



Archaeobotany, vine growing and wine producing in Roman Southern France: the site of Gasquinoy (Béziers, Hérault)

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ABSTRACT

Unequivocal evidence of Roman vine cultivation and wine making is provided from studies of combined archaeological remains from the site of Gasquinoy (Southern France). Waterlogged and charred plant material (fruits/seeds/wood) collected from wells located in the close vicinity of cultivated fields and wine making establishments confirms the local significance of this activity. The results offer insights on particular aspects of wine production ('traumatic' treading of grapes and straining) and provide evidence of secondary agricultural activities such as cereal production and fruit tree cultivation. The potential use of monocotyledonous stems such as *Arundo/Phragmites* in the farming system is discussed.

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1. Introduction

Recent archaeological surveys and excavations carried out in southern France prior to new urban development and motorway construction have identified many Gallo-Roman buildings and evidence of plantations, both of which represent significant elements of the past Mediterranean landscape. Clear archaeological evidence of permanent field systems has been recorded (Boissinot, 1995, 2001; Buffat and Pellecuer et al., 2001; Jung et al., 2001; Vidal and Petitot, 1992), along with aligned plantation pits (*alvei*) and trenches (*sulci*).

Although it is generally accepted that most plantation pits are linked to vine-growing –based on their general size, shape and spacing – they alone are not proof of local wine making. Evidence of local viticulture can also be obtained via the study of production establishments. However, in the Mediterranean area the distinction between wine and olive oil production sites is not easily made, because of their similar characteristics. The interpretation of such sites must take into account the whole structure, its lay out and the presence of specific elements such as crushers for oil making (Brun, 2004a).

Only the combination of different archaeological remains can provide convincing evidence of vine cultivation and wine making; among them, archaeobotanical residues may also contribute to understanding the sequence of events taking place between vine planting and wine consumption. Despite a wide-scale excavation of plantation pits, only sparse plant material, such as few charred remains with no relation to the original cultivated plants have so far been identified (Bouby in press, Figueiral, unpublished). In this study we have located evidence from other types of site and this analysis therefore includes material from wells located in the close vicinity of cultivated fields and wine making establishments. These structures provide a wealth of archaeobotanical information as they combine refuse/rubbish remains preserved in underwater conditions. Anoxic environments prevent growth of most bacteria and fungi thus ensuring preservation of organic material. Evidence of remarkably good preservation of plant material along with a wealth of information has been provided by diverse studies (Greig 1988; Matterné 2000; Giraud et al., 2005; Auxiette et al., 2003; Knörzer 1984, Piques and Buxo, 2005, among others).

In our region, excavations of this type of structure have been necessarily limited because of safety issues, but recent technical improvements have now made it possible to fully exploit their potential.

The site of Gasquinoy (Béziers, Hérault) was studied following the discovery of plantation pits (*alvei*) and trenches (*sulci*) beside

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two farm buildings. Each encloses a stone-lined well and structures interpreted as belonging to a wine making area. In the following study we focus attention on the relationships between agricultural debris and the type of archaeological structure.

In southern France, fields occupied by vineyards have been recorded in the vicinity of the Greek city of Marseille since at least the 4th century B.C. (P. Boissinot, 1995, 2001); by the end of the 2nd century B.C., the development of vine growing may have been linked to local entrepreneurs. The real expansion of this economic activity occurred during the 1st century A.D, when the Narbonnaise is described by Pliny as a wine-growing area of mass production for the urban lower classes and the army (Brun, 2003; Buffat and Pellecuer 2001), i.e., of low quality wine. However, this judgement would not include the wine from Béziers, exported to Rome since the beginning of the 1st century A.D.

1.1. Archaeological background

From July to October 2006, excavation work was carried out at the site of Gasquino (Béziers, Hérault) under the direction of one of the authors (L. Buffat), prior to the construction of the new prison (Buffat, in press). Work effectuated in an area of 2,5 ha uncovered two small gallo-roman farms, set 200 m apart, and occupied during the 1st and 2nd centuries A.D (Figs. 1 and 2).

Farm A, an L shaped building, occupies a surface of 750 m². Two rooms, on the south-east side, may correspond to the *logis* while the wine making structures occupy the rooms on the north side. The vat and remains of the press (foundation only) are located in the western side. The two rooms on the eastern side, which were used as a storage wine area, comprise 27 *dolia defossa* (large coarse-ware containers sunk into the ground) with a capacity of, at least, 400–500 hl. Well 3103 (5 m deep, 90 cm in diameter) is located in the immediate vicinity. The upper part of the infill is 3,5 m thick and composed of large stones and masonry elements (stratigraphic unit 3367). The lower infill (stratigraphic units 3405, 3406, 3407, 3408), contains abundant organic matter and was apparently formed while the well was being used. Several pitchers, some of them unbroken, have been recovered and may have been used to draw water. At present, it is not possible to determine whether the well was operative during the entire period of farm activity. This farmstead appears to have been occupied for a relatively short period.

Farm B, occupies at least 800 m²; the building surrounds a small courtyard of 70 m² bordered by the remains of a vat and a wine



Fig. 2. Site of Gasquino (plan).

store containing 12 *dolia* (capacity = 200hl). Well 5027 (7,5 m deep, 90 cm in diameter) is located immediately beside, in one corner of the courtyard. The infill of this well is very similar to that from farm A: masonry elements in the upper part (stratigraphic unit 5148); pitchers, organic matter and day-to-day objects in the lower fill (stratigraphic units 5149, 5150). We ignore when this well was built but it was apparently abandoned well into the 3rd century AD.

On the north side of the farm, a second wine pressing area, protected by a lean-to, has been uncovered along with a vat and one *dolium*.

It is difficult to understand why both farms were abandoned sometime between the end of the 2nd century and the 3rd century A.D. However, in the Narbonnaise, this appears to be a period of decline for many small farming establishments, while large *villae* still prosper. It is possible that the socio-economical situation no longer favoured small farms.

In the immediate vicinity of the buildings, thousands of vine plantation marks are delimited by ditches, which facilitated drainage prior and during vine growing. *Alvei* predominate while *sulci* are rarer. During the 1st century A.D., the vineyard occupied at least 15 ha of the 20 ha available for study, both over the shingle terraces and deep humid depressions.

The archaeological survey work carried out by G. Fédière has provided evidence of several other farmsteads in the near vicinity (1 km radius). This suggests that each of these establishments farmed a limited area of between 10 and 30 ha, judging from the small-scale production capacities of the wine cellars observed.

1.2. Present day ecology

At present, the site of Gasquino (Béziers) is located in the lowlands of the Bas Languedoc, an area formed by recent alluvial sediments and Miocene/Pliocene marl and molasse plateaux delimited to the north by a series of limestone "Causses".

The Roman farms and associated fields were situated on a gravel terrace, formed during the Saalian (Riss), separated by two depression areas and a thalweg, running East–West.

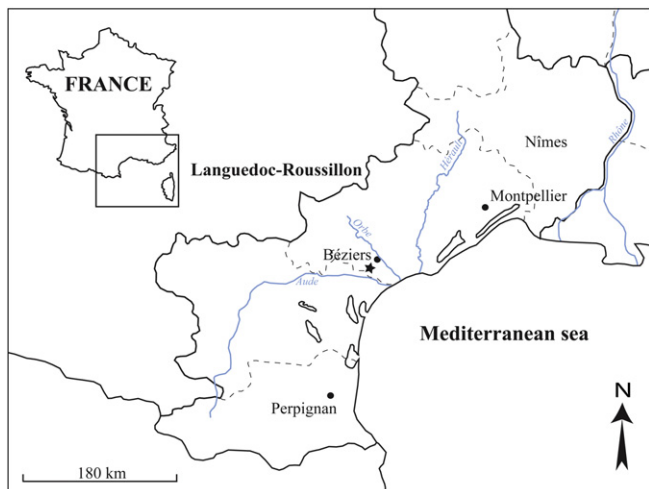


Fig. 1. Map showing the location of the site of Gasquino, in southern France.

The Mediterranean climate here is characterized by long hot summers and mild winters. Present day average annual mean temperature varies between 14 and 16 °C. Annual rainfall is 500–600 mm (with heavy rainfall in the autumn). In this region, the natural tree cover is dominated by *Quercus ilex* while the understorey vegetation consists mainly of *Pistacia lentiscus*, *Quercus coccifera*, *Viburnum tinus*, *Phyllirea media*, *Rhamnus alaternus*, and *Lonicera implexa*. *Quercus pubescens* grows in areas with good soil conditions. Riverside vegetation is dominated by *Alnus glutinosa*, *Fraxinus angustifolia*, *Populus alba* and different species of *Salix* (Gaussens et al., 1964). Today, this natural vegetation is greatly reduced as a result of human influence and arable land is largely occupied by vineyards.

2. Material and methods

Four stratigraphic units have been sampled, three from well 3103 (stratigraphic units 3406, 3407 and 3408) and one from well 5027 (strat. unit 5150). Two different sampling approaches were adopted during excavation work:

- (1) Water-sieving of sediments was carried out *in situ*, using a 2 mm mesh; residues were kept wet and sorted afterwards in the lab.
- (2) Random soil samples were collected and water-sieved later in the lab using a 2 mm, 1 mm and 0.4 mm mesh. Residues from the 2 mm and 1 mm mesh were exhaustively sorted, while those from the 0.4 mm mesh were either partly sorted (minimum 100 ml) (strat. unit 3406 and 3407) or exhaustively sorted (strat. unit 5150). The total number of fragments from partly sorted samples has been extrapolated. Because of the high fragmentation rate of grape pips, the distinction between ‘fragments with stalk’ (narrow proximal part of the seed) and ‘fragments without stalk’ was made, so that a better evaluation of the original number of pips might be possible. It is important to point out that stratigraphic unit 3408 was not exhaustively sampled. The only material available was recovered by hand during field work.

Well preserved plant material recovered included:

- Waterlogged fruits/seeds and wood
- Wood charcoal and charred seeds

The good preservation of waterlogged plant remains suggests that they remained in constant anoxic conditions. Only minor morphological changes were observed in the seeds; particularly fragile plant parts are present, such as pericarps of *Malva*, bryophyte stems, leaf fragments of dicotyledonous plants and Apiaceae seeds. The fragmentation of fruit/seed remains however is very high (average 94.9%). This high rate results from the over fragmentation of *Vitis* pips (average 99.2%). Taking into consideration that grape pips are quite resistant it is possible that natural taphonomy processes might not explain this degree of fragmentation and that human influence must therefore be considered.

The sorting and identification of the fruit and seeds required the use of a binocular microscope at X10–X65, while wood and charcoal fragments were observed under a compound microscope, with a magnification range between X100 and X800. Taxonomic identifications are based on descriptions in identification atlases (Beijerinck, 1947; Cappers et al., 2006; Greguss, 1955, 1959; Schweingruber, 1990, among others) and comparisons with modern reference collections.

Table 1

Absolute frequencies of plant species, based on the identification of seeds/fruits (laboratory sieving, minimum mesh = 0.4 mm).

Le Gasquino (fruit and seeds)					
Well n°		3103		5027	
Stratigraphic unit		3406	3407	5150	Total
Volume sorted (L)		2	2	4	8
minimum sieve mesh		0.4 mm		0.4 mm	
Charred remains					
Fruits					
<i>Vitis vinifera</i>	seed	2	1	–	3
	fg. with stalk	10	–	–	10
	fg. without stalk	3	–	–	3
Weeds					
<i>Galium spurium</i>	seed	1	–	–	1
Varia					
<i>Avena sp.</i>	fg. seed	–	–	1	1
<i>Bromus sp.</i>	seed	–	1	–	1
<i>Malva sp.</i>	seed	1	–	–	1
<i>Trifolium sp.</i>	seed	2	–	–	2
Uncharred remains					
Cereals/chaff					
<i>Hordeum vulgare</i>	rachis segment	–	–	5	5
<i>Triticum aestivum/turgidum</i>	rachis segment	–	–	5	5
<i>Triticum aestivum/turgidum</i>	rachis segment	–	–	1	1
<i>type tétraploïde</i>	segment	–	–	–	–
Fruit/cultivated trees					
<i>Ficus carica</i>	seed	17	27	24	68
	fg. seed	29	1	8	38
<i>Juglans regia</i>	fg.	2	8	14	24
<i>Malus/Pyrus</i>	seed	–	2	–	2
<i>Myrtus communis</i>	seed	2	–	–	2
<i>Olea europaea</i>	endocarp	–	1	–	1
	fg. endocarp	–	1	1	2
<i>Prunus avium/cerasus</i>	endocarp	–	–	2	2
<i>Vitis vinifera</i>	seed	17	107	45	169
	fg. with stalk	369	2293	124	2786
	fg. without stalk	1380	14040	1942	17362
	undevelop. seed	2	1	–	3
	undevelop. berry	12	7	7	26
	skin + seed	–	2	–	2
	fg. skin	–	116	57	173
	pedicel	43	199	146	388
	fg. panicle	17	1	–	18
Other cultivated/useful plants					
<i>Apium graveolens</i>	seed	–	–	1	1
<i>Coriandrum sativum</i>	seed	1	–	–	1
	fg. seed	1	–	1	2
<i>Foeniculum vulgare</i>	seed	–	–	1	1
<i>Origanum vulgare</i>	seed	–	1	–	1
Weeds (winter sown cultures)					
<i>Agrostema githago</i>	fg. seed	–	1	–	1
<i>Anthemis arvensis</i>	fg. seed	–	1	1	2
<i>Calendula arvensis</i>	fg. seed	–	–	1	1
<i>Fallopia convolvulus</i>	fg. seed	1	–	–	1
<i>Glaucium corniculatum</i>	fg. seed	4	–	–	4
<i>Raphanus raphanistrum</i>	fg. silique	2	–	1	3
<i>Reseda phyteuma</i>	fg. seed	–	–	1	1
<i>Valerianella cf. dentata</i>	fg. seed	–	–	1	1
Weeds (spring sown cultures)					
<i>Amaranthus graecizans/lividus</i>	seed	–	13	–	13
<i>Amaranthus sp.</i>	seed	22	–	–	22
	fg. seed	4	–	–	4
<i>Anagallis arvensis</i>	seed	6	–	–	6
<i>Capsella bursa-pastoris</i>	seed	–	–	1	1
<i>Chenopodium album</i>	seed	8	15	1	24
	fg. seed	8	–	–	8

(continued on next page)

Table 1 (continued)

<i>Chenopodium gpe polyspermum</i>	fg. seed	2	–	–	2
<i>Euphorbia helioscopia</i>	seed	2	1	4	7
	fg. seed	5	1	2	8
<i>Fumaria officinalis</i>	seed	–	1	2	3
	fg. seed	–	–	1	1
<i>Heliotropium europaeum</i>	seed	15	–	7	29
	fg. seed	41	–	7	48
<i>Portulaca oleracea</i>	seed.	4	6	1	11
	fg. seed	2	–	–	2
<i>Solanum nigrum</i>	seed	–	–	6	6
<i>Sonchus asper</i>	seed	–	1	1	2
	fg. seed	–	–	1	1
<i>Stellaria media</i>	seed.	–	–	5	5
Ruderal plants					
<i>Chenopodium murale</i>	seed	34	15	1	50
	fg. seed	4	–	–	4
<i>Lamium cf. amplexicaule</i>	seed	4	–	–	4
<i>Malva parviflora</i>	fruit	8	–	–	8
	fg. fruit	9	9	–	18
<i>Malva sylvestris</i>	fruit	5	–	4	9
	fg. fruit	5	–	3	8
<i>Malva sp</i>	seed	21	–	5	26
	fg. seed	37	6	–	43
<i>Picris hieracioides</i>	seed	–	–	1	1
<i>Polygonum aviculare</i>	seed	7	1	7	15
	fg. seed	–	–	1	1
<i>Rumex type crispus/pulcher</i>	seed + valve	3	–	8	11
	fg. valve	–	–	3	3
<i>Sambucus ebulus</i>	seed	–	–	5	5
	fg. seed	–	–	6	6
<i>Silene alba</i>	seed	2	1	1	4
<i>Torilis arvensis</i>	seed	–	–	1	1
<i>Urtica urens</i>	seed	50	3	1	54
	fg. seed	10	–	–	10
<i>Verbena officinalis</i>	seed	–	–	3	3
	fg. seed	2	–	2	4
Woodland, hedges					
<i>Cornus sp.</i>	fg. endocarp	–	–	1	1
<i>Glechoma hederacea</i>	seed	12	–	–	12
<i>Quercus sp.</i>	base gland	4	3	–	7
	fg. pericarp	350	102	–	452
	fg. cupule	8	6	–	14
<i>Rosa sp.</i>	seed	1	–	–	1
<i>Rosa/Rubus</i>	thorn	7	1	7	15
<i>Rubus fruticosus agg.</i>	seed	–	–	34	34
	fg. seed	–	–	49	49
<i>Rubus sp.</i>	fg. seed	2	–	–	2
<i>Sambucus nigra</i>	seed	–	–	2	2
	fg. seed	–	–	1	1
Dry rocky areas					
<i>Cerastium sp</i>	seed	2	–	2	4
<i>Hypericum cf. perforatum</i>	seed	–	–	2	2
<i>Petrorhagia prolifera</i>	seed	–	1	3	4
<i>Silene cf. gallica</i>	seed	–	1	–	1
Grassland/pasture					
<i>Agrimonia eupatoria</i>	seed	–	–	1	1
<i>Daucus carota</i>	seed	3	–	3	6
<i>Linum bienne</i>	seed	–	–	1	1
<i>Medicago minima</i>	pod	–	–	6	6
<i>Medicago type polymorpha</i>	pod	–	–	4	4
	fg. pod	–	–	5	5
Wetlands					
<i>Carex sp.</i>	seed	–	–	2	2
<i>Cyperus longus</i>	seed	4	–	–	4
<i>Cyperus sp.</i>	seed	–	–	4	4
<i>Eleocharis palustris</i>	seed	–	1	–	1
<i>Ranunculus sardous</i>	seed	–	–	1	1
Varia					
Alismataceae	seed	–	–	3	3
Apium/Helosciadium	seed	2	–	–	2
Apiaceae	seed	–	1	2	3
Asteraceae	fg. seed	–	–	2	2
Brassicaceae	fg. seed	–	1	–	1

Bryophyte	fg. stem	16	*	*	16
<i>Bromus sp.</i>	seed	–	2	2	4
<i>Campanula sp.</i>	seed	2	–	–	2
Chenopodiaceae	seed	2	–	–	2
	fg. seed	12	6	–	18
Dicotyledoneous	fg. leaf	75	*	*	75
<i>Epilobium sp.</i>	seed	–	3	–	3
<i>Euphorbia sp.</i>	fg. seed	–	–	2	2
Flower bud	–	6	–	–	6
<i>Glaucium sp.</i>	fg. seed	–	1	–	1
<i>Hypericum sp.</i>	seed	–	–	2	2
Lamiaceae	fg. seed	–	4	1	5
cf. <i>Linum sp.</i>	fg. capsule	–	–	1	1
<i>Lolium sp.</i>	seed	–	–	1	1
<i>Medicago sp.</i>	fg. pod	–	4	18	22
<i>Physalis/Solanum</i>	seed	–	1	–	1
<i>Poa type</i>	seed	4	–	–	4
Poaceae	fg. seed	1	–	–	1
	rachis	–	–	8	8
	element	–	–	–	–
	fg. stalk	–	1	–	1
Polygonaceae	seed	–	1	6	7
	fg. seed	–	–	3	3
<i>Rumex sp.</i>	seed	–	4	5	9
<i>Saponaria sp.</i>	fg. seed	–	–	2	2
<i>Silene nutans/vulgaris</i>	seed	2	–	–	2
<i>Silene sp.</i>	seed	–	3	2	5
<i>Thymelaea sp.</i>	seed	–	1	–	1
<i>Torilis sp.</i>	seed	–	–	1	1
<i>Trifolium sp.</i>	fg. sepal	–	–	1	1
<i>Valerianella sp.</i>	fg. seed	–	–	1	1
Total number		2747	17045	2672	22464
Total charred remains		19	2	1	22
Total number uncharred remains		2728	17043	2671	22442
% charred remains		0.69	0.01	0.04	0.10
Nb specimens/Litre		1373.50	8522.50	668.00	2808.00
fragmentation rate		87.91	97.47	85.52	94.88

3. Results

3.1. Fruits and seeds

Results obtained are shown in Tables 1 and 2 and Fig. 3. Table 1 comprises samples sieved with 2 mm, 1 mm and 0.4 mm mesh, while Table 2 includes samples sieved with a 2 mm mesh only. Discussion of results will be based mainly on the results from the samples sieved with a minimum 0.4 mm mesh. Material from the 2 mm mesh provides complementary information, especially concerning fruit trees (stones and shells).

High densities of fruit/seed remains are recorded in all samples (mean 1053.5 remains/litre) and seems particularly important in stratigraphic unit 3407.

As seen in Tables 1 and 2, charred remains, although present in all stratigraphic units, attain negligible frequencies (only 22 specimens, 0.1%). They comprise *Vitis* pips, *Triticum* sp. and 5 wild plants, from which only one has been identified at species level (*Galium spurium*).

The large majority of fruit/seed remains is waterlogged, with an estimated number of 23 442 specimens, covering at least 77 taxa, characteristic of different plant communities.

The importance of the group 'cultivated fruits' (Fig. 4) is clearly recorded in all stratigraphic units, and especially in unit 3407. This importance results directly from the abundance of *Vitis* (47.5–93%), mostly pips and pip fragments, undeveloped berries, skin fragments, pedicels and other panicle elements (Fig. 5b). Other fruit taxa include *Ficus carica*, *Juglans regia*, *Malus/Pyrus*,

Table 2

Absolute frequencies of plant species, based on the identification of seeds/fruits (field sieving, mesh = 2 mm).

Le Gasquinoi – Béziers					
Well		3103			5027
Stratigraphic unit minimum seed mesh		3406	3407	3408	5150
		2mm	2mm	2mm	2mm
Charred remains					
Cereals					
<i>Triticum</i> sp.	seed	1			
Fruits					
<i>Vitis vinifera</i>	seed		1		
Uncharred remains					
Cultivated/useful fruits					
<i>Ficus carica</i>	seed		1		
<i>Juglans regia</i>	fg. seed	12	98		53
<i>Olea europaea</i>	endocarp		14		16
	fg. endocarp		20		9
<i>Pinus pinea</i>	fg. shell	2	2		4
	cone scales	4	1		
<i>Prunus persica</i>	endocarp	1	12	1	
	fg. endocarp		1		
<i>Prunus avium/cerasus</i>	endocarp		5		
	fg. endocarp		2		
<i>Prunus insititia</i> type	endocarp				10
<i>Prunus spinosa</i> type	endocarp		1		8
	fg. endocarp				4
<i>Vitis vinifera</i>	seed	38	206		38
	fg. without stalk		106		24
	fg. with stalk		65		27
	undevelop. berry	1			
	skin		18		2
	pedicel	26	14		45
	fg. panicle	1			
Woodland, hedges					
<i>Corylus avellana</i>	fr. shell	1	4		7
<i>Quercus</i> sp.	pericarp	6	4		
	fg. pericarp	10	45		7
	base acorn	8			
	cup		1		
	undevelop. cup		1		
	fg. cup		9		
<i>Rosa/Rubus</i>	thorn				1
Varia					
Bud			2		
Lamiaceae	fg. seed				1
<i>Medicago</i> type polymorpha	fg. pod		1		
Total, NR charred		1	1	0	0
Total, NR noncharred		111	633	1	256
Total		112	634	1	256

Myrtus communis, *Olea europaea*, *Prunus avium/cerasus*, *Pinus pinea*, *Prunus persica* and *Prunus domestica* subsp. *insititia* (the last three species identified in samples sieved with a 2 mm mesh only, Table 2). The identification of *Prunus domestica* subsp. *insititia* was based on measurements of complete stones (L mean = 12.7 mm ± 0.8) and overall morphological features such as oval elongated shape, asymmetric, flattened laterally, with two longitudinal furrows, obtuse/truncated base, pointed at the top, irregular surface (Behre, 1978; Jacquat, 1988; Ruas, 1995; Van Zeist and Woldring, 2000).

Wild fruits are also present, especially in unit 5150: *Prunus spinosa*, *Corylus avellana* (which could also be cultivated), *Cornus* sp., *Quercus* sp., *Sambucus nigra*, *Rubus fruticosus* and *Rosa* sp. Stones of *Prunus spinosa* (Stratigraphic unit 5150) are smaller (L mean = 9 mm ± 1.2) than those of *Prunus domestica* subsp. *insititia*, round shaped with an irregular creased surface and deep dorsal furrow (Fig. 5a)



Fig. 3. Well 3103, in the beginning of the excavation.

Low frequencies (<5.8%) of other cultivated plants are also recorded (Fig 4): rachis fragments of *Hordeum vulgare* and *Triticum aestivum/turgidum* (some of the tetraploid type) are identified in well 5027. The very sporadic presence of herbs (*Apium graveolens*, *Coriandrum sativum*, *Foeniculum vulgare*) is also noticed. This contrasts with the diversity of crop weeds and ruderal plants; ruderal plants such as *Amaranthus graecizans/lividus*, *Chenopodium album*, *C. murale*, *Heliotropium europaeum*, *Malva* spp., *Urtica urens* are particularly significant.

The taxonomic spectrum identified includes two additional communities: one comprises plants growing in dry soils (Mediterranean grasslands) the other consists of plants from wet areas.

3.2. Grape pip morphometry

Pips of modern wild (*Vitis vinifera* subsp. *sylvestris*) and cultivated (*V. vinifera* subsp. *vinifera*) grapevines can be differentiated based on morphology, which is smaller more globular in shape in wild pips. The stalk (narrow proximal part of the seed) of wild specimens is also shorter than that from cultivated ones. Morphometric indicators have often been used to distinguish both compartments.

At our site, fifty well preserved pips from each well (strat. units 3407 and 5150) were selected and measured. Measurements carried out include: total length (L), length of stalk (LS), breadth (B), chalaza position (PCH) (according to Kislev, 1988; Mangafa and Kotsakis, 1996; Jacquat and Martinoli, 1999; Bouby and Marinval, 2001; Bouby et al., 2006); data obtained were submitted to Multivariate Analysis. On the basis of the reference collection used by Bouby et al. (2006), the archaeological grape pips were assigned to both compartments (Fig. 7). Some specimens remain unassigned. The probability threshold considered for attribution to a group was $p = 0.75$. As seen in Fig. 7, an even distribution of wild and cultivated grape pips is recorded for each sample. The high proportion pips with shape characteristics of wild pips is not believed to have resulted from taphonomic biases, as waterlogged pips do not suffer the same degree of deformation, as seen in charred material (Smith and Jones, 1990). This may indicate that wild grapes were locally cultivated, as already observed at other sites (Bouby et al., 2006; Terral et al., submitted for publication).

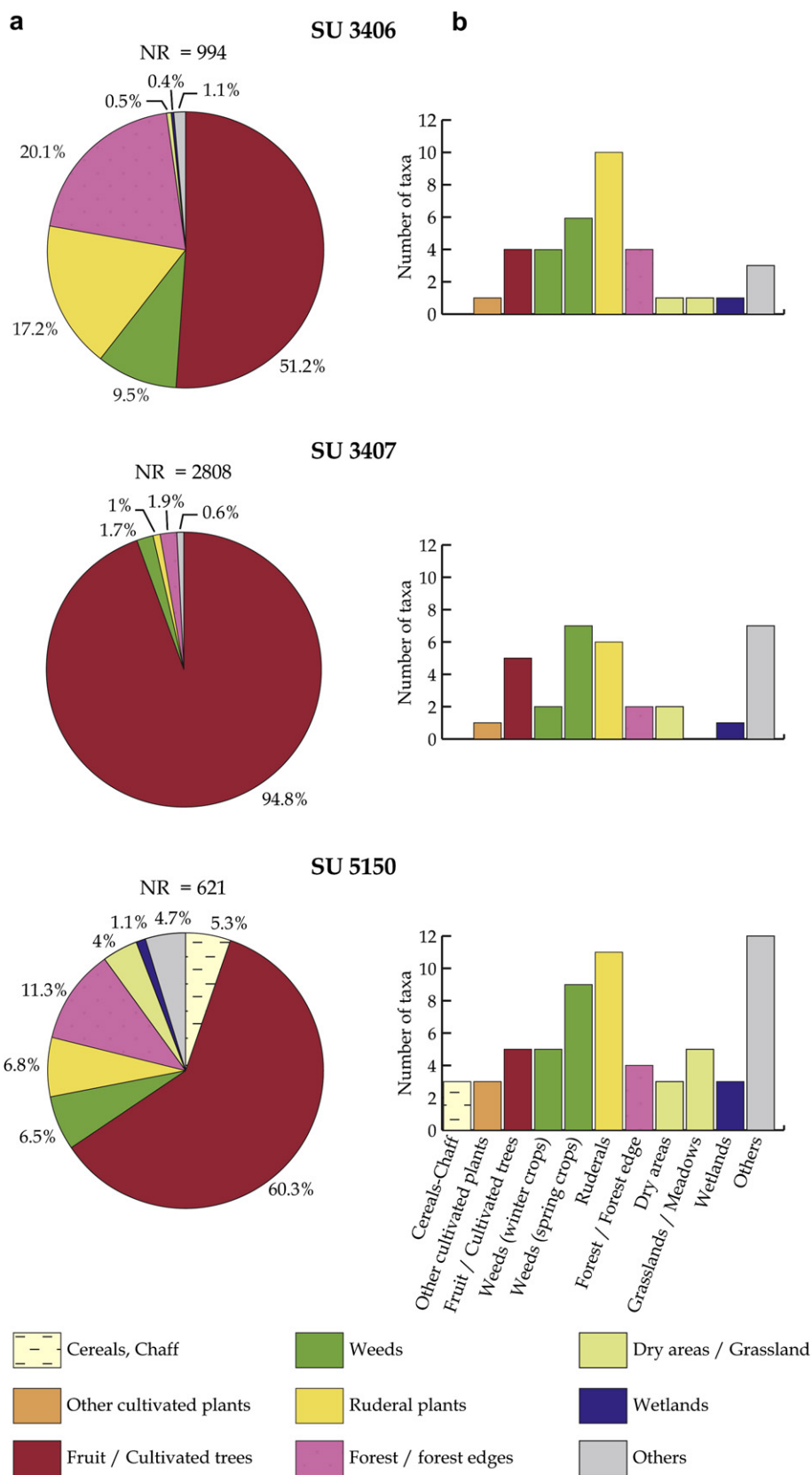


Fig. 4. Main ecological and economical groups in the three stratigraphic units (based only on waterlogged seeds and fruits): A – Proportions of number of remains; B – Minimum number of taxa.

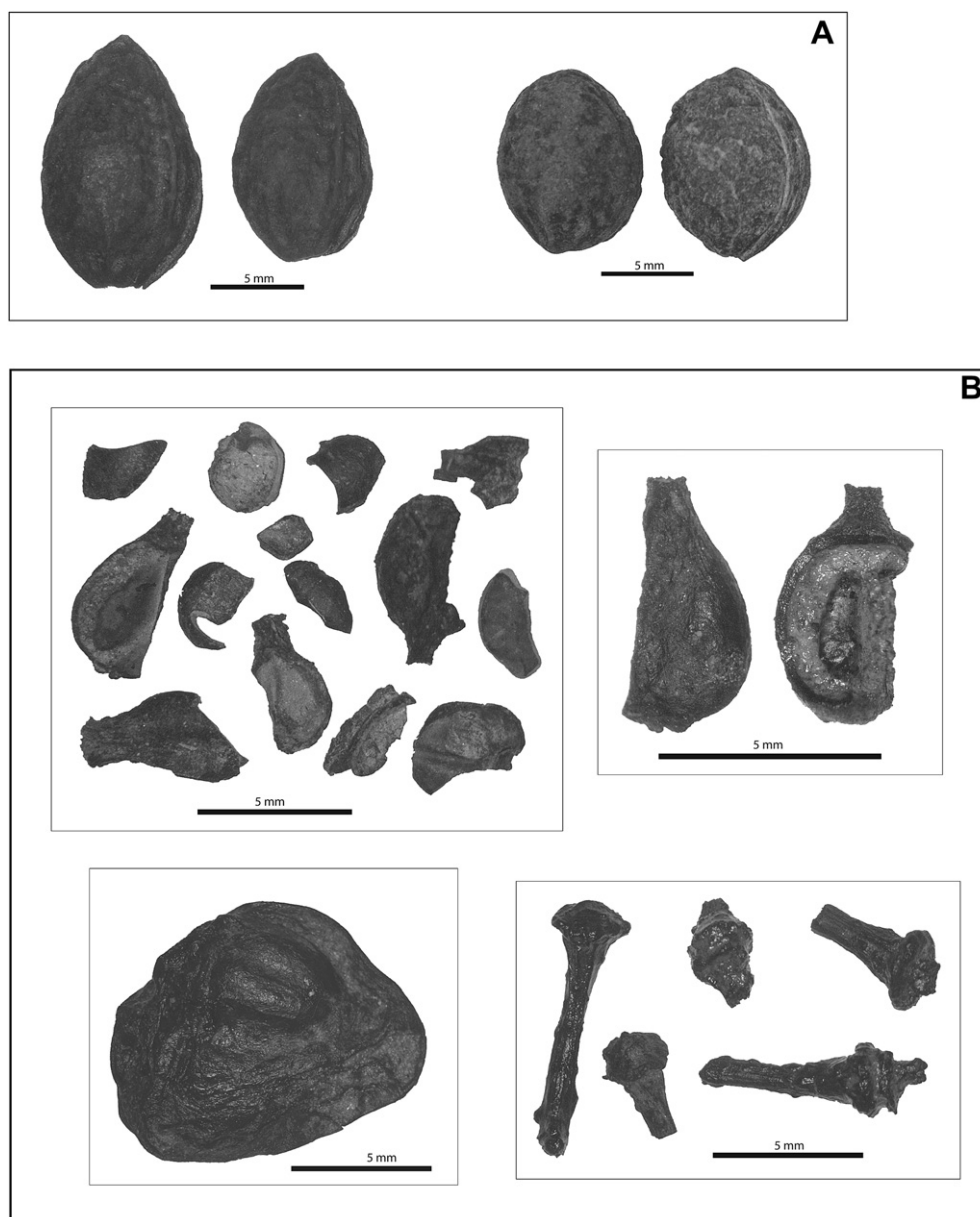


Fig. 5. A – Endocarps of *Prunus domestica* ssp. *insititia* (left hand side) and *Prunus spinosa* (right hand side). B – Remains of *Vitis vinifera*: pip fragments, skin (with pip) and pedicels.

3.3. Waterlogged wood

The wood specimens identified comprise:

- household objects: a hair comb and a spool made out of *Buxus sempervirens*, and a knife with a very well polished wooden handle, probably made of *Juniperus*.
- 'natural' wood fragments, consisting mostly of remains of small branches and twigs (0.2–0.8 mm in diameter). Residues of timber are absent.

As observed in Table 3, 126 fragments of wood were analysed. Stratigraphic unit 3407 provided the largest number of specimens (77), while only four were recovered from SU 3408. The taxonomic spectrum comprises twelve taxa. *Vitis vinifera* is the most abundant species identified, present in three of the units, while *Abies* sp. is the only taxon identified in all stratigraphic units. Other taxa identified include: *Ficus carica* (in three units), Fabaceae, *Prunus* type *avium*,

Prunus sp., *Quercus* (deciduous), *Salix/Populus*, *Larix/Picea* (in two units each). *Fagus sylvatica*, *Buxus sempervirens*, *Prunus* type *spinosa* and *Juniperus* sp. were identified in one unit only.

The presence of three taxa which nowadays grow only at high altitude (*Abies*, *Fagus* and *Larix/Picea*) should be underlined.

3.4. Charcoal

Charcoal fragments were sampled from units 3406 (49 fragments), 3407 (77) and 5051 (108). Eight taxa identified with the wood fragments are also recorded among the charcoal specimen: *Abies*, *Ficus carica*, *Juniperus* sp., *Prunus* type *avium*, *Prunus* type *spinosa*, *Prunus* sp., *Quercus* (deciduous), *Salix/Populus* and *Vitis vinifera*. Further 12 taxa are also identified: *Acer* sp., cf. *Corylus avellana*, *Erica* sp., *Fraxinus* sp., *Juglans regia*, Monocotyledons (*Arundo/Phragmites*), *Pinus pinea*, *Quercus* (evergreen), *Rhamnus/Phyllirea*, Rosaceae Maloideae (including *Malus/Pyrus*), *Sambucus* sp., *Ulmus* cf. *minor*. Taxa *Salix* sp. and *Quercus* sp., included in

Table 3

Absolute frequencies of plant species, based on the identification of waterlogged wood and charcoal. Taxa are given according to their expected vegetation associations: 1 – Mixed oak woodlands, 2 – Riparian forest, 3 – Open areas/woodland clearance indicators, 4 – Cultivated/possibly cultivated plants, 5 – Exogenous elements.

Stratigraphic unit		Well 3103					Well 5027		
		3406		3407		3408	5150		
		Wood	Charcoal	Wood	Charcoal	Wood	Wood	Charcoal	
Taxa		n°	n°	n°	n°	n°	n°	n°	%
Le Gasquinoy (Waterlogged wood and charcoal)									
1	<i>Acer</i> sp.		1						
	<i>Prunus</i> type <i>avium</i>	1		2	1				
	<i>Quercus</i> (<i>deciduous</i>)		5	1	8		1	5	4.8
	<i>Quercus</i> (<i>evergreen</i>)		5		1			5	4.8
	<i>Quercus</i> sp.		1	1				1	1
	<i>Rhamnus</i> / <i>Phyllirea</i>				3				
	cf. <i>Rhamnus</i> / <i>Phyllirea</i>		1						
	cf. <i>Rosaceae</i> <i>Maloideae</i>				2			2	1.9
	cf. <i>Corylus</i> <i>avellana</i>							1	1
	<i>Fraxinus</i> sp.				1				
	Monocotyledonae (<i>Arundo</i> / <i>Phragmites</i>)		2		13			49	47.6
2	<i>Salix</i> sp.		1		2			6	5.8
	<i>Salix</i> / <i>Populus</i>	2		4					
	<i>Sambucus</i> sp.							1	1
	<i>Ulmus</i> cf. <i>minor</i>		3		1			5	4.8
	<i>Buxus</i> <i>sempervirens</i>			2				5	4.8
3	<i>Erica</i> sp.							2	1.9
	Fabaceae			2	1	1		1	1
	<i>Juniperus</i> sp.			1				1	1
	<i>Prunus</i> type <i>spinosa</i>			5					
	<i>Ficus</i> <i>carica</i>	3		4	1		5		
	<i>Juglans</i> <i>regia</i>		5		1			2	1.9
4	cf. <i>Juglans</i> <i>regia</i>				1				
	<i>Malus</i> / <i>Pyrus</i>		1						
	<i>Pinus</i> <i>pinia</i>		1						
	<i>Vitis</i> <i>vinifera</i>	9	10	22	8		9	4	3.9
	<i>Abies</i> sp.	1	2	9	8	2	5	7	6.8
	cf. <i>Abies</i> sp.						1		
5	<i>Fagus</i> <i>sylvatica</i>			3					
	cf. <i>Fagus</i> <i>sylvatica</i>		1						
	<i>Larix</i> / <i>Picea</i>			5		1			
	Angiosperm (indet.)	3	3	8	1			4	3.9
	Fabaceae / <i>Ulmaceae</i>				1				
6	Gymnosperm (indet.)		2	1	2			2	1.9
	<i>Pinus</i> sp.		2		2				
	<i>Prunus</i> sp.	1	1	2					
	Bark (indet.)			3	1		1		
	Indeterminable	2	2	2	2		1	5	
	Total with indeterminable	22	49	77	61	4	23	108	
	Total without indeterminable	20	47	72	58	4	21	103	100%

Table 3 are not taken into account here as we consider that they are included in taxa *Salix/Populus* and *Quercus* (deciduous and evergreen). Please note that although monocotyledons don't strictly have wood, they are included in the general charcoal assemblage.

This list based on charcoal enlarges considerably the spectrum of plants used, as seen in Table 3, where taxa are listed according to present day phytosociological affinities, different vegetation communities are represented: (1) mixed Mediterranean woodland, (2) riverside vegetation, (3) open areas with woodland clearance indicators (4) cultivated or possibly cultivated species (5) exogenous elements.

The abundance of Monocotyledons in stratigraphic units 3407 and 5051 is particularly marked (Table 3, Fig. 6). Morphological and anatomical features of specimens point to the genera *Arundo* and/or *Phragmites* but a more precise identification is not currently possible. *Vitis vinifera* predominates in unit 3406 (Fig. 6). Absolute counts only are presented for units 3406 and 3407, while relative frequencies are also calculated for unit 5051 (with more than 100 specimens available).

3.5. Bryophytes

Relatively abundant remains of bryophytes were present in the samples. Three different species have been identified by Mme Jarry (Herbarium of Montpellier): *Eurhynchium pumilum*, *Eurhynchium praelongum* (= *Kindbergia praelonga*) and *Bryum capillare*. The first two species usually grow in humid and shady areas, and are common on the walls of wells and beside fountains. The third species is usually found over walls and rocky areas.

4. Discussion

4.1. Fruit and seeds

The plant spectrum identified based on seed/fruit remains is dominated by ruderal and food plants especially fruits. This might be considered to represent both the natural (*in situ* deposition) and anthropogenic components of the assemblage. The result is in

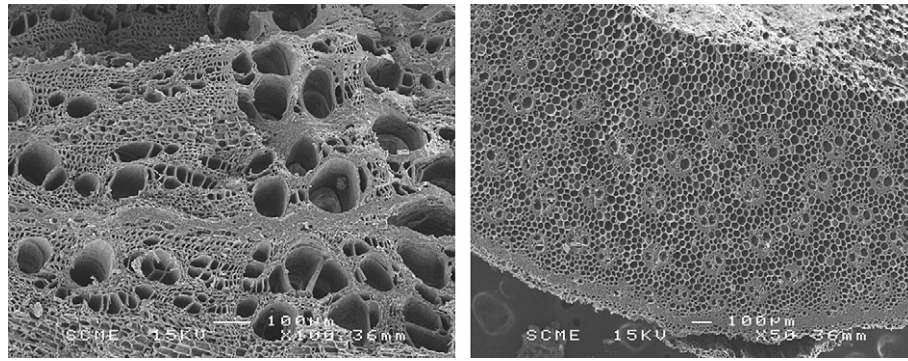


Fig. 6. Transverse sections of charcoal fragments: *Vitis vinifera* (on the left hand side), *Arundo/Phragmites* (on the right hand side).

agreement with data obtained from other wells (Greig, 1988; Zwierzinski et al., 2003, among others).

The abundance of species indicating nitrogen-rich soils illustrates conditions in the immediate vicinity of the wells, i.e. the farm's courtyard. Plants characteristic of both dry and wet soils could also grow in this area.

Not all synanthropic species should be considered as 'natural' components of the plant assemblage. Some of them, considered today as typical segetal weeds, may result from crop processing, and represent by-products discarded in the well. The sporadic presence of cereal remains (rachis elements) is noted in well 5027. The majority of the anthropogenic elements of these wells consist of fruits, but not all the fruit remains may be easily labelled "anthropogenic". In fact, some of the stones of *Prunus spinosa* and *Prunus avium/cerasus*, have been nibbled by rodents clearly showing that at least some of the remains were manipulated by animals and may have been transported from either open air rubbish dumps or from the spot where they had fallen from overhanging branches (Ruas, 2000; Buxó, 2005). The same applies to the preserved acorns.

The results indicate that the presence of *Vitis* residues clearly results from human activities. The association of pips, undeveloped berries, fragments of crushed skins, pedicels and other rachis elements is considered to be direct evidence of grape pressing (Bouby and Marinval, 2001; Mangafa and Kotsakis, 1996; Margaritis and Jones, 2006; Marinval, 1988, 1997; Murray, 1999). The marked abundance of these residues in association with (1) the occurrence of thousands of plantation pits in the surrounding fields, (2) the identification of wood and charcoal fragments of *Vitis*, (3) the presence of basins which could have been used to trap the must and (4) cellars with *dolia* sunk into the ground, combine to provide a clear picture of two vine growing and wine making establishments.

Based on ethnographic observations (Margaritis and Jones, 2006), it is possible that the wine pressing remains from Le Gasquinoy (low frequencies of rachis elements, presence of undeveloped berries and skin fragments, good representation of pedicels)

might result from sieving carried out before the juice from treading/pressing was transferred to the fermentation containers. According to classical written sources this straining was done with a sieve or a basket (Billiard, 1913)

4.1.1. Pip fragmentation

Attention must be drawn to the high fragmentation of grape pips (Table 1). Despite their hardness and mechanical resistance, pips are significantly more fragmented than the other seeds/fruits. Why are pips so fragmented when we know that during treading, grapes are usually pressed as lightly as possible to avoid unnecessary breakage of pips and consequent release of superfluous levels of oil and tannins? These affect wine colour and flavour (Margaritis and Jones, 2006; Murray, 1999).

Apparently grapes were not trodden underfoot by the Romans, as this method usually avoids over fragmentation. Does our fragmentation result from the use of a press?

Archaeological evidence of these is frequently available in wine-producing *villae* from this region. At the site of Gasquinoy, traces of a press (type unknown) have been found. In the *Narbonnaise* the lever press, also known as 'Cato press' is the most common (Brun, 2005). One of these has been reconstructed at Mas des Tourelles (Beaucaire), based on the descriptions made by classical authors and on archaeological evidence, and wine making "à la romaine" is recreated each year during the grape harvest. The comparison of the fragmentation of pip debris from our site with that issued from Mas des Tourelles (harvest of 2007) shows that the archaeological pips are far more fragmented than the modern ones.

So if the lever press is not responsible for over-fragmentation of grape pips, how can we explain our results? A different mechanical action must be considered.

The hypothesis of pip crushing for oil extraction is not consistent with the earliest mention of the preparation of this type of oil that dates back only to the XVIIIth–XIXth centuries (Beutler, 2005; Marinval, 2005). Above all, the presence of rachis elements and the size of pip fragments (relatively large) are not consistent with this activity.

However, over fragmentation of our pips could result from the use a more violent 'treading' of the grapes. Such methods are mentioned, though rare, in the literature, but stone rollers were used in Roman settlements from Syria and Palestine (Brun, 2004b). Also the use of wooden pestles has been described in more recent French texts (Lachiver, 1988).

4.2. Wood and charcoal

The plant assemblage identified based on wood and wood charcoal reveals more about the agriculture and possible plant uses

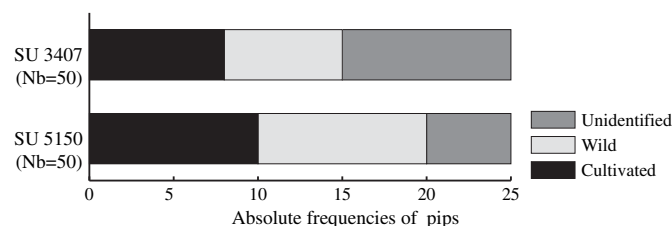


Fig. 7. Results of the classification by Discriminant Analysis (threshold = 0.75) of archaeological pips, by comparison of their measurements with those of specimens from a modern reference collection of wild and domesticated vines.

in agrarian sites than about local woodland composition and structure. Frequencies of taxa identified can not be considered as representative of the structure of local natural vegetation. They are consistent with neither the predicted phyto-sociology for the area nor previous palaeoenvironmental data from southern France (Chabal, 1997; Planchais, 1982; Puertas, 1998; Figueiral, unpublished reports). Instead, the very low frequencies of species characteristic of native mixed oak woodland, the importance of cultivated species, the presence of exogenous elements and the unusually high frequencies of Monocotyledons clearly indicate that our wood-charcoal data is biased by a specific type of human activities.

4.2.1. The presence of exogenous elements

The identification of species of *Abies*, *Fagus*, *Larix/Picea*, which, nowadays, do not grow at low altitude in the Mediterranean area, raises the question of whether such wood types arrived at the site via trade. These species could easily have been brought from the mountains of the Cevennes to the north. However, according to pollen and charcoal analyses from southern France, these elements survived at low altitudes at least until the Middle Ages. Data obtained so far (for references see Chabal 1997; Puertas 1998; Durand 1998) suggest that isolated stands/individuals may have lingered in the lowlands when protected from direct sun and summer draughts. As a result, it is for the moment impossible to decide whether the specimens from le Gasquinoy derive from wood trade or from the collection in isolated stands closer to the farms.

4.2.2. Agrarian sites and the abundance of monocotyledons

The abundance of monocotyledons in units 5051 and 3407 is very noticeable. Current research in the Languedoc area (Figueiral, unpublished reports) associates Gallo-Roman agrarian sites and wells with significant frequencies of monocotyledons (type *Arundo* – *Phragmites*). Abundance of similar monocotyledon remains has also been recorded near Nîmes, Mas de Vignolles 9 (Dir. P. Sejalón, Inrap) and Mas de Vignolles 13 (Dir. M. Piskorz), and Pézenas, Montferrier (Tourbes) (Dir. M. Compan, Inrap). The presence of monocotyledons at George Besse (Nîmes, Dir. G. Escalon, Inrap) has been recorded not in a well but in a basin meant to provide water for farm animals. The ubiquity and abundance of these remains in agrarian sites contrast with data from other archaeological sites. What role did these plants play in the farming system? Although in our case it is impossible to obtain direct evidence of the specific purpose of this plant, possible uses can be suggested. Reeds could be planted for erosion control in drainage ditches and wind protection and used as roofing/covering material. Two further possible functions, concern directly vine growing. According to Columella (Brun, 2003), vine plants could be enclosed by a circle of reeds used as support (*vitis characata*) and, as with the living screens, as protection from wind. Although this particular practice is not clearly referred to in the *Narbonnaise*, where vines were pruned low and allowed to grow along the ground to resist strong winds (Brun, 2003), reeds could have been used to support fragile young vines. Furthermore, and based on the classical authors (Billiard, 1913), reeds could have been used for sieves/baskets to filter the pressing remains before fermentation.

4.3. Other agricultural productions?

Based on both archaeological and archaeobotanical evidence we now know that *Vitis* was grown at le Gasquinoy. Does evidence of cultivation also extend to other plants? Is the cultivation of other fruit trees supported by the joint presence of seeds/fruits and wood/charcoal remains?

As seen in Tables 1–3, *Ficus*, *Prunus* type *avium* and *Prunus* type *spinosa* are identified both as seed/fruit and waterlogged branches/twigs. On the other hand, *Juglans*, *Malus/Pyrus*, *Pinus pinea* and *Corylus* are identified as seed/fruit and as charcoal.

Our results suggest that in addition to vine cultivation, which would cover the largest land surface, fruit trees were also sporadically planted at Le Gasquinoy, either beside the buildings or associated with the vines. These could have included fig trees, *Prunus* (*Prunus insititia*, *P. avium*, *P. persica*?), walnut trees and umbrella pines; Sloes and hazelnuts could have grown spontaneously in hedges.

What is evidence for annual plant cultivation? Evidence is actually rather scant. The presence of cereal rachis elements (*Hordeum vulgare* and *Triticum aestivum/turgidum*) is considered to be a most reliable indication of local cereal cultivation (Hillman, 1984). This is also supported by the identification of typical segetal weeds. Within the areas cultivated with vines, the archaeological dig has uncovered area lacking any plantation traces – the question remains what could have been planted in these areas and whether they were planted with cereals. However the hypothesis that straw could also be imported cannot be ruled out completely.

5. Conclusion

The large scale of this site, its structures and the abundance of *Vitis* remains, provide evidence of the importance of vine growing and wine making in the economy of the region. Besides confirming the status of this establishment, the discovery of these plant remains illustrate some different aspects of wine making, such as traumatic grape pressing and filtering.

Based on the measurements (Bouby et al., 2006) carried out on grape seeds from Le Gasquinoy, we can assign half of the pips to the wild variety (*Vitis vinifera* subsp. *sylvestris*); so only half of our specimens can therefore be considered as cultivated. This distinction is based on comparisons with modern wild populations and cultivated varieties. This raises questions concerning the type of varieties grown in Languedoc region, during Roman times, and their parentage with modern cultivars. To answer these questions we have undertaken outline shape analysis of pips in association with ancient DNA studies. The first results will be available shortly.

The plant remains also testify to the existence of secondary agriculture productions, such as fruit trees and cereals, possibly occurring alongside vine cultivation.

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