NEW PERSPECTIVES ABOUT THE HISTORY OF *CITRUS* IN WESTERN MEDITERRANEAN: A MULTIDISCIPLINARY INVESTIGATION IN THE CAMPANIA REGION (ITALY)

15TH CONFERENCE OF THE INTERNATIONAL WORK GROUP FOR PALAEOETHNOBOTANY
Wilhelmshaven, May 31 – June 5, 2010

Sylvie COUBRAY[1], Girolamo FIORENTINO[2], Véronique ZECH-MATTERNE[3], Maï BUI-THI[4] and Clémence PAGNOUX[5]
1. INRAP CIF, UMR 7209 « Archéozoologie-Archéobotanique : Sociétés, Pratiques et Environnements », 55 rue Buffon, 75005 Paris, France, sylvie.coubray@inrap.fr
2. Università di Lecce, Dipartimento di Beni Culturali, Via D. Birago, 64 73100 Lecce, Italy, girolamo.fiorentino@unisalento.it
3. CNRS/MNHN, UMR 7209 « Archéozoologie-Archéobotanique : Sociétés, Pratiques et Environnements », 55 rue Buffon, 75005 Paris, France, veronique.zechmatterne@mnhn.fr
4. CNRS/CEPAM, UMR 6130, Centre d'études Préhistoire, Antiquité, Moyen Âge, 250 rue Albert Einstein, Sophia Antipolis, 06560 Valbonne, France, buithi@cepam.cnrs.fr
5. Master « environnement et archéologie », Paris I, clemence.pagnoux@orange.fr

While some consensus exists about the role of South-West China and North-Eastern India in the origin and diversification of the genus Citrus, the scarcity of the archaeobotanical remains, as well as some methodological limits in unequivocally assessing taxa, do not facilitate reconstruction of the tempo and mode of spread of hesperids towards other areas, notably the Mediterranean, although rare stake can be found in Hjelmqvist 1979; Van Zeist et al. 2001. Recent discoveries of archaeobotanical macro-remains (seeds and fruits) and pollen records can be used to shed new light on this history, but this raises the problem of the precise identification of the remains.

The first mention of a hesperid - named « Medean apple tree » - is made by Theophrastus, a Greek author from the 4th c. BC, also a physician and a botanist accompanying Alexander the Great during his war campaign in Asia (*Historia Plantarum* 4, 4, 2). The description of the tree according to Virgil (*Georgics* 131) and Pliny the Elder (*NH*, 12, 15) follows his criterias : leaves comparable with the ones of the oriental strawberry tree and walnut tree, spikes as on the pear tree or the burning bush although smooth, very sharp and robust. The first description of the fruit comes from Dioscorides (1st c. AD): shape elongated , wrinkled skin , golden yellow colour , very perfumed and similar to a pear (*Regarding Medical Matters* 1, 115, 15). Galien (2nd – 3rd c. AD) describes it more precisely: the fruit is divided in three parts: the skin, the flesh and the inner part. The flesh is juicy and refreshing, and the inner part, which contain the seeds, acidic (*Ressources et recettes des remèdes simples* 8, 19).
According to the distinction made between the flesh and the inner part, this must be a Citrus fruit with a very developed *albedo*, the reason why the fruit has been identified as a citron (*Citrus medica*) instead of a lemon (*C. limon*). Considering the wrinkled skin mentioned by Dioscorides, V. Loret estimated that the term *kitrion/citrium* was applied from the 1st to the 4th c. AD to the same species, namely a citron, and that the Antique thus known this species only (Loret 1891)

By relying on complete inter-fertility and apomixis (offspring being genetically identical to the parent plant), the classification of this specimen within the genus *Citrus* (or its close relatives) appears quite complicated. In fact, the "classical" classifications based on anatomical and morphological criteria (e.g., Swingle and Reece 1967; Tanaka 1977) have revealed inadequate in appropriately assessing past "species". Recent phylogenetic work based on SSRs molecular (Barkley et al. 2006) and AFLP markers (Pang et al. 2007) supports the original suggestions from Scora (1975) and Barrett and Rhodes (1976) that only *Citrus medica*, *C. maxima*, and *C. reticulata* should be considered a "true species", while *C. limon*, *C. auranthium*, *C. aurantiifolia* more likely represent hybrids occurring from cross-breeding or natural events.

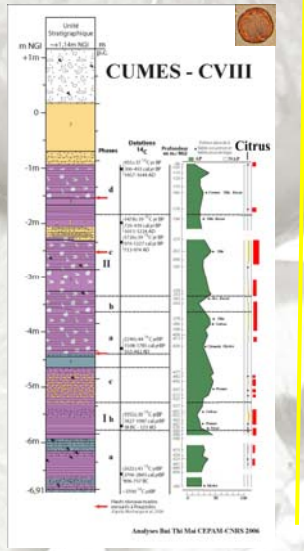
At the present day, the most ancient evidence of *Citrus* macro-remains are coming from Pompei

One single mineralized pip from the House of Hercule and Ebe's wedding, dated to the first half of the 2nd c. BC has been mentioned by Ciaraldi 2007. The cultivation of *Citrus* in Pompeii gardens is confirmed by the recognition of this pollen type in the cores of the same House (Mariotti Lippi 2000).

Pollen evidence is provided by the core from the lake Averno. Six pollen grains of the Citrus type (*C. medica* or *C. lemon*) have been recorded in the zone 3, chronologically corresponding to the Roman period in the section 3 of the profile AV 14 K2 (Grüger et al. 2002).

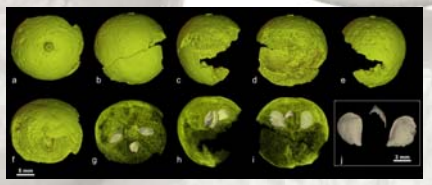
NEW EVIDENCES FROM CUMAE

New research brought to light more **ancient evidence**, from the city of Cumae, one of the earliest Euboeans colonies, which plaid a major role for the transfer of cultural Greek influences in Etruscan and Roman civilisations. The record of *Citrus* pollen type comes from a six meter profile located in the city itself (max. depth core: 7,95 m, see figure). The six available radiocarbon dates calibrate the sequence between the first half of the 8th c.BC and the 15-17th c. AD. Seventy pollen grains have been counted. The first one appears at 896/657BC cal, at the mark -656 cm, the species being then continuously recorded until the top of the core. Considering the insect pollination character of *Citrus* and the paucity of pollen transport, one must discuss the possibility for local cultivation of the trees when this pollen type is observed in rather large quantities. Citrus fruit (citron,lemon,orange) pollen are morphologically similar from one species to another but, with reference to CEPAM laboratory collection, the identification of the Cumae specimens turns to *Citrus medica*, the citron tree.



RE-ASSESSMENT

A Citrus-like fruit, discovered in a funerary offering dating back to the VIth c. BC, in the Ischia Island, has turned to be re-identified as a Malaceae, using µCT scan to characterize its structural morphology (Coubray 1996; Coubray *et al,* in press).



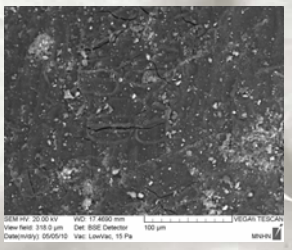
Barkley, N.A., Roose, M.L., Krueger, R.R., Federici, C.T., 2006. Assessing genetic diversity and population structure in a citrus germplasm collection utilizing simple sequence repeat markers (SSRs). Theor. Appl. Genet. 112, 1519-1531.
Barrett, H.C., Rhodes, A.M., 1976. A numerical taxonomic study of affinity relationships in cultivated *Citrus* and its close relatives. System. Botany 1, 105-136.
Pang, X.M., Hu, C.G., Deng, X.X., 2007. Phylogenetic relationships within *Citrus* and its related genera as inferred from AFLP markers. Genet. Ress. Crop Evol. 54, 429-436.
Scora, R.W., 1975. On the history and origin of *Citrus*. Bull. Torrey Bot. Club 102, 369-375.
Swingle, W.T., Reece, P.C., 1967. The botany of *Citrus* and its wild relatives. In: Reuther W., T. Tanaka, Fundamental discussion of Citrus classification, Stud. Citrol. 14 (1977) 1-6.
M. Ciaraldi, People and plants in ancient Pompeii: a new approach to urbanism from the microscope room. The use of plant resources at Pompeii and in the Pompeian area from the 6th century BC to AD 79, Specialist Studies on Italy 12, Accordia Research Institute, London, 2007, 183 p.
Coubray, S., 1996. Restes végétaux du dépôt votif. Atti Mem. Soc. Magna Grecia 3, 105-108.
Coubray S. [1,2*], Zech-Matterne V. [2], Mazurier A. [3] The earliest remains of a *Citrus* fruit from a western Mediterranean archaeological context? A microtomographic-based re-assessment, Comptes Rendus de l'Académie des Sciences Paris, Palevol, in press.
E. Grüger, B. Thulin, J. Müller, J. Schneider, J. Alefs, F.W. Welter-Schultes, Environmental changes in and around Lake Avernus in Greek and Roman times: A study of the plant and animal remains preserved in the lake's sediment, in: W. Jashemski, F.G. Meyer (eds.) The natural history of Pompeii, Cambridge University Press, Cambridge, 2002, pp. 240-273.
W. Jashemski, F.G. Meyer, M. Ricciardi, Plants: evidence from wall paintings, mosaics, sculpture, plant remains, graffiti, inscriptions, and Ancient Authors, in: W. Jashemski, F.G. Meyer (eds.) The natural history of Pompeii, Cambridge University Press, Cambridge, 2002, pp. 80-180.
V. Loret, Le cédratier dans l'antiquité, Annales de la société de botanique de Lyon 17, 1891, pp. 247-249.

NEW EVIDENCES FROM POMPEI

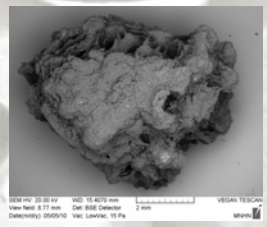
Temple of Venus (3rd-2nd c. BC)

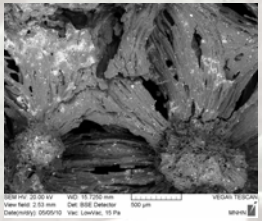
On left: carbonized and mineralized pips compared with modern pips *on right*

Temple of Fortuna Augusta (10 BC-3 AD)



carbonized pip, potentially from a hesperid fruit (scale bar 5 mm) and the seed coat *(right)*





External and internal view of fragments of a mesocarp, showing repeated "star-like" features.

By comparison with different *Citrus* species, the mesocarp remains and some fragments showing the partially preserved exocarp could correspond to the carbonized *albedo* of a Citrus fruit.