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ORIGINAL ARTICLE

New crops in the 1st millennium CE in northern Italy

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Abstract
In order to identify new crops in the 1st millennium CE in northern Italy, a complex and diversified territory, archaeobotanical macroremains from 155 sites dating between the 2nd century BCE and 12th century CE were analysed. In more than half of the sites, taxa were encountered that had never previously been recorded from the area. The new crops are about 30, mainly (~ 70%) fruit plants in the broad sense, which have a clear peak in this time period. Based on the available data, the most prominent time for the introduction of new food plants (both imports and cultivars) seems to have been the Roman Imperial period (1st–2nd century CE), but also later, in Late Antiquity (3rd–6th century CE) and the Middle Ages (7th–12 century CE), there was no lack of new arrivals. Some fruit trees, such as *Prunus persica* (peach) and *Pinus pinea* (stone pine) immediately played an important role, and have continued to do so over time, as these are still grown in the area now.

Keywords Archaeobotany · Roman period · Late Antiquity · Early Middle Ages · Food plants

Introduction

The arrival of new plant foods in any given area is not only determined by ecological criteria, but also by social, economic and ritual factors (Prance and Nesbitt 2005). Travel, commerce and exchanges make new plants more widely known in the world. But the most important factors are the movements of people through migrations, colonisations or invasions, bringing to the newly settled areas the plants of their traditions, and sometimes their cultivation methods. In addition, environmental crises, which are often followed by famines, may determine the use of new plants for food, perhaps including some that were already present in the territory but not used previously. In contrast, introductions that were less widespread may have been due to individuals or elites, which might have made new plants known, promoted their cultivation or ensured their success due to emulation, curiosity, or fashion. A last factor to consider is the close link of some plants with the ritual world, which may have favoured their spread and use, or alternatively may have discouraged their use due to taboos.

The aim of this work is to detect evidence of new food plants through the analysis of plant macroremains, which are first found in northern Italy from the 1st millennium CE, a historical phase in which there was communication between most societies of the ancient world. For this reason, the period "presents a number of scholarly challenges" (Randsborg 1991) in which a multidisciplinary approach has more chances of being successful.

In this chronological range, the historical context of northern Italy is complex, especially in its later phases. Nevertheless, since this area was a contact zone between the Mediterranean basin and central and northern Europe, it seems useful to adopt this particular approach in order to present new information on the diffusion of various crops in the ancient world, especially in light of the great environmental and social transformations that happened during that millennium.

Northern Italy in the 1st millennium CE

The geographical position of northern Italy favoured wide-ranging commercial exchanges. Access to the sea provided close contacts all around the Mediterranean and

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the mountains bordering the area were never an obstacle to trade with central and southern Italy and the rest of Europe.

Before the dominance of the Romans by ca 250 BCE, northern Italy was originally divided between many cultures including Etruscans, Veneti, Umbrians and Ligurians (Malnati and Manzelli 2015). Either these cultures conflicted or integrated with Celts, who came from the west and settled in the Po valley in the 6th–5th century BCE. For hundreds of years northern Italy had intense commercial and cultural exchanges with central Italy, particularly with the Etruscans, who occupied large parts of the river Po plain up to Mantua (De Marinis 1988).

During the 3rd century BCE, with the establishment of the Roman Republic and the spread of its influence, Romans settled near Rimini and in the two following centuries, by both the use of force and alliances with the local elites, northern Italy became completely Romanized. Romanization involved the foundation or re-foundation of numerous urban centres, and reorganisation of their surrounding cultivated land; northern Italy then became the province of Gallia Cisalpina (Gaul on this side of the Alps) which was a very culturally advanced and rich region. The establishment of the Roman Empire in 27 BCE brought two centuries of peace and stability, after which it started to decline. Road construction, reorganisation of land (centuriation) and the arrival of settlers, most of them former soldiers, gave all of northern Italy strong links to Rome, so that this area had access to the same goods that were available in the capital, either produced locally or brought by trade from nearby or far afield (Bosi et al. 2020). This situation, during times of greater or lesser stability (in particular the crisis of the 3rd century CE), was maintained up to the second half of the 5th century CE. In 286 CE the Roman Empire was divided into an eastern and a western part by the emperor Diocletian. The 3rd–5th/6th century CE is the period of Late Antiquity (Roncaglia 2018). The invasions of people from north of the Alps and lasting for several centuries were acts of aggression that involved pillage and destruction, but did not result in settlement by them. Changes in farming and consumption seem to have made by modifications of the organisation of the Empire, with a progressive increase in the importance of peripheral provinces and their interaction with central ones (Roncaglia 2018; Bosi et al. 2020).

However, during the Migration Period in 375–568 CE, the invasions first of the Goths and then the Lombards marked a more notable change. These were people of Germanic origin who quite numerously began to settle in Italy.

The Goths, under Theodoric (493–523 CE), tried to integrate into the Roman Empire and legitimise their kingdom with the eastern Empire in Constantinople, which had meanwhile become its new centre. But the growing political and religious tensions soon broke the agreement between the Goths and the Byzantines, leading to the Gothic war (535–553 CE). This was a dramatic moment for northern Italy, because the negative effects of ongoing climate change (Zolitschka et al. 2003; Büntgen et al. 2016) were now added to the existing political and social instability. Residual forms of trade seem to have survived only along the coasts (Cameron 1985).

The Kingdom of the Lombards (569–774 CE) and the start of the Early Middle Ages began with the invasion of these Germanic people and the Lombards were opposed to the Byzantine Empire. The Lombards were nomads who fought with the Roman Empire against the Goths, but had their own traditions including those of food. They occupied a large portion of northern Italy, apart from modern Emilia-Romagna and Liguria, which remained under Byzantine control. For some decades, the Lombards maintained a tribal organisation with semi-autonomous dukes, unwilling to submit to a single king, who progressively substituted the senatorial aristocracy of Roman tradition, taking control of the land, farming and crafts (Lusuardi Siena and Giostra 2012). The religious conversion of the Lombard chiefs (653–698 CE) and adoption by the Lombards of Roman culture led to wider integration with the Latin populations and improved social and economic conditions in northern Italy. However, the steady political and military decline of the Byzantines, who were also engaged in defending the eastern borders of the Empire, resulted in conflicts with the Pope in Rome and a war against the Franks, who defeated the Lombards resoundingly in 774 CE.

Thanks to Charlemagne, who was emperor of the Holy Roman Empire from 800 CE, the Pope intended to revive the Western Roman Empire. For a short period, the control of northern Italy was passed to the Franks, but the socio-cultural renewal promoted by Charlemagne was only short-lived, as dynastic divisions and civil wars prevented effective control of the territory, and there were new invasions by Normans, Saracens and Hungarians (Settia 2011).

Between 888 and the first decades of the 11th century CE, various Frankish and Ottonian dynasties were briefly in power, but proved unable to maintain control over northern Italy and other parts of the Holy Roman Empire. The absence of central control allowed the independent development of towns and the countryside, also favoured by a warmer climate (Büntgen et al. 2011). The great monastic institutions and some local aristocracies promoted social, cultural and economic regeneration. In the early decades of the 10th century CE, Venice substituted for the Byzantines in controlling the Adriatic Sea against the raids of Saracen pirates, starting a notable commercial relationship with the Levant (Lane 1973). After the destruction of *Fraxinetum* (a Saracen colony on the south coast of France) in 972 CE, Genoa too began to emerge as a naval power, against a

background of great changes that ushered in the 2nd millennium CE (Settia 2011).

Materials and methods

In this work we discuss the macroremains, mostly of seeds or fruits of food plants in a wide sense (Bosi et al. 2020) from a total of 155 archaeological sites in northern Italy which were archaeobotanically sampled (Mercuri et al. 2015; Mariotti Lippi et al. 2018; BRAIN 2023).

Sites and chronological range

All the sites (114) which have already been presented in a previous study of plant foods of the Roman period in northern Italy (Bosi et al. 2020) are considered in this article. Only a few of them cover the 3rd–1st century BCE and in these cases, particular attention was paid to evidence of new crops. Additionally, food plant data from 41 new sites later than the 1st century BCE are discussed, of which one is an important new Roman Imperial site (Concordia Sagittaria, Castiglioni and Rottoli in press) and 40 date from Late Antiquity (3rd–1st/6th century CE) (Roncaglia 2018) to the Middle Ages up to the beginning of the 12th century CE.

Sites and geographical area

All these 155 sites are located in northern Italy and distributed among seven regions; Piemonte (9), Lombardia (55), Trentino-Alto Adige (14), Veneto (18), Friuli-Venezia Giulia (8), Liguria (10) and Emilia-Romagna (40). One site is located in the Repubblica di San Marino (RSM), at the border between northern and central Italy (ESM Table 1, ESM Fig. 1). More than 55% (86) of these sites showed evidence of new crops in the 1st millennium CE (Table 1, Fig. 1).

Categories and taxa

Four categories of food plants are considered: cereals, pulses, fruit plants and vegetables, herbs and spices.

To identify the new crops we compared data from previous and subsequent periods, the types of remains and, if possible, their quantity.

For this we used data from syntheses both already published and still in preparation from earlier periods; for the Neolithic, Rottoli and Castiglioni (2009); for the Iron Age, Rottoli et al. (2016) and unpublished data from more than 100 sites; and for subsequent periods within the region, Bosi et al. (2016) and unpublished data, at present from about 50 sites. For the Bronze Age, a comparison was made with Stika and Heiss (2013) and data from some relevant sites studied by us (for example, Mercuri et al. 2006; Clò et al. 2022; Perego et al. 2022 and unpublished data), as a summary for this period in northern Italy is not yet available.

Information on the status of taxa (simplified) in the Italian flora for northern Italy was considered (Galasso et al. 2018; DRYADES 2023), as well as historical works on the use of plants in the 1st millennium CE, such as Varro, Columella and Pliny (between 1st c. BCE and 1st c. CE; Calzecchi Onesti 1977; Plinius Secundus et al. 1984, Varro and Traglia 1974), in addition to modern studies on the topic (Dalby 2003; Prance and Nesbitt 2005; André 2009, 2010; Carnevale Schianca 2011; Zohary et al. 2012). These data are summarized in Table 2.

Botanical nomenclature was updated according to Pignatti et al. (2017–2019) and POWO (2023); for *Triticum*, it follows the traditional classification after Zohary et al. (2012).

Results and discussion

In the following, we present our results with the new crops not previously identified from the 1st millennium CE. Complete data on all food plants of northern Italy in the Roman period (ca. 3rd century BCE–6th century CE) have already been published in a previous article (Bosi et al. 2020). Complete data on all food plants from Late Antiquity (3rd–5th/6th century CE) to the 12th century CE sites will be included in a future article dedicated to the Middle Ages and Renaissance period (ca. mid-14th–16th century CE) in northern Italy, for which there are some preliminary data in Bosi et al. (2016).

Of the 155 sites considered, 86 (more than 55%) showed evidence of new crops in the 1st millennium CE (Table 1). The 86 sites are distributed throughout the area considered in this study (Fig. 1) as follows: Piemonte (6), Lombardia (28), Trentino-Alto Adige (5), Veneto (10), Friuli-Venezia Giulia (3), Liguria (6), Emilia-Romagna (27) and Repubblica di San Marino (1). As in Bosi et al. (2020), many of the remains came from contexts related to the disposal of waste. For most sites the initial quantities of sieved sediments are known (from 0.4 to over 600 L), but in some cases this information is lacking or only visual sampling (vs) was carried out (Table 1). The large number of sites available for this synthesis should reduce the inevitable biases associated with the various sampling strategies used on the different sites.

The plant remains were preserved in waterlogged deposits or due to carbonization, while very few were mineralized. The sites with the highest numbers of new crops were the waterlogged ones such as Modena (site 18), often containing excellently preserved remains (Bosi et al. 2017a). The evidence of new crops is also abundant in Roman cemeteries, where the offerings are almost always carbonized and rich

Table 1 Archaeological sites with macroremains (mostly seeds and/fruits) that showed the presence of new crops in northern Italy during the 1st millennium CE (*vs* visual sampling, *P* presence only)

Nr	Site name	Chronology (century)	Type of context	Vol (L)	Nr. seeds/fruits	References
1	Cremona—piazza Marconi1	2nd–1st BCE	Productive area	5 + vs	6242	Bosi et al. (2020)
2	Montegibbio1 (Sassuolo—MO)	2nd BCE–1st CE	Sanctuary (Minerva)	13	58	
3	Combolo (Teglio—SO)	2nd BCE–2nd CE	Settlement	vs	54	
4	Modena—ex Cinema Capitol	2th BCE–3rd CE	*Domus* (house)	519	10,283	
5	Vittorio Veneto—loc. S. Rocco (TV)	2nd BCE–5th CE	Settlement	44 + vs	470	
6	Aquileia—ex Essiccatoio (UD)	1st BCE–1st CE	Urban settlement	0.7	1759	
7	Levate—loc. Roggia Colleonesca1 (BG)	1st BCE–1st CE	Cemeteries/graves	vs	P	
8	Nave (BS)	1st BCE–1st CE	Cemeteries/graves	> 40 + vs	> 216	
9	Cremona—S. Lorenzo	1st BCE–1st CE	Cemeteries/graves	vs	88	
10	Albenga—via Pontelungo (SV)	1st BCE–2nd CE	Cemeteries/graves	60 + vs	> 1855	
11	Cerrione (BI)	1st BCE–2nd CE	Cemeteries/graves	> 500 + vs	1909	
12	Calcinate—loc. Villa Passa1 (BG)	1st BCE–2nd CE	Cemeteries/graves	18.2	275	
13	Mezzocorona (TN)	1st BCE–5th CE	Rural settlement	?	679	
14	Varignano (Porto Venere—SP)	1st BCE–6th CE	*Villa* (farmstead)	0.4 + vs	1582	
15	Caldogno (VI)	1st BCE–6th CE	Settlement	18	344	
16	Modena—Ferrovia Modena-Sassuolo	end 1st BCE–begin. 2nd CE	Cemeteries/graves	30	2135	
17	Modena—viale Amendola	before 1st–6th CE	Aqueduct and woodland	51	16,668	
18	Modena—ex Cassa Risparmio	1st half 1st CE	Channel (reclaimed)	606	83,143	
19	Cremona—piazza Marconi2	1st CE	*Domus* (house)	3.5	1923	
20	Bergamo—via degli Orti	1st CE	Cemeteries/graves	15	224	
21	Piadena—S. Paolo Ripa d'Oglio (CR)	1st CE	Cemeteries/graves	vs	8	
22	Marzaglia—cava *Corpus Domini* (Modena)	1st CE	Cemeteries/graves	620	314	
23	Modena—area ex Novi Sad1	1st–beginning 2nd CE	Productive area	101.5	47,262	
24	Angera1 (VA)	1st–2nd CE	Cemeteries/graves	vs	P	
25	Mariano Comense—via Grossi (CO)	1st–2nd CE	Cemeteries/graves	25 + vs	39	
26	Bologna—Nuova Stazione AV	1st–2nd CE	Cemeteries/graves	339.8	P	
27	Gambulaga (Portomaggiore—FE)	1st–2nd CE	Cemeteries/graves	25.7	P	
28	Concordia Sagittaria—*Porta Urbis* (VE)	1st–2nd CE	Cloaca (drain)	13.25	6600	Castiglioni and Rottoli in press
29	Como—via Benzi1	1st–3rd CE	Cemeteries/graves	58 + vs	> 56	Bosi et al. (2020)
30	Manerbio—Cascina Trebeschi (BS)	1st–3rd CE	Cemeteries/graves	15.3 + vs	334	
31	Casalecchio di Reno (BO)	1st–3rd CE	Cemeteries/graves	vs	P	
32	Voghenza (FE)	1st–3rd CE	Cemeteries/graves	vs	P	
33	Russi—villa romana (RA)	1st–4th CE	Well (*villa*)	vs	225	
34	Aquileia—canale Anfora (UD)	1st–4th CE	Channel	0.9	5111	
35	Modena—area ex Novi Sad2	1st–5th CE	Cemeteries/graves	66.1 + vs	1664	
36	S. Agata Bolognese (BO)	end 1st–5th CE	Well	22.5	P	
37	Classe—porto romano (RA)	2nd–6th CE	Water drainage system (port)	70.8	21,612	
38	Cloz—loc. Lanz (TN)	2nd CE	Cemeteries/graves	204	98	

Table 1 (continued)

Nr	Site name	Chronology (century)	Type of context	Vol (L)	Nr. seeds/fruits	References
39	Vercelli—corso Prestinari	2nd–3rd CE	Urban settlement (well)	?	1761	
40	S. Lazzaro di Savena—via Caselle (BO)	End 2nd–beginning 3rd CE	Well	2.5	174	
41	Calcinate—loc. Villa Passa2 (BG)	3rd CE	Pit	8.2	3	
42	Angera2 (VA)	3rd–4th CE	Settlement	vs	39	
43	Alba—Teatro Sociale—Pozzo Corino (CN)	3rd–5th CE	Settlement	5	57	
44	Modena—Palazzo Vaccari	4th CE	*Domus* (house)	33.7	18,115	
45	Cislago (VA)	4th–5th CE	*Villa* (farmstead)	0.5 + vs	12,154	
46	Campi di Riva del Garda—Monte S. Martino (TN)	4th–6th CE	Settlement	10 + vs	1367	
47	Badia Polesine (RO)	Roman	Well	35	P	
48	Campagna Lupia—Santuario Lova (VE)	Roman	Well	1	P	
49	Padova—Banca Etica	Roman	Cemeteries/graves	4.3 + vs	171	
50	Padova—Borgomagno	Roman	Cemeteries/graves	11.4 + vs	288	
51	Montebelluna—Fondo Sernaglia (TV)	Roman	Cemeteries/graves	vs	1	
52	Alba—Chiesa di S. Giuseppe (CN)	5th CE	Settlement	?	471	Motella De Carlo (2002)
53	Loppio—Isola di S. Andrea1 (TN)	5th CE	Settlement	90 + vs	4206	Moser (2016)
54	Bazzano—Pozzo Casini (BO)	5th–6th CE (Romans)	Well	vs	26	Bosi et al. (2020)
55	Sirmione—via Antiche Mura (BS)	5th–6th CE (Romans)	*Villa* (farmstead)	vs	345,682	Bosi et al. (2020)
56	Torba (VA)	5th–6th CE	Tower	4.2	524	Proserpio and Rottoli (2021)
57	Monte Barro (LC)	5th–6th CE	Settlement and "barracks"	vs and ?	14,333	Castelletti and Castiglioni (1991); Castiglioni et al. (2001)
58	Brescia—Santa Giulia2	5th–6th CE (450–569)	Settlement	vs and ?	11,886	Castiglioni et al. (1999); Castiglioni and Rottoli (2018)
59	Brescia—via Alberto Mario	5th–6th CE	Settlement	0.5	21,998	Castelletti and Maspero (1988); Castiglioni and Rottoli (2018)
60	Riese Pio X (PD) (sito ARCH.3B.10)	5th–7th CE	Rural settlement (pits, cattle burial)	10.4	1688	Castiglioni and Rottoli (2021)
61	Levate—loc. Roggia Colleonesca2 (BG)	5th–7th CE	Cemeteries/graves (?)	?	3159	Fortunati et al. in press
62	Modena—via Nonatolana	6th CE (Romans)	Rural settlement	50.6	1170	Bosi et al. (2020)
63	Domagnano (RSM)	6th CE (Goths)	Settlement (well)	10	3283	Mercuri et al. (2009)
64	Rubiera (RE)	6th–7th CE	Well (deposit)	?	435	Bandini Mazzanti et al. (2000) and unpubl. data
65	Brescia—Santa Giulia3	6th–7th CE (569–680)	Settlement	vs and ?	685	Castiglioni et al. (1999); Castiglioni and Rottoli (2018)
66	Collegno (TO)	6th–7th CE	Settlement	38	113	Castiglioni et al. (2004)
67	Brescia—*Domus* dell'Ortaglia	6th–7th CE	*Domus* (house)	vs	807	Castiglioni and Rottoli (2018)
68	Loppio—Isola di S. Andrea2 (TN)	6th–8th CE	Settlement	3155	28,853	Moser (2016)
69	Modena—Cognento1	End 6th CE–Middle Ages	Well (deposit)	80	8431	Bandini Mazzanti et al. (2001)
70	Brescia—*Capitolium*2	7th CE	Latrine	vs	> 22	Castiglioni et al. (2014)
71	Chiari—piazza Zanardelli1 (BS)	7th–8th CE	Cemeteries/graves	vs and ?	2272	Breda et al. (2011) and unpubl. data
72	Priamar—Palazzo della Loggia (SV)	7th–9th CE	Settlement	2	215	Cottini and Rottoli (2001)
73	S. Agata Bolognese—Nuova GEOVIS2 (BO)	7th CE–Middle Ages	Settlement and ditch	27	6528	Bosi et al. (2014)

Table 1 (continued)

Nr	Site name	Chronology (century)	Type of context	Vol (L)	Nr. seeds/fruits	References
74	Classe (RA)—Porto medievale1	8th–10th CE	Productive area	24	149	Augenti et al. (2006)
75	Classe (RA)—Basilica S. Severo1	8th–10th CE	Cemeteries/graves	50	569	Carra and Ferreri (2014)
76	San Bartolomeo de Castelaz (SO)	2nd half 9th–end 10th CE	Settlement (food storage)	?	>9500	Castiglioni (2009)
77	Nogara—loc. Mulino di Sotto (VR)	End 9th–11th CE	Settlement	>3.35	3683	Castiglioni and Rottoli (2011)
78	Parma—piazza Garibaldi2	10th–11th CE	Market square (pits and latrine)	12.5	41,645	Bosi et al. (2011)
79	Corvara di Beverino (SP)	10th–11th CE	Settlement	vs	2	Cagnana et al. (2008)
80	Ferrara—corso Porta Reno/via Vaspergolo1	2nd half 10th–1st half 11th CE	Kitchen gardens (pits)	49	82,485	Bosi (2000); Cuoghi (2006/2007)
81	Luni-Ortonovo2 (SP)	End 10th–beginning 11th CE	Pit	55	17	Castelletti (1977)
82	Sarzana—loc. S. Andrea (SP)	11th CE	Kiln	?	13	Castelletti (1975)
83	Cherasco—Castello di Manzano (CN)	11th–12th CE	Castle	?	1065	Motella De Carlo (1996); Castelletti and Motella De Carlo (1998), and unpubl. data
84	Nave—*S. Cesario* (BS)	11th–12th CE	Storehouse	>5	16,500	Castiglioni and Rottoli (2021)
85	Illegio-Broili (Tolmezzo) (UD)	11th–12th CE	Fortified settlement	2.3	1197	Cagnana et al. (2019) and unpubl. data
86	Ferrara—corso Porta Reno/via Vaspergolo2	2nd half 11th–1st half 12th CE	Kitchen garden/urban green (pits, layer)	6	12,226	Bosi (2000)

in fruit, and sometimes of precious and unusual taxa (Rottoli and Castiglioni 2011).

New crops in northern Italy

A total of 30 useful taxa were identified, of which macrobotanical (not wood or charcoal) evidence appears for the first time from the 1st millennium CE in this area, at least based on currently available data (Table 2, Fig. 2). In the Italian flora (Galasso et al. 2018; DRYADES 2023) most of these taxa (about 69%) are considered allochthonous (of various origins) and mainly archaeophytes (present before 1500 CE) with only one neophyte (later than 1500 CE) (Stace and Crawley 2015), while some 24% are native plants and a few (about 7%) are not even present today; overall, over 86% are currently listed as cultivated or cultivable. Based on these data, in combination with historical information from written sources (see above in materials and methods), we form our hypotheses on how each taxon could be considered in the 1st millennium CE in this area (Table 2).

The new cereals are *Sorghum bicolor* (L.) Moench (sorghum) and *Oryza sativa* L. (rice); the pulses are *Lupinus albus* L. (white lupin) and *Vigna unguiculata* (L.) Walp. (cowpea).

The greatest numbers of new taxa are among the fruit plants. In fact, we have the first evidence of seeds of various Cucurbitaceae such as *Cucumis melo* L. (melon), *Citrullus lanatus* (Thunb.) Matsum. & Nakai (watermelon) and perhaps *Cucumis sativus* L. (cucumber). Another important family is the Rosaceae, with remains of *Cydonia oblonga* Mill. (quince), *Prunus amygdalus* Batsch (almond), *P. persica* (L.) Batsch (peach), *P. cerasus* L. (sour cherry) and perhaps *P. armeniaca* L. (apricot). Furthermore, found for the first time are *Morus nigra* L. (black mulberry), *Punica granatum* L. (pomegranate), *Pinus pinea* L. (stone pine), *P. cembra* Thunb. (arolla pine), *Ziziphus jujuba* Mill. (jujube), perhaps *Z. lotus* (L.) Lam. (lotus tree), *Phoenix dactylifera* L. (date palm), *Diospyros lotus* L. (date-plum) and *Cordia myxa* L. (Assyrian plum). The case of *Castanea sativa* Mill. (chestnut) needs to be discussed separately (see below). Two fruit trees, black mulberry and jujube, were each found from one site, which may indicate their possible presence even before the 1st millennium CE (see below).

Vegetables, herbs and spices also show some novelties: two species among the Apiaceae, *Petroselinum crispum* (Mill.) Fuss (parsley) and *Pimpinella anisum* L. (aniseed), two aromatic shrubs, *Myrtus communis* L. (myrtle) and *Juniperus communis* L. (juniper), *Sinapis alba* L. (white mustard) and perhaps *Cyperus esculentus* L. (chufa). The first macroremains of *Cannabis sativa* L. (hemp) in our area of study were also identified (see below).

Furthermore, three taxa were already known archaeobotanically from the Iron Age, although the currently available data indicate that they were probably cultivated and certainly became more widespread in northern Italy in the 1st millennium CE, *Cicer arietinum* L. (chickpea), *Lagenaria*

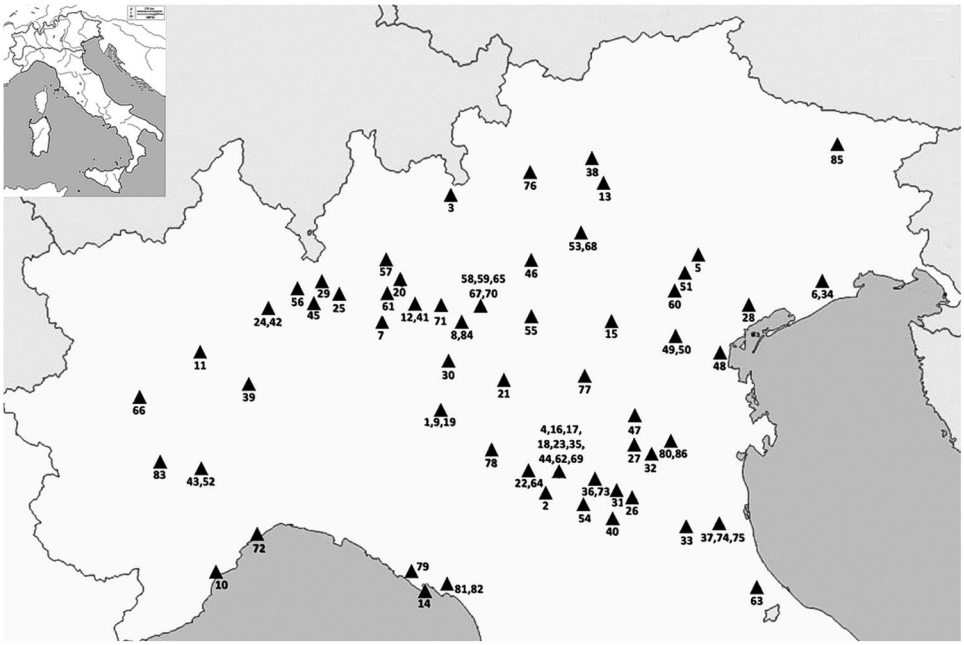


Fig. 1 Map showing the locations of the 86 sites listed in Table 1 with new records of crops from northern Italy

siceraria (Molina) Standl. (bottle gourd) and *Olea europaea* L. (olive). To differentiate them from those cited above, data on these three taxa are not included in the tables and graph, but are however mentioned in the text.

Cereals and pulses

Based on the available data, most of the Old World cereals and pulses were already present in northern Italy before the Roman period (Rottoli and Castiglioni 2009; Rottoli et al. 2016 and unpublished data). Given the importance of these two categories we also mention the taxa present before the 1st millennium CE.

The cultivation of cereals in this area has always been highly varied, as climatic conditions differ between the plains and the Alpine valleys and soil characteristics vary greatly between the high and low plains. This resulted in the continuous cultivation of all known cereals. Particular crops were probably grown in the areas best suited to them, but this hypothesis cannot always be verified (Bosi et al. 2020).

The most frequently found cereals from the 1st millennium CE are *Triticum aestivum/durum* (naked wheats), *Hordeum vulgare* L. (barley) and *Panicum miliaceum* L. (broomcorn millet). Among the hulled grains, *Triticum dicoccum* (emmer) and *T. monococcum* (einkorn) had some importance, whereas *T. spelta* (spelt), as in earlier times, was scarcely grown. *T. timopheevii* ("new glume wheat") was grown during the Bronze Age (Perego et al. 2022) but was probably totally abandoned between the Iron Age and Roman period (Rottoli et al. 2016; Bosi et al. 2020). *Secale cereale* L. (rye), which in earlier periods occurred only occasionally, became important between Late Antiquity (3rd–6th century CE) and the Early Middle Ages, probably because of the food preferences of the Goths and Lombards who came from north of the Alps, or due to its better tolerance of the colder climate of the 6th century CE (Büntgen et al. 2016). *Setaria italica* (L.) Beauv. (foxtail millet) was quite prominent, although to a lesser extent than broomcorn millet. Little can be said about *Avena sativa* L. (oats) as the remains are rare and distinguishing between the cultivated and the wild form is often impossible.

Among the cereals, the greatest novelty of the 1st millennium CE was *Sorghum bicolor*. Although Pliny (ca. 77 CE) accurately describes sorghum (*18, 55*) (Plinius Secundus et al. 1984), reliable archaeobotanical identifications from northern Italy date only from the 5th century CE onwards, and for the subsequent centuries its presence is known from numerous sites (frequency 26%), although often in low abundance. Sorghum has been found most frequently from the easternmost part of the Po valley. It could have been used as a food for humans, as forage or for making brooms. Given the scarce quantity of the remains found from the various sites, its use for craft purposes seems more likely than as food (Castiglioni and Rottoli 2013).

Classe, the port of Ravenna, is the only place (with two sites, 74, 75) where *Oryza sativa* has been found, dating between 8th–10th century CE (Augenti et al. 2006; Carra and Ferreri 2014). As the fleet of Constantinople was based there during this period (Ravegnani 2004), it is probable that the rice was part of a cargo imported from the Levant. The use of rice for medical purposes was known during the Roman period (Grant 2000), but its cultivation seems to have been

Table 2 List of new crops in northern Italy in the 1st millennium CE

Taxon	Type of remains	Presence (site number)	Status (today)	Hypothesized status 1st mill. CE, northern Italy
Cannabis sativa	Achene	18, 37, 44, 64, 69, 77, 80, 86	(ALL A) CLT	Cultivated (fruit, fibre, inflorescence?)
Castanea sativa	Nut, pericarp	7, 11, 25, 34, 39, 43, 45, 56, 57, 59, 61, 65, 66, 76, 77, 80, 86	AUCT—also CLT	Cultivated (timber and nut)
Citrullus lanatus	Seed	18	ALL A CLT	Cultivated (fruit)
Cordia myxa	Endocarp	28	n.p.	Imported (fruit)
Cucumis melo	Seed	14, 18, 23, 36, 37, 39, 47, 78, 80, 86	ALL A CLT	Cultivated (fruit)
Cucumis cf. *sativus*	Seed	34, 62	ALL A CLT	Cultivated (fruit)
Cydonia oblonga	Seed	34, 86	ALL A CLT	Cultivated (fruit)
Cyperus cf. *esculentus*	Achene, rhizome	17, 18, 23, 49	ALL A	Wild? (rhizome)
Diospyros lotus	Calyx	18	ALL N CLT	Imported (fruit)
Juniperus communis	Seed, male cone	3, 18, 23	AUCT—also CLT	Wild/cultivated (female cone, timber, ornamental)
Lupinus albus	Seed	2, 16, 35	CLT—AUCT in C/S Italy	Cultivated (seed)
Morus nigra	Endocarp	1, 18, 23, 34, 37, 58	ALL A CLT	Cultivated (fruit)
Myrtus communis	Seed	4, 14, 18, 34	CLT—AUCT mostly in C/S Italy	Cultivated (fruit, ornamental)
Oryza sativa	Caryopsis	74, 75	ALL A CLT	Imported? (grain)
Petroselinum crispum	Mericarp	6, 18, 28, 70, 77, 78, 80, 86	ALL A CLT	Cultivated (leaf, fruit)
Phoenix dactylifera	Berry, seed, calyx	8, 10, 16, 19, 21, 23, 24, 25, 26, 27, 29, 31, 35, 49, 50, 51	n.p.—in N-Italy only in LI CLT	Imported (fruit)
Pimpinella anisum	Mericarp	18, 80	ALL A CLT	Cultivated (fruit)
Pinus cembra	Seed	18	AUCT—not in LI and ER	Wild (seed, timber)
Pinus pinea	Seed, scale, cone	9, 11, 12, 18, 20, 23, 24, 28, 29, 31, 32, 33, 34, 35, 37, 38, 39, 40, 48, 49, 63, 73, 80, 81, 83, 86	ALL A CLT	Cultivated (seed, timber, ornamental)
Prunus amygdalus (=P. dulcis)	Endocarp	6, 18, 28, 37, 39	ALL A CLT	Cultivated (seed)
Prunus cf. *armeniaca*	Endocarp	34	ALL A CLT	Cultivated (fruit)
Prunus cerasus	Endocarp	57, 69, 73, 78, 79	ALL A CLT	Cultivated (fruit)
Prunus persica	Endocarp, pedicel	11, 13, 16, 18, 22, 23, 24, 25, 28, 29, 30, 33, 34, 35, 36, 37, 39, 40, 41, 42, 44, 46, 49, 53, 54, 56, 57, 58, 62, 64, 65, 67, 68, 72, 73, 77, 78, 80, 83, 86	ALL A CLT	Cultivated (fruit)
Punica granatum	Seed	10, 11, 18, 30, 34	ALL A CLT	Cultivated (seed, ornamental)
Sinapis alba	Seed	18, 68, 86	AUCT—not in PI, LO and TAA—also CLT	Cultivated (seed)
Sorghum bicolor	Caryopsis	5, 15, 52, 53, 55, 58, 60, 61, 67, 71, 72, 73, 75, 76, 77, 80, 82, 83, 84, 85, 86	ALL A CLT	Cultivated (grain, craft material)
Vigna unguiculata	Seed	52, 58	ALL A CLT	Cultivated (seed)
Ziziphus jujuba	Endocarp	1, 10, 28, 34, 37, 39, 49	ALL A CLT	Cultivated (fruit, ornamental)
Ziziphus cf. *lotus*	Endocarp	39	CLT?—AUCT only in Sicily	Imported (fruit)

For each taxon: (I) kind of remains found; (II) sites where the taxon was reported (for site numbering see Table 1); (III) information on *status* (simplified) in Italian Flora for northern Italy; (IV) hypothesized ruling condition for taxon in northern Italy in the period under review. For references, see text (Material and methods). Information on status (simplified) according to Italian Flora for northern Italy (Galasso et al. 2018; DRYADES 2023): *ALL* allochthonous, *AUCT* autochthonous, *N* neophyte, *A* archaeophyte, *CLT* cultivated, *n.p.* not present (in brackets: status currently under discussion). Regions of northern Italy: *ER* Emilia-Romagna, *LI* Liguria, *LO* Lombardia, *PI* Piemonte, *TAA* Trentino-Alto Adige

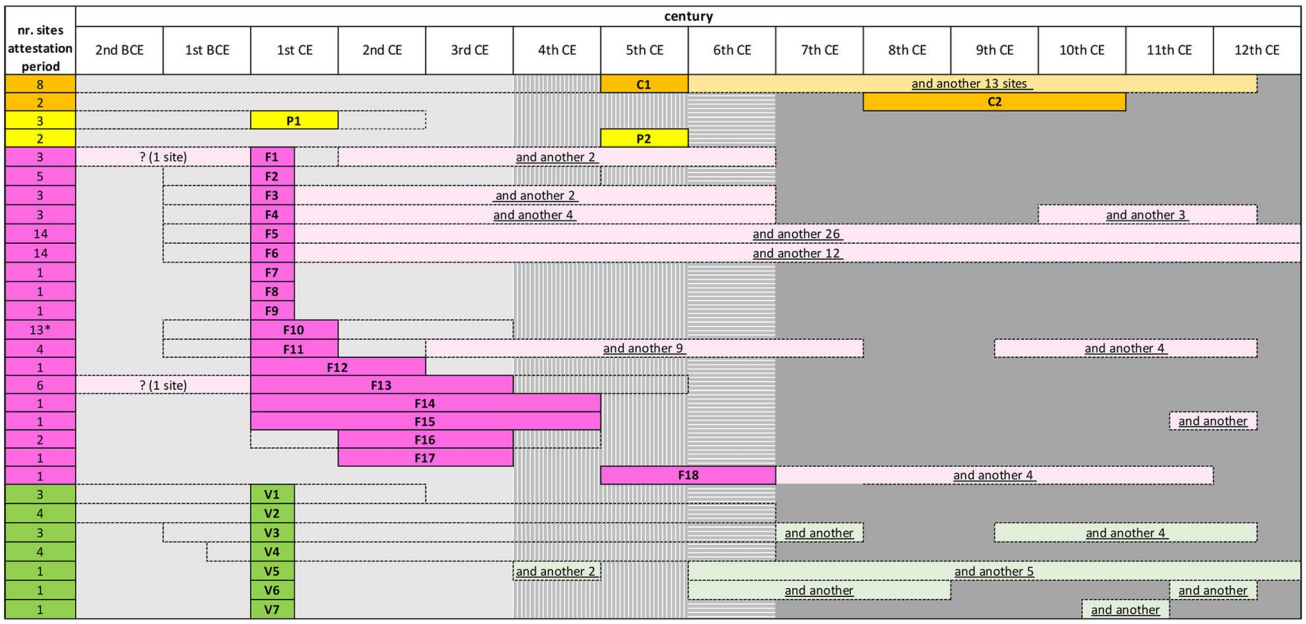


Fig. 2 Records of cereals (C, orange), pulses (P, yellow), fruits (F, purple) and vegetables/herbs/spices (V, green) that appeared in northern Italy during the 1st millennium CE. C1, *Sorghum bicolor*; C2, *Oryza sativa*; P1, *Lupinus albus*; P2, *Vigna unguiculata*; F1, *Morus nigra*; F2, *Punica granatum*; F3, *Prunus amygdalus*; F4, *Cucumis melo*; F5, *Prunus persica*; F6, *Pinus pinea*; F7, *Pinus cembra*; F8, *Citrullus lanatus*; F9, *Diospyros lotus*; F10, *Phoenix dactylifera*; F11, *Castanea sativa*; F12, *Cordia myxa*; F13, *Ziziphus jujuba*; F14, *Prunus* cf. *armeniaca*; F15, *Cydonia oblonga*; F16, *Cucumis* cf. *sativus*; F17, *Ziziphus* cf. *lotus*; F18, *Prunus cerasus*; V1, *Juniperus communis*; V2, *Myrtus communis*; V3, *Petroselinum crispum*; V4, *Cyperus* cf. *esculentus*; V5, *Cannabis sativa*; V6, *Sinapis alba*; V7, *Pimpinella anisum*. The box with its name code corresponds to the first time when the crop shows a higher frequency (in the first column, the numbers of sites involved; * plus three sites generically "Roman"); the dotted lines indicate any wider chronological range; the lighter coloured boxes show the number of additional sites where the taxon appears (for *Castanea* and *Cannabis*. see details in the text)

introduced to northern Italy only some centuries later by monasteries and the duchy of Milan (Zucchini 1967).

Concerning pulses, *Vicia lens* (L.) Coss. & Germ. (ex *Lens culinaris* Medik., lentil) and *Lathyrus oleraceus* Lam. (ex *Pisum sativum* L., pea), which were both cultivated since the Neolithic, maintained a continuously great importance in northern Italy. *Vicia faba* L. var. *minor* (broad bean) is doubtfully present from the Neolithic, but it became the most widely cultivated legume in the Iron Age and Roman period, and in the Middle Ages it still showed a notable presence. *Vicia ervilia* (L.) Willd. (bitter vetch), *Lathyrus sativus* L. and *L. cicera* L. (grass and red peas), which are rarely found from prehistoric times, spread during the Iron Age, but were hardly grown in the Roman and Medieval periods. It is difficult to estimate the importance of *Vicia sativa* L. (common vetch) because of the uncertain distinction between wild and cultivated forms (Bouby and Lea 2006), but it is frequently found, although in small quantities.

Cicer arietinum was part of the "Neolithic package" of crop plants (Zohary et al. 2012), but it was probably not grown in northern Italy in the Neolithic and Bronze Age. Chickpeas were present since the Iron Age, but they are rarely found and confined to funerary contexts at the southern edge of the Po valley (Sala and Rottoli 2018). Their use as funerary offerings continued in the Roman period and in such cases it may be assumed that they were imported from central or southern Italy. In our opinion, the discovery of chickpea from four medieval settlements (5th–10th century CE), one of which (76) is situated in the Alps at 900 m a.s.l., may be considered evidence of the introduction of its cultivation.

Likewise, *Lupinus albus*, a Mediterranean species (Pignatti et al. 2017–2019), was little grown in northern Italy, as the sole records are from Roman graveyards in Emilia and Lombardia (2, 16, 35) which suggest that it was brought from elsewhere or perhaps that some was grown locally.

In contrast, the beginning of the cultivation of *Vigna unguiculata*, a species of African origin (POWO 2023), is more probable. Cowpea, although it was probably known earlier (André 2009), appears for the first time from two Late Antiquity sites (52, 58), comprising a few seeds that might derive from trade, or alternatively from small scale growing, given its notable adaptability (Guzzetti et al. 2020).

The triumph of fruit

Fruit, in the broad sense, is the category that shows the most novelties from the 1st millennium CE in our area of study. This situation was already highlighted in the previous

synthesis (Bosi et al. 2020), which also outlined the general picture of the other fruit taxa present in northern Italy during the Roman period.

Among Cucurbitaceae, only *Lagenaria siceraria* is recorded since the Iron Age (Maselli Scotti and Rottoli 2007), but it spread only in the Roman Imperial period, from when it has been recovered from a dozen sites (Bosi et al. 2020; Castiglioni and Rottoli in press). However, three other species appear for the first time from the Roman Imperial period onwards, *Citrullus lanatus*, and some centuries later *Cucumis* cf. *sativus* and *C. melo* at a frequency of 12%, of which the latter is the only species with a continuous record, suggesting that it was introduced and then always grown (Bandini Mazzanti et al. 2005; Bosi et al. 2009).

Among Rosaceae, the earliest finds of *Prunus persica*, *P. amygdalus*, *Cydonia oblonga* and perhaps *Prunus* cf. *armeniaca* appear from the Imperial period. Apart from peach (see below), the presence of the other taxa, which are mostly encountered during the Roman Imperial period, seems sporadic, with a slightly higher frequency only for almond; one may therefore suppose that these fruits were imported rather than locally grown.

Remains quite surely attributable (based on Frank and Stika 1988) to *Prunus cerasus* (sour cherry) and not to *P. avium* L. (sweet cherry) were found, although there are earlier records from some parts of northern Italy, they reappear only in the 5th–6th century CE and Middle Ages and onwards, showing that sour cherry became progressively more important over time (Bosi et al. 2009).

Some remains are clearly of imported fruits, which appear only in the Roman Imperial period and then are no longer found. Remains of *Diospyros lotus* (Bosi et al. 2017b) and *Cordia myxa* (Castiglioni and Rottoli, in press) were found from one site only; both are surely of extra-Italian provenance, and probably *Ziziphus* cf. *lotus* too, although the latter is native to Sicily (Pignatti et al. 2017–2019). For the Roman period, the presence of remains of Assyrian plum can be explained by its medicinal use rather than for food (André 2009).

Remains of *Punica granatum* were found in five Roman Imperial period sites from both funerary and other types of contexts. A single charcoal fragment, which was found in Trentino-Alto Adige in a *villa rustica* (farmhouse) attributable, though with some uncertainty, to the 4th century CE (Castiglioni and Rottoli 1994), may suggest that some pomegranates were grown there in the late Roman Imperial period, although not in sufficient numbers to satisfy the demand indicated by the imported fruits. Pomegranate is found again in significant numbers of macroremains from the early Renaissance period (14th century) in this area, showing that it was certainly grown in this area for both its fruit and as an ornament (Bandini Mazzanti et al. 2005; Bosi et al. 2009).

Phoenix dactylifera were undoubtedly imported and expensive products (Zohary et al. 2012), that in the Imperial period were widespread throughout the studied area, as they were found from 16 sites (frequency 20%) most often, but not only, in funerary contexts which demonstrates their importance for Roman ritual according to Ovid (*I, 185*) (Ovid and Canali 2006) and other Latin authors (André 2009).

Two other tree fruits, *Morus nigra* and *Ziziphus jujuba* appear for the first time in the macrobotanical record, although only from one site each, and with such a wide chronological range that their appearance in northern Italy might be as early as the period when the Roman Republic was spreading its influence in the area in the 3rd–2nd century BCE. Both of these originated in Asia, and in Italy they are regarded as non-native archaeophytes (Pignatti et al. 2017–2019; DRYADES 2023); Pliny (*15, 47*) (Plinius Secundus et al. 1984) cites the jujube among the cultivated trees introduced to Italy, while Columella (*9, 4, 6*) (Calzecchi Onesti 1977) mentions it as a good plant for honey. Although *Olea europaea* was present from the Iron Age onwards (Maselli Scotti and Rottoli 2007), the tiny numbers of stones indicate that they were imported. Of course, cultivation of this taxon in the 1st millennium CE is principally affirmed in the area with pre-Alpine lakes, as indicated by widespread finds of stones, which from some sites are abundant already even by the Roman period (in 28 sites of every type—Bosi et al. 2020; Castiglioni and Rottoli in press) and by charcoal (Castiglioni et al. 2007). Even pollen signals indicate a more widespread presence of *Olea* from the Roman period onwards, although to a much lesser extent than in central-southern Italy (Bosi et al. 2019; Mercuri et al. 2013). Olive growing was maintained, although to a lesser extent, up to Late Antiquity and the Middle Ages (Bosi et al. 2016 and unpublished data).

There are also the first finds of pine nuts from both *Pinus pinea* (see below) and *P. cembra*; while the former are frequent, the latter is limited to only one Roman Imperial period site in Modena (18) and probably arrived in this town from the central-eastern Alps via trade (Bosi et al. 2017a).

For the Roman period, the presence in seven sites, including graves, of *Castanea sativa* has already been discussed (Bosi et al. 2020). It was present between Late Antiquity and the Middle Ages at ten sites, but in order to understand the history of the chestnut in the area, which was initially used almost only for its timber, it would be necessary to complete the synthesis begun in Bosi et al. (2016).

According to available archaeobotanical data, peaches, pine nuts (of *Pinus pinea*), chestnuts and dates seem to have been most widely used in northern Italy during the 1st millennium CE (Fig. 3).

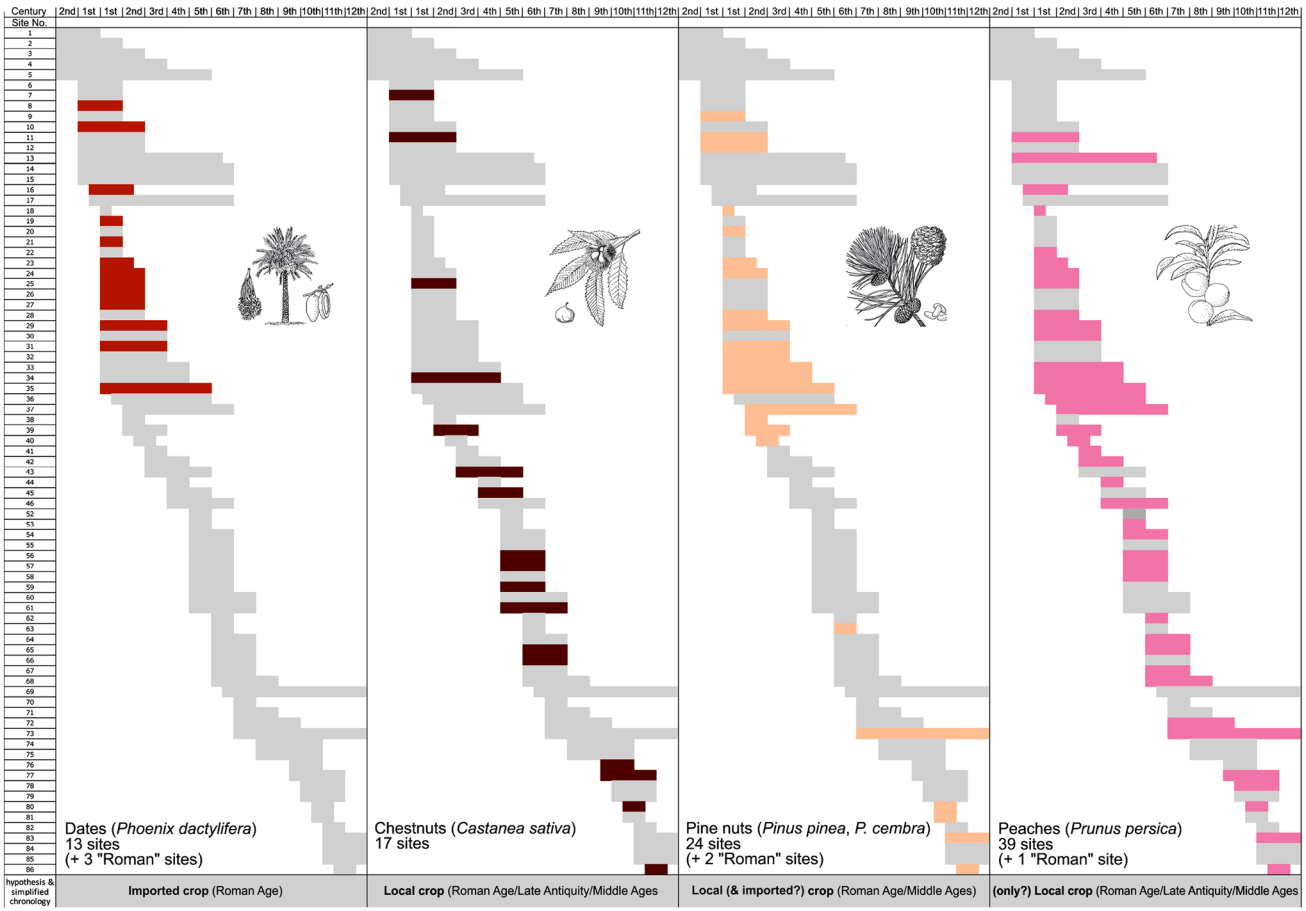


Fig. 3 Trend over time of four fruit trees: *Phoenix dactylifera* (date palm), *Castanea sativa* (chestnut), *Pinus pinea* (stone pine) and *Prunus persica* (peach). In the left column the sites (see Table 1) with their chronological range in centuries BCE/CE (excluding the five with a generic "Roman" chronology—site nos. 47 to 51). Colour indicates that the taxon is present on the site

There is plenty of evidence for the arrival of *Prunus persica* in both northern and southern Italy in the 1st century CE, as already discussed by Sadori et al. (2009). Based on our data, it can be assumed that since its introduction to certain areas of northern Italy, peach growing spread widely and constantly over time thanks to the very favourable conditions for its cultivation there. It has the highest frequency of all (50%) and occurs from the entire millennium.

In Italy, *Pinus pinea* is considered by many botanists as a naturalised archaeophyte (Pignatti et al. 2017–2019; Acta Plantarum 2023), while others instead assume it to be native, thus reinforcing the uncertainty about its status, also on a wider European level (Abad Viñas et al. 2016). Anyway, it is clear that in Italy, stone pine increased probably first in the Etruscan period and certainly during the Roman period, when large coastal plantations were established, perhaps created initially to protect inland farmland and for the excellent timber, which was used to build boats. Only later was stone pine grown for its nuts too (Lorenzini and Nali 2013). Pine nuts, although expensive, were a widely used ingredient in Roman cuisine (André 2009, 2017) and were increasingly appreciated with time. A market for pine nuts is documented with certainty in the Ravenna area in the 13th century CE (Lorenzini and Nali 2013). This popularity is also visible in the archaeobotanical data where pine nuts have a frequency of about 32% (from 86 sites) and show a stable continuity comparable to that of peaches.

New "green" flavours

The qualitative increase in the vegetables, herbs and spices category of plant remains begins already in the Iron Age and becomes important in the Roman period (Rottoli et al. 2016 and unpublished data; Bosi et al. 2020). As previously pointed out, food choices in this timespan became notably more complex (Bosi et al. 2020), but various taxa in this category pose questions that may be answered only when the syntheses on the Iron Age and Middle Ages are completed.

From the 1st millennium CE there are found for the first time in the Imperial Roman period and onwards the remains

of two herbs of the Apiaceae family: *Petroselinum crispum* and *Pimpinella anisum*, of which both are considered as non-native to Italy (Pignatti et al. 2017–2019). However, there are doubts whether parsley was really considered to be an herb by Romans, mainly based on problems of interpreting written sources (Herchenbach and Meurers-Balke in preparation); some archaeobotanists believe its use as a food ingredient only to be certain since the Middle Ages (Rösch 2002). *Foeniculum vulgare* Mill. (fennel) ought probably to be included too (Bosi et al. 2020), but there are still doubts regarding a site dating to either to the Iron Age or Roman period (Bosi et al. 2011) and hence its presence could also predate the 1st millennium CE.

Furthermore, for the first time in this area we have macroremains (non-woody) of two aromatic shrubs native to Italy (Pignatti et al. 2017–2019), *Juniperus communis* and *Myrtus communis*. They are found from the Roman Imperial period onwards, probably demonstrating that they became important in cooking then (André 2009); but the small numbers of their remains might also indicate their use as ornamental plants (von Stackelberg 2009). A probable female cone of *Juniperus* sp. was also found from a Palaeolithic site in the Trentino Alps (Carra et al. 2011), but here it was certainly a wild plant find.

The first seeds of *Sinapis alba* appear, accompanying the evidence of *Rhamphospermum nigrum* (L.) Al-Shehbaz [ex *Brassica nigra* (L.) Koch] (black mustard), which had been present from the Iron Age and onwards (Rottoli et al. 2016 and unpublished data). However, unambiguous evidence of these mustards and other Brassicaceae as foods, rather than being merely occasionally present in the deposits, dates only from the late Middle Ages and Renaissance period (14th–16th CE) (Bosi et al. 2022).

From the Roman period, remains potentially attributable to *Cyperus* cf. *esculentus* are present. This identification is based on about 40 rhizomes found in a tomb (49) (Rottoli and Castiglioni 2011), which probably represent funerary offerings, comparable to reliably identified finds from Egyptian funerary contexts (Zohary et al. 2012).

According to the currently available data, the earliest achenes of *Cannabis sativa* in northern Italy date to the 1st millennium CE, from one site of the Roman period (18), a few from Late Antiquity, and more frequently from the Middle Ages. However, recent studies have even proposed that hemp is native to Europe (McPartland et al. 2018), and there is evidence of it from pollen records in our area from the Bronze Age and onwards (Mercuri et al. 2006), so it seems to have been cultivated for a long time, most probably for its fibre. The modest frequency of the macroremains of hemp is in any case insufficient to suggest that it was used as food in northern Italy. Written sources, although they mention hemp together with cereals, do not give many indications about the possible uses of its seeds, which might perhaps have played an important role for medicine (André 2009).

Conclusions

The novelties that appeared in northern Italy from the 1st millennium CE were many and various and are associated with three distinct periods.

The most important time was the 1st–2nd century CE, the time of the Roman Empire. Besides *Lupinus albus* which accompanied *Cicer arietinum* in funerary offerings, the first evidence from this area of various herbs is found, but fruit is the principal category. Some, such as *Morus nigra* and *Ziziphus jujuba* were probably already present in the area, as were definitely *Olea europaea*, *Lagenaria siceraria* and perhaps *Castanea sativa*, but from the 1st–2nd century the earliest macroremains of more than ten new fruit taxa have been found. These new introductions became integrated into northern Italian food in various ways. While *Cordia myxa*, *Diospyros lotus* and *Ziziphus* cf. *lotus* (and perhaps also the pine nuts of *Pinus cembra*) can be defined as food curiosities with a very limited spatial and chronological range, *Phoenix dactylifera* seems to have entered the market as a luxury food with a widespread distribution of the dates, but limited to the Roman Imperial period. Other taxa gained more significant influence, including *Cucurbita melo*, *Citrullus lanatus*, *Cydonia oblonga*, *Prunus amygdalus*, *Punica granatum*, perhaps *Cucumis sativus* and *Prunus armenaica*, as these appear from several periods and were probably cultivated in the area. Lastly there are *Prunus persica* and *Pinus pinea*, which were certainly cultivated and became widespread in some areas of northern Italy, where they are still typical local crops and foods.

The great increase of fruits in this time period is certainly linked to the expansion of the Roman Empire, which enabled extensive movements of people and goods, and improvements in transport and preservation of foodstuffs (Parisi Presicce and Rossini 2015). During this period, widespread affluence also promoted some ephemeral fashions including the adoption of exotic rituals involving offerings of dates, for example. Furthermore, it is clear that settler groups started growing typical Mediterranean crops such as the olive in the most climatically suitable areas of northern Italy, especially the Adriatic coasts, pre-Alpine lakes and other hilly areas.

The second period was the 5th–6th century, Late Antiquity, when *Sorghum bicolor* arrived and began to spread. In this phase the first evidence of *Vigna unguiculata* appears, although it does not seem to have been adopted widely, whereas *Prunus cerasus* in some cases became even more abundant than *P. avium* in the Middle Ages. We do not know the reason for the growing of sorghum from Late Antiquity onwards; probably, as also assumed for chestnut, it was at

first used mainly for craft purposes and became used for food only later, at a time of greater economic instability.

Lastly, between the 8th and 10th century, the Early Middle Ages, there is evidence of *Oryza sativa*, which was probably imported for medical use.

Neither did the various peoples from north of the Alps who invaded Italy over the centuries bring any novelties and nor did, according to the currently available archaeobotanical evidence from the Early Middle Ages, the activities in monastery herb gardens and Charlemagne's edicts, which were so far reaching in various parts of Europe (Landsberg 2005), add any new food plants to the great number already in use.

In the Roman Imperial period we may assume that a large part of northern Italy had access to the same resources, either produced locally or available through trade. In the Roman Imperial sites considered, the differences between them seem to be linked to two factors: (a) context type (well, cemetery, landfill, etc.) and (b) quality and quantity of sampling. However, it is possible that the finding of some crops such as dates is strongly linked to the social levels of past societies; for other remains, the area in which they were found may have played a more important role, as in the case of rice from the port of Ravenna.

Since the end of Late Antiquity and the beginning of the Middle Ages, there may have been greater differences between the various areas, due to the lack of uniformity of the economic, social and political systems. To evaluate this idea, however, it would be necessary to prepare a complete overview of food plant evidence for the Middle Ages in northern Italy.

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Declarations

Competing interests The authors have no relevant financial or non-financial interests to disclose.

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