.

128 Findings of straw have not been registered.

129 See Körber-Grohne/Piening 1983 (footnote 70) 17-88. – M. Klee, Ackerbau und Grünlandwirtschaft: Ergebnisse der archäobotanischen Untersuchungen. In: J. Rychener (ed.), Der römische Gutshof in Neftenbach (Zürich 1999) 464-472.

Molinio-Arrhenatheretea	*Achillea millefolium*	6.-9	*Nardus stricta**	5.-7
cultivated meadows and pastures	*Agrostis* sp.	6.-8	*Plantago lanceolata*	4.-9
	Bromus cf. *commutatus*	5.-6	*Plantago media*	5.-7
	Bromus hordeaceus	5.-6	*Poa pratensis*	5.-6
	Centaurea sp.	6.-9	*Potentilla erecta*	6.-9
	Dactylis glomerata	5.-6	*Prunella vulgaris*	6.-9
	Deschampsia caespitosa	6.-8	*Ranunculus acris*	4.-9
	Festuca rubra/ovina	5.-9	*Rhinanthus* sp.	5.-8
	Holcus lanatus	5.-8	*Rumex acetosa*	5.-8
	Leontodon autumnalis	7.-9	*Silene vulgaris*	6.-9
	Leucanthemum vulgare	5.-10	*Taraxacum officinale*	4.-10
	Lolium perenne	6.-9	*Trifolium pratense*	**5.-10**

Festuco-Brometea	*Dianthus* sp.	5.-10
moor or less arid poor calcareous swards	*Medicago lupulina*	5.-9
	Medicago minima	5.-6
	Odontites sp.	6.-10
	Prunella grandiflora	6.-10
	Scabiosa columbaria	6.-9
	Trifolium cf. *campestre*	5.-8

Table 4 Grassland taxa recorded in Pit BK 99-04-01 indicating blooming times of each taxon (indicated by month 1 to 12).

Summary

Indications for agricultural practices in and around Roman Oedenburg are numerous (**tab. 4**). Cereal cultivation played an important role in the local agricultural system. Study of the arable weeds suggests that cereal fields were located on the calcareous gravel terraces along the Rhine as well as on the nutrient-rich loamy and sandy soils in the near vicinity of the settlement. Although local cultivation of cereals is evident, import of cereals can not be excluded. Whether this was a single event at the beginning of the Roman occupation in Oedenburg or a continuous event throughout its occupation is hard to verify. In and around the settlement small garden plots were operated for the cultivation of mainly vegetables, spices and possibly fruit trees. Besides cereal fields and gardens, it is thought that meadows and pastures were located in the near vicinity of the settlement, the plant remains indicate their management.

Roman introductions and imports

At the beginning of the Roman period many new food plants are introduced north of the Alps, many of which are also found in Roman Oedenburg[130]. In **Table 5** the newly introduced and imported food plants found in the studied samples are summarised. In this table we differentiate in the first place between those

[130] These food plants have been the subject of a previous publication, therefore we only briefly touch upon this issue; see Vandorpe/Jacomet 2005 (footnote 39) 252-257.

Imports		
Nigella sativa	black cumin	*spice*
Olea europaea	olive	*fruit*
Phoenix dactylifera	date	*fruit*
Pinus pinea	stone pine	*nut*
Piper nigrum	black pepper	*spice*
Imported, local cultivation is questioned		
Carthamus tinctorius	saflor	*oil, dye and fibre plant*
Cucumis melo	melon	*fruit*
Cucumis sativus	cucumber	*fruit*
Ficus carica	fig	*fruit*
Lagenaria siceraria	bottle gourd	*vegetable*
Prunus persica	peach	*fruit*
Vitis vinifera	grapevine	*fruit*
Introduced and local cultivation plausible		
Allium sativum	garlic	*vegetable*
Anethum graveolens	dill	*spice*
Apium graveolens	celery	*spice*
Beta vulgaris	beet	*vegetable*
Carum carvi	caraway	*spice*
Coriandrum sativum	coriander	*spice*
Foeniculum vulgare	fennel	*spice*
Juglans regia	walnut	*nut*
Malus domestica	apple	*fruit*
Morus nigra	black mulberry	*fruit*
Pastinaca sativa	parsnip	*vegetable*
cf. *Petroselinum crispum*	parsley	*spice*
Pimpinella anisum	aniseed	*spice*
Prunus avium/cerasus	cherry	*fruit*
Prunus domestica	plum	*fruit*
Prunus insititia	plum	*fruit*
Pyrus communis/pyraster	pear	*fruit*
cf. *Ruta graveolens*	common rue	*spice*
Satureja hortensis	summer savory	*spice*

Table 5 Overview of the newly introduced and imported food plants recorded in Roman Oedenburg.

plants which can and those which can not grow north of the Alps. Species belonging to the last group require different climatic conditions and were thus certainly imported. Species belonging to the first group could grow in Alsace meaning the climatic conditions do not prohibit their growth (they may however be damaged by cold winters or late frosts).

As stated above, macro plant remains combined with data from off-site pollen cores can suggest local production. In the studied area, there exist only very few analyses of off-site pollen profiles[131]. Study of off-site pollen profiles are only then of use to determine local cultivation when the pollen can be determined to species level. This is for many of the listed plants difficult. In addition, many of the newly introduced food plants are insect-pollinated species. This means their pollen is hardly ever found in off-site pollen cores. The ideal context to recover pollen of these food plants would be a compost heap or garden structures.
Besides the study of off-site pollen profiles, analyses of ancient DNA[132] enables the exploration of local cultivation. Studies of ancient DNA have the potential to add to the identification of a taxon (e.g. wild versus domesticated), in addition the origin of plant taxa and the kinship between certain plant taxa can be explored. The results obtained from aDNA studies always need to be seen relative to other archaeological evidence to give a reliable result.
In general, local cultivation of newly introduced food plants is thought to have started towards the 2nd half of the 1st cent. AD[133]. This theory is mainly supported through the more frequent findings of these food plants from that time onwards. We think this theory could apply for Roman Oedenburg, too.
In the following we discuss the origin of the imported food plants and the plausibility of local cultivation of certain plants.

Origin of the imported food plants

The majority of the new food plants, introductions as well as imports, originate from the Mediterranean region. Findings of olive, date and stone pine nuts in the 1st and 2nd cent. AD layers, all of which can not grow in Alsace, confirm the steady trade contacts with the South[134]. They represent uncommon findings in Oedenburg and are regarded as »luxury« food (or at least as »food« for very special purposes like rituals) in all areas north of the Alps[135].
Another imported plant represents black cumin (*Nigella* cf. *sativa*). Black cumin is native in the Mediterranean area too and does not grow north of the Alps. It is used as a condiment and a medicinal plant in southern Europe and the Near East[136]. Archaeological findings of black cumin are very rare north of the Alps, hitherto no other recordings of this spice are known for the Roman period[137]. The mineralised seeds found in Roman Oedenburg are therefore important findings.
Within the Oedenburg plant assemblage, there are only few plant taxa which are evidence of long-distance trade relations. They include black pepper (*Piper nigrum*) and bottle gourd (*Lagenaria siceraria*). Black pepper is imported from India[138]. Bottle gourd is thought to be imported from subtropical Africa. Recent DNA

131 Pollen profile in Mengen/D published in Wick/Schlumbaum 2009 (footnote 11) 37-43 – pollen profile Riedgraben see chapter 1 of this volume
132 e.g. B. Pollmann / S. Jacomet / A. Schlumbaum, Morphological and genetic studies of waterlogged Prunus species from the Roman vicus Tasgetium (Eschenz, Switzerland). Journal Arch. Scien. 32, 2005, 1471-1480. – A. Schlumbaum / M. Tensen / V. Jaenicke-Després, Ancient plant DNA in Archaeobotany. Veg. Hist. Arch. 17, 2008, 233-234.
133 Bakels/Jacomet 2003 (footnote 50) 542-557.
134 Transport of e.g. vegetable foods, ceramics etc. is very fragile, therefore it is likely that they were stored in boxes which were lined with vegetative material (e.g. straw) to secure their transport. This could have been another way of introducing plants from the Mediterranean region into Alsace.
135 Bakels/Jacomet 2003 (footnote 50) 542-557 – Vandorpe/Jacomet 2005 (footnote 39) 252-257 and cited literature – Vandorpe/Jacomet in press (footnote 19) and cited literature.
136 Heiss/Oeggl 2005 (footnote 54) 562-570.
137 A. Heiss pers. comm.
138 S. Jacomet / J. Schibler, Les contributions de l'archéobotanique et de l'archéozoologie à la connaissance de l'agriculture et de l'alimentation du site de Biesheim-Kunheim. In: S. Plouin / M. Reddé / C. Boutanin (eds.), La frontière romaine sur le Rhin supérieur. À propos des fouilles récentes de Biesheim-Kunheim, 60-69 [Exposition Biesheim] (Biesheim 2001) 60-69. – See Vandorpe/Jacomet 2005 (footnote 39) 252-257 and cited literature; Jacomet/Brombacher 2009 (footnote 6) 27-106 and cited literature.

studies however have proven that bottle gourds are independently domesticated in Asia, long before its domestication took place in Africa[139]. The morphology of the bottle gourd seeds shows that the ones found in Roman Oedenburg are of the Asian type[140]. It is therefore likely that bottle gourd arrived in Oedenburg via the same routes as e. g. black pepper. On-going research into ancient DNA of the Roman bottle gourd seeds along with morphological study of the seeds found in Oedenburg confirms this theory[141].

Assumptions about local growing and import?

As stated above, gardening of vegetables and spices and growing of fruit trees including walnut and chestnut develop during the Roman period[142]. It is believed that the majority of newly introduced spices and vegetables were cultivated locally in the garden plots in and around the settlement[143]. The beginning of local cultivation of fruit trees is difficult to prove/evidence. Jacomet[144] provides a good overview of the cultivated plants introduced north of the Alps during the Roman period. In this publication the issue of local cultivation versus import is discussed. It is thought that many of the fruits were dried prior to transport for reasons of preservation. Figs e. g. can grow north of the Alps but the fruits hardly ever ripen. The findings of fig on Roman archaeological sites north of the Alps are therefore mainly interpreted as imports of dried fig fruits[145]. Accordingly, we think many of the grape pips reached the settlement as dried raisins.

In the following we consider local cultivation of selected food plants based on findings in Oedenburg. To confirm the growing of fruit trees, evidence of off-site pollen profiles or wood/trunks is required. For most fruit and/or nut trees, these are not available. However, pollen of walnut was identified in a ditch in the temple area[146]. These deposits are dated to the 2nd and 3rd cent. AD. In addition, charred wood was identified in the offering pit (see chapter 8). Based on these findings, we assume walnut trees were planted within the temple complex. It is likely that they were restricted to the sacred area as no other pollen evidence for walnut was found in Oedenburg. Archaeological findings of walnut are, in the early Roman period, rather scarce north of the Alps[147]. At that time walnuts were not part of the basic diet but represented delicacies[148]. It is only towards the end of the 1st cent. AD that archaeological findings of walnut become more abundant which can possibly be linked to the beginning of the local cultivation of this tree[149]. Consequently the earliest macro remains of walnut we find, in all probability represent imported goods[150]. As with walnut, it is plausible that the growing of other fruit trees (e. g. peach) initiated also towards the end of the 1st cent. AD.

139 D. L. Erickson / B. D. Smith / A. C. Clarke / D. H. Sandweiss / N. Tuross, An Asian origin for a 10000-year-old domesticated plant in the Americas. Proc. Nat. Acad. Scien. United States of America (PNAS) 102, 2005, 18315-18320.

140 J. A. Kobyakova, The bottle gourd. Bull. Applied Botany, Genetics and Plant Breeding 23, 1930, 475-520.

141 P. Vandorpe / A. Schlumbaum, Genetische und morphologische Untersuchungen am römischen Flaschenkürbissen aus der Nordwestschweiz, in prep.

142 e. g. Wiethold 2003 (footnote 102) 269-282.

143 Based on the regular findings of certain condiments Livarda/van der Veen 2008 (footnote 124) 201-209 suggest local cultivation of these species

144 Jacomet 2003 (footnote 3) 173-229.

145 Bakels/Jacomet 2003 (footnote 50) 542-557. – Jacomet/Brombacher 2009 (footnote 6) 27-106. – Kreuz 2004 (footnote 117) 97-292.

146 See chapter 8.

147 Jacomet 2003 (footnote 3) 173-229.

148 André 1998 (footnote 44) 161 ff.

149 Bakels/Jacomet 2003 (footnote 50) 542-557.

150 Vandorpe/Jacomet 2005 (footnote 39) 252-257.

As for the beginnings of wine growing in the southern Upper Rhine region, the information is vague. It is clear that the climatic conditions needed for wine growing are available; today the Alsace is a well-known wine growing area. However to determine when local cultivation first started[151], there is a lack of evidence. So far no archaeological wood could be identified, in addition pollen from wild and cultivated grape can not be differentiated.
Bottle gourd (*Lagenaria siceraria*) represents another doubtful case of local cultivation. It is not native in the Upper Rhine region. However, experiments in the Botanical Garden in Basel in the summer of 2000 have demonstrated that bottle gourd can grow in the climatic conditions of the Upper Rhine region[152]. So far no pollen data is available to support this theory. Seeds of bottle gourd at the Roman site »Le Bois Harlé« (Oise, F), were recovered from a well located within a large ditched enclosure divided into small plots[153]. This complex was interpreted as small garden plots used for horticultural purposes. In »Le Bois Harlé«, it is assumed that the combination of bottle gourd seeds and garden plots could be the indication for its local cultivation[154]. Local cultivation is also believable in Oedenburg. The findings of a nearly whole fruit, stalks etc. point in this direction. In addition, the climate in the southern Upper Rhine area is a lot milder than in Northern France.
The findings of safflower seeds (*Carthamus tinctorius*) represent another important finding. First of all, findings of safflower are very rare North of the Alps, if not absent in Roman times. Kroll[155] identified safflower in Feudvar, a Bronze Age settlement in Serbia. Other archaeological findings of safflower are recorded in the Near East and Egypt[156]. The safflower seeds in Oedenburg are most probably not the remains of oil extraction. Oil is much easier to transport as a finished product. Whether or not they are the remains of dyeing practices is difficult to tell while no flower fragments were recovered. A hypothesis could be that the safflower seeds are part of a seed transport for the initiation of local cultivation. In Roman Oedenburg, they are found as part of waste material. The presence of small circular wholes within almost every seed is most likely the result of insects which could mean we are dealing with an infested seed transport.

Chronological and spatial tendencies across the civil settlement

Spatial variations across the site

In the Roman civil settlement, excavations were conducted in three distinct locations (**fig. 7.1**). These locations do not only represent a spatial difference but also implicate a different type of occupation. Hence

[151] In Wallis recent studies identified the beginning of wine growing in the Iron Age; see P. Curdy / O. Paccolat / L. Wick, Les premiers vignerons du Valais / Die ersten Weinbauern im Wallis. Arch. Schweiz 32, 2009, 2-19.
[152] Jacomet/Schibler 2001 (footnote 138) 60-69. – Jacomet/Brombacher 2009 (footnote 6) 27-106.
[153] A. E. de Hingh, Bottle gourd seeds at Gallo-Roman Le Bois Harlé (Oise, France). Analecta Praehistorica Leidensia 26, 1993, 93-97.
[154] de Hingh 1993 (footnote 153) 93-97.
[155] H. Kroll, Saflor von Feudvar, Vojvodina. Ein Fruchtfund von Carthamus tinctorius belegt diese Färbepflanze für die Bronzezeit Jugoslawiens. Arch. Korrbl. 20, 1990, 41-46.
[156] M. van der Veen, The botanical evidence. In: V. A. Maxfield / D. Peacock (eds.), Survey and excavation Mons Claudius 1987-1993. Excavations: Part I. Institut Francais d'archéologie orientale, Fouilles de l'IFAO 2, 2001, 175-246. – W. A. van Zeist / S. Bottema / M. van der Veen, Diet and vegetation at Ancient Carthage. The archaeobotanical evidence (Groningen 2001) 104. – W. A. van Zeist / W. Waterbolk-van Rooijen / R. M. Palfenier-Vegter / G. J. de Roller, Plant cultivation at Tell Hammam Et-Turkman. In: W. A. van Zeist (ed.), Reports on archaeobotanical studies in the Old World (Groningen 2003) 61-114. – C. E. Vermeeren / R. T. J. Cappers, Ethnographic and archaeobotanical evidence of local cultivation of plants in Roman Berenike and Shenshef (Red Sea coast, Egypt). BIAXiaal 140, 2002, 1-12.

the spatial variation of plant macro remains across the civil settlement is likely to be more and/or primarily dependent on the character of the excavated structures and to a lesser extent on its immediate surroundings. The area Civil East is an area of intense human activity along a navigable arm of the river Rhine. The plant assemblages recovered from this area represent mainly latrine and other cultural waste deposits. The majority of the archaeobotanically-analysed structures are contemporaneous with the 1st cent. AD military camp; five structures are definitively in use after the abandonment of the camp. Therefore, an association between the 1st cent. AD structures and the military occupation of the camp is plausible. It is suggested that waste products, such as latrine contents, produced in the camp were discarded in the area Civil East. According to the archaeologists, a wooden bridge existed across an active palaeochannel that connected the camp to this area of the settlement. In addition to waste disposal, it is thought that handicraft activities were carried out outside the camp (in the samples there is evidence for metal working). At least in the 1st cent. AD, this area was under influence of the military presence.
The area Surroundings of the temple complex is in its Western part civilian in character (living quarters). The plant assemblages recovered from this area originate from waste deposition. In contrast to the area Civil East, latrine deposits are rare which impedes a direct comparison of e. g. eating habits. Waste products include mainly cereal processing debris. In its Eastern part this area is related to sacred practices (e. g. temples, the basin, the stone built well). Nevertheless no evidence of this sacred nature is found in the plant macro remains.
Finally, the Temple complex has an obvious sacred nature. This is confirmed by findings of vegetable offerings. The remaining plant macro remains represent a mix of natural and human deposits. The latter are very poor and can be defined as settlement noise.

A difference in distribution of the cultural and gathered plants is apparent. In the area Civil East an abundance of food plants is recorded. In particular fruits and spices[157] are well represented, varied and unique. They include many locally grown plants as well as imported plants. Cereal remains are dominated by glume wheats and broomcorn millet. In the Surroundings of the temple complex, a less varied assemblage of edible plants is recorded (primarily considering the spices). Yet imported food plants are also found here (e. g. olive, bottle gourd). Considering cereal remains, we remark that findings of barley and rye are more frequent than glume wheat. Finally, we notice that the use of some plant species is restricted to sacred practices. Findings of date and stone pine are only recorded in the Temple complex. It is thought that only those plants required for offering practices are deliberately brought to the Temple complex. This assumption is based on the near absence of plant remains representing waste material within the studied structures.

Considering the wild plant taxa, there is hardly any spatial diversity across the site. Noteworthy is the presence of grassland taxa in the area Civil East. They originate of two pits (BK 99-04-01 and BK 01-04-24). As discussed it is likely that these deposits derive from stable manure and/or litter. They could be related to the presence/keeping of animals like horses for the military. The near absence of arable weeds in the temple complex can possibly be explained through the lack of cereal waste products in its samples.

[157] Livarda/van der Veen 2008 (footnote 124) 201-209 claim a strong military association considering the dispersal of condiments in Northwest Europe during the Roman times.

To summarise, there are differences in plant distribution across the civil settlement. These can be clarified on the one hand by the different nature of the settlement (military versus civil versus sacred). On the other hand it is likely that differences in plant distribution are the result of different types of excavated contexts (latrine versus offering pit versus layers of crop processing debris). In all three areas of excavations, we examined very different types of structures and / or deposits. It is clear that a deposit of crop processing activity provides a completely different plant assemblage than a latrine or a deposit of vegetable offerings.

Chronological changes

Assumptions about chronological change are possible when a large dataset of well-dated structures is available. For Roman Oedenburg, we can only try to differentiate / compare 1st and 2nd cent. AD deposits. This is however delicate as many samples could not be dated in much detail. In the Surroundings of the temple complex, the majority of structures could not be dated with certainty; none are attributed to the 2nd cent. AD. In the Temple complex, five chronological phases are determined. Nonetheless in this area the majority of plant assemblages are too poor to make any inferences about chronological changes. Only the area Civil East allows such a comparison.

In the area Civil East, structures could be dated to both the 1st (N=20) and 2nd cent. AD (N=5). Based on ubiquity of plant species within the samples, no clear difference between the plant assemblages recovered from the 1st and 2nd cent. AD is noticeable. However, the amount of »exotic« food plants is generally high in the 2nd cent. AD pits. We infer that even after the abandonment of the military occupation in Oedenburg, the local population had access to the »exotic« and typically Roman food plants.

This could be due to several reasons. First of all, the large temple complex was in use until the 3rd cent. AD and possibly represented a centre of pilgrimage. Vegetable offerings usually included exotic food plants, as shown by the findings of date and stone pine. Therefore, trade with the Mediterranean area was still active after the abandonment of the military camp. A second hypothesis could be the existence of a port in Roman Oedenburg. The settlement could have functioned as a centre of distribution of goods for settlements not located along the river Rhine (see also below). So far no archaeological evidence can support this hypothesis. Another hypothesis of the more frequent findings of exotic food plants (e. g. mulberry, walnut, etc…) could be the start of local cultivation of the introduced food plants and hence the more frequent findings.

Significance and / or standing of the site Oedenburg during the Roman period based on the archaeobotanical data

Based on the archaeological evidence, Oedenburg was an important settlement in the Roman period; it was continuously inhabited and well integrated in the Roman road network. It was situated on the road leading from *Augusta Raurica* / Augst or *Epomanduodurum* / Mandeure via *Cambete* / Kembs to *Argentorate* / Strasbourg. It is possible that the archaeological site Oedenburg can be identified as Roman *Argentovaria*[158]. *Argentovaria* was mentioned by Ptolemaeus as the *polis* of the Rauraci and afterwards indicated

[158] It cannot be said with certainty as no inscriptions were yet recovered. See Reddé et al. 2005 (footnote 39) 215 ff.

in the *Itinerarium of Antoninus* and the *Tabula Peutingeriana*[159]. The Rauraci are the indigenous population occupying the southern Upper Rhine region and part of the Hochrhein area. Oedenburg was located in the northern part of their territory and represented an important settlement besides the colonial town of *Augusta Raurica* (Augst/CH).

Based on historical evidence[160], Oedenburg was located on the border (river Rhine) of the Roman Empire in the early Roman period. From 70 AD onward the Romans begin their conquest to the East of the river Rhine. Towards the end of the 3rd cent. AD, the border of the Roman Empire is relocated and is again formed by the river Rhine. At that time, Alsace is once more prone to raids of the Germanic tribes and now belongs to the *Provincia Maxima sequanorum*.

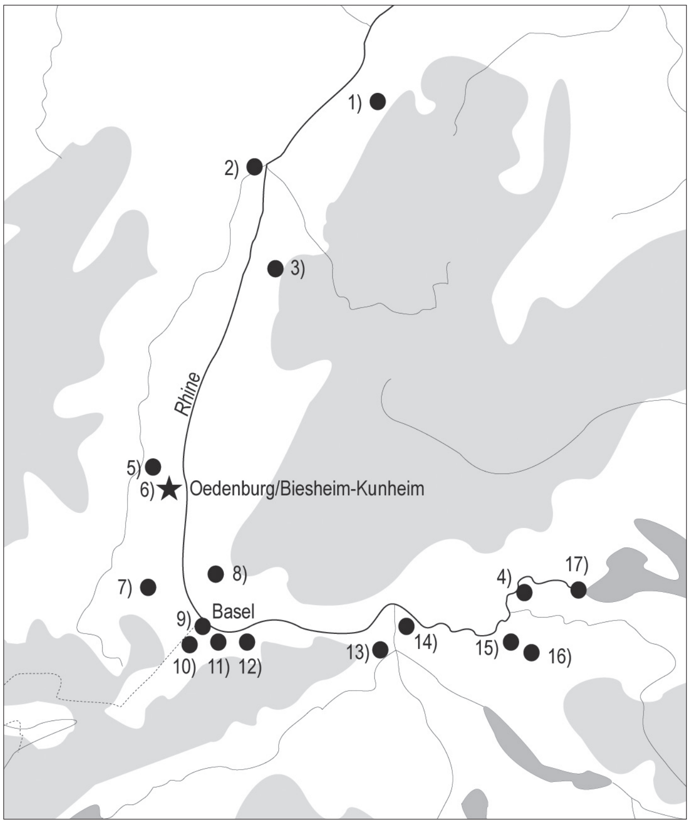

Fig. 7.12 Location of sites used in our regional comparison: **1** Baden-Baden/D. – **2** Strasbourg/F. – **3** Lahr-Dinglingen/D. – **4** Schleitheim/CH. – **5** Oedenburg/F. – **6** Horbourg-Wihr/F. – **7** Sierentz/F. – **8** Badenweiler/D. – **9** Basel/CH. – **10** Allschwill/CH. – **11** Reinach/CH. – **12** Augst/CH. – **13** Windisch/CH. – **14** Zurzach/CH. – **15** Neftenbach/CH. – **16** Oberwinterthur/CH. – **17** Eschenz/CH.

To understand the standing of the civil settlement in Oedenburg based on the archaeobotanical record, we collected archaeobotanical data of sites located in a selected region. **Figure 7.12** shows the geographical location of the settlements. For the purpose of this comparison, we have included those food plants which were imported and/or introduced with the beginning of the Roman period as listed in our table 7.4. **Table 7.6** lists the sites considered for regional comparison and summarises the data. The data is presented here as presence or absence of a given taxon. A site is defined as a well dated phase or defined type of settlement within an excavation, hence the plural occurrence of several places[161]. In total 38 sites were considered for regional comparison (Oedenburg excluded), they are located in 17 different places, in France (3), Germany (3) and Switzerland (10). Sites were selected on

[159] See Reddé et al. 2005 (footnote 39) 215 ff.

[160] After H. Bender / G. Pohl, Der Münsterberg in Breisach, Bd. 1. Römische Zeit und Frühmittelalter Karolingisch-vorstaufische Zeit (München 2005).

[161] After Bakels/Jacomet 2003 (footnote 50) 542-557.

the basis of their geographical location and on the basis of their chronology. The region of comparison represents partly the territory inhabited by the indigenous people the Rauraci.

The geographical area was defined as follows: all sites located in and close to the alluvial plains of the river Rhine, with Baden-Baden/D as northern limit, the Vosges mountains as Western limit, the Jura mountains as Southern limit and Eschenz/*Tasgetium*/CH as eastern limit. In addition we included in our table all plus/minus well investigated and datable sites from the North of Switzerland like Oberwinterthur/*Vitudurum* or Windisch/*Vindonissa*/CH, the latter is situated on one of the Rhine's tributaries (the river Aare). Geographically, the core of the selected area of comparison can be defined as the southern Upper Rhine region and the »Hochrhein« region. The latter represents that part of the river Rhine coming out of Lake Constance near Eschenz/*Tasgetium* until Basel in Switzerland.

For the chronological framework we concentrated on 1st and 2nd cent. AD findings while the majority of the archaeological layers in Oedenburg belong to this period. Within our selected area of research, we made three chronological groups, namely 1st cent. AD (21 sites), 1st/2nd cent. AD (7 sites) and 2nd cent. AD (10 sites). These three groups correspond to the chronological framework we defined for our main analysis of the Oedenburg samples.

Within our selection of sites, there are different types of settlements. The majority is of a civilian nature, only three have an exclusively military character. They include the military camps of *Vindonissa* (excavation Windisch-Breite HP 5-7, excavation Windisch-Dägerli/Südfriedhof and Schutthügel) and Strasbourg (excavation Grenier d'abondance). Four sites have a clear civilian character but included a military occupation of the site[162]. They include Basel (excavation Rittergasse), Vindonissa (excavation Windisch-Breite HP 2-4) and Zurzach Tenedo in Switzerland and the site under study, Oedenburg. In addition two sites representing Roman *villae* are included, in particular Reinach (BL) (excavation Mausackerweg) and Neftenbach (ZH), both in Switzerland.

The different types of settlements contained many different types of contexts. Plant assemblages have been recovered from pits, latrines, hearths, ovens, layers, wells, graveyards and cremation graves, drainage channels and cellars. As the type of context mainly determines the composition and richness of the plant assemblage – as clearly shown for Oedenburg (see above) – in a strict sense, comparison between different types of contexts should be avoided. Nevertheless, as the data available for our area of comparison is limited, we had to include all analysed contexts without differentiating between them in our table. For one site (Oberwinterthur, excavation Gebhardtstrasse) the information to the type of context could not be obtained. Within the frame of future research the evaluation of the mentioned sites according to structures is planned.

In addition, we consider archaeological sites with different conditions of preservation. In 3.1 we discussed the influence of the conditions of preservation on the representation of plant remains on archaeological sites. It is clear that the plant assemblage of a site where waterlogging occurred, is often much more rich and diverse in comparison to sites located in dry deposits where plant remains can only survive as charred and/or mineralised remains. However there are exceptions when e.g. dealing with layers of destruction through fire. The plant spectrum recovered from such deposits (e.g. *Vindonissa*, excavation Windisch-Breite) can be as rich as those from certain waterlogged deposits. In our area of comparison, 19 sites included a mainly waterlogged plant assemblages, 16 sites had a predominant charred plant assemblage,

162 After Jacomet 2003 (footnote 3) 173-229.

1 an exclusively mineralised plant assemblage (Zurzach[163]) and two a mainly mineralised plant assemblage (Augst, excavation Tophaus[164] and the legionary camp phase of *Vindonissa* (HP 5-7), excavation Windisch-Breite[165]). As the conditions of preservation of plant macro remains are influenced by so many different factors, we have not differentiated between types of preservation in our table.
A last issue which can influence the outcome of a regional comparison is the type and scale of analysis. It is clear that the volume of soil and number of samples studied in Oedenburg are of a much higher scale than the majority of sites in the area of comparison (2513.3 litres of soil for 310 samples).

To begin with, we evaluate the attested plant taxa. From **Table 6** we infer that imported food plants (of which nine species are identified) are uncommon in the area of comparison, both in the 1st and the 2nd cent. AD (five sites). Besides Oedenburg, they are found in those settlements with an exceptional preservation of macro remains (the pre-military and legionary camp phases of *Vindonissa* [excavation Windisch-Breite][166]; and a well in the *vicus* of Lahr-Dinglingen) and those linked to sacrificial practices (the graveyard belonging to the legionary camp of *Vindonissa* [excavation Windisch Dägerli, Südfriedhof]; the temple area in the *vicus* of Sierentz [excavation Zac Hoell]). Considering the latter, date (*Phoenix dactylifera*) and stone pine (*Pinus pinea*) were registered in the fillings of an offering pit located within a temple area of the *vicus* of Sierentz (excavation Zac Hoell). In the graveyard belonging to the legionary camp of *Vindonissa* (excavation Windisch Dägerli, Südfriedhof[167]) olive and date were recorded. Other imports in the pre-military camp phases of Vindonissa include olive (*Olea europaea*), date, and possibly stone pine. In the 2nd cent. AD well in the *vicus* of Lahr-Dinglingen[168] a peppercorn (*Piper nigrum*) was registered.
There are only few of the imported food plants which were present in our selected area but not recorded in Oedenburg. These include one pulse, one fruit and two nut species. Chickpea (*Cicer arietinum*) was possibly registered in the earliest phases of the legionary camp of *Vindonissa* (excavation Windisch-Breite (HP5-7)[169]). The representation of pulses on archaeological sites is highly influenced by the conditions of preservation. In Oedenburg, we have only few findings of pulses as they do not preserve well in waterlogged environments (see above). In the early Roman period (pre-military camp phases) of *Vindonissa* (excavation Windisch-Breite[170]) charred seeds and fruit flesh of pomegranate (*Punica granatum*) were found at the bottom of two barrels[171]. Findings of pomegranate are very rare also in the Mediterranean area[172]. Another unique import in the pre-military camp phases of *Vindonissa* includes pistachio (*Pistacia* sp.). The latter is a single find and dates between 10 BC and 15 AD[173]. Waterlogged almond (*Prunus dulcis*) was found in a 2nd cent. AD well in the *vicus* of Lahr-Dinglingen[174]. Almond and pistachio are hardly ever recovered from Roman

163 S. Jacomet / C. Wagner, Mineralisierte Pflanzenreste aus einer römischen Latrine des Kastell-Vicus (Zurzach). In: R. Hänggi / C. Doswald / K. Roth-Rubi (eds.), Die frühen römischen Kastelle und der Kastell-Vicus von Tenedo-Zurzach. Veröffentlichungen der Gesellschaft Pro Vindonissa 11 (Brugg 1994) 321-343.

164 H. Hüster Plogmann / S. Jacomet / M. Klee / U. Müller / V. Vogel Müller, Ein stilles Örtchen. Zur Latrinengrube in Feld 6, Grabung TOP-Haus AG, Kaiseraugst (2001.01). Jahresber. Augst u. Kaiseraugst 24, 2003, 159-191.

165 S. Jacomet 2003 (footnote 3) 173-229.

166 It concerns burnt destruction layers. In addition to conditions of preservation the presence of the military is likely to play an important role.

167 Petrucci-Bavaud / Schlumbaum / Jacomet 2000 (footnote 93) 151-159.

168 M. Roesch pers. comm.

169 Jacomet 2003 (footnote 3) 173-229.

170 S. Jacomet / D. Kucan / A. Ritter / G. Suter / A. Hagendorn, Punica granatum L. (Pomegranates) from early Roman contexts in Vindonissa (Switzerland). Veg. Hist. Arch. 11, 2002, 79-92. – Jacomet 2003 (footnote 3) 173-229.

171 Recent excavations in the vicus of Eschenz/Tasgetium have yielded waterlogged pomegranate seeds too (S. Jacomet pers. comm.). They date in the 1st cent. AD.

172 For an overview see Jacomet et al. 2002 (footnote 170) 79-92. – Jacomet 2003 (footnote 3) 173-229.

173 Jacomet 2003 (footnote 3) 173-229.

174 M. Roesch pers. comm.

Location	Status	Preservation	N° of samples	Volume	Total group 1	Total group 2	Total group 3	Group 1: Imports								
								cf. Cicer arietinum	*Nigella* cf. *sativa*	*Olea europaea*	*Phoenix dactylifera*	*Pinus pinea*	*Piper nigrum*	*Pistacia* sp.	*Prunus dulcis*	*Punica granatum*
1st cent. AD																
Total findings 1st cent. AD except Oedenburg								1	0	1	2	1	0	1	0	1
Augst, Forum 1 and 2 (CH)	civil	ch	9	12l	0	0	0									
Augst, Insula 23 (CH)	civil	ch	12	20.15l	0	0	0									
Augst, Kastelen 1 (CH)	civil	ch	7	48l	0	0	0									
Augst, Sägerei Ruder (CH)	civil	ch	23	229.4l	0	0	2									
Basel, Rittergasse (CH)	civil with mil. occ.	ch	7	37.6l	0	0	0									
Basel, Rittergasse (CH)	civil with mil. occ.	ch	11	57.1l	0	2	7									
Oberwinterthur, Gebhardtstrasse (CH)	civil	ch	1	5l	0	0	1									
Sierentz, Zac Hoell (CH)	civil	ch	1	280.4l	2	2	1				1	1				
Windisch-Breite 1996-1998 (HP2-4) (CH)	civil and military	ch/min	55	547l	4	1	5			1	1	cf		1		1
Windisch-Breite 1996-1998 (HP5-7) (CH)	military	ch/min	3	39l	1	2	7	1								
Zurzach, Tenedo (CH)	civil with mil. occ.	min	4	4.1l	0	2	7									
Eschenz, Areal Rebmann (CH)	civil	wl	1	1.62l	0	1	10									
Windisch, Schutthügel (CH)	military	wl	no	no	0	1	3									
Allschwil, Neuweilerstrasse (CH)	unclear	wl/ch	7	32.75l	0	2	10									
Baden-Baden, Gernsbacher Strasse 30 (D)	civil	wl/ch	14	2904g	0	1	4									
Badenweiler (D)	civil	wl/ch	11	29.5l	0	1	6									
Eschenz, 1999.010 (CH)	civil	wl/ch	2	11.2l	0	2	2									
Oberwinther, Römerstrasse and Unteres Bühl (CH)	civil	wl/ch	35	no	0	2	8									
Oberwinterthur, Kastellweg (CH)	civil	wl/min	2	34.8l	0	2	7									
Strasbourg, Grenier d'abondance (F)	military	wl/ch	2	4l	0	0	2									
Oberwinther, Gebhardtstrasse (CH)	civil	wl/ch/min	1	6l	0	1	1									
Oedenburg/Biesheim-Kunheim (F)	civil with mil.occ.	wl/ch/min	164	1127.5l	2	7	19			1			1			
1st/2nd cent. AD																
Total findings 1st/2nd cent. AD except Oedenburg								0	0	1	1	0	0	0	0	0
Augst, Rheinstrasse (CH)	civil	ch	31	no	0	2	2									
Augst, Rundbau beim Osttor (CH)	civil	ch	4	65l	0	0	0									
Reinach, Mausackerweg (CH)	civil (villa)	ch	5	no	0	1	1									
Windisch, Dägerli (CH)	military	ch	217	no	2	3	6			1	1					
Neftenbach (CH)	civil (villa)	ch/min/ metal	159	678l	0	1	6									
Baden-Baden, Gernsbacher Strasse 30 (GE)	civil	wl/ch	3	1297g	0	2	5									
Eschenz, 1999.010 (CH)	civil	wl/ch	2	16.5l	0	1	1									
Oedenburg/Biesheim-Kunheim (F)	civil with mil. occ.	wl/ch/min	70	575.3l	0	5	13									
2nd cent. AD																
Total findings 1st/2nd cent. AD except Oedenburg								0	0	0	0	0	1	0	1	0
Augst, Kastelen 2 (CH)	civil	ch	4	13.8l	0	1	1									
Augst, Kastelen 2 (CH)	civil	ch	3	34l	0	1	1									
Augst, Tophaus (CH)	civil	ch/min	8	38l	0	3	6									
Horbourg-Wihr, Nouvelle Mairie (F)	civil	wl	no	no	0	3	4									
Baden-Baden, Gernsbacher Strasse 13 (D)	civil	wl/ch	2	1432g	0	2	8									
Eschenz, 1999.010 (CH)	civil	wl/ch	2	9.5l	0	1	3									
Oberwinther, Gebhardtstrasse (CH)	civil	wl/ch	4	44.25l	0	2	7									
Schleitheim, Z'underst Wyler (CH)	civil	wl/ch	2	27.9l	0	1	8									
Baden-Baden, Gernsbacher Strasse 30 (D)	civil	wl/ch/min	2	1177g	0	2	2									
Lahr-Dinglingen (D)	civil	wl/ch/min	59	no	2	4	17						1		1	
Oedenburg/Biesheim-Kunheim (F)	civil	wl/ch/min	76	810.5l	4	7	16		1	1	1	1	cf			
Total findings in the area of comparison except Oedenburg								1	0	2	3	1	1	1	1	1

Table 6 Presence-absence data of the newly-introduced and imported food plants on Roman sites in a selected area of comparison

a: Dick 1989 (footnote 4) 347-350. – b: Dick 1989 (footnote 4) 347-350. – c: Jacomet / Petrucci-Bavaud 2004 (footnote 4) 241-299. – d: Ö. Akeret, Samen und Früchte. In: B. Pfäffli / H. Sütterlin / Ö. Akeret / S. Deschler-Erb / E. Langenegger / A. Schlumbaum, Die Gräber aus dem Areal der Sägerei Ruder – ein Ausschnitt aus dem Nordwestgräberfeld von Augusta Raurica. Jahresberichte aus Augst und Kaiseraugst 25, 2004, 111-178. – e: Petrucci-Bavaud pers. comm. – f: C. Brombacher, Archäobotanische Untersuchungen von Getreideproben aus dem römischen Vicus Basel-Rittergasse. In: G. Helmig / U. Schön (eds.), Neue Befunde zur antiken Zufahrtsstrasse auf den Basler Münsterhügel. Jahresbericht der Archäologischen Bodenforschung des Kantons Basel-Stadt, 1995, 55-56 and Brombacher pers. comm. – g: Kuhn pers. comm. – h: own research. – i: Jacomet 2003 (footnote 3) 173-229. – j: Jacomet 2003 (footnote 3) 173-229. – k: Jacomet / Wagner 1994 (footnote 163) 321-343. – l: Feigenwinter 1997 (footnote 2) 21-28 – m: Neuweiler 1908 (footnote 185) 393-407. – n: Kuhn pers. comm. – o: Stika 1996 (footnote 22) 207. – p: H.-P. Stika, Botanische Grossreste aus Feuchtsedimenten vom Drainagekanal der römischen Heilthermen von Badenweiler, Kr. Breisgau-Hochschwarzwald.

Group 2: Imports and local cultivation questioned								Group 3: Introduced and local cultivation																								
Carthamus tinctorius	*Cucumis sativus*	*Cucumis melo*	*Cucumis melo/ sativus*	*Ficus carica*	*Lagenaria sicerari*a	*Prunus persica*	*Vitis vinifera*	*Allium sativum*	*Anethum graveolens*	*Apium graveolens*	*Beta vulgaris*	*Carum carvi*	*Castanea sativa*	*Coriandrum sativum*	*Foeniculum vulgare*	*Juglans regia*	*Malus sylvestris/ domestica*	*Malus/Pyrus*	*Morus alba + nigra*	*cf. Origanum majorana*	*Origanum vulgare*	*Pastinaca sativa*	*cf. Petroselinum crispum*	*Pimpinella anisum*	*Portulaca oleracea*	*Prunus avium + cerasus*	*Prunus domestica + insititia*	*Pyrus communis/ pyraster*	*Ruta graveolens*	*Satureja hortensis*	*Thymus cf. vulgaris*	
0	0	0	0	10	0	3	9	0	6	10	2	3	0	9	0	12	5	10	1	0	2	0	0	0	2	6	6	4	0	5	0	
																																a
																																b
																																c
																1		1														d
																																e
				1			1			1		1		1		1	1	1	cf							cf				1		f
																1																g
				1			1									1																h
		cf				1										1	1	1								1	1					i
			cf	1			1		1	1		1		1		1		1								cf	cf			1	cf	j
				1			1		1	1		1		1			1	1								cf		1				k
				1					1	1	1			1			1	1								1	1	1		1		l
						1							sp			1										1	1					m
				1			1		1	1				1		1		1	1						1	1	1			1		n
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				1			1			1	1																					q
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				1			1		1	1				1				1								1	1			1		s
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1		1	1	1	1	1	1		1	1	1	1		1	1	1	1	1	1		1	1	1	1	1	1	1	1	cf	1		
0	0	0	0	2	0	2	6	1	2	2	0	0	0	2	0	4	2	0	0	0	2	2	0	0	0	1	1	1	0	1	0	
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							1									1																x
				1		1	1									1	1				1					1	1	1				y
							1		1	1				1		1					1	1				cf						z
						1	1		1	1				1								1								1		aa
							1									1																ab
			1	1	1	1	1		1	1	1			1	1	1		1	1						1	1	1	1		1		
0	0	2	1	8	1	2	6	0	6	6	4	0	1	6	1	9	1	3	2	1	2	0	0	0	1	4	4	2	1	2	1	
				1												1																ac
				1												1																ad
	cf	cf	1	1			1		1	1				1		1		1												1		ae
		1				1	1									1			1							1	1					af
				1			1		1	1	1			1		1				1	1							1				ag
				1										1		1										1						ah
				1			1		1	1	1			1		1											1		1			ai
				1					1	1	1			1	cf	1		1								1	1					aj
		1					1		1	1																						ak
				1	1	1	1		1	1	1	cf	1	1	1	1	1	1	1		1	cf			1	1	1	1		1	1	al
	1	1	1	1	1	1	1	1	1	1	1	1		1	1	1		1	1		1				1	1	1	1		1		
0	0	2	1	20	1	7	21	1	14	18	6	3	1	17	1	25	8	13	3	1	6	2	0	0	3	11	11	7	1	8	1	

Fundberichte aus Baden-Württemberg 23, 1999, 119-126 and Rösch 1995 (footnote 183) 151-156. – q: Pollmann 2003 (footnote 2). – r: Jacquat 1986 (footnote 1) 241-264. – s: own research. – t: Akeret pers. comm. – u: Kuhn pers. comm. – v: Petrucci Bavaud 1997 (footnote 4) 253-259 – w: Jacomet / Bavaud 1992 (footnote 4) 103-111 and M. Dick / S. Jacomet, Verkohlte Pflanzenreste aus einem römischen Grabmonument beim Augster Osttor. Jahresberichte aus Augst und Kaiseraugst 6, 1986, 7-53. – x: A. Schlumbaum / M. Petrucci-Bavaud, Die Pflanzenreste. In: S. Ammann (ed.), Fünf Gräber und eine Villa. Befunde und Funde der Römerzeit in Reinach (BL), Archäologie und Museum. Berichte aus Archäologie und Kantonsmuseum Baselland 46, 2003, 69-77. – y: Petrucci-Bavaud / Schlumbaum / Jacomet 2000 (footnote 93) 151-159. – z: Klee 1999 (footnote 129) 464-472. – aa: Stika 1996 (footnote 22) 207. – ab: Pollmann 2003 (footnote 2). – ac: Petrucci-Bavaud 1999 (footnote 4) 165-184. – ad: Petrucci-Bavaud 1999 (footnote 4). – ae: Hüster Plogmann et al. 2003 (footnote 164) 159-191. – af: Zehner 1996 (footnote 180) 103-113. – ag: Stika 1996 (footnote 22) 207. – ah: Pollmann 2003 (footnote 2). – ai: Kuhn pers. comm. – aj: own research. – ak: Stika 1996 (footnote 22) 207. – al: Rösch 1995 (footnote 183) 151-156 and Rösch pers. comm.

archaeological sites in Central Europe[175]. Pistachio was also very rare in ancient Rome, nothing is known about its use as a food plant[176]. Almond is more common than pistachio. It is consumed fresh as well as dried or roasted like most nut species[177]. Finally, there is one imported food plant which is only registered in Oedenburg. It concerns the spice black cumin (*Nigella sativa*).

Considering those plants that were introduced in Roman times and possibly cultivated locally, they are more widespread in the area of comparison. Eight species are identified. We remark that fig (*Ficus carica*) (N of sites=20) and grapevine (*Vitis vinifera*) (N=21) are the commonest plant taxa of this group in the selected area. They are found charred and mineralised but are definitively more frequent in waterlogged environments. Their distribution is not directly connected to the type of settlement. Peach is much less common. We have evidence in eight of the considered sites. The majority of the peach stones were found waterlogged. The remaining food plants in this group are very unusual. Melon (*Cucumis melo*) could be identified on two sites[178]. It involves waterlogged findings in the *vici* of Baden-Baden (excavation Gernsbacherstrasse 30[179]) and Horbourg-Wihr (excavation Nouvelle Mairie[180]). In Augst (excavation Tophaus)[181] there is a possible find of cucumber and/or melon. Remains of bottle gourd (*Lagenaria siceraria*) are equally rare[182]. Waterlogged seeds of bottle gourd were found in the wells of Lahr-Dinglingen[183]. The last economic plant in this group is safflower (*Carthamus tinctoria*). It is only recorded in Oedenburg.

In the last group of plants – representing those food plants that were introduced during the Roman period and where local cultivation is almost certain – only some species are very common; others remain rare findings. Among the common findings we count dill (*Anethum graveolens*) (N=14), celery (*Apium graveolens)* (N=18), coriander (*Coriandrum sativum)* (N=17), walnut (*Juglans regia)* (N=25), apple/pear (*Malus/Pyrus*) (N=13), cherry (*Prunus avium/cerasus*) (N=11) and plum (*Prunus domestica/insititia*) (N=11). Less common are beet (*Beta vulgaris*) (N=6), summer savory (*Satureja hortensis*) (N=8) and oregano (*Origanum vulgare*) (N=6). Caraway (*Carum carvi*), mulberry (*Morus alba* and *nigra*) and little hogweed (*Portulaca oleacea*) were registered in three sites, parsnip (*Pastinaca sativa)* and chestnut (*Castanea sativa*) in two sites. Findings of chestnut are generally very rare in archaeobotanical assemblages. Waterlogged chestnut was found in the 2nd cent. AD well in the *vicus* of Lahr-Dinglingen[184]. Neuweiler[185] recorded a find of charred chestnut (*Castanea* sp.) in the so-called Schutthügel (large waste disposal area) of the legionary camp of *Vindonissa*. The remaining (garlic (*Allium sativum*), marjory (*Origanum majorana*), fennel (*Foeniculum vulgare*), common rue (*Ruta graveolens*) and thyme (*Thymus vularis*)) were found on single sites. Aniseed (*Pimpinella anisum*) and parsley (*Petroselinum crispum*) were only identified in Oedenburg. Thyme, marjory and chestnut were not found in Oedenburg.

175 See Bakels/Jacomet 2003 (footnote 50) 542-557. – There are many charred almond finds from offerings in incineration graves in western Switzerland (Arconciel FR), dating not yet confirmed (unpublished data, Basel Archaeobotany Lab).

176 André 1998 (footnote 44) 72 f.

177 André 1998 (footnote 44) 71 ff.

178 The remainder are doubtful identifications.

179 Stika 1996 (footnote 22).

180 M. Zehner, Derniers résultats de la campagne de fouilles 1993 Horbourg-Wihr – »Nouvelle Mairie«. In: M. Fuchs (ed.), Horbourg-Wihr à la lumière de l'archéologie: histoire et nouveautés: mélanges offerts à Charles Bonnet. Actes d'ARCHIHW 2, 1996, 103-113.

181 Hüster Plogmann et al. 2003 (footnote 164) 159-191.

182 It is found in waterlogged conditions only.

183 M. Rösch, Römische Brunnen in Lahr – Fundgruben für die Botanik. Archäologische Ausgrabungen in Baden-Württemberg 1994, 1995, 151-156. – M. Roesch pers. comm. – During the very recent excavations in Eschenz (early 1st cent. AD) waterlogged bottle gourd remains (seeds, fruit wall) were detected (S. Jacomet pers. comm.).

184 M. Roesch pers. comm.

185 E. Neuweiler, Pflanzenreste aus der römischen Niederlassung Vindonissa. Vierteljahrsschrift der Naturforschenden Ges. Zürich 53, 1908, 393-407.

Considering the plant spectrum, we note that those sites where waterlogging occurred, yielded the largest amount of the considered food plants. In addition, those sites where only charred remains are preserved – except the burnt layers in *Vindonissa* – yielded the lowest numbers of plant taxa. Taking into account the type of settlement, we observe that the presence of a military occupation can have a positive impact on the diversity of food plants as does the presence of sacrificial installations.

In comparison to the majority of Roman archaeological sites in the area of comparison, the plant assemblage in Roman Oedenburg is very rich, diverse and contains many imported food plants. On the whole, those sites in the area of comparison where the plant spectra are similar to those found in Oedenburg include the *vicus* of Lahr-Dinglingen and the military settlement of *Vindonissa*. Both of them have favourable conditions of preservation. The samples from Lahr-Dinglingen were taken in waterlogged deposits of three wells. The majority of plant remains is waterlogged. The plant assemblage recovered from the early Roman occupation layers in *Vindonissa* (excavation Windisch-Breite) originate from the burnt destruction layers within dry deposits. Plant remains were preserved charred.

The rich and above all exotic plant spectrum found in *Vindonissa* is likely to be the result of the presence of the military[186]. This is also observed in other Roman sites with a military character, namely the military camps of Neuss/D[187] and Oberaden/D[188]. The impact of a military occupation on the plant assemblage during the Roman times has been observed by several authors. Livarda and Van der Veen[189] discerned a connection between military occupied sites and the dispersal of condiments in North-West Europe during the Roman times. Bakels and Jacomet noticed a link between the distribution of luxury foods and the presence of military[190].

From our regional comparison it becomes apparent that the extraordinary plant assemblage found in Oedenburg is the result of several factors, basically outstanding conditions of preservation and the presence of a military occupation. However, after the abandonment of the military camp, we do not observe any »decline« in plant remains; the spectrum is as rich and »exotic« as during the military occupation. This is mainly due to the location of the settlement on an important transport route (the river Rhine and the river Rhone). As outlined in our introduction, at the beginning of the 1st cent. AD, Oedenburg was located on the border of the Roman Empire; towards the second half of the 1st c. this border is suspended; Roman Oedenburg's location is secured. During the early Roman period, trading routes were established. As is known from other archaeological artefacts, trading activities intensified during the 2nd half of the 1st cent. AD and the 2nd cent. AD[191]. There is a development in the transport routes; watercourses are chosen to transport the bulk of imported goods as they are cheaper. Considering the expansion of the Roman Empire

186 Although the majority of exotic food plants is from the pre-legionary camp phases, it is thought they are related to the presence of the military; see summary in Jacomet 2003 (footnote 3) 173-229.

187 Knörzer 1970 (footnote 22) 162.

188 D. Kuçan, Die Pflanzenreste aus dem römischen Militärlager Oberaden. In: J. S. Kühlborn (ed.), Das Römerlager in Oberaden III. Die Ausgrabungen im nordwestlichen Lagerbereich und weitere Baustellenuntersuchungen. Bodenaltertümer Westfalens 27 (Münster 1992) 237-265. Plant remains originate respectively from burnt destruction layers and waterlogged deposits which can again be the cause for its more diverse and exotic plant spectrum. From these examples we can thus not conclude that the presence of a military occupation gave more access to a wide variety of food plants.

189 Livarda/van der Veen 2008 (footnote 124) 201-209.

190 Bakels/Jacomet 2003 (footnote 50) 542-557.

191 M.-A. Haldimann, Der Handel in römischer Zeit. In: L. Flutsch / U. Niffeler / F. Rossi (eds.), Römische Zeit. Die Schweiz vom Paläolithikum bis zum frühen Mittelalter 5 (Basel 2002) 187-196 .

and the secure location of the site on a very active trade route, it is not unusual that the plant spectrum in the 2nd cent. AD is still of a very high standard. It is likely that Roman Oedenburg evolved as an important trade centre during and after the military occupation.