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Roman landscape and agriculture on the Ligurian coast through macro and microremains from a Vada Sabatia well (Vado Ligure, Italy)

Daniele Arobba[a*], Francesca Bulgarelli[b], Consolata Siniscalco[c] & Rosanna Caramiello[c]

Abstract

The results of an analysis on plant remains (fruit, seeds, pollen and wood) found in sediments in a Roman well in *Vada Sabatia* (Vado Ligure, Liguria, Italy), dated between the first and fourth centuries AD are presented. The remains are well preserved and constitute an exceptional record of the Ligurian area. Five layers have been recognised: three corresponding to the well when in use and two to the well when it was no longer in use. The vegetational cover of the area has been found to be similar to that observed in the coastal plain near *Albingaunum* (Albenga) pertaining to the same period. Moreover, the two superficial layers have cumulated a large amount of macroremains related to the period in which the well was no longer in use. The principal tree and vegetable crops and cereals of the coastal plain were present, due to the influence of maritime and mercantile trade, as were the prevailing ruderal and weed species and the tree cover. The presence of carpological remains of *Castanea sativa*, *Secale cereale*, *Beta vulgaris* and *Cucumis sativus* is reported for the first time in the Roman Age in Liguria. The influence of the arrival of the Romans can be seen from new crops, such as *Prunus persica*, and the introduction of exotic fruit like *Phoenix dactylifera* and *Ziziphus jujuba*. Several wooden artefacts, for example, a rack for drying lucerne and a tool handle, made of *Cornus* or *Viburnum* and *Viburnum* cf. *lantana* respectively, have been found. The well has proved to be an ideal location for the preservation of plant remains compared with other studied archaeological situations in Liguria and in Southern France, as it presents a higher variety of cultivated fruits, vegetables and cereals.

Keywords

- Agriculture,
- Archaeobotany,
- Macro-microremains,
- The Roman Age,
- Waterlogged,
- Well

Introduction

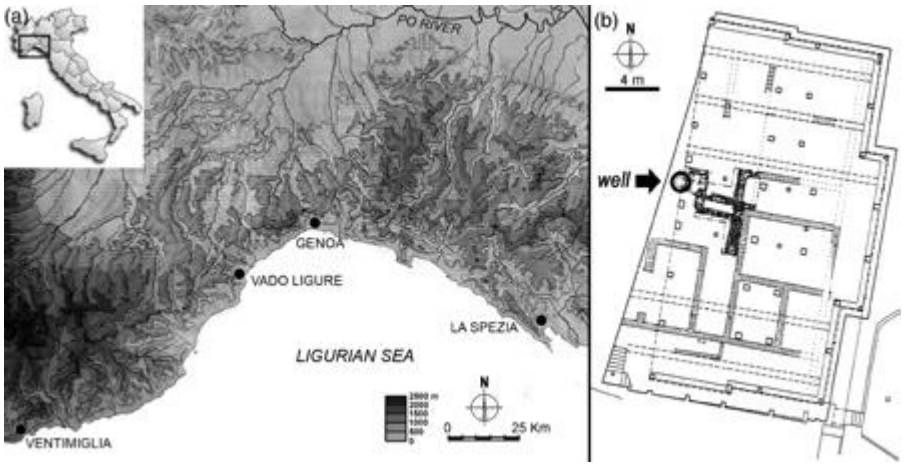
The archaeobotany of the Roman period in Liguria has so far been studied very little, although there are many important urban sites along the coast, such as *Albintimilium* (Ventimiglia), *Albingaunum* (Albenga), *Vada Sabatia* (Vado Ligure), *Genua* (Genoa) and *Luna* (Luni). Until now, no wells have been found in this region containing preserved material of archaeobotanical interest. Studies have instead been conducted on well sediments from other areas in Northern Italy, especially Emilia Romagna (Accorsi *et al*. 1997; Gelichi 1994; Bandini Mazzanti *et al*. 2001; Marchesini *et al*. 2001, 2008). Roman wells have been studied for their plant and animal remains in the Midlands in England (Greig 1988), in the North-West of France (Ruas 2000) and in Switzerland (Klee 2007). Some Roman wells, dating from 50 BC to 125 AD, have been studied at *Lattara*, in the Southern part of France, and have provided detailed information on the carpological remains of a

Mediterranean site (Buxó and Piqués 2005; Figueiral *et al*. 2010). These studies have all provided valuable information for the reconstruction of the landscape and agriculture as well as on the introduction of new plant species from other regions. Some have also provided information on the way the well fills have been formed, on when the well was in use or when it was no longer in use, and whether they were filled by natural sedimentation or backfilled with waste.

In this work, data are presented that refer to a well in *Vada Sabatia*, the first Roman well to be found in Liguria with abundant and well-conserved archaeobotanical material.

Vada Sabatia (today known as Vado Ligure) has been identified as the capital of the *Sabates*. It was founded in one of the more favourable sites in Liguria, as it has a deepwater port with a gently sloping sandy bottom that ensured safe approach from the sea. There are two streams in the valley nearby: the Segno and the Quiliano. In Roman times, *Vada Sabatia* was also an important junction because there were easy passes through the Apennines to Piedmont and the Po Valley, including the *Aemilia Scauri* route, which was opened at the end of the second century BC, and the *Iulia Augusta* route, from Augustan times, which was used in part until the Middle Ages, and is in part still used even today (Fig. 1a).

Figure 1. Maps showing the geographical position of the site (a). Planimetry of the roman *domus* and indication of the well position (b). Graphics by the Soprintendenza per i Beni Archeologici della Liguria.



These features, which favoured communication, commerce and both civil and military transport, allowed the town to prosper and become prominent in the Northern Tyrrhenian area (Bulgarelli 2007). *Vada* has been mentioned in historical, travel, geographic and maritime sources. *Vada* became an administrative centre between the first and fourth centuries AD (from early Augustan times), its neighbours being *Genua*, *Albingaunum* and *Alba Pompeia* (Alba).

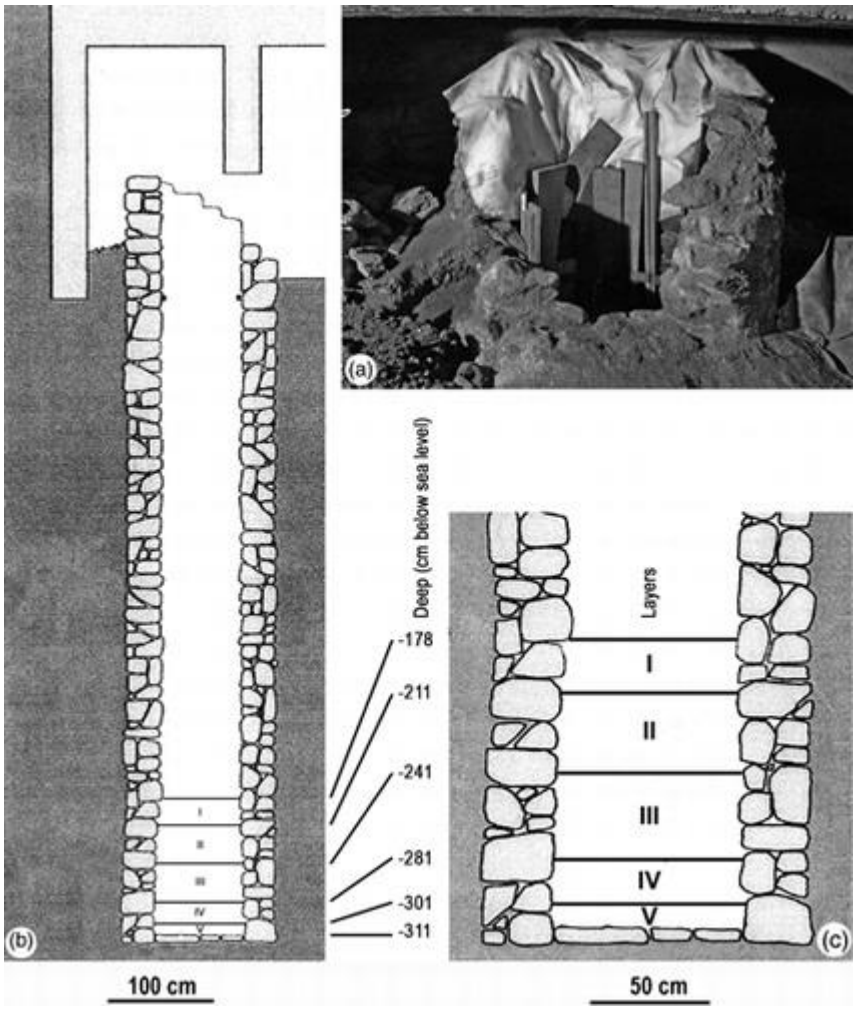
Modern archaeological work began in *Vada Sabatia* with Lamboglia in 1939, and studies in the 1950s and 1960s confirmed its importance from Late Republican times, through Late Antiquity to the Early Middle Ages. However, intensive industrial development over the site, after the Second World War, has obliterated the outlines of the ancient city; the site of the port and the type of structure are also uncertain.

In 1953–1954, during the construction of the new town hall in Vado Ligure, Lamboglia came across the walls of a *domus* or *villa* with a typical square Roman plan (Fig. 1b), built over structures of the Republican Age and with the same orientation as these structures, above masonry from the early Romanisation time (Lamboglia 1955). The archaeological excavation brought to light different levels beginning with those of the second century BC and Late Antiquity. A well was found inside the *domus* but was not examined at the time.

In 2003, new work began which showed that the complex had been a public building with storage rooms (Bulgarelli 2004). On this occasion the well was investigated. The original well-head was missing but a round shaft of about 70 cm in diameter, emerged from the soil for about 100 cm (Fig.

2a). The inner wall was made of rounded river pebbles without mortar to allow drainage; traces of mortar were only found in the upper part. The first excavations, which were concluded in 2003, in collaboration with the *Centro Studi Sotterranei* from Genoa, involved the removal of a 394 cm thick layer of building rubble, animal remains and pieces of pottery that were dated to the fifth or sixth centuries AD (Bixio *et al*. 2011). In this period, the well, which was no longer in use, became a rubbish disposal site. The last two levels of this fill contained large blocks of cemented flooring that seem to have been put there to close the shaft which indicate that the place was already a ruin, thus confirming the picture of an abandoned collapsed structure which was too confusing to offer a clear idea of the environment at that time (Rottoli 2005).

Figure 2. Well-mouth (a). Section and stratigraphy of the Roman well (b). Detail of the studied layers (c). Graphics by the *Centro Studi Sotterranei*, Genoa.



In the second excavation phase, in 2005, the well was emptied, with the removal of the last 133 cm of sediment, to a point 311 cm below sea level. After pumping out the water, the archaeologists found five clay-like layers (Fig. 2b, c). On the basis of the preservation state of the material in the five layers it is possible to assume that all five recognised layers had always been in a waterlogged state.

The well was pumped dry, and about 46 cm of mud was removed, as it was considered to be of recent origin and to have accumulated in the interval between the first and second excavations. No similar deposit was found in the ancient series of sediments, suggesting that the successive phases followed one another without any long interval of disuse. This work is a study of the pollen in the five layers of the deposit, of the organic remains attached to pottery fragments and of the plant macroremains, such as fruits, seeds, the basketry material, cord and wooden artefacts.

The main aim of this work was to correlate results from pollen analysis of various layers, which allows the prevailing vegetation in the area to be reconstructed, with an analysis of the plant macroremains, which generally gives more precise local information. In the present case, these combined data have provided a detailed picture of the agriculture of various periods and of crops that had newly been introduced into the area.

Materials and Methods

Stratigraphy of the Well

The five recognised layers are described hereafter, layer V being the lowest.

Layer V (311–301 cm deep, 50 l volume)

Two vases, one almost intact, another in fragments, and some disc-shaped lamps with a round spout for the wick (Dressel 17–20 – Loeschcke VIII) of a type produced in early Tiberian times and which was widespread in the Antonine period were found at the bottom, in a layer containing a few animal remains and charcoal. A lamp showing traces of woven plant fibres and the remains of a suspension cradle was also found. A dark pottery cooking pot with downturned perimeter, of a pattern found from the first to the second centuries AD, containing food residues, was unearthed. The pottery was dated to 50–100 AD (the Antonine period), and its presence dates to the earliest use of the well to the end of the first and second centuries AD.

Layer IV (301–281 cm deep, 70 l volume) and layer III (281–241 cm deep, 70 l volume)

These two levels, dated to the second to third centuries AD, were composed of a finer light-coloured sediment, without building rubble, indicating that the well had been abandoned as a source of water.

Layer II (241–211 cm deep, 120 l volume)

This layer was very dark and rich in organic matter, with highly carbonised wood and building rubble. There was also an *appliqué*, depicting the baby Dionysus, belonging to a small bronze container of a type known from Cisalpine Gaul in the third century AD (Bulgarelli and Panizzoli 2010).

Layer I (211–178 cm deep, 72 l volume)

This was a very dark deposit with high organic content. It contained amphorae and common micaceous pottery from Provence, *Terra Sigillata italica*, the wooden handle of a tool and three bronze vases, together with a Gallieno coin. The crockery showed signs of use and frequent repair, two *olpi* were dated to the first or second centuries AD. A bottle in sheet bronze (*blechkanne*) was also found, probably of Cisalpine origine from the third or early fourth centuries AD. This material all seems to have been part of a ‘treasure’, that was intentionally hidden, perhaps during difficult political or economic times, but which was never recovered. Like other contemporary finds in well deposits, such as those in Emilia, where relatively modest but precious goods were hidden among layers or bundles of twigs, the treasure in this well seems to have been covered by broken paving and perhaps protected by bundles of twigs (Gelichi 1994).

Pollen analysis

Five sediment samples (1–5) were taken from the central portion of each of layers I–V. Further samples were taken from incrustation inside a broken pot that was included in layer V. The incrustation consisted of an inner organic and partially burned part (6a) and an external, surficial mainly inorganic part, pertinent to the filling of the well (6b). The samples were processed according to Nakagawa *et al*. (1998) with graded sieving of the fine clay fractions (Moore *et al*. 1991). *Lycopodium* spore tablets were added to estimate the total pollen concentration of each sample (Stockmarr 1971).
A pollen count requires more than 300 grains in each sample, including pollen from all trees, shrubs and herbs, but excluding *Pseudoschizaea* cists which are counted separately.
The pollen percentages were calculated and diagrams plotted using the Tilia 2.0 and TG View programmes. Keys and atlases (Eide 1981; Moore *et al*. 1991; Reille 1992–1998; Beug 2004) were used to identify the pollen grains.

Plant macroremains analysis

The sediment in the well (382 l) was treated by wet sieving through 2- and 0.25-mm meshes for carpological analysis. 35.2 l of material, which was kept wet in water and benzalconiumchloride 5%, during recovery and analysis, was obtained. Since there was a high concentration of carpological remains, representative subsamples of each fraction (of 2 and of 0.5 mm) were taken for each of the five levels. The subsampling technique was that of the composite or 'pinch' method (Pearsall 2000) with which a homogenous and representative subsample of the complete sediment is extracted. This method, suggested by Pearsall (2000), has the purpose of obtaining a complete list of the taxa that are present in a simple way. Each fragment was counted as one item. The volume of sediment containing the maximum number of taxa which did not increase when other sediments were analysed, was considered representative of the specific richness. The representative volume, in this work, was on average 6.2 l for each subsample, considering all fractions together.
The results are presented as the number of units in 10 l of sediment (Table 1). The works of Berggren (1969, 1981), Schoch *et al*. (1988), Anderberg (1994), Bosi *et al*. (2006), Cappers *et al*. (2006) and Bojnanský and Fargašová (2007) were used to identify the fruits and seeds as a reference collection from the Archaeological Museum in Finale. The formulas proposed by Mangafa and Kotsakis (1996), which consider the total length, the stalk length and the position of the calaza, were adopted to identify *Vitis vinifera* seeds.
Table 1. Results of carpological analysis in the five layers
CSVPDFDisplay Table
Fragments of small twigs from the wicker basket found in layer V and wooden artefacts from layer I were wax-embedded, sectioned by means of sledge microtome at 15–25 µm and examined under a microscope. The Schweingruber atlas (1990) was used to identify the wooden artefacts. The basket texture was studied from photographs taken at the Restoration Laboratory of *Soprintendenza per i Beni Archeologici della Liguria*. The string in layer II was identified according to Catling and Grayson (1982).
The data obtained from the *Vada Sabatia* well were compared with published data on the presence/absence of cultivated and useful plants from 17 different Ligurian sites (e.g. graves, flower boxes, latrines). Plant nomenclature follows Tutin *et al*. (1964–1980) and Pignatti (1982).

Results

A substantial number of pollen grains, 2167 in all, were counted. These grains were well preserved due to anaerobic conditions and constant wetness. The absolute pollen frequency (APF) was

between 887 and 4214 grains per gram. The pollen percentages of the taxa found in the five levels and in samples 6a–6b are shown in Fig. 3, while the percentage variations in pollen groups related to different vegetation types in the five levels, and the APF are shown in Fig. 4.

Figure 3. Percentage pollen diagram for five sediment levels in the well and for the mineral (6a) and organic (6b) matter encrusting the cooking pot.

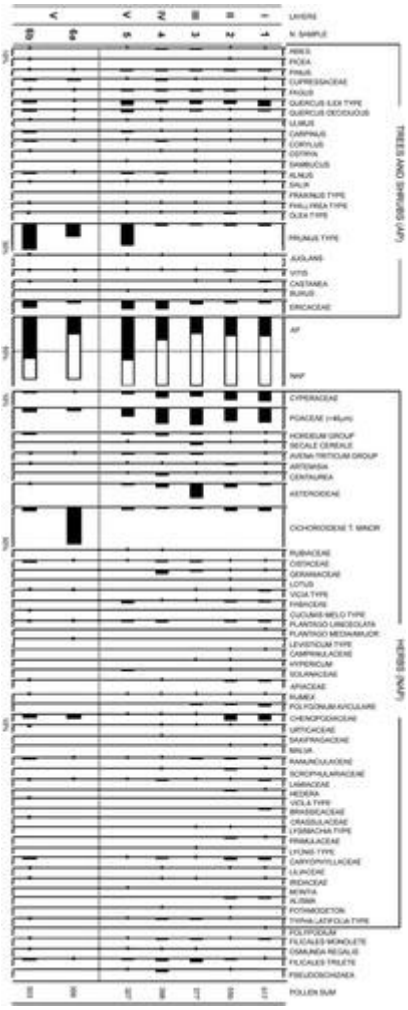
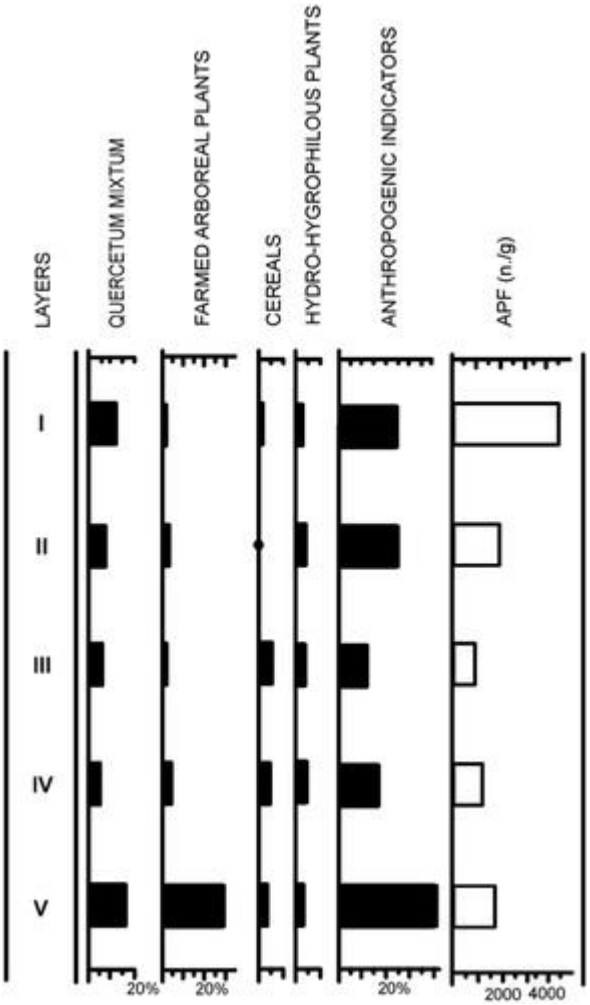


Figure 4. Percentage pollen diagram of different floristic-vegetational categories in the five levels, with the APF trend.



A total concentration of 3468 macroremains per 10 l resulted from the analysis, corresponding to the 96 taxa listed in Table 1.

In the deeper layers (V–IV–III), relative to the well in use, fruits and seeds are less abundant than in two higher layers (II–I): charred seeds show a range from 18 to 31 units/10 l, waterlogged seeds from 85 to 133, versus 214–197 charred and 1158–1550 waterlogged, respectively.

The sum of the concentrations of different carpological groups found in the five levels is reported in Fig. 5 with selected species illustrated in Fig. 6. The results for each layer are given hereafter.

Figure 5. Carpological diagram showing densities per 10 l of crop categories and wild vegetation groups recorded in five layers.

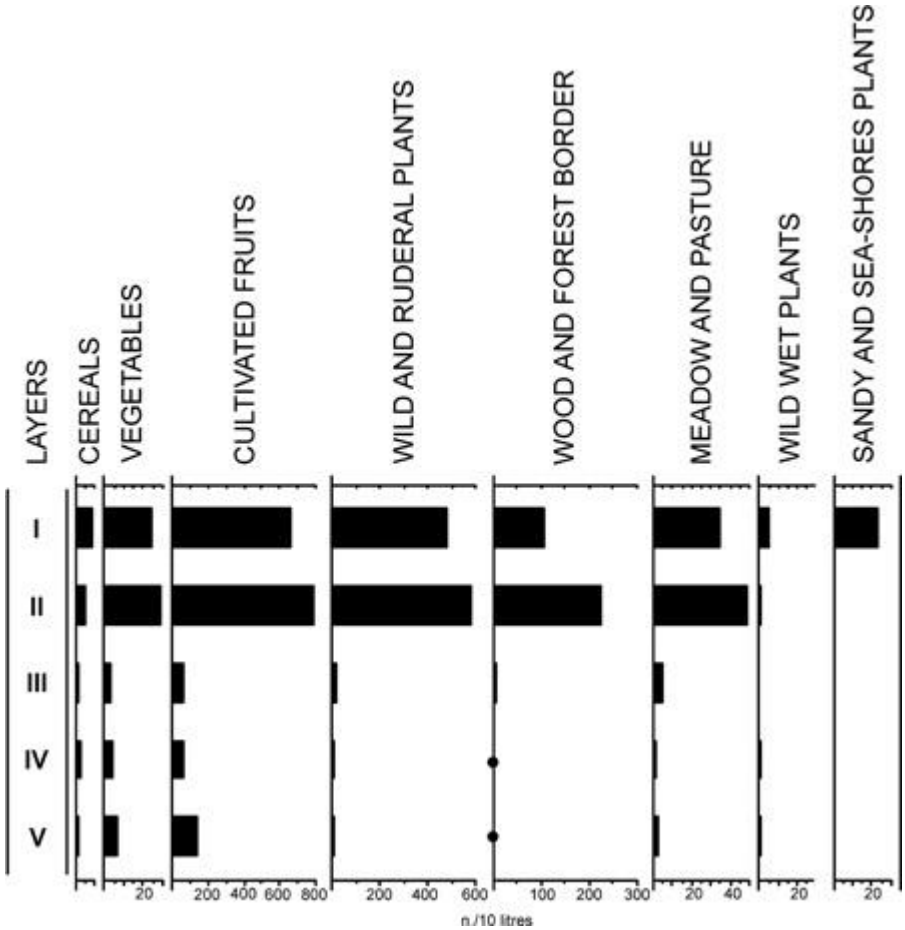
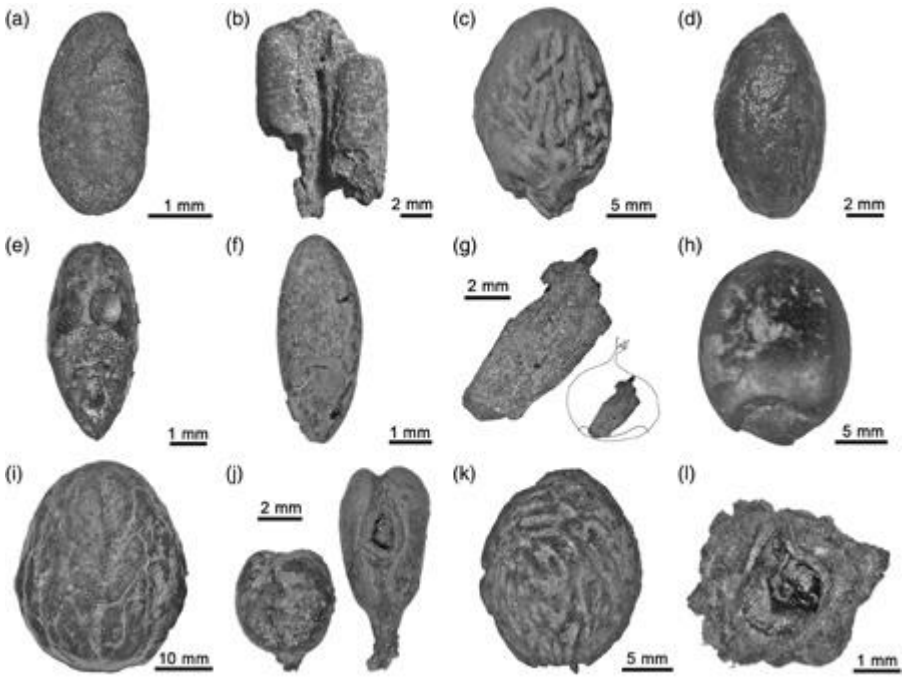


Figure 6. Carpological remains. (a) Seed of *Linum* sp.; (b) fragment of seed of *Phoenix dactylifera*; (c) endocarp of *Ziziphus jujuba*; (d) endocarp of *Olea europaea*; (e) caryopsis of *Secale cereale*; (f) seed of *Cucumis sativus*; (g) fragment of pericarp of *Castanea sativa*; (h) nucule of *Corylus avellana*; (i) endocarp of *Juglans regia*; (j) seeds of *Vitis vinifera* ssp. *sylvestris* and *Vitis vinifera* ssp. *vinifera*; (k) endocarp of *Prunus persica*; (l) fruit of *Beta vulgaris*.

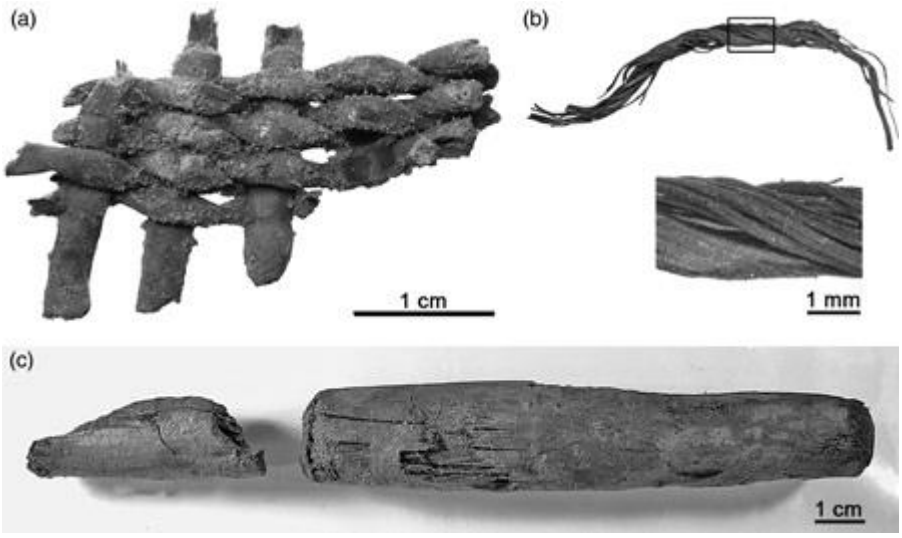


Layer V

The arboreal pollen (AP) in this layer was the highest (63.9%) with *Quercetum mixtum* species pollen (13.5%), riparial willow formations (*Alnus*) and probably also cultivated fruit trees as indicated by the high level of *Prunus*-type pollen (31.8%) together with anther fragments with pollen aggregates. Ericaceae shrubs were present (12.2%). The most common cereal pollens were *Hordeum*-type (1.8%) and *Avena*/*Triticum*-type (1.3%) with only 0.3% of *Secale*-type. The herb component was mostly composed of wild Poaceae (11.9%), Cyperaceae (3.4%), Fabaceae (3.1%) and *Plantago lanceolata*-type (1.8%), indicators of open lands such as pastures and meadows. Anthropically associated weeds were found: *Artemisia*, *Centaurea*, Cichorioideae *minor*-type, *Plantago*, *Rumex*, *Polygonum* and others, that represented 5.2% of the total contents.
Very few carpological remains were found, in particular for cereals, or for wild and ruderal plants, while some remains were referable to cultivated fruit: *Ficus carica*, *Juglans regia*, *Vitis vinifera* and *Olea europaea.* Moreover, the carbonised flax seeds (Fig. 6a) encountered in this level were 2.50–2.55 mm long, still far from the cutoff limit of 3 mm that is taken to distinguish wild (*Linum tenuifolium*, *Linum collinum*, etc.) from cultivated species (*Linum usitatissimum*).
Macroremains of exotic species, such as *Phoenix dactylifera* (Fig. 6b), *Ziziphus jujuba* (Fig. 6c) and *Prunus persica* (Fig. 6k), were also found.
Sample 6 was taken from the cooking pot found in layer V (Fig. 7). The pollen profiles from the two sub-samples (6a and 6b) were quantitatively different. The APF values were 111,250 and 13,572 grains/g, respectively. Sample 6a, which was dark brown and amorphous, showed a high peak of Cichorioideae *minor*-type pollen together with anther remains, which constituted 59.6% of the total contents. Detailed analysis of this category showed 92% of *Lactuca*-type, and 8.0% of *Crepis*-type. *Cucumis melo*-type pollen was also present (0.3%). Sample 6a also contained fragments of *Sitophilus granarius*, a curculionid beetle which feeds on stored grain. The morphotypes in 6b were the same as those in layer V, with an AP value of 66.3%, and with 40.9% of *Prunus*-type pollen.
Figure 7. Bottom of the cooking pot from level V, with food residue on the inside part.

Several sherds of oil lamps, associated with the remains of a basket that must have been used to hold them were found in level V. The fabric had a very regular weave and was made of two different threads. The warp was made of 3.2–3.4 mm diameter thread while the weft was of finer material with a flattened cross-section of about 2 × 0.9 mm (Fig. 8a). The warp material, in the

cross-section, showed diffuse-porous heteroxylous wood with many solitary vessels with a mean diameter of 31 µm and apotracheal diffuse parenchyma. The wood was first-year growth. The tangential and radial sections showed heterogeneous 8–10-cell high and 120 µm long uniseriate or biseriate rays. These features are typical of first-year growth of *Cornus* or *Viburnum*.
Figure 8. (a) Fragment of basket. (b) Carbonised string. (c) Two pieces of a wooden artefact.



The weft consisted of thin threads, deformed because of strong tension. In the transverse section, these threads showed diffuse-porous heteroxylous wood; the longitudinal sections offered no useful information. The origin of the weft threads was not clear but it may have been the same as the warp.

Layers IV–III

These layers contained much lower quantities of tree pollen (AP = 32.7 and 23.6%), largely due to a reduction in the *Prunus*-type, which fell to 3.5 and 1.9%, respectively. The other tree and shrub components were almost the same as in the other layers. The herb component showed a consistent rise in wild Poaceae (21.9 and 23.1%) while the cereals showed a slight increase (4.5 and 6.1%). *Secale*-type pollen was only found in level III, but in quite large amounts (2.7%). Level III also showed a particularly high peak of Asteroideae pollen (20.2%). The anthropic weed species were higher in level IV (8.0%) than in level III (4.5%).
Caryopsis of *Hordeum vulgare* v. *tetrastichum*, *Panicum miliaceum* and *Secale cereale* (Fig. 6e), seeds of *Lens culinaris* and *Vicia ervilia* and cultivated fruit/seeds of *Ficus carica*, *Juglans regia*, *Vitis vinifera*, *Cucumis sativus* (Fig. 6f) and *Olea europaea* (Fig. 6d) were observed in these layers.

Layers II–I

These two levels were very similar from a qualitative and quantitative point of view as far as the pollen grains and macroremains are concerned. The AP values were low (24.5 and 24.2%). The pollen from cultivated/cultivable trees increased slightly (6.4 and 6.0%) with higher values of *Vitis* (1.1%), *Castanea* (1.0%) and part of the *Olea*-type (1.3%), while the percentage of *Juglans* grains was constant.
The carpological remains confirmed these pollen data and showed a very large amount of fruits and seeds. *Castanea sativa* (Fig. 6g), *Corylus avellana* (Fig. 6h) and *Juglans regia* (Fig. 6i) were, in particular, well preserved.
Vitis vinifera (Fig. 6j) were the most common seeds in these recent levels and confirm the increase in pollen percentages of this species observed in layer II.
It was not possible to measure the *Olea europaea* endocarps found in layer I because they were fragmented.

Only a few pollen grains were found among the Rosaceae while there were many fruit remains of several species of *Prunus* all of which were highly frequent in the higher levels. Entire endocarps of *Prunus persica* were present and also seeds of *Pyrus* (level I) and *Malus* (level II).
Cone scales of *Pinus pinea* were only encountered in level I and this suggests the use of the pine-seed for food purposes or an ornamental use of the tree.
The quantity of cereal pollen dropped sharply: the corresponding macroremains in layer I were only represented by caryopsis generally carbonised of *Triticum aestivum durum* and *T. dicoccum*, while *Hordeum vulgare* var. *tetrastichum*, *Secale cereale* and *Avena* sp. were also present in layer II. The absence of intact caryopsis and glumes prevented us from distinguishing cultivated *A. sativa* from wild species, such as *A. fatua* and *A. sterilis*.
Moreover, the *Avena* sp. caryopsis was not charred and this suggests that the analysed samples came from wild species or that, if cultivated, they were not roasted because the caryopsis can easily be divided from the glumes, unlike other cereals which need this treatment. The herbaceous cover was dominated by wild Poaceae (pollen percentages 18.4 and 19.7%) and by anthropic weeds (18.9 and 19.1%) as can be seen from the *Chenopodium* sp., *Cyperus* cf. *rotundus*, Caryophyllaceae, Solanaceae and Urticaceae seeds. There was a slight increase in pollen of herbs from damp and wet places, in agreement with the carpological remains (*Carex* sp., *Epilobium* sp., *Oenanthe* sp. and *Ranunculus* cf. *sardous*).
Brassica oleracea and *Linum* sp. remains were also present. A few seeds of edible plants were also found in layer II, such as *Vicia faba* var. *minor* and *Cucumis sativus*. *Beta vulgaris* was only found in the upper level, representing either crops or wild coastal taxa (Fig. 6l).
A second textile artefact was found in layer II: a 29.5-mm-long and 1.4-mm-wide piece of cord, composed of 20–25 units, each 0.2–0.8 mm in diameter (Fig. 8b). Each element had been made by ‘Z’ twisting the fibres, which appeared ribbon-like with longitudinal striping. Carbonisation made it impossible to separate the single fibres and the whole cord was too opaque to examine by means of transmitted light. The absence of a typical scaly surface excluded any animal origin. The object could have been a string made of hemp or flax, which would agree with the presence of *Cannabis sativa* fibres in tomb 5 at the Fornicoke area on *Vada Sabatia* (Bulgarelli 1999), but it is not possible to exclude other plant fibres.
Two pieces of wood whose shapes suggest that they were from a single piece, the handle of a tool were found in level I (Fig. 8c). The larger fragment was 16 cm long, 3.2–3.9 cm wide and 2.3–2.9 cm thick. It had a smooth surface and was wider and flatter at one end, while it was finished with rounded edges and longitudinal grooving to ensure a good grip; the other end was oval in section and thinner, and ended in a break. The second, 6.8-cm-long, 2.7-cm-wide and 2.2-cm-thick piece was only smooth on one surface and probably fitted with the first piece, as it had similar grooving. One end was broken whereas the other thinner and finished end seemed to have been shaped to fit into some kind of tool, such as a handle.
The anatomical study of the wood from the two pieces showed in the cross-section that the heteroxylous wood was diffuse-porous with a clear late wood ring; the single pores were 34–55 µm in diameter with diffuse apotracheal parenchyma and rays that were heterogeneous, biseriate, 8–20-cell high and with 1–2 procumbent cells in tangential section. The radial sections showed vessels with cell walls that were perforated by scalariform plates with 30 thin bars; there was spiral thickening in the vessels and fibre-tracheids. These features correspond to *Viburnum* sp., especially *V. lantana*, a species that can currently be found in the hills around Vado Ligure to a height of 1000 m, in deciduous temperate woodlands.
A comparison of the list of taxa from useful plants obtained from the well and other archaeological sites dated between the Roman Age and late Antiquity in Liguria has shown 35 taxa compared with a minimum of 2 and a maximum of 16 in the other archaeological sites in Liguria (Table 2).
Table 2. Cultivated and useful plants from Liguria between the Roman and Early Medieval periods
CSVPDFDisplay Table

Discussion

Taphonomical considerations

The well fill is made up of sediments dating from the late first century AD to the fourth century AD. Considering the archaeological finds (artefacts) and the texture of the sediments, layers V to III very probably represent the time span covering the use of the well for water supply, from ca. the end of the first century AD until the end of the second century AD. This can be corroborated from only a few artefacts and the low density of the carpological remains in these sediments. The presence of artefacts and macroremains is probably due to their having accidentally fallen into the well during the period it was in use. This hypothesis is in agreement with the lowermost layers of other wells as suggested by Greig (1988). Therefore, it is possible to conclude that the pollen in these samples could mainly be due to natural pollen rain and will therefore provide information on the surrounding vegetation. Hence, this well is also significant with respect to the reconstruction of the landscape, although it should also be considered that plants could have grown among the pebbles that lined the well (Urticaceae, Scrophulariaceae, etc.) and that fig trees often grew near or inside the abandoned well. Moreover, the use of buckets to draw water surely introduced pollen grains into the well.

Unlike the layers pertaining to the time of use of the well, the uppermost layers II and I are of a dark colour and showed a high organic content, seeds and fruit as well as different artefacts. It is therefore no surprise to find a much higher density of macroremains in these layers mainly made up of cultivated plant remains, above all fruits and nuts, kitchen herbs and pulses, as well as many weeds and ruderal plants. The greater amount of macroremains in layers II and I can be explained by the fact that the well was filled with waste material and no longer used to draw water. The latter plants may have grown near the well, in the settlement area. This spectrum – apart from the artefacts (Bulgarelli and Panizzoli 2010) – clearly points to the fact that this material was intentionally put into the well when it was not longer in use, sometime between the end of the second century AD and the fourth century AD. This material is in part made up of kitchen refuse, but also other waste material derived from agricultural practices. The high amounts of *Ficus* achenes, which are typical of latrine sediment spectra, suggest the presence of human excrements in the well (Knörzer 1984; Hellwig 1989). Such deposits are also present in many other wells and therefore the sequence of the filling in the *Vada Sabatia* well seems to be the same as those described by Greig (1988) and by Buxó and Piqués (2005).

Layers I and II, therefore, offer very important information on the use of the area and above all on the plants used and growing in the surrounding area. It could be supposed that the higher APF, and the low amount of AP, above all in layer I, are also due to the introduction of material containing pollen. Therefore, the pollen spectra in this type of sediment could be interpreted in a slightly different way, that is as a mixture of natural deposits and filling due to human activities. In the lowermost layer, V, the AP are by far the highest, at a first glance suggesting that the landscape around the well might have been more forested than later on. However, much of the pollen is of *Prunus* type: *Prunus* is an insect-pollinated plant that does not scatter much pollen, rarely represented by more than one or two pollen grains in the diagrams. The high percentage that was observed reinforces the hypothesis that *Prunus* was cultivated in proximity to the well. When *Prunus* is excluded, the percentage of AP is no higher than in the later layers. In fact, the low percentage of AP in the lower, almost ‘naturally’ sedimented layers suggests that the landscape was rather open, already at the beginning of the Roman age.

The Vegetation Surrounding the Vada Sabatia Well

The vegetation surrounding the well during its use (end of first to second centuries AD, layers V–III) consisted of a mixed oak forest with deciduous (*Quercus* sp., *Carpinus betulus*, *Ostrya carpinifolia* and *Fraxinus* sp.) and evergreen species (*Quercus ilex*). The pollen assemblage in layers V and IV can be interpreted as coming from a medium distance scarcely dense forest of deciduous and evergreen oaks situated on distant hill slopes. The wood pollen spectrum indirectly corroborates this interpretation since forest border shrubs, such as *Buxus*, *Phillyrea*, *Olea* and Ericaceae, are regularly represented. Hygrophilous woods with *Salix* and *Alnus* are also represented in layers V–III, as in the plain of the Segno and Quiliano streams, and are related to herbaceous wetland species, such as *Montia*, *Potamogeton*, *Typha* and Cyperaceae. In addition, a rather diverse spectrum of non-hygrophilous NAP can also be observed, with Poaceae, Asteroideae, *Centaurea*, Fabaceae and *Plantago lanceolata*, all indicating the presence of pastures. Information from the macro and microremains shows that cereals, vegetables, flax and stone fruit (*Prunus* sp.) would have grown in the rural area near the well, with the odd olive and walnut trees and grapevine. Palynological data pertaining to layers II and I confirm that the agricultural and vegetational situation of the area was maintained without any considerable change in land use.
Pollen analyses conducted in the coastal area of *Albingaunum* on the Centa River delta, highlighted, in layers dated to the Roman period, a similar situation to that observed in layers V–III: the presence of a mixed oak forest, accompanied by hygrophilous communities. Pollen from *Vitis*, *Cannabis* and cultivated cereals were also present (Arobba *et al*. 2004).

Cultivated and Useful Taxa

Layers II and I offer interesting information on the rural use of the area and on the useful food plants.
Considering the single groups of useful plants, it is possible to hypothesise their use in this short time, by comparing their presence at the local and regional scales. *Vitis*, *Olea*, *Juglans*, *Castanea*, Prunoideae and *Ficus* were present in the highest quantities.
The results of the entire carpological record of *Vitis vinifera* suggest that a cultivated type (54%) of seeds, an intermediate type (29%) and the wild type (17%) were present. The cultivated plants may have had different origins and selections. The evidence on the cultivation of *V. vinifera* ssp. *vinifera* is in agreement with other records from Liguria pertaining to the first century BC and the fifth century AD, referring to wine-making equipment (Gervasini 2005; Bulgarelli 2008, Bulgarelli and Vanali 2010). Recent studies conducted in two wells in Provence in France referring to the first to second centuries AD, have highlighted the squeezing of both wild and cultivated grapes (Marinval 1997; Figueiral *et al*. 2010). This continued in the fourth to sixth centuries AD in several sites in Southern France, was followed by a decrease until the ninth to tenth centuries AD (Bouby and Marinval 2001; Durand and Leveau 2004). However, grape cultivation arrived late in Liguria (about first century BC), compared with the Provence area (about sixth century BC).
The low pollen percentage of olives (1.5%) found in the sediments of the climatic optimum of the Roman Age, could indicate transport from the wild vegetation nearby as well as the first stage of domestication. The decrease in this pollen percentage in the subsequent periods at nearby sites (Ruas 1996; Andrieu-Ponel *et al*. 2000; Arobba *et al*. 2004) could be due to the colder temperatures of the Little Medieval Ice Age. Olive cultivation, which has been documented in Liguria and Provence in the 12th to 13th centuries corresponds to the Medieval optimum and to ameliorated agronomical and selective techniques (Quaini 1973; Durand and Leveau 2004).
Recent studies (Terral *et al*. 2004) have highlighted the limits of the traditional parameters that is maximum length and width of endocarps (Buxó i Capdevila 1993), to discriminate wild and cultivated olives. In the present case, since the number of samples was relatively low and several samples were fragmented, it was not possible to use these parameters or conduct statistical analyses.

A low pollen concentration corresponded to a low number of endocarps that presented a maximum length of more than 10 mm: this value, although not statistically evaluated, could suggest that olive cultivation already took place at *Vada Sabatia* in that period, as in Languedoc, Provence and Eastern Liguria (Laval *et al*. 1990; Buxó and Piqués 2005; Gervasini 2005) and not from medieval times as has been supposed till now (Quaini 1973; Arobba and Murialdo 2001). The carpological remains of *Olea europaea* show mean values of the morphological parameters of complete endocarps (minimum and maximum length and width) that increase in layers V (7.1 × 4.8 × 4.5 mm), IV (9.6 × 6.2 × 5.7 mm) and II (11.2 × 7.1 × 6.8 mm). The progressive increase of endocarp length in recent layers is in agreement with a selection for cultivation.

The morphology and size (29–30 mm long and 26–28 mm wide) of the *Juglans* endocarps are similar to those of endocarps found in many sites in the Vesuvian area (Pompei, Ercolano and Oplontis) dating back to the second half of the first century AD (Borgongino 2006) and in Liguria at Pieve del Finale in the same period (Arobba and Murialdo 1996). These values are slightly higher than those of wild fruit and are similar to those of fruit produced by similar plants to the wild ones, that currently grow at the edge of actually grown at the border of the Northern Italian woods (Bandini Mazzanti *et al*. 2000; Zohary and Hopf 2000). The pollen traces of *Juglans*, considered an anthropogenic indicator (*Juglans* line in the third century BC), increased at *Vada Sabatia* in the Emperor Age and could be considered as a very early domestication of the species before a true selection of cultivars occurred.

The abundance of *Castanea* macroremains in layers II and I, together with the increase in pollen concentration, suggests an early use of this species compared with the main period of established domestication in Liguria, from late Antiquity to the High Middle Ages (Piccazzo *et al*. 1994; Rottoli and Negri 1998; Cagnana 2005; Arobba *et al*. 2007; Di Pasquale *et al*. 2008).

The decrease in *Prunus*-type pollen in the IV layer could be due to a change of use of the area near the well involving a reduction in the local culture. Entire endocarps of *Prunus persica* were present; this plant, from Tibet and China, was already known to the Greeks in the third century BC, and its presence in level V shows that it was introduced early to Liguria by the Romans in the first century AD (Zohary and Hopf 2000; Bandini Mazzanti *et al*. 2000; Ciarallo 2004; Sadori *et al*. 2009) as in Southern France at Lattara (Buxó and Piqués 2005).

The presence of *Ficus carica* fruit highlights the continuous use of this species in the Mediterranean basin, which has been registered in Italian archaeological sites since the Neolithic period (Costantini 1989).

As far as the herbaceous species is concerned, *Secale cereale*, *Beta vulgaris* and *Cucumis sativus* have been found in Liguria for the first time. Records exist pertaining to the earlier presence of *Secale* in archaeological sites in Southern Piedmont (Nisbet 1991; Motella De Carlo 1995). The percentage of *Secale* pollen (2.7) could be an indicator of a culture of this cereal, although only two caryopsis were found in the well. The general increase in cereal pollen in layer III can be considered an indicator of an increase in this cultivation.

Morphological data measured on *Linum* sp. seeds, which are near the lower threshold level for cultivated types, suggest a possible cultivation in Liguria at this time, since carbonisation tends to shrink the seeds, and it is known that evidence already exists on the cultivation of this herbaceous plant in Central and Northern Italy in the early Neolithic Age (Rottoli 2003). *Beta vulgaris* was only found in the uppermost level, where it represented either crops or wild coastal taxa. Other insight into the use of vegetables can be gleamed from the analysis of the cooking pan which was rich in Cichorioideae pollen and was probably used to cook soup.

The carpological remains of wild and ruderal plants, together with other weeds and nitrophilous plants, in layers II–I confirm human occupation. Discarded rubble and rubbish were also found and these constitute a suitable habitat for synanthropic plants at the margins of meadows and fields, arable crops, uncultivated wet lands and saline soils.

The presence of exotic fruit (*Phoenix dactylifera* and *Ziziphus jujuba*) at the end of the first century and in the second century AD documents a lively commerce, which was favoured by the easy

landing-site. Fruit of these two species has been found at burial sites of the same period in *Albingaunum* (Albenga) nearby; rare, new or particular objects, such as these types of exotic fruit were usually used as offering to the Gods (Massabò 2005).
The basket (layer V) and the wooden artefact (layer I) are the first evidence in Liguria of the use of *Cornus* or *Viburnum* in these types of manufacture.

Interpretation of the Vessel Contents in Layer V

Insight into the use of the well and the artefacts found in layer V can be obtained from the presence of the cooking pot dated 50–100 AD. The APF calculated for the brown incrustation shows higher values of some pollen types than the values registered in layer V, as the ratio between the incrustation and layer is 151:1 for Cichorioideae, 12:1 for Chenopodiaceae and 8:1 for Poaceae. *Prunus* pollen was also more abundant in 6a (4:1). These data suggest that the incrustation originates from a soup made of vegetables and the probable addition of flowers and flour; the presence of the beetle confirmed the hypothesis of the use of cereals caryopsis/flour. The presence of *Prunus* pollen suggests that honey was added to the soup rather than contamination from the surroundings.

Conclusions

Archaeological and sedimentological data have provided information on the way the *Vada Sabatia* well fills may have formed, during the period the well was in use (layers V, IV and III) and during the period it was out of use (layers II and I), when it was mainly backfilled with rubbish and in part filled with natural sedimentation. Palynological data, referring to the deepest layers, have offered an insight into the surrounding vegetation, while the macroremains, which were abundant in layers II and I, have provided a great deal of information on the species used as food, as well as on the artefacts.
The results obtained from the well offer a valuable contribution to the reconstruction of the landscape and rural activity around the site from the second half of the first to the fourth centuries AD in the region. They also help enrich the picture of the rural economy and complement the classical and archaeobotanical sources that have been available until now from Liguria (Arobba and Murialdo 1996; Castelletti *et al*. 1996a, b, c; Arobba *et al*. 2005a, b, c; Massabò 2005), the French Midi (Buxó and Piqués 2005; Rovira and Chabal 2008) and the Tyrrhenian coast (Ciarallo 2004; Borgongino 2006). The micro and macro-remains suggest that an extensive agricultural exploitation of the land took place in the area from the first century AD and did not change notably over the following centuries.
Thanks to the presence of 35 taxa, a high number compared with other archaeological sites in Liguria, the well was an ideal site for the recovery of plant remains, both because of the number of species and the good preservation due to saturated conditions (Table 2). As already observed at Lattara, this optimal conservation of biological carbonised and waterlogged materials (a total of 28 taxa, 23 of which were used as food) has been confirmed (Buxó and Piqués 2005). Research carried out in other Ligurian sites, with similar geomorphological conditions, such as the towns of *Luna* and *Albintimilium*, did not furnish rich data, due to the fact that analyses in the past were focussed more on archaeological than biological remains, and because of the different uses of the analysed structures (buildings and graves).
The richness of the results obtained at *Vada Sabatia* had offered new insight into the agricultural economy which involved the use of cereals, vegetables, kitchen herbs, oleiferous plants and cultivated fruit (Prunoideae/Maloideae, *Castanea sativa*, *Vitis vinifera*, *Olea europaea*, *Juglans regia* and *Ficus carica*) cultivations which seem to have been absent in Western Ligurian populations living on the hills near *Vada Sabatia* before the Roman conquest in the second century BC (Arobba and Caramiello 2009).

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