



## NEOLITHIC PLANT USE IN THE WESTERN MEDITERRANEAN REGION: PRELIMINARY RESULTS FROM THE AGRIWESTMED PROJECT

LEONOR PEÑA-CHOCARRO<sup>1,2\*</sup>, GUILLEM PÉREZ JORDÀ<sup>2</sup>, JACOB MORALES MATEOS<sup>2</sup>, LYDIA ZAPATA<sup>3</sup>

<sup>1</sup>*Escuela Española de Historia y Arqueología en Roma (EEHAR-CSIC). Via di Torre Argentina 18, 00186 Rome. Italy*

<sup>2</sup>*Laboratorio de Arqueobiología. Instituto de Historia (CCHS-CSIC). Albasanz 26-28. 28037 Madrid. Spain*

<sup>3</sup>*University of the Basque Country (UPV/EHU). F. Tomás y Valiente s/n. 01006 Vitoria-Gasteiz. Spain*

\*Corresponding author: Telephone: +39 0668100024; e-mail [leonor.chocarro@csic.it](mailto:leonor.chocarro@csic.it)

(RECEIVED 14 MARCH 2013; RECEIVED IN REVISED FORM 29 MARCH 2013; ACCEPTED 29 MARCH 2013)

**ABSTRACT** – This contribution focuses on the preliminary results of the AGRIWESTMED project which focuses on the archaeobotanical analyses of early Neolithic sites in the western Mediterranean region (both in Iberia and in northern Morocco). A large number of sites has been studied producing an interesting dataset of plant remains which places the earliest examples of domesticated plants in the second half of the 6<sup>th</sup> millennium cal BC. Plant diversity is high as it is shown by the large number of species represented: hulled and naked wheats, barley, peas, fava beans, vetches, lentils and grass peas. To more crops, poppy and flax, are also part of the first agricultural crops of the area. Although agriculture seems to occupy a first place in the production of food, gathering is well represented in the Moroccan sites where a large number of species has been identified.

**KEYWORDS:** ARCHAEOBOTANY, NEOLITHIC, WESTERN MEDITERRANEAN, AGRICULTURE, POPPY

### INTRODUCTION

The origins and spread of agriculture from Southwest Asia to Europe has been one of the key topics in archaeological research for the past forty years. There are many studies focusing on the multi-faceted aspects of the subject and major works that have guided the advances in the understanding of this chief turning point. These developments are based on the refinement of interpretative models and, particularly, on the application of new techniques of analysis and methodologies coming mainly from the domain of natural sciences. In addition, new interdisciplinary projects across large areas of Europe have contributed to improve our knowledge of this fascinating period. One of these projects is the AGRIWESTMED project (Origins and spread of agriculture in the western Mediterranean region) funded by the European Research Council (ERC-AdG 230561) and led by the Spanish Research Council (CSIC) with the participation of several European institutions.

The project main focus has been the study of early agriculture across the Iberian Peninsula and northern Morocco through the analysis of various archaeological and environmental proxies which should provide a better comprehension of the multifaceted and complex nature of farming. This paper illustrates results produced by the analyses of seeds and fruits from Neolithic contexts in the area. It highlights the large diversity of cultivated species documented from the early stages of agriculture as well as the significant role wild plants have had in areas such as northern Morocco.

### MATERIALS AND METHODS

Located in the Mediterranean Far West, the southwestern Mediterranean region occupies modern Iberia and northern Morocco. The area is situated in a marginal position in relation to the European continent and here agriculture arrived to an

end in its westerly spread across the Mediterranean shores. The region lies at the confluence of both Mediterranean and Atlantic influences which favoured a great diversity of climates and landscapes to which farming had to adapt. Over the past years, research into Neolithic farming has increasingly developed in this region with particular emphases in the coastal Mediterranean area (Valencia and Cataluña) where projects including systematic recovery of plant remains have been set. For other regions of this large territory the development of archaeobotany and the application of proper sampling and recovery techniques have been characterized by a punctuated distribution. So, in

Andalucía, for instance, archaeobotanical research has been concentrated in the central part, in the Córdoba, Granada and Málaga provinces where the main Neolithic sites have been investigated. The same situation applies to the other regions such as central Iberia where only a few sites have been analyzed (Fig. 1).

More than 30 sites have been studied for one or more proxies and partial results or general views have been already published (e.g., López Merino et al., 2010; Peña-Chocarro & Zapata, 2010; Aguilera et al., 2011; Oliveira et al., 2011; Palomo et al., 2011; Pérez Jordà et al., 2011; Cortés et al., 2012; Gibaja et al., 2012; Peña-Chocarro & Zapata, 2012;

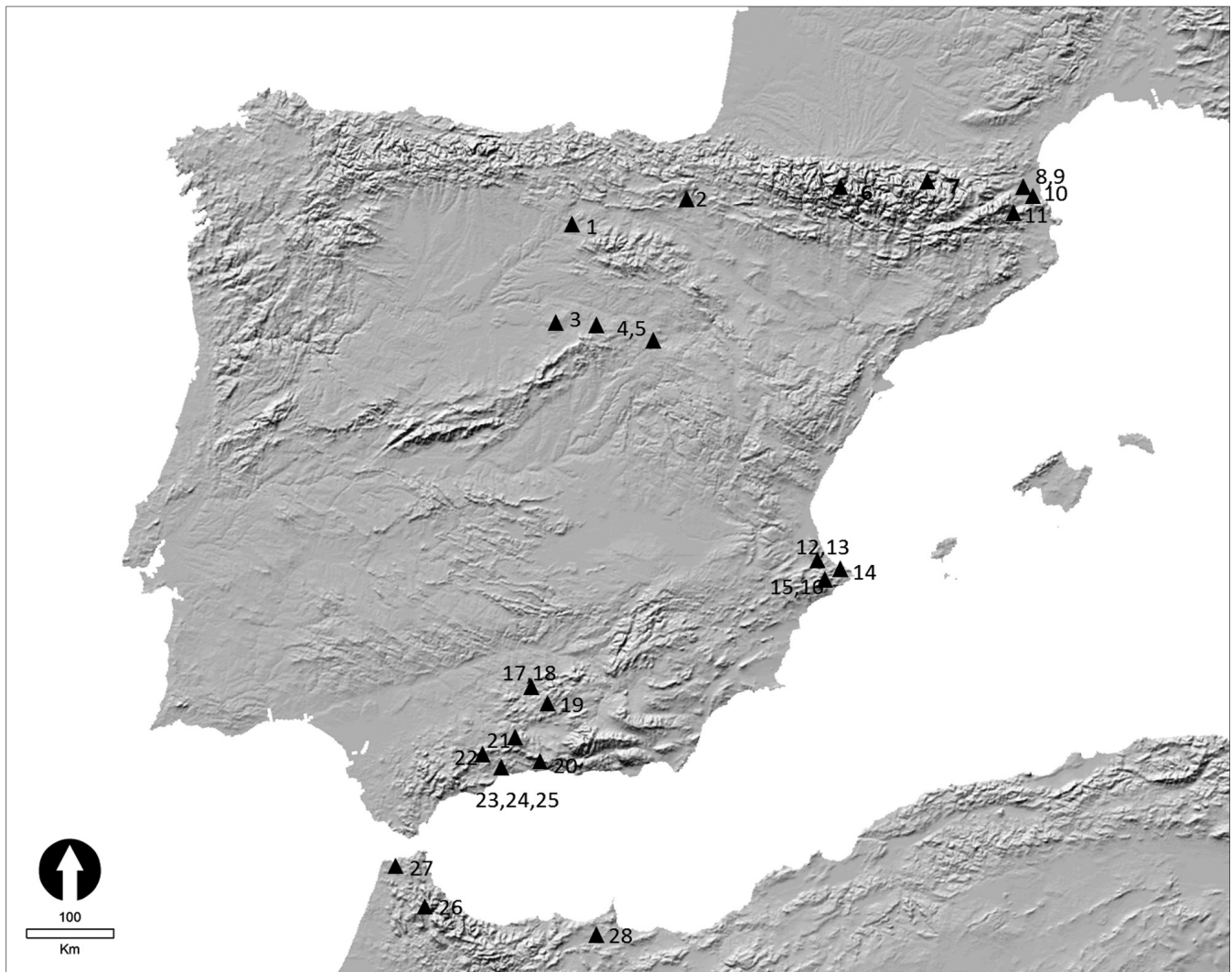


Fig. 1. Map showing Iberian 6th millennium cal BC sites with archaeobotanical data from which 15 have been studied or reviewed within the AGRIVESTMED project. - 1. El Mirador, 2. Los Cascajos, 3. La Vaquera, 4. La Revilla del Campo, 5. La Lámpara, 6. Trocs, 7. Balma Margineda, 8. Cova 120, 9. Plansallosa, 10. La Draga, 11. Can Sadurní, 12. Cova de l'Or, 13. Cova d'En Pardo, 14. Cova de les Cendres, 15. Mas d'Is, 16. Abric de Falguera, 17. Cueva de los Murcielagos de Zuheros, 18. Cueva de los Mármoles, 19. Castillejos de Montefrío, 20. Cueva de Nerja, 21. Cueva del Toro, 22. La Higuera, 23. Bajondillo, 24. Hostal Guadalupe, 25. Roca Chica, 26. KafTaht el-Ghar, 27. Grottes du Khil, 28. IfriOudadane

Schellekens et al., 2012; Morales et al., 2013; Zapata et al., 2013).

Early Neolithic sites across the region have been systematically sampled for seeds and fruits. Soil samples have been processed using a flotation machine that has allowed the recovery of rich assemblages of plant remains. The identification work has been carried out at the Laboratorio de Arqueobiología of the Centro de Ciencias Humanas y Sociales (CSIC) at Madrid (Spain).

## RESULTS

Archaeobotanical data collected over the past two decades suggests a quick spread of agriculture throughout the Iberian Peninsula (Zapata et al., 2004, Peña-Chocarro & Zapata, 2010, 2012). The first domesticated plants appear almost simultaneously in different regions setting the beginning of agriculture in this territory by c.5600-5500 BC when the earliest domesticated plants associated to Impressed pottery and domestic animals appeared at the site of Mas d'Is on the eastern coast of Valencia (Bernabeu *et al.* 2003). Further north, in Cataluña, the first evidence is dated between 5500-5300 BC (Buxó, 2007; Antolín & Buxó, 2012). The Catalan coast has provided with interesting sites such as Can Sadurni (Antolín & Buxó, 2011a) or La Draga (Antolín & Buxó, 2011b) where rich assemblages of plant remains have been studied.

In both coastal and inland sites of Andalucía (Peña-Chocarro & Zapata, 2010, Cortés et al., 2010, 2012; Pérez Jordà et al., 2011), AMS dates from seeds and fruits of cultivated plants seem to be concentrated around 5300 cal BC while dates from inner Iberia (Stika, 2005; Peña-Chocarro et al., 2005; Peña-Chocarro, 2007) point also to the same date. In the Atlantic coast available data points to domesticates being present at least from the early 5<sup>th</sup> millennium BC (Zapata, 2007) while in the Pyrenees, most recent work has shown much earlier evidence for the presence of cultivated plants (Rojo, pers. comm).

It is paradoxical that when discussing the spread of agriculture into Europe through the Mediterranean corridor most of Northern Africa is a blank area in terms of archaeobiological studies. Dates on plants and animals are almost inexistent and environmental work is still limited compared to other regions. We know almost nothing about when food production started in this vast territory and where the first evidences occurred. Data is still limited but recent developments in northern Morocco where various sites have been excavated and sampled for plant remains have also provided early Neolithic dates which are contributing to increase our knowledge on this vast territory. Prior to our work, the only

available date from a charred cereal grain from this area (from Morocco to Lybia) was that of Kaf That el-Ghar (KTG) which placed the earliest evidence of agriculture between 5480 and 5080 cal BC (Ballouche & Marinval, 2003). Over the past few years work carried out by Linstädter at the site of Ifri Oudadane (Linstädter & Kehl, 2012) has allowed recovering and studying an impressive dataset of plant remains. The assemblage includes more than 8000 plant remains, being probably one of best studied sites within the region (Morales et al., 2013). A lentil (*Lens culinaris*) has been dated to 5661 ± 37 cal BC while the earliest cereals in this site appear some 500 years later. Further sites such as Grottes du Khil (Tanger) are currently under study.

## DISCUSSION

According to current data, first farmers from the western Mediterranean grew a large variety of crops which included hulled (einkorn-*Triticum monococcum*- and emmer-*Triticum dicoccum*) and free-threshing wheats (*T. durum* and *T. aestivum*), barley (*Hordeum vulgare*) and a wide variety of legumes such as peas (*Pisum sativum*), lentils (*Lens culinaris*), broad beans (*Vicia faba*), vetches (*Vicia ervilia* and *Vicia sativa*) and grass peas (*Lathyrus sativus* and *Lathyrus cicera*). Flax (*Linum usitatissimum*) and poppy (*Papaver somniferum*) were also part of the broad range of crops cultivated in the region. Although most of the available data focuses on domestic crops, there is growing evidence of wild foodstuffs being consumed by early farmers, increasing the range of plant resources used for subsistence. However, their importance in the overall diet is difficult to evaluate.

The predominant crop species are the free-threshing wheats and the naked barley while the hulled species seem to have played a secondary role except than in some sites of inner Iberia (sites of the Ambrona complex and Los Cascajos) where they appear to be the main cereals (Peña-Chocarro et al., 2005; Stika, 2005). In some areas like Valencia, einkorn and emmer seem to have already disappeared by 4500 (Pérez Jordà & Peña-Chocarro, pers. comm.) while in others they kept being grown even if their presence is always limited. Legumes appear frequently in the archaeobotanical record of the western Mediterranean but always in low numbers. The wide range of species represented (peas, lentils, fava beans, vetches and grass pea) highlights the great crop diversity of this territory. Pulses are significantly more abundant in southern Iberia and northern Morocco while in the north these are less represented. Two more crops should be added to the cultivated plants identified in the area: flax and poppy. In the first case, flax seems to represent a significant addition introduction in some of the areas studied. For example,

in Valencia, this species is not recorded until the late 3<sup>rd</sup> millennium (Pérez Jordà, 2011) whereas in Andalucía, at Los Castillejos, its presence is well attested from the 5<sup>th</sup> millennium BC (Rovira-Buendía, 2007). The presence of poppy from the at least 5300 BC in sites of Iberia addresses the question of its domestication. Based on the archaeobotanical data available, it has been suggested that this species belongs to the second group of domesticates from outside the Fertile Crescent were added to the original crop assemblage (Zohary et al., 2012). In fact, several authors have suggested that it was domesticated in the western Mediterranean area (Bakels, 1982; Zohary et al., 2012). Apart from a single find of wild poppy from Israel (Kislev et al., 2004), most data comes from both the central and western Mediterranean area and central Europe. Earliest evidence comes from Italy, from the site of La Marmotta (Rottoli & Pessina, 2007) while from Central Europe poppy appeared between 5300-5200 cal BC (Salavert, 2010). Further data has been retrieved from Iberia, from the Cueva de Los Murciélagos (Córdoba) where a significant amount of seeds has been identified (Peña-Chocarro, 1999; Pérez Jordà et al., 2011) (Fig. 2). One of the main problems raised is that of the correct identification of poppy seeds. In fact, distinguishing between the wild *P. somniferum* ssp. *Setigerum* and the

domesticated *P. somniferum* ssp. *somniferum* is impossible in the absence of poppy capsules (Fritsch, 1979).

Despite the main element of the food producing economies were cultivated plants, wild species kept to be exploited adding diversity to subsistence. For other areas such as the Near East, archaeobotanical studies (Fairbairn, 2007) have demonstrated the collection and processing of wild seeds. Examples from Europe are also abundant (e.g. Jones, 2000). The available evidence from plant remains for the western Mediterranean has been traditional limited, mainly consisting of the presence acorns, hazel nuts and in few cases of wild *Prunus* fruits. However, fresh data from northern Morocco (Morales et al., 2013) reveals an extraordinary rich assemblage (more than 7000 remains) including different taxa which suggest the importance of gathering in these communities. Seeds of the mastic tree (*Pistacia lentiscus*) are the most abundant but there are also many other species such as the dwarf palm (*Chamaerops humilis*) or the juniper (*Juniperus phoenicea*) are common. Plant groups such as the wild legumes, particularly *Vicia* and *Lathyrus* spp. are frequent while other food species such as *Quercus* and *Olea* are less common (Morales et al., 2013). Interestingly, a common macroremain is represented by the aerial rhizome of alfa grass (*Stipa tenacissima*).



Fig. 2. Seeds of *Papaver somniferum*, poppy, preserved by charring (left) and by dessication (centre and right) from Cueva de Los Murciélagos (Zuheros, Córdoba). Photograph: J. Morales.

## CONCLUSIONS

This contribution has outlined some of the archaeobotanical results of the AGRIWESTMED project stressing the diversity of species found in this region. Domesticated plants are attested from the second half of the 6<sup>th</sup> millennium cal BC. The plant remain assemblages include a wide variety of

cereals and legumes as well as poppy and flax. This diversity of species implied a deep knowledge of the various species agricultural cycles as well as of the various farming systems and agricultural practices. The systematic dating of short-lived specimens from a large number of sites in Iberia and north Morocco allows suggesting a quick spread of farming throughout the region. Early dates are found in

Valencia and North Africa with dates around 5600 cal BC whereas for the remaining areas most dates concentrate around 5300 cal BC. Wild plants are well represented in Moroccan sites indicating that gathering was still a common practice.

## ACKNOWLEDGEMENTS

The research leading to these results has received funding from the European Research Council under the European Union's Seventh Framework Programme (FP7/2007-2013)/ERC Grant Agreement n° 230561. In addition, the research has also benefited from the project I-COOP0011 funded by the CSIC (Spanish National Research Council) and from projects TPC-CSD2007-00058, HAR2008-09120/HIST and HAR2011-23716 funded by the Ministry of Science and Innovation of Spain. L. Zapata is part of the Research Group in Prehistory IT622-13/ UFI 11-09 of the University of the Basque Country UPV/EHU.

## REFERENCES

- Aguilera C., Ferrio J.P., Araus J.L., Tarrús J., Voltas, J., 2011. Climate at the onset of western Mediterranean agriculture expansion: evidence from stable isotopes of sub-fossil oak tree-rings in Spain. *Paleogeography, Paleoclimatology and Paleoecology* 299, 541-551.
- Antolín F., Buxó R., 2011a. Proposal for the systematic description and taphonomic study of carbonized cereal grain assemblages. A case study of an Early Neolithic funerary context in the cave of Can Sadurní (Begues, Barcelona province, Spain). *Vegetation History and Archaeobotany* 20, 53-66.
- Antolín F., Buxó R., 2011b. L'exploració de les plantes al jaciment de la Draga: contribució a la història de l'agricultura i de l'alimentació vegetal del neolític a Catalunya. In: J. Bosch, J. Chinchilla and J. Tarrús (Coord) *El poblament lacustre del neolític antic de La Draga: Excavacions de 2000-2005*, pp. 147-174. MAC-CASC (Monografies del CASC, 9), Girona, Spain.
- Antolín F., Buxó R., 2012. Chasing the traces of diffusion of agriculture during the Early Neolithic in the western Mediterranean. *Rubricatum. Revista del Museu de Gavà* 5, 95-102.
- Bakels C., 1982. Der Mohn, die Linearbandkeramik und das Westliche Mittelmeergebiet. *Archäologisches Korrespondenzblatt* 12, 11-13.
- Ballouche A., Marinval P., 2003. Données palynologiques et carpologiques sur la domestication des plantes et l'agriculture dans le Néolithique ancien du Maroc septentrional. (Site de Kaf Taht El-Ghar). *Revue d'Archéométrie* 27, 49-54.
- Bernabeu Aubán J., Orozco Köhler T., Díez Castillo A., Gómez M., Molina F.J., 2003. Mas d'Is (Penàguila, Alicante): Aldeas y recintos monumentales del Neolítico inicial en el Valle del Serpis. *Trabajos de Prehistoria* 60 (2), 39-59.
- Buxó R., 2007. Crop evolution: new evidence from the Neolithic of west Mediterranean Europe. In: S. Colledge and J. Conolly (Eds.) *The origins and spread of domestic plants in Southwest Asia and Europe*, pp. 155-171. Left Coast Press and UCL Institute of Archaeology Publications, Walnut Creek, Ca, USA.
- Cortés Sánchez M., Simón Vallejo M.D., Riquelme J.A., Peña-Chocarro L., Gibaja Bao J.F., de la Rubia de Gracia J.J., Martínez Sánchez R.M., 2010. El neolítico en la costa de Málaga (España): viejos y nuevos datos para su contextualización en el proceso de neolitización del sur de la península Ibérica. In: J.F. Gibaja Bao and A. Faustino Carvalho (Eds.) *Os últimos caçadores-recolectores e as primeiras comunidades produtoras do sul da Península Ibérica e do norte de Marrocos*. Promontoria Monográfica 15, 151-162. Universidade do Algarve, Faro, Portugal.
- Cortés Sánchez M., Jiménez Espejo F.J., Simón Vallejo M.D., Gibaja Bao J.F., Faustino Carvalho A., Martínez-Ruiz F., Rodrigo Gamiz M., Flores J.A., Paytan A., López Sáez J.A., Peña-Chocarro L., Carrión J.S., Morales Muñoz A., Roselló Izquierdo E., Riquelme Cantal J.A., Dean R.M., Salgueiro E., Martínez Sánchez R.M., de la Rubia de Gracia J.J., Lozano Francisco M.C., Vera Peláez J.L., Llorente Rodríguez L., Bicho N.F. 2012. The Mesolithic-Neolithic transition in southern Iberia. *Quaternary Research* 77 (2), 221-234.
- Fairbairn A., Martinoli D., Butler A., Hillman, G.C., 2007. Wild plant seed storage at Neolithic Çatalhöyük, East Turkey. *Vegetation History and Archaeobotany* 16 (6), 467-479.
- Fritsch R., 1979. Zur Samenmorphologie des Kulturmohns (*Papaver somniferum* L.). *Kulturpflanze* 27, 217-227.
- Gibaja Bao J.F., Peña-Chocarro L., Ibáñez J.J., Zapata L., Rodríguez A., Linstädter J., Pérez G., Morales J., Gassin B., Faustino Carvalho A., González J.E., Clemente I., 2012. A los dos lados del Estrecho: las primeras hoces líticas y evidencias de agricultura en el sur de la Península Ibérica y el norte de Marruecos. Una perspectiva de futuro. *Rubricatum. Revista del Museu de Gavà* 5, 87-93.

- Jones G., 2000. Evaluating the importance of cultivation and collecting in Neolithic Britain. In: A. Fairbairn (Ed.) *Plants in Neolithic Britain and beyond*, pp 79-84. Oxbow Books, Oxford, UK.
- Kislev M., Hartmann A., Galili, E., 2004. Archaeobotanical and archaeoentomological evidence from a well at Atlit-Yam indicates colder, more humid climate on the Israeli coast during the PPNC period. *Journal of Archaeological Science* 31, 1301-1310.
- Linstädter J., Kehl M., 2012. The Holocene archaeological sequence and sedimentological processes at Ifri Oudadane, NE Morocco. *Journal of Archaeological Science* 39, 3306-3323.
- López-Merino L., Martínez Cortizas A., López-Sáez J.A., 2010. Early agriculture and palaeoenvironmental history in the north of the Iberian Peninsula: a multiproxy analysis of the Monte Areo mire (Asturias, Spain). *Journal of Archaeological Science* 37, 1978-1988.
- Morales J., Pérez Jordà G., Peña-Chocarro L., Zapata L., Ruiz-Alonso M., López-Sáez J.A., Linstädter, J., 2013. The origins of agriculture in North-West Africa: macro-botanical remains from Epipalaeolithic and Early Neolithic levels of Ifri Oudadane (Morocco). *Journal of Archaeological Science* 40 (6), 2659-2669.
- Oliveira H., Jones H., Leigh F., Lister D., Jones M.K., Peña-Chocarro L., 2011. Phylogeography of einkorn landraces in the Mediterranean basin and Central Europe: population structure and cultivation history. *Archaeological and Anthropological Sciences* 3, 327-341.
- Palomo A., Gibaja Bao J.F., Piqué R., Bosch A., Chinchilla J., Tarrús J., 2011. Harvesting cereals and other plants in Neolithic Iberia: the assemblage from the lake settlement at La Draga. *Antiquity* 85, 759-771.
- Peña-Chocarro L., 1999. Prehistoric agriculture in Spain. The application of ethnographic models. BAR International Series S818, Oxbow, Oxford, UK.
- Peña-Chocarro L., 2007. Early Agriculture in southern and central Spain. In: S. Colledge and J. Conolly (Eds.) *The origins and spread of domestic plants in Southwest Asia and Europe*, pp. 173-187. Left Coast Press and UCL Institute of Archaeology Publications, Walnut Creek, Ca, USA.
- Peña-Chocarro L., Zapata L., Iriarte M.J., González Morales M., Straus, L., 2005. The oldest agriculture in Northern Atlantic Spain. *Journal of Archaeological Science* 32 (4), 579-587.
- Peña-Chocarro L., Zapata L., 2010. Neolithic agriculture in southwestern mediterranean region. In: J.F. Gibaja Bao and A. Faustino Carvalho (Eds.) *Os últimos caçadores-recolectores e as primeiras comunidades produtoras do sul da Península Ibérica e do norte de Marrocos*. Promontoria Monográfica 15, 191-198, Universidade do Algarve, Faro, Portugal.
- Peña-Chocarro L., Zapata L., 2012. Las transformaciones económicas del Neolítico en la P. Ibérica: la agricultura. In: M.A. Rojo Guerra, R. Garrido Pena and I. García Martínez de Lagrán (Eds.) *El Neolítico en la P. Ibérica y su contexto europeo*, pp. 95-106. Cátedra, Madrid.
- Pérez Jordà G., Carrión Marco Y., 2011. Los recursos vegetales. In: G. Pérez Jordà, J. Bernabeu Aubán, Y. Carrión Marco, O. García Puchol, L. Molina Balaguer, M. Gómez Puche (Eds) *La Vital (Gandía, València)*. Vida y muerte en la desembocadura del Serpis durante el III y el I Milenio a.C. Serie Trabajos Varios del SIP, Servei d'Investigacions Prehistòriques, Diputació de València, Valencia, Spain.
- Pérez Jordà G., Peña-Chocarro L., Morales Mateos J., 2011. Agricultura neolítica en Andalucía: semillas y frutos. *Menga. Revista de Prehistoria de Andalucía* 2, 57-72.
- Rottoli M., Pessina A., 2007. Neolithic agriculture in Italy: an update of archaeobotanical data with particular emphases on northern settlements. In: S. Colledge and J. Conolly (Eds.) *The origins and spread of domestic plants in Southwest Asia and Europe*, pp.141-154. Left Coast Press and UCL Institute of Archaeology Publications, Walnut Creek, Ca, USA.
- Rovira i Buendía N., 2007. Agricultura y gestión de los recursos vegetales en el sureste de la Península ibérica durante la Prehistoria Reciente. Unpublished PhD Thesis, Universitat Pompeu Fabra, Barcelona. Retrieved from <http://www.tdx.cat/handle/10803/7468>
- Salavert A., 2010. Le pavot (*Papaver somniferum*) à la fin du 6e millénaire av. J.-C. en Europe occidentale. *Anthropobotanica* 1(3), 3-16.
- Schellekens J., Barberá G.G., Buurman P., 2013. Potential vegetation markers- analytical pyrolysis of modern plant species representative of Neolithic SE Spain. *Journal of Archaeological Science* 40, 365-379.
- Stika H.P., 2005. Early Neolithic agriculture in Ambrona, Provincia Soria, central Spain. *Vegetation History and Archaeobotany* 14 (3), 189-197.
- Zapata L., 2007. First farmers along the coast of the Bay of Biscay. In: S. Colledge and J. Conolly (Eds.) *The origins and spread of domestic plants in Southwest Asia and Europe*, pp. 189-208. Left Coast Press and UCL Institute of Archaeology Publications, Walnut Creek, Ca, USA.
- Zapata L., Peña-Chocarro L., Pérez Jordà G., Stika H.P., 2004. Early Neolithic agriculture in the Iberian Peninsula. *Journal of World Prehistory* 18 (4), 285-326.

---

Zohary D., Hopf M., Weiss E., 2012. Domestication of plants in the Old World. The origin and spread of cultivated plants in West Asia, Europe and the Nile Valley. Oxford University Press, Oxford, UK.