

EVOLUTION OF ARABLE-WEED FLORA DURING PROTOHISTORIC AND EARLY HISTORIC PERIOD IN NORTHERN GAUL:

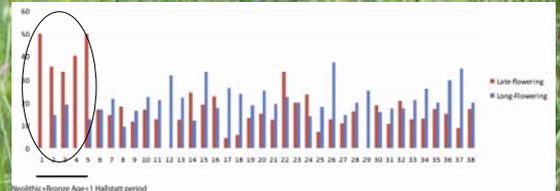
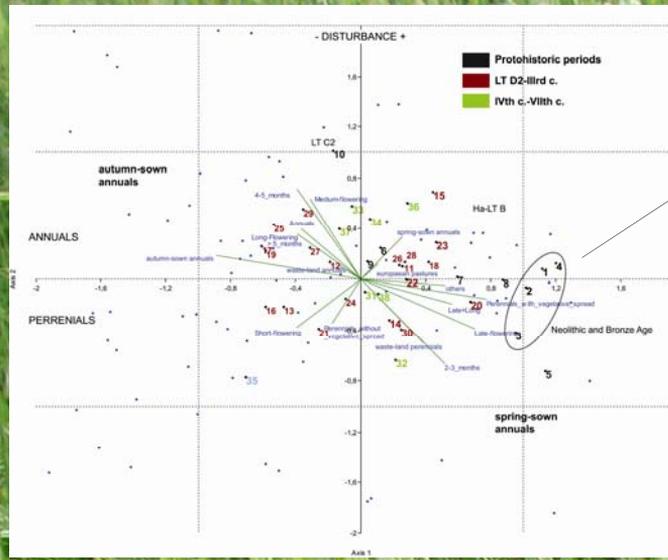
A STATISTICAL APPROACH TAKING ACCOUNT OF ARCHAEOBOTANICAL RESULTS AND POLLEN STUDIES SURVEYS IN PRESENT-DAY NON-MECHANISED AGRICULTURES

Cécile BRUN¹, Véronique MATTERNE-ZECH² and Marie DERREUMAUX³



Traditional reconstruction of arable weeds communities from archaeological assemblages, using the present day ecological groups and phytosociology indicators has been widely discussed and questioned (Küster 1991; Hillman 1991; Behre and Jacomet 1991; Jones 1992). As an alternative method, the FIBS-Functional Interpretation of Weed Flora in relation to Husbandry Practices has been developed (Charles *et al.* 1997; Jones *et al.* 2010). This approach is supported by the rationale that husbandry practises modify the arable habitat in different ways and therefore promote the species that possess a high potential of adaptability or specific characteristics in response to the new ecological conditions developed. In this presentation, we applied selected functional attributes from the FIBS (Bogaard 2004; Jones *et al.* 2005) to a long-term approach based on a Northern France archaeological dataset (regions of Nord/Pas de Calais, Picardy, Champagne-Ardenne, Normandy), including about 220 settlements dated from the early Neolithic up to the beginning of the medieval period (Bakels 1984; 1999; De Hingh 2000, Dietsch 2000; Matterne 2001 and unpublished data from Bonnaire, Derreumaux, Matterne, Pals, Toulemonde, Wiethold). The aims of this study were to identify the characteristics of the species which could disappear, but also be introduced in relation to the main switches observed in crop husbandry practices and crop balance, like the cultivation of pulses at a large scale and the promotion of naked cereals (wheat and rye) in the beginning of the Gallo-Roman period (Zech-Matterne *et al.* 2009).

The work focuses on arable weeds, including present-day species actually considered as ruderals or pasture adventives, which could be part of the cultivated fields flora in ancient time. In order to avoid the problems inferred by the removal of selected weeds during crop processing (Jones 1992; Bogaard *et al.* 2005), only domestic refuses: waterlogged fillings from wells and latrines and long-term charred accumulations (pit refuses) have been taken into account.



Canonical Correspondence Analysis on 113 taxa, 38 occupation phases and 17 attributes; waterlogged assemblages only. Plot of species according to functional attributes relating to the capacity to regenerate under conditions of disturbance

The CCA plots the taxa according to an obvious opposition between annual and perennial plants, on the first axis (horizontal). On the second axis, the repartition of the assemblages relies on the level of disturbance.

- Protohistoric periods (1-10, in black)
- sites grouped together on the positive side, except for n°10 dated to LT C
- associated with late and late/long flowering species = spring-sowing crop cultivation (Jones *et al.* 2010)
- high level of disturbance. Annuals with short growing period, late flowering annuals and perennials with vegetative spread, able to regenerate after weeding (Bogaard *et al.* 2001; Jones *et al.* 2005).

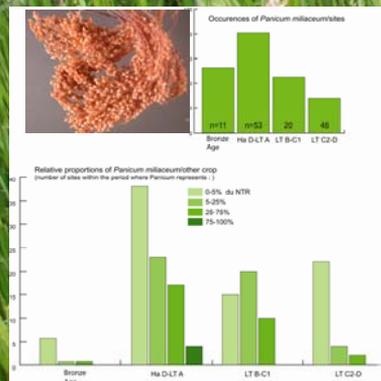
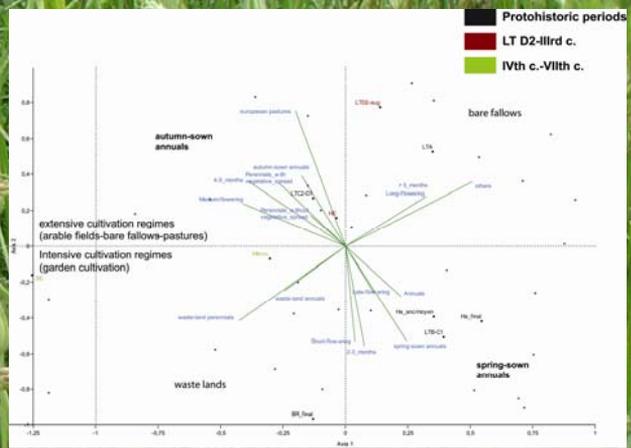
From the middle Bronze Age up to the LT C period, archaeobotanical studies reveal the progressive diversification of crops, the increasing importance of millets and the introduction of maslin. This could be related to **intensive cultivation regimes, of gardening type** (Bogaard 2004) for Neolithic and Bronze Age period, or to a mosaic of small fields with a highly diversified crop rotation system and maslin cultivation type for more recent periods. Although the weeding could be intensively and regularly practiced, it is done by hand or with wooden tools, probably less efficiently than it will be using ard-plough instead.

- LT C2-D and Gallo-Roman period (11-30, in red)
- situations much contrasted, probably due to regional specificities in plant husbandry systems.
- winter annuals now encountered, and **more extensive regimes**, where arable field cultivation alternates with **bare fallow**, long flowering annuals being able to regenerate from crossed-ploughing (Bogaard *et al.* 1999). These periods are characterised by the generalisation of iron tools, monocrops and specialised production and trade based on high yield wheats, in order to feed the *oppida* (Pion 2010) and cities.
- end of the Roman period and beginning of the Middle Ages (31-38, in green)
- plotted again preferably with spring-sown annuals = **new changes in crop growing practises** ?

Canonical Correspondence Analysis on 88 taxa, 216 sites, 10 periods and 16 attributes; carbonised assemblages only

The figure shows a very similar distribution than previously for waterlogged assemblages:

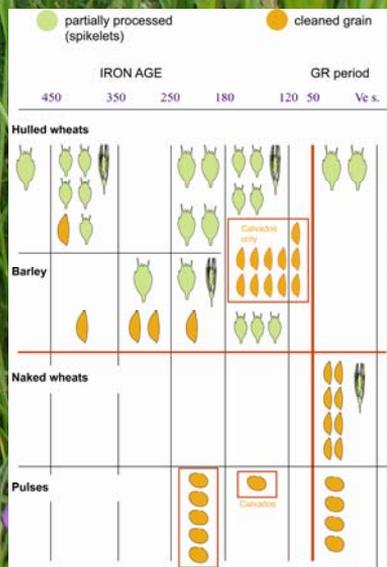
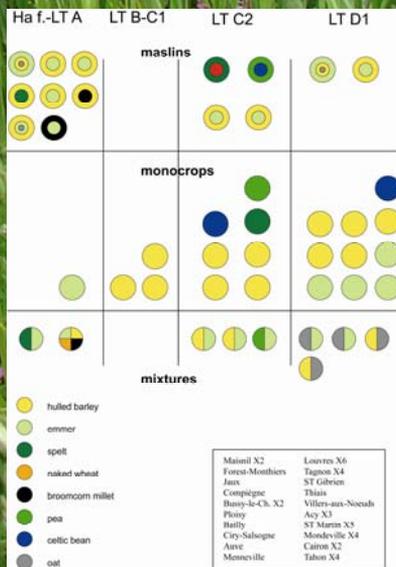
- spring-sown annuals and late flowering species, associated with intensive cultivation regimes, plotted together with the early protohistoric periods until LT C (with the exception of LT A)
- at the opposite, autumn-sown annuals and extensive cultivation regimes associated with the La Tène C, D and the Roman Empire periods
- the possibility for cultivated fallows suggested by the long-flowering species and perennials able to regenerate from repetitive ploughing
- interestingly the association of Late Empire and Merovingian sites together with waste lands. We interpret this potentially as the concentration of arable fields around the settlements still densely occupied. The question of the *agri deserti* has been discussed by several authors (Ouzoulias 1997)



The transformation of agricultural systems

The evolutions observable within the composition of arable-weed flora accompany several transformations of plant husbandry regimes, as shown by archaeobotanical studies, such as:

- the fluctuation of the importance of the millets in agricultural systems (above)
- the balance between maslins and monocrops (centre)
- the introduction of pulses in arable fields rotations (from the LT C in Calvados region and from Gallo-Roman period elsewhere in northern France) (right)
- the most important shifting, from garden cultivation and spring-sowing crop to the extensive cultivation of fields and pastures is probably due to the generalisation of the iron tools, especially for tillage, and the possibility to exploit any kind of soils (around the Ild c. BC in northern France)



References
 Bakels C.C., 1984. Carbonised seeds from Northern France. *Antiquaries Journal* 64, 17-27.
 Bakels C.C., 1989. Archaeobotanical investigations in the Aisne valley, northern France, from the Neolithic to the early Middle Ages. *Vegetation History and Archaeobotany* 7, 71-77.
 Behre K.E. & Jacomet S., 1991. The ecological interpretation of archaeological data from Zaatari, Bahra K.E. & Wadhvani K.J. (eds) *Progress in Old World Palaeoethnobotany. A retrospective view on the occasion of 25 years of the International Group for Palaeoethnobotany*. A. Bakels, Rotterdam, 41-43.
 Bogaard A., 2004. *Intensive farming in Central Europe: An archaeological study of crop husbandry practices*. Routledge, London and New York, 209.
 Bogaard A., Jones G. & Charles M., 2001. On the archaeological relevance of crop weeding using the FIBS method. *Journal of Archaeological Science* 28, 1171-1183.
 Bogaard A., Jones G. & Charles M., 2005. The impact of crop processing on the reconstruction of crop sowing time and cultivation intensity from archaeological weed evidence. *Vegetation History and Archaeobotany* 14, 205-210.
 Charles M., Jones G. & Charles M., 1995. The functional ecology of present-day arable weed flora and its applicability for the identification of past crop husbandry. *Vegetation History and Archaeobotany* 4, 149-164.
 Charles M., Jones G. & Hodgson J.G., 1997. FIBS: Functional Interpretation of weed flora in relation to husbandry practices. *Journal of Archaeological Science* 24, 1151-1161.
 De Hingh A., 2000. *Food production and food processing in the Bronze age and Early Iron age (2000-600 BC): The vegetation of a diversified arable system in the Basse-Entre-Sambre region (The Netherlands and Belgium) and the region of the river Scheldt (Lombardy and France)*. Archaeological Studies Leiden University. Faculty of Archaeology, Leiden University, Leiden, 329 p.
 De Hingh A., 2000. *Millets: Histoire et évolution dans la Basse Vallée (étude de cas: la Vallée de la Sambre, France)*. Presses de Septentrion, Thèse à la carte, Villeneuve d'Ascq, 155 p., annexes.
 Hillman G., 1991. *Phytosociology and ancient weed flora: taking account of leptomorphs and changes in cultivation methods*. In: Harris D.R. & Thomas K.D. (eds) *Modelling ecological change*. Institute of Archaeology University College London, London, 27-40.
 Jones G., 1992. *Weed phytosociology and crop husbandry: identifying a contrast between ancient and modern practice*. *Review of Palaeobotany and Palynology* 73, 133-143.
 Jones G., Charles M., Bogaard A. & Hillman G., 2005. *Crops and weeds: the role of weed functional ecology in the identification of crop husbandry methods*. *Journal of Archaeological Science* 32, 2507-71.
 Jones G., Charles M., Bogaard A., Hillman G. & Palmer C., 2005. The functional ecology of present-day arable weed flora and its applicability for the identification of past crop husbandry. *Vegetation History and Archaeobotany* 14, 149-164.
 Küster H., 1991. *Phytosociology and archaeobotany*. In: Harris D.R. & Thomas K.D. (eds) *Modelling ecological change*. Institute of Archaeology University College London, London, 17-26.
 Matterne V., 2001. *Spécificités agricoles et végétales des sites de la Vallée de la Sambre (France septentrionale)*. Archéologie des Paysans et des Animaux 1, Editions M. Margat, Montargis, 310 p., 105 p. annexes.
 Pion R., 1997. *La culture agricole du Bas-Empire: un phytosociologique*. Thèse de Doctorat de l'Université de Valenciennes et du Hainaut-Cambrésis, Valenciennes, 310 p., 105 p. annexes.
 Pion R., 2010. *Oppida et agriculture au début du Haut-Empire: des lieux aux modalités de la production. Colloque de la Société des Antiquaires de France, La Découverte, Paris, 55-66.
 Zech-Matterne V., Boudry J., Bouchette A., Cabanis M., Derreumaux M., Durost F., Maraval P.H., Pradère B., Salen M.-F., al Warhol J., 2005. *L'agriculture du Val de la Sambre au début de l'ère chrétienne*. Actes du XXXIX colloque de l'AFEF, 17-20 mai 2007, Chauray (Vienne), Tome I. Association des Publications Chronologiques (Mémoires XXXIX), Chauray, 2005, 363-416.*