

Marta Bandini Mazzanti · Giovanna Bosi ·
Anna Maria Mercuri · Carla Alberta Accorsi ·
Chiara Guarnieri

Plant use in a city in Northern Italy during the late Mediaeval and Renaissance periods: results of the archaeobotanical investigation of “The Mirror Pit” (14th–15th century A.D.) in Ferrara

Received: 30 August 2004 / Accepted: 6 April 2005 / Published online: 1 June 2005
© Springer-Verlag 2005

Abstract Results are presented from archaeobotanical analyses carried out in ‘The Mirror Pit’, a rectangular pit, situated in the city of Ferrara, in Emilia Romagna—Northern Italy. The study is part of wider research focused on the Mediaeval period of this city. The pit belongs to a building which was in use from the second half of 14th to the end of 15th century A.D. The pit itself was filled with domestic rubbish during a few years in the middle of the 15th century. The layers were preserved by waterlogging and are therefore extraordinarily rich in organic remains and artifacts, among which was the beautiful spherical mirror which gave its name to the pit. Approximately 256,000 well-preserved seeds and fruits belonging to 98 species or carpological types were identified in 12 l of sediment from the different layers. *Ficus carica*, *Brassica rapa* subsp. *rapa*/subsp. *sylvestris* and *Vitis vinifera* subsp. *vinifera* prevailed. Many cultivated plants and weeds were present, together with a smaller number of wild plants of wet environments and woodlands. Altogether they provided much new information on the diet (cultivated and wild fruits, cereals and pulses, vegetables, spices and medicinal/fibre/oil plants) of the middle to upper class inhabitants of a city in Northern Italy during the Renaissance period. The records also yielded evidence of domestic activities such as wine-making, oil making, mustard making and other kitchen practices.

Keywords Seeds/fruits · Northern Italy · Pit · Diet · Mediaeval period · Renaissance · Household tasks

M. Bandini Mazzanti · G. Bosi · A. M. Mercuri (✉) · C. A. Accorsi
Laboratorio di Palinologia e Paleobotanica,
Dipartimento del Museo di Paleobiologia e dell’Orto Botanico -
Università degli Studi di Modena e Reggio Emilia,
V.le Caduti in Guerra 127, 41100 Modena, Italy
e-mail: mercuri.annamaria@unimo.it

C. Guarnieri
Soprintendenza per i Beni Archeologici dell’Emilia Romagna -
Museo Archeologico Nazionale,
Ferrara, Italy

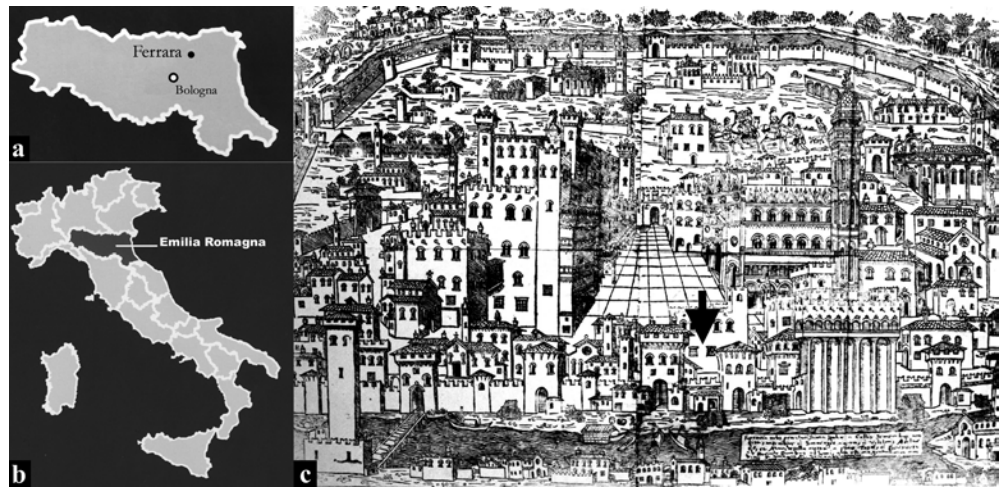
Introduction

In the Emilia Romagna region, archaeobotanical research has increased progressively in the last ten years and has involved a number of sites, dated from the Bronze Age to the Mediaeval times (e.g. Bandini Mazzanti et al. 1992, 1999; Forlani et al. 1992; Marchesini 1997; Accorsi et al. 1997a, 1999; Barbi et al. 1998; Mercuri et al. 1999a, b; Bosi 2000). The present work is part of wider research on Ferrara (10 m a.s.l.; Fig. 1), a city in the Po plain characterised by a renowned Mediaeval-Renaissance centre, probably founded in the 7th century A.D. and declared a World Heritage Site by UNESCO in 1995. From the second half of the 13th century, the city was ruled by the Este family and reached its apogee in the period from the second half of 14th to the end of 15th century A.D. Then, in the 16th century, its importance had begun to decline.

In 1993–94, while carrying out building works, important archaeological finds were made. As a result the Soprintendenza Archeologica of Emilia Romagna carried out a large excavation (approx. 300 m²). This was in the centre of Ferrara, between Corso Porta Reno and Via Vaspergolo (Fig. 1c), in a key position in the mediaeval city, i.e. between the Eastern Mediaeval *castrum*, a southern branch of the Po river and the Cathedral which was begun in 1135. The excavation exposed a well preserved historical stratification of the city dated from the second half of 10th century A.D. to the 16th century A.D. The site was inhabited until after the Second World War (Guarnieri and Librenti 1996).

Among the archaeological structures, a quadrangular brickwork rubbish pit of an urban house was discovered at the basal floor level (Fig. 2a). This was built together with the house in the second half of the 14th to the middle of the 15th century A.D., and was used for the disposal of rubbish for a few years at the middle of the 15th century (Guarnieri 1995; Fig. 2a and b). Such types of structures were built with the primary purpose of household rubbish disposal, and were quite frequent in middle-high class family contexts from the city in the late Mediaeval-Re-

Fig. 1 Location map: **a** - Emilia Romagna in Italy; **b** - Ferrara in Emilia Romagna; **c** - ancient map of Ferrara (1499, Archivio di Stato di Modena), the arrow points to the excavation site i.e. Corso Porta Reno/via Vaspergolo



naissance age. Seventeen pits, two or three per house, have already been excavated at Ferrara, for example, at Palazzo Schifanoia and Palazzo Paradiso. Although this particular type of structure is still under investigation, archaeologists interpret them as being pits for the disposal of broken or unwanted objects besides rubbish, rather than as cesspits. After being filled for a few years, each pit was sealed and definitively abandoned. In the pit discussed in this paper, the brick walls and the vaulted roof were almost entirely preserved and therefore the fill of the pit accumulated during the phase of its use was well sealed. Valuable artifacts were discovered in the pit. Among these was a very well preserved spherical mirror that is a *unicum* in Italy and perhaps in Europe (Guarnieri 2000; Fig. 2c). For this reason, the brickwork pit was named “The Mirror Pit”. The beauty and quality of the mirror and other artifacts indicated that the owners of the house belonged to an upper middle or middle class family.

Besides artifacts, the pit contained organic remains: fragments of bones, shells and a lot of vegetal remains, especially seeds and fruits. Most of them were well preserved by waterlogging in a subfossil state, as the pit was below the ground water table. Only the larger part of the cereal caryopses, pulses, and the chestnut pericarp (this latter on one side only) were carbonised. Due to the abundance, variety and good preservation of the vegetal remains, the archaeobotanical research focused on seeds and fruits (Bosi 2000; wood and charcoal analyses are in progress).

The main aim of the study was to provide direct evidence of a number of plants, identified to species level, that were certainly used in an upper middle class urban house during the apogee of Ferrara. Although there have been many similar investigations north of the Alps (material from latrines, e.g. Brombacher et al. 1999; Hellwig 1997; van Zeist and Woldring 2000; or from waterlogged layers in drains and ditches, e.g. Dickson 1996; Beneš et al. 2002), carpological research from the Mediaeval period is rare in Italy (Rottoli 1996; Castelletti et al. 1999, and references therein). This is possibly because information on some of the relevant topics is available from

literature and archives. However the need for the provision of scientific botanical evidence is increasingly stressed (e.g. Ruas 1992 for France, and Behre 1999 for Northern Europe). Since the purpose of the pit was clearly apparent from the archaeological investigations, it was not felt necessary to emphasise additional information on the filling history and the type of materials in the pit.

Materials and methods

The pit has approximately the shape of a parallelepiped (3.5 m × 1.5 m in area and 1.4 m deep, from 3.80 to 2.40 m below the modern ground surface; Fig. 2b). The fill consisted for the most part of artifacts and broken objects (broken mirrors, wooden boxes, fragments of wood, bricks, pottery, glass, pieces of eggshell etc.). Archeological data and analyses on pottery and pieces of glass recovered in the different layers of the pit (Fig. 2b) showed that the filling was deposited during a short period datable to the middle of the 15th century. Materials for the carpological study were collected from the bottom to 2.60 m depth. The 20 cm at the top of the pit, partially damaged during the above-mentioned building work, were excluded.

Six samples, of about 10 l each, were randomly collected in the filling of the pit (they are visible on Fig. 2b). The matrix was highly incoherent, mainly consisting of clay, sand and organic material, giving the sediment a brown or pale brown colour. A 2 l subsample from each sample (in total = 12 l) was soaked in water to disaggregate lumps. As it is usual in our experience with the commonly incoherent deposits from beneath Ferrara, this process was easily performed. The subsamples were then washed through a bank of three sieves with 10, 0.5 and 0.2 mm meshes. Seeds and fruits of each fraction were sorted and counted under a stereomicroscope. The number of records is given for the estimated number of all seeds/fruits if they were incomplete. In case of *Ficus* and *Vitis*, which were very abundant, only a part of each fraction was analysed, i.e. 50–100 ml of sieved material per subsample. The volume of this fraction was established by the method of sorting small subsamples (15–20 ml each) from the residues of the 2 l subsamples (excluding the coarser fraction which was analysed completely). Then the number/2 l per subsample was extrapolated. Seeds and fruits were examined with a Wild M10 stereomicroscope (up to 80x magnification) and identified with the help of current atlases and keys (Anderberg 1994; Beijerinck 1947; Berggren 1969; Berggren 1981; Davis 1993; Delorit 1970; Frank and Stika 1988 (for *Cucumis*); Häflinger and Brun-Hool 1981; Hubbard 1992; Jacomet et al. 1991; Jacquat 1988; Kiffman 1958; Montegut 1972; Pignotti 1998;

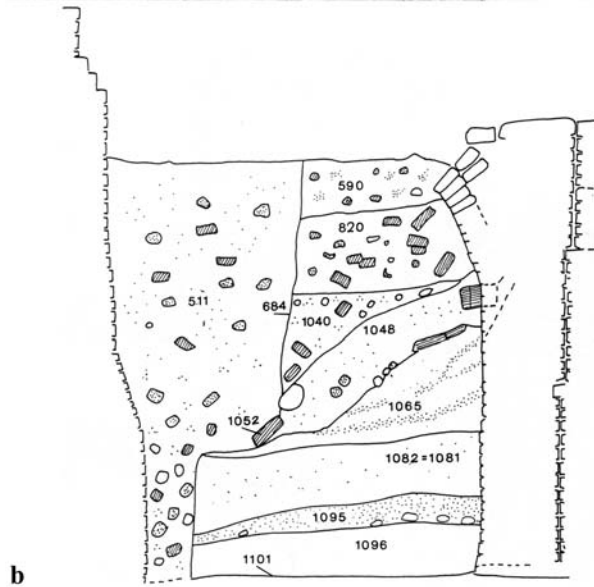


Fig. 2 Archaeology: **a.** the pit (view from above); **b.** stratigraphy of the pit (US = archaeological layer numbers, modified from Guarneri 2000): samples were collected from layers 1095, 1081, 1048 and 1040; **c.** the spherical mirror which gave the name to 'The Mirror Pit' of Ferrara

Renfrew 1973; Schoch et al. 1988; Scurti 1948; Spjut 1994; Young and Young 1992; Viggiani 1991) and the reference collection of our laboratory.

As the samples showed a homogeneous carpological content and were of the same age, the seeds and fruits from the six subsamples were totaled. Table 1 shows the list of records plus indications of the uses of the plants, the concentration values (seeds/fruits (=sf) per 12 l) and the percentage values (calculated on a seed/fruit sum which excludes *Ficus* and *Vitis*. Unless otherwise specified, percentage data in the text are referred to this sum). Both the Italian Flora (Pignatti 1982) and the European Flora (Tutin et al. 1964–80) were used for scientific plant names.

Results and discussion

Approximately 256,000 seeds and fruits were identified, belonging to 98 species or carpological types, 70 genera and 31 families. The assemblage was dominated by cultivated plants (90% of records – 44% of taxa; Table 1; Fig. 3).

Useful plants

Cultivated or possibly cultivated plants

The largest group of useful plants is formed by remains of woody plants (indicated by frw in Table 1). *Ficus carica* and *Vitis vinifera* subsp. *vinifera* largely predominate (82% out of the seed/fruit sum incl. *Ficus* and *Vitis*) indicating they were the main component of the carpological assemblage. In fact they are both frequent and abundant in archaeological sites in Emilia Romagna from the Roman period onwards (Bandini Mazzanti et al. 2001a).

Figs (*Ficus carica*: achenes) is the most abundant (>185,000 sf/12l), and its large presence in the deposit is clearly linked to the use of the pit for disposal of kitchen refuse, but a contribution from excrement cannot be completely excluded. In fact, besides being eaten raw, figs could have been used to make jam, a type of wine and an alcoholic drink (Flandrin and Montanari 2003). The latter involves straining and produces a refuse rich in achenes. *Ficus carica* is a Mediterranean tree, but it could have easily been cultivated in Ferrara in sheltered places in both house or kitchen gardens, as it is today. However the possibility cannot be excluded that the fig grains came from imported dried figs.

Grapes (*Vitis vinifera* subsp. *vinifera*: pips) are the second most abundant record (>22000 sf/12l). Obviously, the pips had the typical morpho-biometrical characters of the cultivated grapes, including elongated form, long stalk, sculpture of fossettes absent, radial rows of the *chalaza* absent (Castelletti and Di Vora 1994). Again, the high number of pips indicated that grapes were used to make wine or syrups besides being eaten fresh as table-grapes. The pips were mostly unbroken. Since bunches were absent we assume that possibly only the individual grapes were pressed. Winemaking is perhaps most probable as it is known from written sources that winemaking

Table 1 Carpological records from ‘The Mirror Pit’, Ferrara: list of taxa (all records were of uncharred remains with few exceptions; the different state of preservation is indicated in brackets), type of remains, total number of records per 12 l, percentages based on the total number of records excluding *Ficus* and *Vitis*; o = approx. 1000 records. For the group ‘Cultivated or possibly cultivated plants’, the prevalent use (as discussed in the text) is also reported: *frw* = fruits and nuts, woody plants; *vasmh* = vegetables/aromatics/spices/medicinal, herbaceous plants; *foh* = fibre/oil, herbaceous plants; *cp* = cereal and pulses; *frh* = fruits, herbaceous plants; *flh* = flowers, herbaceous plants

	Type of remains	use	n/12 l	%
Useful plants				
Cultivated or possibly cultivated				
Cereals and pulses				
<i>Hordeum vulgare</i> L. (charred)	caryopsis	cp	1	0.002
<i>Panicum miliaceum</i> L. (charred)	caryopsis	cp	242	0.531
<i>Sorghum bicolor</i> (L.) Moench (charred/uncharred)	caryopsis	cp	13	0.029
<i>Triticum aestivum</i> s.l./ <i>turgidum</i> (charred)	caryopsis	cp	1	0.002
<i>Pisum sativum</i> L. (charred)	seed	cp	1	0.002
<i>Vicia</i> cf. <i>faba</i> L. (charred)	hilum	cp	1	0.002
Total cereals and pulses			259	0.6
Fruits and nuts				
<i>Castanea sativa</i> Miller (partially charred)	pericarp	frw	1	0.002
<i>Cucumis melo</i> L.	seed	frh	29	0.064
<i>Ficus carica</i> L.	achene	frw	187148	out %
<i>Fragaria vesca</i> L.	achene	frh	228	0.501
<i>Juglans regia</i> L.	endocarp	frw	7	0.015
<i>Malus domestica</i> Borkh.	seed	frw	5	0.011
<i>Mespilus germanica</i> L.	pyrenes	frw	230	0.505
<i>Morus</i> cf. <i>nigra</i> L.	endocarp	frw	75	0.165
<i>Prunus avium</i> L.	endocarp	frw	24	0.053
<i>Prunus avium/cerasus</i>	endocarp	frw	3	0.007
<i>Prunus cerasus</i> L.	endocarp	frw	88	0.193
<i>Prunus domestica</i> L. subsp. <i>insititia</i>	endocarp	frw	170	0.373
<i>Prunus persica</i> (L.) Batsch	endocarp	frw	1	0.002
<i>Prunus spinosa</i> L.	endocarp	frw	121	0.266
<i>Punica granatum</i> L.	seed	frw	31	0.068
<i>Pyrus communis</i> L.	seed	frw	26	0.057
<i>Rubus fruticosus</i> s.l.	endocarp	frw	1193	2.619
<i>Rubus idaeus</i> L.	endocarp	frw	47	0.103
<i>Sorbus domestica</i> L.	pyrene	frw	3	0.007
<i>Vitis vinifera</i> L. subsp. <i>vinifera</i>	pip	frw	22914	out %
<i>Vitis vinifera</i> L. subsp. <i>vinifera</i>	pedicels	frw	ooo	out %
<i>Vitis vinifera</i> L. subsp. <i>vinifera</i>	grape skins	frw	o	out %
<i>Ziziphus jujuba</i> Miller	endocarp	frw	3	0.007
Total fruits and nuts			212347	
Total fruits and nuts excl. Ficus and Vitis			2285	5.5
Fibre-and oil plants				
<i>Brassica rapa</i> L. subsp. <i>rapa</i> /subsp. <i>sylvestris</i> (L.) Janchen	seed	foh	30056	65.993
<i>Camelina sativa</i> (L.) Crantz	seed	foh	2	0.004
<i>Cannabis sativa</i> L.	achene	foh	2	0.004
<i>Linum usitatissimum</i> L.	seed	foh	1	0.002
Total fibre-and oil plants			30061	73.1
Vegetables, spices, medicinal plants				
<i>Anethum graveolens</i> L.	mericarp	vasmh	58	0.127
<i>Brassica nigra</i> (L.) Koch	seed	vasmh	677	1.486
<i>Coriandrum sativum</i> L.	mericarp	vasmh	10	0.022
<i>Cuminum cyminum</i> L.	mericarp	vasmh	2	0.004
<i>Daucus carota</i> L.	mericarp	vasmh	2	0.004
<i>Foeniculum vulgare</i> Miller	mericarp	vasmh	13	0.029
<i>Papaver somniferum</i> L.	seed	vasmh	5	0.011
<i>Petroselinum sativum</i> Hoffm	mericarp	vasmh	1078	2.367
<i>Pimpinella anisum</i> L.	mericarp	vasmh	301	0.661
<i>Portulaca oleracea</i> L.	seed	vasmh	6388	14.026
Total vegetables, spices, medicinal plants			8534	20.7
Flowers				
<i>Dianthus</i> sp	seed	flh	1	0.002
<i>Viola</i> sp	seed	flh	2	0.004
Total flowers			3	<0.1
Wild plants utilised				
Fruits and nuts				
<i>Corylus avellana</i> L.	nut	frw	1	0.002
<i>Crataegus</i> cf. <i>monogyna</i> Jacq	pyrene	frw	1	0.002
<i>Rubus caesius</i> L.	endocarp	frw	109	0.239

Table 1 (continued)

	Type of remains	use	n/12 l	%
<i>Sorbus cf. torminalis</i> (L.) Crantz	seed	frw	2	0.004
Total wild plants utilised			113	<1
Wild plants not obviously used (*weeds)				
<i>Agrostemma githago</i> L.*	seed		1	0.002
<i>Ammi visnaga</i> (L.) Lam.*	mericarp		8	0.018
<i>Anagallis cf. arvensis</i> L.*	seed		2	0.004
<i>Anthemis</i> sp.	cypsela		10	0.022
<i>Arum italicum</i> Miller	seed		1	0.002
<i>Atriplex</i> sp.*	achene		3477	7.634
<i>Bolboschoenus maritimus</i> (L.) Palla	nutlet		1	0.002
<i>Bromus</i> sp.	caryopsis		1	0.002
<i>Calystegia sepium</i> (L.) R. Br.	seed		1	0.002
<i>Capsella bursa-pastoris</i> (L.) Medicus*	seed		2	0.004
<i>Carex hirta</i> L.	nutlet		4	0.009
<i>Carex</i> sp.	nutlet		2	0.004
<i>Chenopodium album</i> L.*	achene		68	0.149
<i>Chenopodium cf. rubrum</i> L.*	achene		60	0.132
<i>Chenopodium ficifolium</i> Sm.*	achene		120	0.263
<i>Chenopodium</i> sp.*	achene		4	0.009
<i>Convolvulus</i> sp.	seed		1	0.002
<i>Eleocharis palustris/uniglumis</i>	nutlet		1	0.002
<i>Fallopia convolvulus</i> (L.) Holub*	achene		2	0.004
<i>Galeopsis tetrahit/speciosa</i> *	mericarp		2	0.004
<i>Galium aparine</i> L.*	mericarp		1	0.002
<i>Galium cf. verum</i> L.	mericarp		1	0.002
<i>Galium</i> sp.	mericarp		7	0.015
Gramineae indet., wild	caryopsis		4	0.009
<i>Matricaria chamomilla</i> L.*	cypsela		1	0.002
<i>Papaver rhoeas/dubium</i> *	seed		1	0.002
<i>Polygonum aviculare</i> group*	achene		1	0.002
<i>Polygonum lapathifolium</i> L.*	achene		2	0.004
<i>Polygonum persicaria</i> L.*	achene		1	0.002
Pomoideae deteriorated	seed		8	0.018
<i>Potentilla cf. anserina</i> L.*	achene		6	0.013
<i>Quercus</i> sp.	cupule		1	0.002
<i>Ranunculus acris</i> L.*	achene		1	0.002
<i>Ranunculus</i> sp.	achene		2	0.004
<i>Raphanus raphanistrum</i> L.*	seed		2	0.004
<i>Raphistrum rugosum</i> (L.) All.*	silicula		9	0,020
<i>Sanguisorba cf. minor</i> Scop.*	achene		1	0.002
<i>Setaria viridis/verticillata</i> *	caryopsis		6	0.013
<i>Silene alba</i> (Miller) Krause*	seed		3	0.007
<i>Silene cf. nutans</i> L.	seed		1	0.002
<i>Solanum dulcamara</i> L.	seed		2	0.004
<i>Solanum nigrum</i> L.*	seed		3	0.007
<i>Sonchus oleraceus</i> L.*	cypsela		1	0.002
<i>Sonchus</i> sp.	cypsela		2	0.004
<i>Sorbus</i> sp. (wild)	seed		4	0.009
<i>Stellaria media</i> (L.) Vill.*	seed		9	0.020
<i>Teucrium scordium</i> L. cf.	mericarp		2	0.004
Umbelliferae indet.	mericarp		415	0.911
<i>Urtica dioica</i> L.*	achene		19	0.042
<i>Urtica urens</i> L.*	achene		1	0.002
<i>Vicia</i> sp.	seed		4	0.009
Total of wild plants			4289	9
Total	Taxa		remains	
	98		255606	
Total (excl. <i>Ficus</i> and <i>Vitis</i>)	96		45544	
Cultivated or possibly cultivated plants (excl. <i>Ficus</i> and <i>Vitis</i>)	41		41142	90%
Wild plants utilised	4		113	<1%
Wild plants not obviously used	51		4289	9%

was a household task in Mediaeval mansions, and people used to press only the individual grapes by trampling them in vats, a method that did not crush the pips. Some

pips could also represent the refuse of “sapa” or “saba”, a kind of dense syrup that still today has various uses in the kitchen in the region, and is prepared by concentrating the

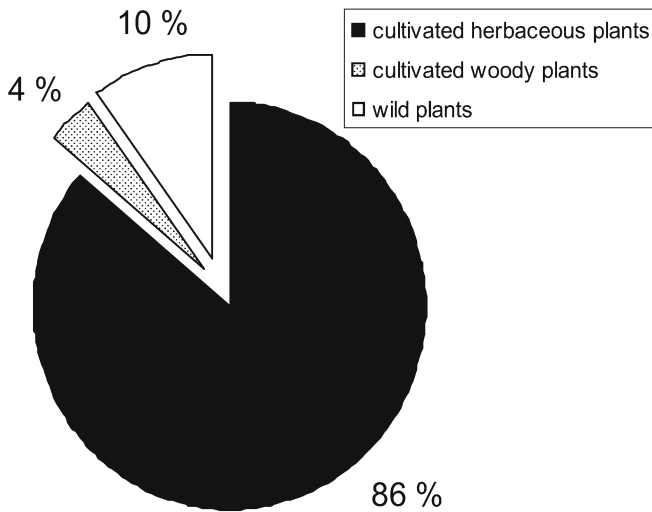


Fig. 3 The percentage of possibly or definitely cultivated plants largely dominates the carpological records

grape must be boiled down to a third of its volume, according to Pliny (“*Vino cognata res sapa est musto decocto, donec tertia pars supersit*”, Plinius, *Naturalis historia* XXIII. 62). The grape vine was a common plant in Ferrara in the Middle Ages, cultivated within the walls of the city, and also used for decoration, e.g. for bowers in house-gardens.

Brambles (*Rubus*: endocarps) Blackberry (*Rubus fruticosus* s.l.) is the most abundant bramble (>1100 sf/12l). *Rubus ulmifolius* is the most common species among those belonging to this carpological type in the region. The high number of records suggests that blackberries were used in the kitchen besides being eaten raw. They were probably also used to make jams, jellies, syrups and drinks. The latter three preparations involve straining and produce refuse rich in endocarps. Blackberry usually grows wild in bushes and hedges. Interestingly, its records are scarce from Roman sites in the region but become rather more frequent from mediaeval sites, especially Late Middle Ages (Bandini Mazzanti and Bosi in press). Possibly during the Middle Ages wild blackberries were first protected in their natural/seminatural habitats, and then planted in little orchards and gardens. In fact Ruas (1992: p 304, and p 311) also observed that “*Rubus fruticosus*, *Prunus spinosa* and *Fragaria vesca* were firstly maintained in their natural habitats and gradually taken into cultivation in the 12th–13th century” in France. In the pit deposit, Raspberry (*Rubus idaeus*) is scarce (47 sf/12l). This plant is not frequent in mediaeval sites in Emilia Romagna. It grows wild in hills and mountains and people possibly planted it in gardens, but we can not rule out the pickling of raspberries in woods. For dewberry (*R. caesius*) see below (Wild plants).

Medlar (*Mespilus germanica*: pyrenes) and **Black Mulberry** (*Morus* cf. *nigra*: endocarps) are quite abundant. They are common records from archaeological sites in the region in the Late Middle Ages (from 13th century onwards—Bosi 2000; Bandini Mazzanti and Bosi in

press). Medlar and Mulberry trees were planted for their fruits, and possibly also for decoration (Harvey 1981).

Prunoideae (endocarps) are quite abundant and various. They are mainly represented by bullace (*Prunus domestica* subsp. *insititia*), common sloe (*P. spinosa*), and sour cherry (*P. cerasus*), together with sweet cherries (*P. avium*) and a few peaches (*P. persica*). The identification of sweet and sour cherries was basically made by comparison with reference material collected from several Italian localities. In our records attributed to *P. cerasus*, the most important discriminating character is the ‘hilum’, which is particularly marked having robust ribs that radiate on the lateral surfaces, while in *P. avium* the hilum is punctiform. These records are common from mediaeval sites in our region. Note that common sloe notably increased in the Late Middle Ages (Bandini Mazzanti et al. unpublished data). Like blackberry, it was possibly taken into cultivation gradually.

Other edible fruits were scarce but included pomegranate (*Punica granatum*: seeds), pear (*Pyrus communis*: seeds), walnut (*Juglans regia*: endocarps), apple (*Malus domestica*: seeds), true service (*Sorbus domestica*: seeds), chestnut (*Castanea sativa*: pericarps) and jujuba (*Ziziphus jujuba*: endocarps). Interestingly, pericarps of Maloideae were not recorded, possibly because such a material was used as ‘compost’ for fields or, when dried, burned for use as a flavouring (Nada Patrone 1989) as is still the practice in the region today.

Beside the remains of the woody plants, a large variety of species of herbaceous plants, useful for food, medicine, fibre and decoration were detected. Most of them were cultivated during Mediaeval times (Montanari 1979; Lieutaghi 1992; Cambornac 1998; Scully 1998).

Vegetables/aromatics/spices/medicinal plants

Vegetables are represented by abundant seeds of purslane (*Portulaca oleracea* >6300 sf/12l) and occasional mericarps of *Daucus carota*. The abundance of purslane records and some seeds with maximum diameter of 1.0–1.1 mm (*sensu* Danin et al. 1978: 5.7% of purslane seeds) suggested the presence of *P. oleracea* subsp. *sativa*, certainly cultivated. Purslane is a plant appreciated in salad and also as medicine. On a carpological basis, it is not clear if the subspecies *Daucus carota* subsp. *sativus* and the wild *D. carota* subsp. *carota* are distinguishable. Aromatics/spices/medicinal plants included parsley (*Petroselinum sativum*), black mustard (*Brassica nigra*), anise (*Pimpinella anisum*), dill (*Anethum graveolens*), fennel (*Foeniculum vulgare*), coriander (*Coriandrum sativum*), poppy (*Papaver somniferum*), cumin (*Cuminum cyminum*), and also chamomile (*Matricaria chamomilla*; wild plants - Table 1), a very common weed of disturbed ground. Whether it was cultivated was difficult to establish, but it is well known that it was largely used for medicinal purposes. The other plants were almost certainly cultivated for their aromatic seeds/fruits, leaves and/or stems, according to documentary evidence (Badiali



Fig. 4 *Brassica rapa* subsp. *rapa/sylvestris*: **a** – seed (length 1.71 mm); **b** – detail of the surface (mean size of meshes: 160 μ m); **c** – seeds suggesting oil manufacture - they are unbroken but

usually their integument is split, and the shape of the seed resembles a deflated rubber ball

1999; Redon et al. 1994; Sabban and Serventi 1996; Scully 1998). Some of them, i.e. parsley, black mustard and anise, found in high concentrations, seem to have been used frequently in the house. In case of black mustard, it is worth noting that besides the abundant unbroken seeds (>670 sf/12l) a lot of fragments were also found, suggesting that seeds had been crushed to make mustard (Bandini 1992; Redon et al. 1994; Sabban and Serventi 1996; Vannini et al. 2004).

Fibre and oil plants

Few occurrences of hemp (*Cannabis sativa*) and flax (*Linum usitatissimum*) which supplied fibre and oil were recorded. In particular, flax yielded linseed oil which has a therapeutic use. Hemp was commonly cultivated for fibre in the lowlands of the region, mainly in the provinces of Bologna and Ferrara, from the period of the Roman Empire to some decades after the Second World War (Marchesini 1997; Bandini Mazzanti et al. 1999; Bosi 2000). The neighbourhood of Ferrara was particularly suited to this cultivation due to its abundance of wet environments suitable for hemp retting. The most interesting records of oil plants are seeds of *B. rapa* subsp. *rapa*/subsp. *sylvestris* found in great abundance (>30000 seeds/12 l; Fig. 4) in a state which testified to their use to obtain oil. In fact the majority of records were concave-convex suggesting that the seeds had been pressed to extract the oil.

Cereals and pulses

These were scarce. Among cereals, broomcorn millet (*Panicum miliaceum*) was the most abundant (>200 sf/12l), together with a few records of sorghum (*Sorghum bicolor*), barley (*Hordeum vulgare*) and wheat (*Triticum aestivum* s.l./*turgidum*). Only whole grains in a carbonised state were found, there was no uncarbonised testa or pericarp and no glumes. Pulses include only two spe-

cies, pea (*Pisum sativum*) and broad bean (*Vicia faba*), with one record each. The pulses and most cereals were charred, probably because they arrived in the pit via the fireside of the cooking-room. *Sorghum* alone was prevalently uncharred, suggesting a different use for this plant, such as the making of brooms as currently occurs in the Ferrara area (Revedin 1909).

Fruits

Strawberry (*Fragaria* cf. *vesca*) and melon (*Cucumis melo*) were recorded. In this context, the abundance of strawberry suggested that it was grown in the house garden in a cultivated state. This was also supported by the frescoes of Schifanoia (see below), more precisely the April fresco, where strawberry is seen drawn in a garden (Piccoli 1989). Melon has been grown without interruption in Ferrara since the 10th century A.D., i.e. a short time after the city's foundation. This is shown by the frequent records of its seeds in archaeological deposits from the area and by the current spread of melon cultivation in the Ferrara country where it is still a habitual, appreciated and renowned crop.

Flowers

Pansy (*Viola* sp.) and pink (*Dianthus* sp.) seeds were recorded, in a bad state of preservation, which prevented identification to species. They were probably grown in the garden of the house as they were popular garden flowers. Pinks were also shown in the frescoes of Schifanoia (see below). Note that in the Middle Ages pansies were often eaten as candied flowers (Scully 1997), as they currently are, but at that time they were added to salads (Faccioli 1988) while today they are mainly used in cake decoration.

Some of the above mentioned plants were recorded in large amounts thus showing that, as supported by pictures and written sources, the relevant trees/shrubs and herbs

were cultivated or cared for in the garden of the house or in the neighbourhood. Furthermore some other studies in progress from open area deposits in the city of Ferrara are in accordance with this hypothesis as the above-mentioned records are very common.

Even when carpological records are sparse, the general archaeological/historical context suggests these plants were cultivated. For example the chestnut tree (*Castanea sativa*), which typically grows in the hills of the region, could have been cultivated near the house. Only one record with traces of having been burnt was found in our deposit. Perhaps more remains from the chestnut tree were lacking because of the use of pericarps for burning. In fact it is recorded in the Statute of the Monastery of Pomposa, a Mediaeval abbey near Ferrara dated 1295 A.D., that people were forced to grow chestnut trees in the area (Zucchini 1967). Also pollen and other archaeobotanical records from the Po Plain suggest that the chestnut tree has been grown here and there from the Roman period onwards (Accorsi et al. 1997b; Rottoli 2001; Trevisan Grandi et al. 2001). Several plants in the records, i.e. fig, grape, pomegranate, apple, pear, peach, cherry, strawberry, flax, and often their cultivation, are painted in the frescoes of the "Salone dei Mesi" of the mansion of Schifanoia at Ferrara. The fresco was dated to the end of 15th century A.D. and therefore was almost contemporary with the filling phase of the pit. It depicts the yearly cycle of rural labour in the country around Ferrara month by month, with a rich variety of details of gardens and natural environments (Piccoli 1989). Other trees/shrubs, i.e. walnut, fig, true service, grapevines, pomegranate and jujube, were most probably also grown for decoration, as currently occurs with the latter three in the house gardens in the centre of Ferrara. Altogether, the records suggested that a considerable variety of fruit was eaten in the house. This was the sign of a rich diet, and therefore that the owners probably belonged to an upper middle or middle class family.

Wild plants utilised (<1%)

Other records came from wild food or fodder plants. Hazel (*Corylus avellana*), blueberry (*Rubus caesius*), wild service (*Sorbus* cf. *torminalis*) and hawthorn (*Crataegus* cf. *monogyna*). These plants were certainly common in the meso-hygrophilous oak forest that was still spread about the Po plain in the Middle Ages (Accorsi et al. 1997b) or also in garden hedges and their fruits could have been gathered there as they are today.

Wild plants not obviously used (10%)

Weeds (29 taxa; 8%; marked with a * in Table 1):

This group is low in abundance but varied. It includes a number of wild synanthropic plants growing next to the house or in the surrounding area, in various habitats such as disturbed ground (e.g. refuse areas, kitchen and house

gardens), trampled areas (e.g. streets, courts, waysides), waste and cultivated suburban land (e.g. fields, orchards, vineyards). It should be noted that among them were some weeds of nitrogen-rich soils such as Chenopodiaceae (mainly *Atriplex* sp., *Chenopodium ficifolium*, *C. rubrum* and *C. album* group), nettles (*Urtica dioica* and *U. urens*), *Silene alba* and *Solanum nigrum*, also some weeds of cereal fields such as *Agrostemma githago*, *Galeopsis tetrahit/speciosa* type, *Fallopia convolvulus*, *Papaver rhoeas/dubium* type, *Raphistrum rugosum* and *Stellaria media*. Other weeds of present day manured fields (i.e. *Anagallis* cf. *arvensis*, *Polygonum laphatifolium*, *P. persicaria*, *Raphanus raphanistrum*, *Setaria viridis/verticillata* type, *Sonchus oleraceus*) probably grew in kitchen gardens in the Middle Ages, since at that time these were commonly manured. Moreover, the record of other plants suggested damp meadows (i.e. *Ammi visnaga*, *Arum italicum*, *Potentilla* cf. *anserina*).

Plants of wet ground (<1%)

This group mainly includes Cyperaceae, represented by sedges (*Carex hirta*, *Carex* sp.) and spikerushes (*Bolboschoenus maritimus*, *Eleocharis palustris/uniglumis* type). Moreover, note the record of the water germander (*Teucrium* cf. *scordium*) a species of damp meadow and marshes which today is rare in Emilia Romagna (Pignatti 1982). Plants of wet ground, even if we include those of damp meadows, were scarce in the pit fill when compared with their abundance in contemporary deposits from open areas belonging to the same archaeological stratification (Bosi 2000). However, considering that these seeds/fruits of wet plants were casual arrivals in the pit, probably via mud trampled in open areas, they are in accordance with the picture created by the whole carpological assemblage of the site of an environment well provided with water.

Conclusions

The pit was used for disposal of kitchen waste and floor sweepings. In fact the records, especially of food plants, indicate that the deposit mainly consisted of rubbish. Also the presence of excrement was implied by much of the remains, e.g. fig achenes and blackberry endocarps. However, fecal material seems not to constitute a large part of the filling since many carpological records including those of fig and blackberry could also have been derived from refuse from fruit wines and other kitchen preparations. Moreover, testa and pericarp fragments of cereals, typical of faecal debris, were absent. This hypothesis agrees with the archaeological interpretation described above.

Altogether, the assemblage provided information about the domestic life in the house.

The inhabitants ate a notable variety of fruits: mainly grapes and figs, together with many others. Some fruits were collected from wild vegetation, but the majority of

them were cultivated. Note that *Rubus fruticosus*, *Prunus spinosa* and *Fragaria* were probably planted as is suggested by the increase in the number of their records from the Roman period to the Late Middle Ages observed in the Emilia Romagna region (Bandini Mazzanti et al. 2001a, b; Bandini Mazzanti and Bosi in press). People also ate vegetables (*Portulaca oleracea*, *Daucus carota*), probably decorated salads with pansies and were in the habit of spicing their food. Spices were probably also used for medicinal purposes, as *Matricaria chamomilla* certainly was.

The plant spectrum suggests also that some household tasks were carried out in the house:

- (a) careful *winemaking*, performed by pressing only the individual grapes, as was suggested by the abundance of unbroken pips. This method, which produces particular varieties of wine, was already evidenced by well-preserved marcs recorded in several rubbish pits in the Castello Estense area in Ferrara dated to the Late Middle Ages (Bandini Mazzanti et al. 1992)
- (b) *mustard making*, suggested by the abundance of seeds of black mustard, broken as if they had been crushed in a mortar
- (c) *oil making*, suggested by the abundance and particular form of *Brassica rapa* seeds, concave-convex as if they had been pressed to extract the oil
- (d) *fruit wines* and *syrup making* by methods involving straining, suggested by the high number of *Rubus fruticosus* endocarps and fig achenes. Spices, vegetables, medicinal plants, flowers and fruit trees grew in the house/kitchen garden or in the neighborhood, not far from the house.

Some trees such as true service, pomegranate, jujube, walnut, fig and grape vines were possibly grown for two purposes, for food and for decoration. This is suggested by iconographic sources (e.g. the Salone dei Mesi already cited). Even today, *Vitis vinifera* subsp. *vinifera*, *Ficus carica*, *Punica granatum* and *Ziziphus jujuba* are currently cultivated in the gardens of homes in the mediaeval center of Ferrara.

Cereals (*Hordeum vulgare*, *Panicum miliaceum*, *Sorghum bicolor* and *Triticum aestivum* s.l./*turgidum*), pulses (*Pisum sativum* and *Vicia faba*), oil or oil/textile plants (*Brassica rapa*, *Linum usitatissimum* and *Cannabis sativa*) were cultivated in the fields neighboring Ferrara. Obviously, only cereal grains were brought into the house, as no chaff was found. *Prunus cerasus* and *Cucumis melo* are still favoured and customary crops in the Ferrara country.

Most records of synanthropic plants indicate growth on nitrogen-rich soil, in urban streets and squares as well as on weeded and/or manured cultivated sites. The latter were almost certainly kitchen gardens, which in the Late Middle Ages were manured (Montanari 1979). Therefore, besides the food/decoration plants described above, even the weeds are evidence of the presence of a kitchen garden in the house. This was traditional in Ferrara. In fact

ancient maps show the city as a patchwork of open and covered areas (Bonasera 1965; Farinelli Toselli and Scafuri 1993) such as streets, squares, houses, mansions, sacred or governmental buildings, courtyards and house gardens. Indeed today the well preserved mediaeval center of Ferrara, which has retained its urban fabric virtually intact, contains many house and kitchen gardens and even small orchards.

The records of some species now infrequent or absent in the region (Pignatti 1982) are worth mentioning. These are *Agrostemma githago*, *Teucrium scordium* and *Chenopodium ficifolium*. The latter two plants very probably grew in the city in the Middle Ages. In the case of *C. ficifolium*, note that a few plants are found today in the area of the walls of Ferrara (Piccoli 1986) although the species is not listed for Emilia Romagna in the Flora d'Italia (Pignatti 1982). *Agrostemma githago* could also have been imported with cereals into the house, but unlike the cereal grains it was not carbonised.

The rich variety of fruits, the care in preparing first-rate wine and the variety of spices suggests that inhabitants of the house had a varied diet and that its owners belonged to the upper-middle or middle classes. In particular, two fruits (*Punica granatum* and *Ziziphus jujuba*) suggest people of high status.

The pit-fill did not permit the reconstruction of the natural landscape as most of the remains were deliberately brought in by the inhabitants. On the whole, wild plants were scarce, while in contemporary open-air layers of the same archaeological stratification age they were more abundant (Bosi 2000). This once again stresses that the deposit was mainly the result of household activity, and that cleaning of cereals for example took place at the point of their production. We can conclude that "The Mirror Pit" is a good mirror of the domestic life of fairly wealthy mediaeval inhabitants of the city.

Acknowledgements This research is the result of the long-lasting collaboration between our laboratory and the Soprintendenza Archeologica of Emilia Romagna. This work was funded by C.N.R. (Centro Nazionale delle Ricerche; P.F. Beni Culturali – President: A. Guarino, Director: U. Baldini, Coordinator Subproject.4: G. De Stefano; Operative Unit: C.A. Accorsi). Figures and photographs in Fig. 2 are reproduced by permission of the Ministero Beni Culturali e Ambientali – Soprintendenza per i Beni Archeologici dell'Emilia Romagna

References

- Accorsi CA, Bandini Mazzanti M, Forlani L, Giordani N, Marchesini M, Marvelli S, Bosi G (1997a) Archeobotany of the Cognento hiding well (Modena; northern Italy; 34 m a.s.l.; 44°38'12" N 10°35'2" E; late roman—modern age). In: Proceedings of 1st International Congress on: Science and Technology for the Safeguard of Cultural Heritage in the Mediterranean Basin, Vol. 2 (November 27–December 2, 1995—Catania, Siracusa, Italy), pp 1537–1544
- Accorsi CA, Bandini Mazzanti M, Mercuri AM, Rivalenti C, Trevisan Grandi G (1997b) Holocene forest pollen vegetation of the Po Plain—Northern Italy (Emilia Romagna Data). *Alfionia* 24(1996):233–275

- Accorsi CA, Bandini Mazzanti M, Mercuri AM, Trevisan Grandi G, Farello P, Pellegrini S (1999) Archeologia e paesaggio. Indagini archeologiche, botaniche e zoologiche integrate applicate ai sondaggi geognostici in un settore urbano di Mutina. In: Quilici Gigli S (ed) La forma della città e del territorio. "L'Erma" di Bretschneider, Roma, pp 157–186
- Anderberg AL (1994) Atlas of seeds. Part 4 Resedaceae-Umbelliferae. Swedish Museum of Natural History, Stockholm
- Badiali F (1999) Cucina medioevale italiana. Stupor mundi, Bologna
- Bandini F (ed) (1992) Cristoforo da Messisbugo. Banchetti composizioni di vivande e apparecchio generale. Neri Pozza, Vicenza
- Bandini Mazzanti M, Bosi G (in press) La frutta sulle tavole medievali emiliane: testimonianze carpologiche nei siti archeologici. In: Atti Convegno Nazionale 'La ricerca paleobotanica/paleopalino-logica in Italia: stato dell'arte e spunti di interesse' (Modena 20–21 novembre 2003). Informatore Botanico
- Bandini Mazzanti M, Accorsi CA, Forlani L, Marchesini M, Torri P (1992) Semi e frutti dalla Ferrara basso medioevale. In: Gelichi S (ed) Ferrara prima e dopo il Castello. Spazio Libri Editori, Ferrara, pp 118–137
- Bandini Mazzanti M, Mercuri AM, Trevisan Grandi G, Barbi M, Accorsi CA (1999) Il fossato di Argenta (Ferrara) e la sua bonifica in età medievale: contributo alla ricostruzione della storia del sito in base ai semi e frutti del riempimento. In: Guarnieri C (ed) Il Tardo Medioevo ad Argenta - Lo scarico di via Vinarola-Aleotti. Quaderni di archeologia dell'Emilia Romagna 2. Edizioni All'Insegna del Giglio, Firenze, pp 219–237
- Bandini Mazzanti M, Bosi G, Marchesini M, Mercuri AM, Accorsi CA (2001a) Quale frutta circolava sulle tavole emiliano-romagnole nel periodo romano? Suggerimenti dai semi e frutti rinvenuti in siti archeologici. Atti Società Naturalisti e Matematici Modena 131:63–92
- Bandini Mazzanti M, Mercuri AM, Bosi G, Marchesini M, Accorsi CA (2001b) The Archaeobotanical Archive: plants used by man (which, where, how, when?) - What fruits did Romans eat in Emilia Romagna (Northern Italy)? Some responses from seeds and fruits. In: Guarino A (ed) Proc. 3rd Int. Congr. 'Science and Technology for the safeguard of Cultural Heritage in the Mediterranean Basin' (9–14 July 2001, Alcalá de Henares, Spain), I. CNR-Progetto Finalizzato Beni Culturali, Roma, pp 318–324
- Barbi M, Mercuri AM, Bandini Mazzanti M, Guarnieri C (1998) Semi e frutti dalla latrina di un monastero rinascimentale (XV–XVI sec. d.C.) ad Argenta (Ferrara - Nord Italia). In: Bertuzzi G (ed) Studi in ricordo di Daria Bertolani Marchetti. Aedes Muratoriana, Modena, pp 225–230
- Behre KE (1999) The history of beer additives in Europe – a review. *Vegetation History and Archaeobotany* 8:35–48
- Beneš J, Kaštovský J, Kočárová R, Kočár P, Kubečková K, Pokorný P, Starec P (2002) Archeobotany of Old Prague Town defence system, Czech Republic: archaeology, macro-remains, pollen and diatoms. In: Jacomet S, Jones G, Charles M, Bittmann F (eds) *Archaeology of plants. Current research in archaeobotany. Proceedings of the 12th IWGP Symposium, Sheffield 2001. Vegetation History and Archaeobotany* 11:107–109
- Beijerinck W (1947) *Zadenatlas der Nederlandsche Flora*. H. Veenman & Zonen, Wageningen
- Berggren G (1969) Atlas of seeds—Part 2 Cyperaceae. Swedish Museum of Natural History, Stockholm
- Berggren G (1981) Atlas of seeds—Part 3 Salicaceae – Cruciferae. Swedish Museum of Natural History, Stockholm
- Brombacher C, Helmig G, Hüster-Plogmann H, Klee M, Rentzel P, Rodel S und Veszeli M (1999) ...und was davon übrig bleibt - Untersuchungen an einem mittelalterlichen Latrinenschacht an der Bäumleingasse 14 (1992/20). Jahresbericht der Archäologischen Bodenforschung des Kantons Basel-Stadt 1998, pp 93–131
- Bonasera F (1965) *Forma veteris urbis Ferrariae*. Olschki, Firenze
- Bosi G (2000) Flora e ambiente vegetale a Ferrara tra il X e il XV secolo attraverso i reperti carpologici dello scavo di Corso Porta Reno - Via Vaspergolo nell'attuale centro storico. Doctoral thesis, Università degli Studi di Firenze
- Cambornac M (1998) *Plantes et jardins du Moyen Age*. Hartmann Édition, Paris
- Castelletti L, Di Vora A (1994) Indagine preliminare sull'archeologia della vite (*Vitis vinifera* L.) in base ai caratteri diagnostici del vinacciolo. *Rivista archeologica dell'antica provincia e diocesi di Como* 176:333–358
- Castelletti L, Castiglioni E, Rottoli M (1999) L'agricoltura dell'Italia settentrionale dal Neolitico al Medioevo. In: Failla O, Forni G (eds) *Le piante coltivate e la loro storia*. Franco Angeli, Milano, pp 33–84
- Danin A, Baker I, Baker HG (1978) Cytogeography and taxonomy of the *Portulaca oleracea* L. polyploid complex. *Israel Journal of Botany* 27:177–211
- Davis LW (1993) *Weed seeds of the Great Plains*. University Press of Kansas, Kansas
- Delorit RJ (1970) *An illustrated taxonomy manual of weed seeds*. Agronomy Publications, Wisconsin
- Dickson C (1996) Food, medicinal and other plants from the 15th century drains of Paisley Abbey, Scotland. *Vegetation History and Archaeobotany* 5:25–31
- Faccioli E (ed) (1988) Giacomo Castelvetto. Brieve racconto di tutte le radici di tutte le erbe e di tutti i frutti che crudi o cotti in Italia si mangiano. Gianluigi Arcari Editore, Mantova
- Farinelli Toselli A, Scafuri F (1993) Ferrara VII–XX secolo. Giardini e fortificazioni. Comune di Ferrara
- Flandrin JL, Montanari M (eds) (2003) *Storia dell'alimentazione*. Editori Laterza, Bari
- Forlani L, Accorsi CA, Bandini Mazzanti M, Marchesini M (1992) Legni e carboni di Piazza della Repubblica a Ferrara - XIV secolo (Basso Medioevo). In: Gelichi S (ed) Ferrara prima e dopo il Castello. Spazio Libri edizioni, Ferrara, pp 138–150
- Frank K-S, Stika H-P (1988) Bearbeitung der makroskopischen Pflanzen- und einiger Tierreste des Römerkastells Sablonetum (Ellingen bei Weissenburg in Bayern). Materialhefte zur bayerischen Vorgeschichte A61
- Guarnieri C (1995) Archeologia urbana a Ferrara e nel ferrarese; le ultime scoperte. In: Berti F (ed) *Uno sguardo sul passato. Archeologia nel ferrarese*. Firenze, pp 183–206
- Guarnieri C (2000) Un singolare esemplare di specchio a supporto ligneo proveniente dallo scavo di via Vaspergolo a Ferrara. In: *Annales du 14e Congrès de l'Association Internationale pour l'Histoire du Verre*. Venezia Milano 1998. Lochem, pp 287–292
- Guarnieri C, Librenti M (1996) Ferrara, sequenza insediativa pluristratificata. Via Vaspergolo- Corso Porta Reno (1993–94). 1. Lo scavo. *Archeologia Mediaevale* 23:275–307
- Häflinger E, Brun-Hool J (1981) *Tavole delle malerbe*. CIBA-GEIGY Edizioni, Basle
- Harvey J (1981) *Mediaeval Garden*. Batsford, London
- Hellwig M (1997) Plant remains from two cesspits (15th and 16th century) and a pond (13th century) from Göttingen, southern Lower Saxony, Germany. *Vegetation History and Archaeobotany* 6:105–116
- Hubbard NRLB (1992) *Dichotomus keys for identification of the major Old World crops*. *Review of Palaeobotany and Palynology* 73:105–115
- Jacomet S, Brombacher C, Dick M (1989) *Archäobotanik am Zürichsee. Ackerbau, Sammelwirtschaft und Umwelt von neolithischen und bronzezeitlichen Seeufersiedlungen im Raum Zürich. Makroreste der Jahre 1979–1988. Berichte der Zürcher Denkmalpflege, Monographien* 7, Zürich
- Jacquat C (1988) *Hauterive-Champrèveyres. 1. Les Plantes de l'âge du Bronze. Catalogue des fruits et graines*. Archéologie neuchâteloise, 7. Edition du Ruau, Saint-Blaise
- Kiffman R (1958) *Bestimmungsatlas für Sämereien der Wiesen- und Weidepflanzen des mitteleuropäischen Flachlandes—Kräuter—Teil D, E, F. Freising-Weihenstephan*

- Lieutaghi P (1992) Jardins des savoirs, Jardins d'histoire. Les Alpes de Lumière, Marseille
- Marchesini M (1997) Il paesaggio vegetale nella pianura bolognese in età romana sulla base di analisi archeopalinologiche ed archeocarpologiche. Doctoral thesis, Università degli Studi di Firenze
- Mercuri AM, Gasparini E, Bosi G, Guarnieri C, Bandini Mazzanti M (1999a) Seeds and fruits from the town of Ferrara (Emilia Romagna – Northern Italy) in the Middle Age (X–XII century AD). In: Lenzi F (ed) Archeologia e ambiente. Atti del convegno internazionale, Ferrara, 3–4 aprile 1998. Documenti/30 1999, pp 231–236, Forlì
- Mercuri AM, Trevisan Grandi G, Bandini Mazzanti M, Barbi M, Accorsi CA (1999b) I semi/frutti della latrina del Monastero di S. Caterina. In: Guarnieri C (ed) Il Tardo Medioevo ad Argenta—Lo scarico di via Vinarola-Aleotti. Quaderni di archeologia dell'Emilia Romagna 2. Edizioni All'Insegna del Giglio, Firenze, pp 238–245
- Montanari M (1979) L'alimentazione contadina nell'Alto Medioevo. Liguori Editore, Napoli
- Montegut J (1972) Clé de détermination des semences de mauvaises herbes. Laboratoire de Botanique Ecole nationale Supérieure d'Horticulture de Versailles
- Nada Patrone AM (1989) Il cibo del ricco e il cibo del povero: contributo alla storia qualitativa dell'alimentazione: l'area pedemontana negli ultimi secoli del Medio Evo. Centro studi piemontesi, Torino
- Piccoli F (1986) La flora delle mura di Ferrara. Quaderno 13 La Pianura, Camera di Commercio Industria Artigianato e Agricoltura di Ferrara
- Piccoli F (1989) La flora. In: Atlante di Schifanoia, Edizioni Panini, Modena, pp 213–215
- Pignatti S (1982) Flora d'Italia - I-II-III. Edagricole, Bologna
- Pignotti L (1998) Revisione sistematica dei generi *Scirpus* L. Sect. Plur. (*Bolboscoenus*, *Schoenoplectus*, *Actaeteton*, *Isolepis*, *Eleogiton*) e *Blysmus* Panz. (CYPERACEAE) in Italia. Doctoral Thesis, Università degli Studi di Firenze
- Redon O, Sabban F, Serventi S (1994) A tavola nel Medioevo. Editori Laterza, Bari
- Renfrew JM (1973) Paleoethnobotany. Methuen & Co., London
- Revedin P (1909) Contributo alla flora vascolare della provincia di Ferrara. Nuovo Giornale Botanico Italiano, 16 (Nuova serie), pp 269–333
- Rottoli M (1996) L'orto medievale fra botanica, storia e archeologia: un contributo all'interpretazione dei termini botanici medievali. Archeologia uomo territorio 15:127–140
- Rottoli M (2001) Indagini archeobotaniche e ricostruzioni delle antiche foreste. In: Ruffo S (ed) Le foreste della Pianura Padana—Un labirinto dissolto. Quaderni habitat. Ministero dell'Ambiente—Museo friulano di Storia Naturale, Udine, pp 20–21
- Ruas MP (1992) The archaeobotanical record of cultivated and collected plants of economic importance from medieval sites in France. Review of Palaeobotany and Palynology 73:301–314
- Sabban F, Serventi S (1996) A tavola nel Rinascimento. Editori Laterza, Bari
- Schoch WH, Pawlik B, Schweingruber FH (1988) Botanische Makroreste. Paul Haupt, Bern
- Scully T (1998) L'arte della cucina nel Medioevo. Piemme, Torino
- Scurti JM (1948) Chiave analitica per il riconoscimento delle piante infestanti attraverso i semi. Annali Sperimentazione Agraria, suppl. 2(3): 1–45
- Spjut RW (1994) A systematic treatment of fruit types. Memoirs of the New York Botanical Garden, vol 70, New York
- Tutin TG et al. (1964–80) Flora Europaea, vol 1(1964); vol 2 (1968); vol 3 (1972); vol 4 (1976); vol 5 (1980). Cambridge University Press, Cambridge
- Trevisan Grandi G, Accorsi CA, Bandini Mazzanti M, Forlani L, Marchesini M, Mercuri AM (2001) Green Cultural Heritage in Emilia Romagna – Northern Italy – 1: *Castanea sativa* Mill. (Holocene pollen, fruit and wood/charcoal). In: Alpuente J, De Bustamante I, López PL, Sanz J (eds) 3rd International Congress on Science and Technology for the safeguard of Cultural Heritage the Mediterranean Basin, 9–14 July 2001, Alcalá de Henares, Spain, p 10
- Young JA, Young CG (1992) Seeds of Woody Plants in North America. Dioscorides Press, Portland, Oregon
- Vannini R, Stefanini S, Ciancolini R (2004) Notae de Coquina. Horus, Prato
- Viggiani P (1991) Erbe spontanee e infestanti: tecniche di riconoscimento. Edagricole, Milano
- Zucchini M (1967) L'agricoltura ferrarese attraverso i secoli. G. Volpe Editore, Roma
- van Zeist W, Woldring H (2000) Plum (*Prunus domestica* L.) varieties in late- and post-medieval Groningen: the archaeobotanical evidence. Palaeohistoria 39/40:563–576