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Palynology from the Molino San Vincenzo site in Tuscany
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The plant landscape from the Roman layers

The palynological investigation carried out at the site of Molino San Vincenzo (Tuscany, central Italy) in 2015 was useful to collect information about the palaeoenvironment of the site. The environment of Roman Molino San Vincenzo was greatly influenced by human presence and activities; pasturelands and crop fields (mainly barley and wheat cultivations) characterised the agrarian system while no evidence of cultivation of woody plants were found. Wet habitats like rivers or ponds were present near the site and the open landscape hosted some wild vegetation mainly consisting of Mediterranean macchia with fragments of mixed oak woods quite far from the site.

Keywords: *archaeobotany; settlement archaeology; Roman rural landscape; palaeoenvironment; plant landscape*

1 Introduction

The archaeobotanical research has the potential to reconstruct plant landscape, land exploitation, ethnobotany and agriculture based on the plant remains discovered from archaeological sites.[1] The palynological investigation carried out at the site of Molino San Vincenzo (Tuscany, central Italy) was especially useful to collect information about the use of the site. The list of pollen taxa corresponds to plant families/genera, rarely species, and their association allow us to infer the habitats and vegetation cover that were spread near and around the site.

Palaeoenvironmental reconstructions rely firstly on the floristic list and, secondly, on percentages and concentrations of the different pollen taxa identified at light microscope. Then, the ensemble of pollen taxa is interpreted as vegetational associations or habitats such as, for example, oak woods or wet environments. In off-site cores, such as lake records sometimes available for correlations, the oscillations of pollen curves along sequences (sampling in vertical series) may give reason of changes in plant cover and environment in subsequent chronological phases. In the on-site contexts, like Molino San Vincenzo, the environmental context inferred from pollen is mainly a result of the economy and cultural landscape of the area. The study of pollen from archaeological layers has been utilized for many decades, and is an important part of archaeobotany.[2] However, the poor state of preservation of pollen grains, especially due to oxidation or the local use of fire in archaeological sites,[3] often discourages analysts to per-

1 Faegri et al. 1989; Pearsall 2000; Mercuri et al. 2010; Mercuri et al. 2015.
2 Behre 1986; Berglund and Ralska-Jasiewiczowa 1986; Mercuri et al. 2015.
3 Dimbleby 1985.

form such studies. Below, this paper illustrates the palynological analysis, part of the archaeobotanical record of Molino San Vincenzo.

2 Materials and Methods

Sampling

A total of 14 pollen samples have been collected and treated. The samples were taken from a trench resulting in a short stratigraphic sequence (ID 1-9: 9 samples from Stratigraphical Units 9900, 11500, 13200, 11600, 11900 and 100), and the bottom/under a Roman wall (3 samples from SU 4600, 4900); 2 samples were taken from top layers that resulted the plough zone.

The Roman samples are:
- SU 9900, samples 1 and 2, stone accumulation - foundation
- SU 11500, samples 3 and 4, filling at the base of the Roman wall
- SU 13200, sample 9, charcoal from a Roman kiln
- SU 4600, samples Wall 1-2, Roman wall (ID 12, 13)
- SU 4900, sample Wall 3, Roman wall (ID 14)

The Post-Roman samples are:
- SU 11600, samples 5 and 6, ancient material refilled into trench in modern times
- SU 11900, samples 7 and 8, ancient material refilled into trench in modern times
- SU 100, samples 10 and 11, plough zone

Pollen extraction

Samples were treated according to the routine method for pollen analyses in use in the laboratory of Modena.[4] About 4-9 g of dry matter for each sample was treated with 10% tetra-Na-pyrophosphate to deflocculate the sediment matrix, HCl 10% to eliminate carbonates, acetolysis to eliminate the organic matter different than pollen wall (made by sporopollenins), separation with heavy liquid (Na-metatungstate hydrate) to favourite pollen floatation, HF 40% to eliminate silicates, and ethanol. The residues were gently dried in stove. Permanent pollen slides were mounted in glycerol jelly. *Lycopodium* spores were added to calculate concentrations, which were expressed as pollen per gram (=p/g). The method has provided sufficient amounts of pollen even when pollen concentrations were very low, and therefore resulted very useful in our case study, and in general for pollen extraction from archaeological layers.

Pollen, NPPs and microcharcoals were counted in the same samples. Pollen identification was made at 400x and at 1000x magnification with the help of keys, atlases and the reference pollen collection of Modena.[5] The identification of cereal pollen was based mainly on the

4 Florenzano et al. 2012.

5 Moore et al. 1991; Reille 1999 and followings.

criteria in Andersen[6], Beug[7] and Bottema[8] with the correction factor for glycerol jelly.[9] Pollen percentages were calculated on a Pollen Sum including all pollen grains.

Non Pollen Palynomorphs (NPPs) were identified according to van Geel:[10] they can be indicative of presence of wet environments (algae), animal breeding (coprophilous fungi), erosive or degradation environmental situations (mycorrhizas, other fungi and algae), or some animal pathologies (parasite eggs). The charcoal particles were counted subdividing four size classes: 125-200 μm; 201-500 μm; 501-1000 μm; >1000 μm. NPP and microcharcoal values are expressed in concentration per gram of dry sediment (npp/g, ch/g). The smallest particles are probably transported from long distance while the charcoal particles >125 μm are indicative of local fires (without possibility to distinguish between a wild or human-induced fire).

3 Results

A total of 1237 pollen grains (ca. 103 p/sample) were counted from twelve samples. Two Roman samples (Wall 2,3: ID 11 and 12) did not contain pollen and are, therefore, sterile.

Pollen (tab. 1 and 2)

a) Concentration and preservation

Pollen was found in the twelve samples with an average amount of 13,122 p/g. The six Roman samples have lower concentrations (5505 p/g on average) than the post-Roman samples (20,740 p/g on average). Roman samples show the highest value in sample 4 (SU 11500) with 19,516 p/g; samples 1,2,3 and Wall1 (US 9900, 11500 and 4600) have some thousand pollen grains concentration, from 6713 (sample 3) to 1075 p/g (samples 1). Only sample 9 (SU 13200) has a very low concentration (648 p/g), and this is quite expected as the sediment was collected near a kiln, where fire can have destroyed most pollen.

State of preservation: In general pollen was relatively well preserved. The Roman samples contained less preserved pollen (broken, crumpled) than the other samples, and many crystals were observed in the slides. The different preservation was probably explained by the fact that grains were pressed or partly reworked in the archaeological site as a consequence of trampling and other human activities.

6 Andersen 1979.
7 Beug 1961.
8 Bottema et al. 1992.
9 Faegri et al. 1989.
10 van Geel 1986.

sample 1/US 9900	Lycopodium: 1255
	Algae: ++
	Fungi: ++
	F/V:
	Charcoal:
	Animals: eggs of *Dicrocoelium*
	Pollen: well preserved with some broken pollen
sample 2/US 9900	Lycopodium: 622
	Algae: ++
	Fungi: ++
	F/V: +
	Charcoal:
	Animals:
	Pollen: not well preserved but present
sample 3/US 11500	Lycopodium: 278
	Algae: +
	Fungi: +
	F/V: +
	Charcoal: +
	Animals: eggs of *Dicrocoelium* and *Capillaria*
	Pollen: not well preserved but present
sample 4/US 11500	Lycopodium: 82
	Algae: +
	Fungi: +
	F/V:
	Charcoal:
	Animals:
	Pollen: not well preserved but present
sample 5/US 11600	Lycopodium: 42
	Algae: +
	Fungi: +
	F/V:
	Charcoal:
	Animals:
	Pollen: preserved
sample 6/US 11600	Lycopodium: 39
	Algae: +
	Fungi: +
	F/V:
	Charcoal:
	Animals: eggs of *Capillaria* and many hairs
	Pollen: not well preserved but present

Tab. 1 Palynofacies of the 14 samples studied from Molino San Vincenzo (F/V = vegetal fragments) (E. Rattighieri – A. M. Mercuri)

sample 7/US 11900	Lycopodium:74
	Algae: +
	Fungi: +
	F/V:
	Charcoal:
	Animals: eggs of *Capillaria*
	Pollen: bad preserved with many deteriorated
sample 8/US 11900	Lycopodium: 419
	Algae: ++
	Fungi: +
	F/V:
	Charcoal: +
	Animals:
	Pollen: abundant and well preserved
sample 9/US 13200	Licopodi: 2023
	Algae: +
	Fungi: + (*Glomus*)
	F/V: +
	Charcoal:
	Animals: traces
	Pollen: few, preserved
sample 10/US 100	Lycopodium: 148
	Algae: +
	Fungi:
	F/V: ++
	Charcoal:
	Animals:
	Pollen: preserved
sample 11/US 100	Lycopodium: 85
	Algae: ++
	Fungi: +
	F/V: ++
	Charcoal:
	Animals:
	Pollen: well preserved
sample Wall 1	Lycopodium: 814
	Algae: +
	Fungi: +
	F/V:
	Charcoal:
	Animals:
	Pollen: very well preserved

Tab. 1 (continued) Palynofacies of the 14 samples studied from Molino San Vincenzo (F/V = vegetal fragments) (E. Rattighieri – A. M. Mercuri)

sample Wall 2	Lycopodium: 314
	Algae:
	Fungi:
	F/V: +
	Charcoal: +
	Animals:
	Pollen: few but well preserved
sample Wall 3	Sterile

Tab. 1 (continued) Palynofacies of the 14 samples studied from Molino San Vincenzo (F/V = vegetal fragments) (E. Rattighieri – A. M. Mercuri)

Sample	1	2	3	4	9	Wall 1	5	6	7	8	10	11
Layer	9900	9900	11500	11500	13200	4600	11600	11600	11900	11900	100	100
Concentration (p/g)	1072	2830	6713	19516	648	2249	36957	37092	17141	4173	9453	19622
Pollen sum	102	103	111	109	100	101	102	102	101	104	102	100
Number of Taxa	26	22	27	19	21	23	16	23	21	25	21	26

Tab. 2 Pollen analyses of Molino San Vincenzo site. Table of pollen results of the report (E. Rattighieri – A. M. Mercuri)

b) Richness of pollen taxa (fig. 1)

Samples have quite-high number of taxa in the pollen list as an effect of environmental diversity. The total number of taxa found in the deposit is 72, ranging from 27 (ID 3) to 16 (ID 5) taxa per sample. Trees, shrubs and lianas are represented by 20 taxa in the Roman samples, and 16 taxa in the post-Roman samples; in general, there is less than one third of pollen from tree/shrub plants (21 taxa). The herbaceous species are 51 taxa, the herbs are represented by 40 taxa in the Roman samples and 35 taxa in the post-Roman samples.

c) AP/NAP (tab. 3)

It corresponds to the ratio between the percentages of the Arboreal or woody pollen (trees, shrubs and lianas) and the Non Arboreal or prevalently herbaceous pollen in the spectra. This ratio helps to evaluate the forest cover of the site and its surroundings.

At Molino San Vincenzo, it is 15/85 as average in Roman, and 14/86 in the post-Roman samples. In the two most recent samples, belonging to the current arable land, the ratio is 20/80. Although these samples are quite disturbed and pollen content is mixed (it may arrive from different sources including vegetation and other soils), it is arguable that forest cover was less represented in Roman times than today. This may be an effect of the archaeological site, as it is obvious to find no evidence of trees/shrubs within a house.

d) Flora composition

The spectra are characterised by flora belonging to natural and human environments: to the first group, there are the Mediterranean and the mixed oak wood vegetation, and to the second

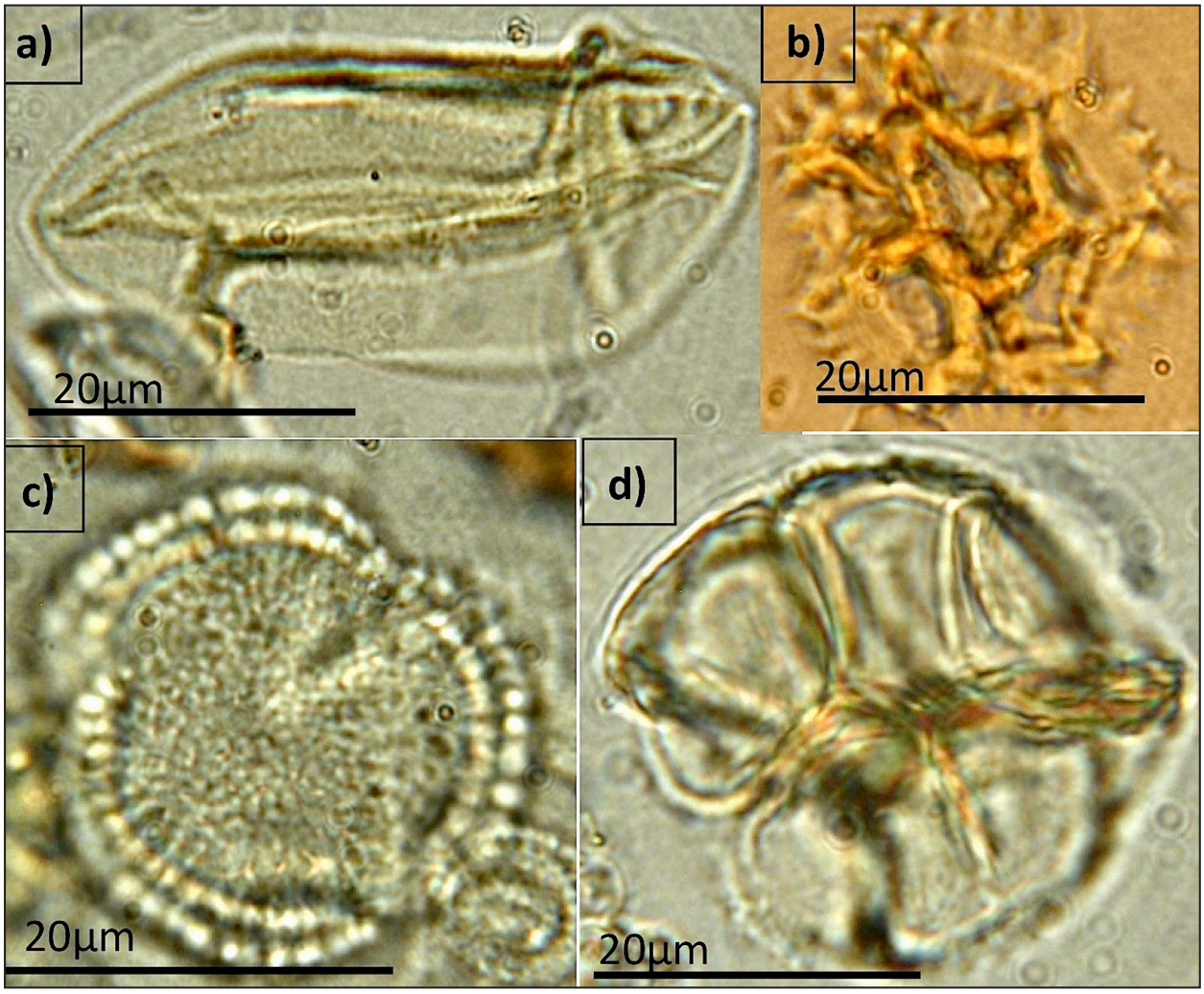

Fig. 1 Pollen from Molino San Vincenzo (1000x magnification): a) Hordeum *40µm, from sample no. 1, US9900; b) Cichorieae 22µm, from sample Wall1; c)* Olea *25µm, from sample no. 9, US13200; d)* Typha *27µm, from sample no. 1, US9900 (E. Rattighieri – A. M. Mercuri)*

group we found the evidence of crop fields and breeding activities.In the Roman samples, the most represented trees are: *Pinus* (4.3% on average) and deciduous *Quercus* (1.4%), and shrubs are *Erica* (2.2%) and *Corylus* (1.7%). Data from the post-Roman samples are similar, with dominance of *Pinus* (3.6%) and deciduous *Quercus* (2.0%), and shrubs like *Erica* and *Cistus* (1.1% each).

Woody plants of economic interest in the Roman samples are few: *Olea* (ID 9: 2.0%), *Juglans* (ID 2 and 3: 1% each) and possibly *Myrtus* (ID 3: 1%) and *Prunus* (ID 2: 1%), testifying a locally low importance of these types of cultivation. In the other samples, again *Olea* (0.7%) is not important, and there are traces of *Vitis* (0.2%) only in the plough zone. The Roman spectra are featured by herbaceous taxa: *Aster* type (4.2%); cereals (5.1%); Cichorieae (24.9%); Cyperaceae indiff. (5.3%) and Poaceae wild group (11.5%). Most of them are plants of economic importance or indicative of agrarian systems in the surroundings of the

Sample	**1**	**2**	**3**	**4**	**9**	**Wall 1**	**5**	**6**	**7**	**8**	**10**	**11**
Layer	**9900**	**9900**	**11500**	**11500**	**13200**	**4600**	**11600**	**11600**	**11900**	**11900**	**100**	**100**
AP	14,7	12,6	19,8	21,1	10,0	10,9	3,9	14,7	9,9	13,5	22,5	17,0
NAP	85,3	87,4	80,2	78,9	90,0	89,1	96,1	85,3	90,1	86,5	77,5	83,0
Pistacia	0,0	0,0	0,0	0,0	0,0	1,0	1,0	2,0	3,0	0,0	0,0	0,0
Alnus	1,0	2,9	0,0	0,0	0,0	2,0	0,0	0,0	0,0	0,0	2,9	0,0
Carpinus betulus	0,0	0,0	0,0	0,0	2,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
Corylus	2,0	1,0	1,8	4,6	0,0	1,0	0,0	2,0	0,0	1,9	0,0	1,0
Celtis	0,0	0,0	0,0	0,0	3,0	0,0	0,0	0,0	0,0	0,0	0,0	1,0
Cistus	0,0	0,0	0,9	0,0	0,0	0,0	0,0	2,0	0,0	0,0	3,9	1,0
Helianthemum	0,0	0,0	0,0	3,7	0,0	0,0	0,0	2,0	0,0	1,0	0,0	0,0
Erica	2,9	0,0	6,3	3,7	0,0	0,0	2,0	2,0	0,0	1,0	1,0	1,0
Pyrola	0,0	1,9	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
Quercus deciduous undiff.	2,0	0,0	1,8	4,6	0,0	0,0	0,0	0,0	0,0	4,8	2,0	5,0
Quercus ilex type	2,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	4,0	0,0	0,0	0,0
Tilia	0,0	0,0	0,9	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
Myrtus	0,0	0,0	0,9	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
Juglans	0,0	1,0	0,9	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	2,0
Olea	0,0	0,0	0,0	0,0	2,0	0,0	0,0	0,0	0,0	0,0	2,0	2,0
Abies	1,0	0,0	0,0	0,0	0,0	0,0	0,0	1,0	0,0	0,0	0,0	0,0
Pinus	3,9	4,9	6,3	3,7	3,0	4,0	1,0	2,9	1,0	4,8	8,8	3,0
Prunus	0,0	1,0	0,0	0,0	0,0	2,0	0,0	0,0	0,0	0,0	0,0	0,0
Populus	0,0	0,0	0,0	0,0	0,0	1,0	0,0	1,0	0,0	0,0	2,0	0,0
Salix	0,0	0,0	0,0	0,9	0,0	0,0	0,0	0,0	2,0	0,0	0,0	0,0
Vitis vinifera	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	1,0
Sagittaria	0,0	0,0	0,9	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
Allium	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	1,9	0,0	0,0
Apiaceae	1,0	0,0	0,0	0,0	0,0	0,0	4,9	2,0	0,0	1,9	0,0	0,0
Apium	0,0	0,0	0,0	0,0	0,0	3,0	0,0	0,0	0,0	0,0	0,0	0,0
Asparagus	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	1,0	0,0	0,0	0,0
Artemisia	0,0	0,0	0,0	0,0	3,0	0,0	0,0	2,0	0,0	1,0	1,0	0,0
Aster type	5,9	4,9	1,8	0,9	8,0	4,0	4,9	0,0	3,0	3,8	0,0	0,0
Centaurea nigra type	2,0	4,9	4,5	6,4	0,0	1,0	7,8	4,9	3,0	1,0	9,8	6,0
Cichorieae	23,5	21,4	23,4	25,7	13,0	42,6	39,2	32,4	33,7	40,4	35,3	33,0
Brassica type	0,0	0,0	0,9	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
Brassicaceae undiff.	0,0	2,9	0,0	0,0	0,0	1,0	0,0	2,0	2,0	0,0	3,9	0,0
Sinapis	4,9	0,0	0,0	0,0	0,0	0,0	0,0	3,9	0,0	1,0	0,0	2,0
Cannabis	0,0	0,0	0,0	0,0	1,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
Chenopodium	1,0	0,0	1,8	1,8	2,0	0,0	0,0	0,0	0,0	0,0	2,0	10,0
Cyperaceae undiff.	5,9	5,8	3,6	4,6	10,0	2,0	1,0	3,9	4,0	5,8	1,0	4,0
Cyperus	0,0	1,9	0,9	0,9	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
Scirpus lacustris	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	1,0	0,0	0,0
Dipsacaceae undiff.	0,0	1,9	0,0	0,0	0,0	1,0	0,0	0,0	0,0	0,0	0,0	0,0

Tab. 3 Pollen spectra of Molino San Vincenzo (E. Rattighieri – A. M. Mercuri)

Sample	**1**	**2**	**3**	**4**	**9**	**Wall 1**	**5**	**6**	**7**	**8**	**10**	**11**
Layer	**9900**	**9900**	**11500**	**11500**	**13200**	**4600**	**11600**	**11600**	**11900**	**11900**	**100**	**100**
Euphorbiaceae	0,0	0,0	1,8	0,0	0,0	0,0	1,0	1,0	0,0	0,0	0,0	0,0
Astragalus	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	1,0	0,0	0,0	0,0
Dorycnium	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	1,0	0,0	3,0
Fabaceae undiff.	1,0	1,9	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
Lotus	0,0	0,0	0,0	0,0	1,0	0,0	0,0	1,0	2,0	0,0	0,0	0,0
Trifolium type	0,0	0,0	3,6	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
Trifolium pratense	0,0	0,0	0,0	0,0	0,0	0,0	0,0	2,9	0,0	0,0	1,0	0,0
Fumaria	0,0	0,0	0,0	0,9	3,0	1,0	0,0	0,0	0,0	1,9	0,0	1,0
Geraniaceae	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	4,0	0,0	0,0	2,0
Lamiaceae undiff.	3,9	0,0	0,9	0,9	4,0	3,0	2,9	2,9	0,0	0,0	2,0	0,0
Mentha type	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	2,9	0,0	1,0
Malva	0,0	0,0	0,0	0,0	1,0	0,0	0,0	0,0	0,0	1,0	0,0	1,0
Plantago undiff.	6,9	3,9	3,6	0,0	0,0	4,0	7,8	0,0	2,0	1,0	2,0	1,0
Avena/Triticum group	0,0	1,0	0,0	0,0	0,0	1,0	0,0	0,0	0,0	0,0	0,0	2,0
Cerealia undiff.	1,0	2,9	0,9	5,5	0,0	1,0	1,0	3,9	0,0	1,9	3,9	2,0
Hordeum group	2,0	6,8	1,8	0,0	4,0	0,0	1,0	2,0	2,0	1,9	2,0	0,0
Secale	0,0	1,0	0,0	1,8	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
Poaceae wild grass group	11,8	13,6	9,0	14,7	12,0	7,9	5,9	12,7	8,9	6,7	0,0	4,0
Polygonum aviculare type	0,0	0,0	0,0	0,0	2,0	0,0	0,0	0,0	3,0	0,0	0,0	0,0
Rumex	0,0	0,0	2,7	0,0	1,0	0,0	0,0	0,0	0,0	0,0	0,0	1,0
Potamogeton	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	2,0	0,0	0,0	0,0
Ramnus	0,0	0,0	0,0	0,0	1,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
Ranunculus type	0,0	0,0	0,0	2,8	8,0	3,0	2,9	0,0	5,0	1,0	2,9	4,0
Thalictrum	0,0	1,0	7,2	0,0	0,0	3,0	0,0	2,0	0,0	2,9	0,0	0,0
Filipendula	1,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
Rosaceae undiff.	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	2,0	0,0	1,0	0,0
Saxifraga	0,0	0,0	1,8	0,0	0,0	2,0	0,0	0,0	0,0	0,0	0,0	0,0
Melampyrum	1,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
Scrophulariaceae	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	1,0	0,0	0,0
Verbascum	1,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
Typha/sparganium	1,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
Urtica dioica type	1,0	1,9	0,9	0,0	8,0	4,0	6,9	0,0	3,0	0,0	2,0	1,0
Urtica cf. pilulifera	1,0	0,0	0,0	4,6	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
Indeterminable	8,8	9,7	8,1	7,3	8,0	5,0	8,8	5,9	8,9	5,8	7,8	5,0

Tab. 3 (continued) Pollen spectra of Molino San Vincenzo (E. Rattighieri – A. M. Mercuri)

site. The cereals include prevalently *Hordeum* group (2.4% on average), i.e. pollen produced by cultivated barley or by a few number of wild species. The records of *Avena/Triticum* group (0.3%) are especially important because they are evidence of the presence of wheat fields; to this category, probably can be added also the Cerealia undiff. type (1.9%) which includes the very large pollen grains that cannot be measured to identify them more precisely. Significant are also the records of *Secale* (0.5%) as rye was only found in two Roman samples (ID 2 and 4). The large pollen grains of cereals are known to be underrepresented in spectra, and therefore these values are strongly indicative of the presence of cereal fields quite close to the site during Roman times. Poaceae wild group (11.4%), Cyperaceae indiff. and Cichorieae, *Aster* type are prevalent, and indicative of open grasslands with seasonal alternation of wet (sedges) and dry (daisy family) pasturelands. Mostly Poaceae-wild group and *Cyperaceae* grew together in wet grasslands.

In general, the LPPI - Local Pastoral Pollen Indicators (Mazier, 2007) are well represented in these pollen spectra: this sum includes *Asteroideae* (including *Aster* type, *Centaurea nigra* type and Cichorieae), Ranunculaceae (*Ranunculus* type). In the post-Roman spectra, the dry grasslands/pasturelands prevailed with higher values of Cichorieae (35.7%), here together with *Centaurea nigra* type (5.4%). Indeed, the wet grasslands with Cyperaceae indiff. (3.3%) and Poaceae wild group (6.4%) are less represented. Cereals (3.9%) are lower than the Roman samples but still significant. The increase of dry pastures and the presence of crops is joined by good values of Fabaceae-legumes wild or cultivated for fodder (now 2% vs 1.3% of the older samples, with *Dorycnium*, and *Trifolium pratense*, *Lotus*, *Astragalus*).

2.) NPPs and Microcharcoals

Notes on the observation of NPPs (Non Pollen Palynomorphs) and microcharcoals are reported in the table of the palynofacies (Tab. 1). In particular, their presence was marked as '+', as they were more or less abundant in the slides. Moreover, some NPPs of particular interest have been noted. They include *Glomus* (*fungi*) and *Concentricystis* (*algae*), both indicators of soil erosion; and some eggs of intestinal parasites like *Capillaria* and *Dicrocoelium*; of great interest is the presence of *Puccinia*, a pest of foodstuffs, especially cereals.

4 Discussion of the Roman samples

1.) Natural environments

a) Forest cover and woodland composition

Woodlands are represented by very low percentage suggesting that the landscape was open and trees or shrubs lived fairly far from the site. Conifers like *Abies* and *Pinus* grew at higher elevation, and their pollen arrived in site thanks to wind transport. Probably around the site there were low shrubs, mainly belonging to Mediterranean vegetation, including *Erica*, *Helianthemum*, *Myrtus* and *Pistacia*, and trees as *Quercus ilex* type. *Olea* is present only in one

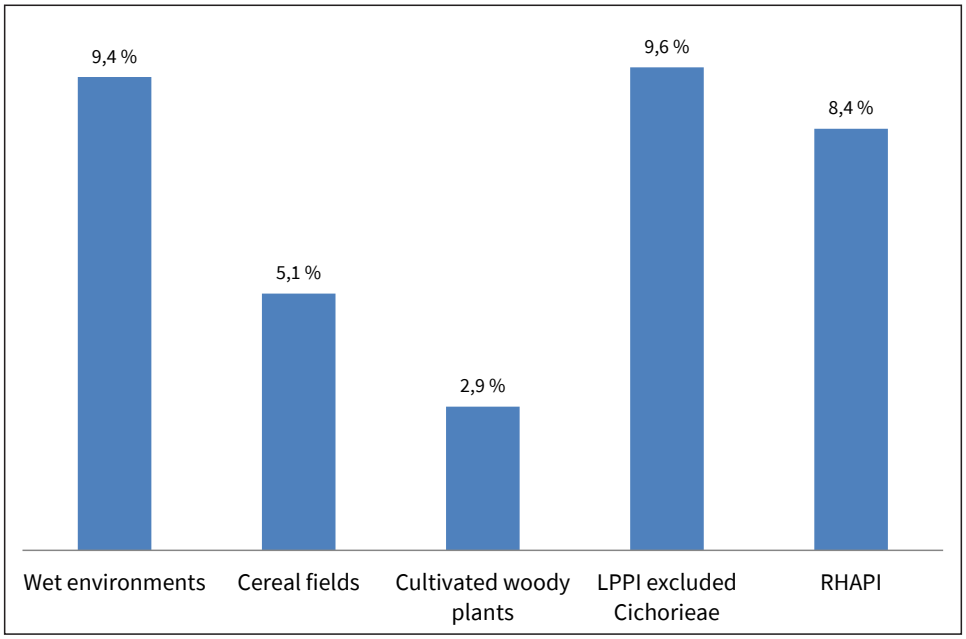

Fig. 2 Main pollen taxa groups showing wetlands and the human-induced environments from Roman layers (average data) (E. Rattighieri – A. M. Mercuri)

sample was not spread suggesting that these plants grew far from the site, they were not wild elements of the local macchia and were not cultivated locally. We can suggest that the local presence of few pollen of olive trees may have been also originated by the transport of woods used for fuel. Also, there is not evidence of grapevine cultivation at the site. Wooded areas with mixed broadleaves were present but not very extended, consisting of deciduous *Quercus*, and with *Juglans*, *Corylus* and *Prunus* providing food fruits and fuel. The hygrophilous woods, mainly composed of *Alnus* with some *Salix* and *Populus*, were near the site living near rivers and waterplaces.

b) Wet environments

Besides the hygrophilous woods mentioned above, wetlands were represented by significant percentages of total wetland plants (9.4% on average; Fig. 2) like aquatic, floating or helophyte plants growing into and at the shores of waterbodies (*Sagittaria sagittifolia* type, *Typha latifolia* type and *Cyperaceae*, *Scirpus* and *Thalictrum*). This suggests that there was a good presence of wet habitats in the area; they probably included natural habitats such as rivers or small lakes, and also artificial mires or canals.

2.) Human environments

a) Cereal fields

Present in all samples with different percentages, cereals are 5.1%, on average with the highest percentage in sample ID 2 (11.7%), and the lower percentage in the sample ID 10 - Wall 1

(2%). As mentioned above, cereal fields were grown in the vicinity of the site. The very high presence of *Hordeum* group (6.8%) in ID 2 also may be interpreted as the evidence of possible plant processing or storage in the site (at that chronology). Diverse cereals were cultivated, represented in the spectra by *Hordeum* group, *Avena-Triticum* group and *Secale*. *Cerealia undiff.* includes the folded-crumpled grains that cannot be distinguished and ascribed to the previous groups but probably they are wheats. The Roman samples are coherent with a phase of strong human activity characterized by the development of an agrarian system in the site. From our samples, this seems to have been articulated into crop fields and grasslands. Locally, the cereal fields were grown probably alternated with areas of lawn / pasturelands in a clearly human-shaped landscape.

b) Pastures and areas cultivated for animal fodder

The indicators of pasture LPPI (fig.2) are 34.6% on average. Cichorieae are an important part of these spectra; they are pasture indicators reflecting animal breeding and grazing areas.[11] When the high presence of *Cichoriae* is observed in badly preserved sediments, selective corrosion might have destroyed the thinner exines,[12] so sometimes you decide to keep them out of the counts. In our case, LPPI are high even when Cichorieae are excluded (9.6% on average) suggesting pasture/breeding activities on pasturelands were of economic importance at the site. Moreover, legumes (*Fabaceae*) like *Astragalus*, *Dorycnium*, *Fabaceae undiff.*, *Lotus*, *Trifolium* type and *Trifolium pratense*, which amount to 1.3% on average, together with Poaceae-wild group (11.5% on average), include species that may have been cultivated for fodder. They have the propriety to enrich soils with nitrogen, and have been traditionally employed in agriculture to rotate fields.[13]

c) Other Anthropogenic Indicators and regional activities

The RHAPI – Regional Human Activities Pollen Indicator sum (fig.2) is correlated to a wide set of regional activities. In this site they resulted 8.4% on average, a high percentage. This group of pollen includes *Artemisia*, *Cannabis* (present only in ID 9), Caryophyllaceae, *Chenopodium*, *Plantago undiff.*, *Urtica dioica* type. They are evidence of a number of synanthropic species growing in human environments without an intentional action of cultivation made by humans, and revealing human-shaped habitats. They are ruderal plants living on walls (i.e. *Chenopodium*), plants resistant to trampling of humans and animals (*Plantago*), and nitrophilous plants with preference for nitrogen-rich soils (*Urtica dioica*).

11 Behre 1986.

12 Bottema 1975; Navarro et al. 2001.

13 This is one of the central evidence also for the Roman Peasant Project: Rattigheri 2013, Bowes et al. 2015; Bowes et al. 2017; Vaccaro et al. 2015.

5 Conclusive remarks

As main traits of Roman Molino San Vincenzo we conclude that:

1. The environment was greatly influenced by human presence and activities
2. Pasturelands and crop fields – especially barley and wheat cultivations - characterised the agrarian system while no evidence of cultivation of woody plants were found
3. Wet habitats like rivers or ponds were present near the site
4. The open landscape hosted some wild vegetation mainly consisting of Mediterranean macchia with fragments of mixed oak woods quite far from the site.

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