17th Conference of the International Work Group for Palaeoethnobotany

Paris, France

Muséum national d'Histoire naturelle, Jardin des Plantes

July 4-9, 2016

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ABSTRACTS: LECTURES and POSTERS

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studies and archaeological data show an intensive cultivation of grapevines, fig and olive trees in the Roman Empire. In Mediterranean France, the chronology of these changes is still under scrutiny due to the uneven distribution of information, most particularly concerning the Provence region. Archaeological excavations suggest regional specializations; the production of olive oil seems to be locally important in Provence while wine producing is repeatedly attested in the Languedoc. This archaeobotanical synthesis assembles published data and new results. Recent and ongoing analysis of waterlogged contexts (for example: harbour dumps and wells) allows us to register a wider spectrum of economic plants (both cultivated and wild) and to draw a new appraisal on economical plants during this period. It provides new insights on consumption, plant processing and local cultivation, especially for condiments, fruits such as grapevine, olive, walnut, umbrella pine, and exotic goods acquired from trade. The diversity of contexts studied (urban, rural, funerary, ritual etc.) makes it sometimes possible to assess the social, cultural and symbolic status of plants and their uses. We notice that the presence of imported exotic foods highlights particular uses (funeral symbolism and high social distinction) linked to the status of site.

Keywords: Antiquity, Southern France, Diffusion, Trade, Economic plants

Identification of *Prunus domestica* L. endocarps from a Phoenician-Punic context (5th - 2nd century BC) by image analysis

Identification d'endocarpes de Prunus domestica L. en contexte phénico-punique (Ve s.-IIe s. av. J.-C.) par l'analyse d'images

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During the archaeological excavation in the Phoenician-Punic settlement of Santa Giusta (Oristano, Sardinia), dated to the 5th - 2nd century BC, several *Prunus* spp. endocarps were recovered. The exceptional state of preservation of the waterlogged remains allowed us to perform morphological and morphometric analysis by computer vision. Digital images, were acquired with a flatbed scanner and processed and analysed using the open source image analysis software ImageJ v. 1.49. The morphometric parameters were obtained through a specific plugin able to measure 26 morphometric features and 80 Elliptic Fourier Descriptors (EFDs). Applying the stepwise Linear Discriminant Analysis (LDA), a morphological comparison among the archaeological endocarps of *Prunus* and the modern one collected in Sardinia was performed. These analyses allowed to identify 53 and 11 endocarps of *Prunus spinosa* and *Prunus domestica*, respectively. The results showed that the archaeological endocarps of *P. spinosa* have morphometric similarities in the 92.5% of the cases with *P. spinosa* that at present grow near the Phoenician-Punic settlement of Santa Giusta. In addition, the archaeological endocarps identified as *P. domestica* showed similarity with the modern variety of plum so-called Sanguigna di Bosa actually cultivated in the village of Bosa (Oristano). In this case, the correct classification has been 81.8%. These results, as far as we know, provide the first evidence of *P. domestica* in Sardinia during the Phoenician-Punic period. Moreover, these archaeological remains represents the early evidence of P. *domestica* in the Western Mediterranean Basin.

Keywords: Archaeological fruit stones, Archaeobotany, Endocarp image analysis, *Prunus spinosa*, *Prunus domestica*, Sardinia

Correct identification of archaeological grape seeds by computer vision: support for archaeobotanical study

Identification exacte de pépins de raisins archéologiques par ordinateur : aide à l'analyse archéobotanique

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The identification of archaeological charred grape seeds is a difficult task due to the alteration of the morphological seeds shape. In archaeobotanical studies, the correct discrimination between *Vitis vinifera* subsp. *sylvestris* and *Vitis vinifera* subsp. *vinifera* grape seeds is very important to understand the history and origin of the domesticated grapevine. In this work, different carbonisation experiments were carried out using a hearth to reproduce the same burning conditions occurring in archaeological contexts. In addition, several carbonisation trials on modern wild and cultivated grape seeds were performed using a muffle furnace. In order to implement morphological comparison with archaeological materials, modern grape seed samples were treated applying seven different temperatures of carbonisation, ranging between 180 and 340 C for 120 min. Analysing the grape seed size and shape by computer vision techniques, and applying the stepwise Linear Discriminant Analysis (LDA) method, it was possible to discriminate between the wild from and the cultivated charred grape seeds. An overall correct classification of 93.3% was achieved.Applying the same statistical procedure to compare modern charred with archaeological grape seeds, found in Sardinia and dating back to the Early Bronze Age (2017–1751 2σ cal. BC), the 75.0% of the cases have been identified as wild grape. The proposed method proved to be an useful and effective tool for the identification of charred grape seeds found in archaeological sites. Moreover, it may be considered valid support for advances in the knowledge and comprehension of viticulture adoption and the grape domestication process. The same methodology may also be successful when applied to other plant remains, providing important information about the history of domesticated plants.

Keywords: Carbonisation experiment, Grape seeds identification, Image analysis, Seed remains, *Vitis vinifera*

Traditional wheat cultivation: the case of east Anatolia

Culture traditionnelle de blé : le cas de l'Anatolie orientale

IDENTIFICATION OF *PRUNUS DOMESTICA* L. ENDOCARPS FROM A PHOENICIAN-PUNIC CONTEXT (5TH - 2ND CENTURY BC) BY IMAGE ANALYSIS

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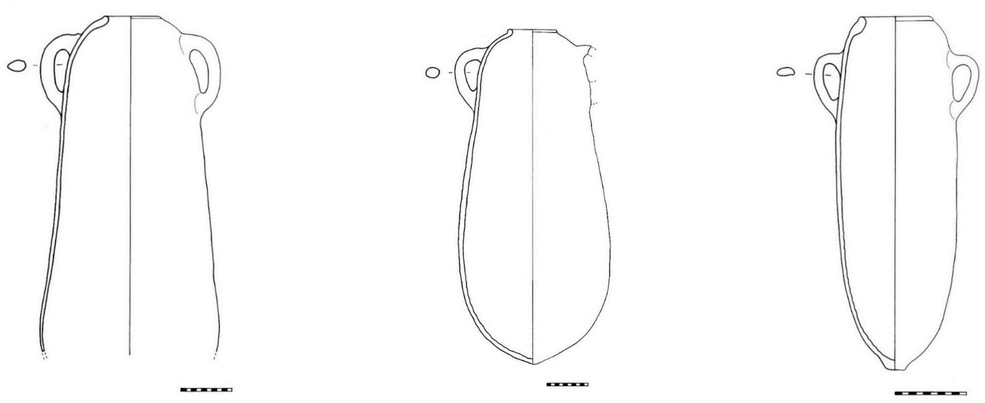
Introduction

Image analysis techniques represent a more accurate reliable and repeatable alternative to distinguish wild species from cultivated ones. In this work we present the results obtained by computer vision techniques applied on *Prunus* L. archaeological endocarps from the waterlogged Phoenician-Punic settlement of Santa Giusta (Oristano, Sardinia) dated to the 5th - 2nd century BC. The main goals are to identify and characterize *Prunus* remains from this archaeological context in order to investigate the domestication level of these waterlogged remains and explore the possible relationships among archaeological remains, local cultivated plums and wild populations present today in Sardinia.

Archaeological context of Santa Giusta

The Phoenician-Punic settlement of Santa Giusta is located in the central-west part of Sardinia. The site is a waterlogged context and has been subjected to excavation since 2006 by University of Cagliari and Soprintendenza Archeologica della Sardegna.
The underwater excavation allowed to recover several amphorae dating back to the 5th - 2nd century BC (Del Vais and Sanna 2009).
Inside several amphorae and sediments, different materials were found, including animal bones and macro plant remains who were preserved in excellent condition thanks to the anaerobic conditions.



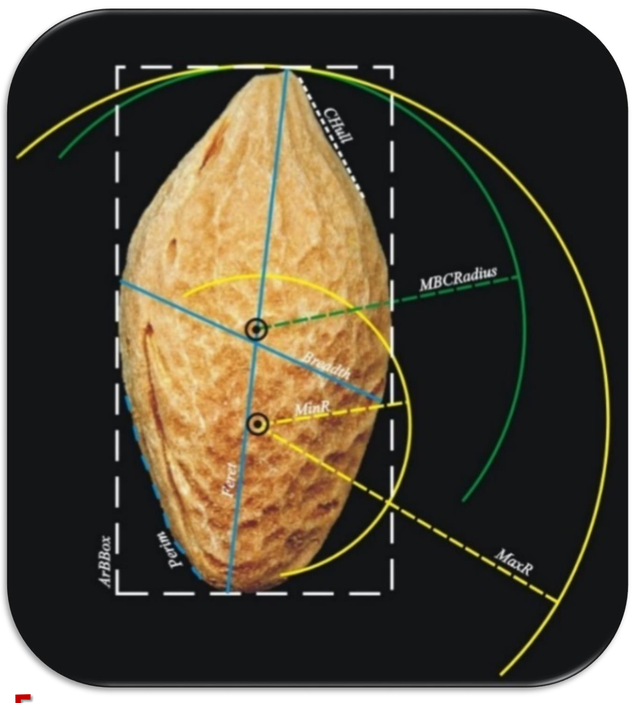
Material and Methods

Archaeological samples: 64 waterlogged endocarps of *Prunus* (PRU_SG).

Modern samples: *P. spinosa* modern samples from 11 different localities of Sardinia; *P. domestica* modern endocarps referring to 22 traditional Sardinian varieties from the field catalog of CNR-ISPA (Nuraxinieddu, OR-Sardinia). *P. domestica* subsp. *insititia* modern samples from BG-SAR.

Digital Imaging Analysis

Acquiring source: Flatbed scanner (Epson Perfection V550)
Images: Black / White background
Resolution: 400 dpi
Frame: 1024×1024 pixels (Bacchetta et al. 2008).
Software: ImageJ v. 1.49 (http://rsb.info.nih.gov/ij)
Plugin: Particles8 (Landini 2006)
Features: 26 endocarp morphometric features; 80 Elliptic Fourier Descriptors (EFDs);
Statistical Analysis: Linear Discriminant Analysis (LDA), SPSS version 16.



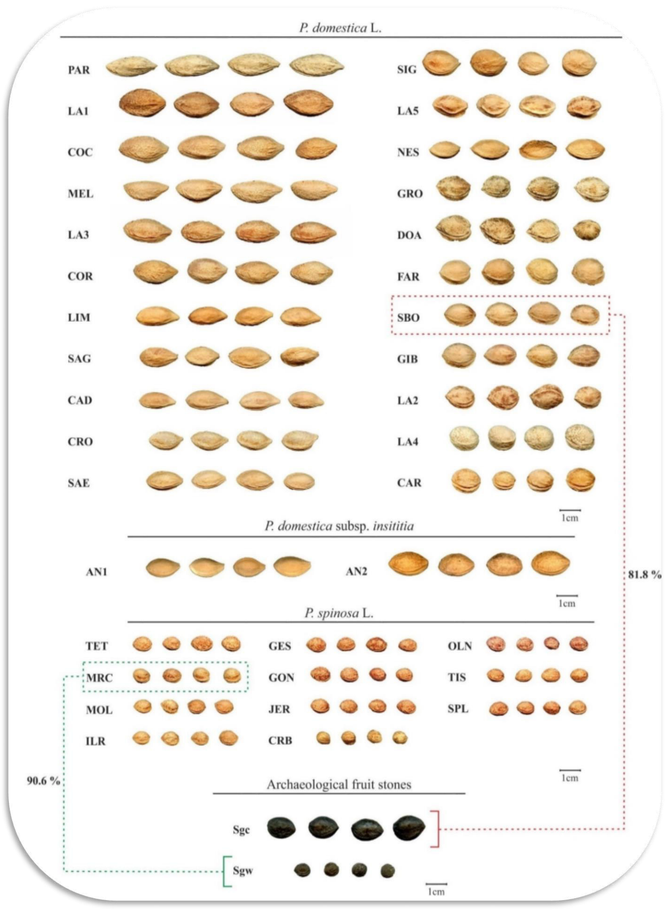
Parameter	Description
Perim	Perimeter, calculated from the centres of the boundary pixels
Area	Area inside the polygon defined by the perimeter
Pixels	Number of pixels forming the endocarp image
MinR	Radius of the inscribed circle centred at the middle of mass
MaxR	Radius of the enclosing circle centred at the middle of mass
Feret	Largest axis length
Breadth	Largest axis perpendicular to the Feret
CHull	Convex hull or convex polygon calculated from pixel centres
CArea	Area of the convex hull polygon
MBCRadius	Radius of the minimal bounding circle
AspRatio	Aspect ratio = Feret/Breadth
Circ	Circularity = $4\cdot\pi\cdot Area/Perimeter^2$
Roundness	Roundness = $4\cdot Area/(\pi\cdot Feret^2)$
ArEquivD	Area equivalent diameter = $\sqrt{((4/\pi)\cdot Area)}$
PerEquivD	Perimeter equivalent diameter = $Area/\pi$
EquivEllAr	Equivalent ellipse area = $(\pi\cdot Feret\cdot Breadth)/4$
Compactness	Compactness = $\sqrt{((4/\pi)\cdot Area)}/Feret$
Solidity	Solidity = Area/Convex_Area
Concavity	Concavity = Convex_Area-Area
Convexity	Convexity = Convex_hull/Perimeter
Shape	Shape = $Perimeter^2/Area$
RFactor	RFactor = Convex_Hull /$(Feret\cdot\pi)$
ModRatio	Modification ratio = $(2\cdot MinR)/Feret$
Sphericity	Sphericity = MinR/MaxR
ArBBox	Area of the bounding box along the feret diameter = Feret·Breadth
Rectang	Rectangularity = Area/ArBBox

Results

53 *Prunus* remains were classified as *P. spinosa* and were similar to the Monte Arci (MRC) population in the **90.6%** of the cases, while the other 11 classified as *P. domestica* showed main similarities with the variety Sanguigna di Bosa (SBO) in the **81.8%** of the cases.

Comparison between the archaeological endocarps of *Prunus* and the modern one

	P. domestica	*P. spinosa*	*P. domestica* subsp. *insititia*	Total
P. domestica	99.9 (1,661)	0.1 (2)	-	100.0 (1,663)
P. spinosa	-	100.0 (984)	-	100.0 (984)
P. domestica subsp. *insititia*	12.0 (24)	-	82.0 (110)	100.0 (134)
Pru_SG	17.0 (11)	83.0 (53)	-	100.0 (64)
Overall				94,0 % (2,845)



Sanguigna di Bosa is a traditional variety actually little cultivated in the territory of Bosa (northwest Sardinia).

Discussion

Thanks to new computer vision technologies applied to plant biology, it was possible to distinguish wild species from cultivated ones also in the archaeobotanical field (Terral et al. 2010; Bouby et al. 2013; Orrù et al. 2013; Sabato et al. 2014; Ucchesu et al. 2014, 2016; Pagnoux et al. 2015). This study confirming the validity of this approach also for the *Prunus* endocarps and it can be concluded that:

- ✓ Introduction of primitive cultivated forms of plums in Sardinia have been started by the Phoenicians people;
- ✓ These endocarps represent the first cultivated plums findings in Sardinia.

Acknowledgments

The authors wish to thank all the staff of "Soprintendenza per i Beni Archeologici per le Province di Cagliari e Oristano" for assistance and for allowing us the use of archaeological material. We wish to acknowledge Giuseppe Rosas, Liberato Fara and all the staff of the CNR-ISPA (Nuraxinieddu, OR-Sardinia) for technical assistance during the samples collection.

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