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Foxtail Millet (*Setaria italica* [L.] P. Beauv.) in Western Central Europe

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Introduction[1]

Excavations in Sittard-Geleen 'Hof van Limburg' (Netherlands) revealed a substantial part of an Early Iron Age settlement (800–500 BC). The field work was carried out by the company Archol, Leiden. The traces of former occupation comprised postholes and pits. Many postholes were remnants of four- and six-poster granaries, i. e. buildings with a frame consisting of four or six sturdy posts, supporting a wattle-and-daub structure and interpreted as above-ground storage of agricultural products. One of the six-posters had burnt down evidently and part of its charred contents had filled the holes left after salvage of the posts. Such posts were often removed for secondary use.

The site is situated in the southeastern part of the Netherlands, which is characterized by loess soils (Fig. 1). The surface of the area with the former settlement is fairly level. At present the annual rainfall is 800 mm and the mean annual temperature 10.5 °C, with a mean of 3 °C in winter and 18 °C in summer.

This contribution in honour of Helmut Kroll deals with the burnt-down granary mentioned above and one of the products stored there, foxtail millet.

Fig. 1. The location of Sittard-Geleen in the Netherlands.

Material and method

During the excavation the fill of three of the six postholes was sampled for the study of botanical macroremains. With hindsight it is regrettable that not all six were sampled, but the excavation was a commercial rescue excavation and three out of six is already more than one would expect.

The samples were brought to the archaeobotanical laboratory of the Faculty of Archaeology, Leiden University, the Netherlands, where they were handsieved under gently running tap water. The smallest mesh used was 0.25 mm. The residues were air-dried, sorted with the aid of a microscope with magnification up to 50 x and the retrieved plant remains identified and counted. All remains were carbonized as would be expected in a site with a water table well below the surface. The work was carried out by the author.

[1] I thank Kelly Fennema for improving my English and Hanna Stöger for providing me with a German *Zusammenfassung*.

Results

The results of identification and counting are presented in Table 1. The list comprises seven crop plants: spelt wheat (*Triticum spelta* L.), hulled multirowed barley (*Hordeum vulgare* L.), broomcorn millet (*Panicum miliaceum* L.), foxtail millet (*Setaria italica* [L.] P. Beauv.), pea (*Pisum sativum* L.), gold-of-pleasure (*Camelina sativa* [L.] Crantz), and flax (*Linum usitatissimum* L.). An eighth crop plant may be oats (*Avena sativa* L.) but as no floret bases were found it is not clear whether the remains represent cultivated oats or a weed. In addition to the cultivated plants, wild species were present and all of these can be interpreted as field weeds.

It is obvious that the granary was used for storing harvests before catching fire. The most numerous remains are of spelt wheat which was not yet dehusked. Spelt wheat is often found in Iron Age contexts in the southern Netherlands. The second most numerous remains are of foxtail millet, which, on the contrary, was not common at all. The other crop plants are well-known for the period (Brinkkemper/van Wijngaarden-Bakker 2005).

In the following, attention will be focused on the foxtail millet for the very reason that it is uncommon.

Table 1. Sittard-Geleen. The contents of the three postholes.

posthole	19	34	42
sample size, litre	1	2	4
Cultivated Plants			
Avena sp.	–	4	1
Avena sp., awn	–	2	1
Triticum spelta	1300	360	3200
Triticum spelta, spikelet bases	54	114	104
Triticum spelta, lemma bases	48	–	108
Triticum sp., awn	1	–	–
Hordeum vulgare	5	64	16
Hordeum vulgare, internodium	–	–	2
Triticum sp./*Hordeum* sp., awn	–	1	–
Panicum miliaceum	–	1	–
Setaria italica	1	414	140
Pisum sativum	–	6	–
Camelina sativa	–	2	–
Linum usitatissimum	–	1	–
Weeds			
Bromus secalinus-type	16	2	10
Chenopodium album	–	5	4
Chenopodium polyspermum	–	–	1
Digitaria ischaemum	–	1	–
Fallopia convolvulus	–	5	–
Festuca sp./*Lolium* sp.	–	–	2
Persicaria lapathifolia	–	40	10
Persicaria maculosa	–	–	3
Phleum sp.	–	1	–
Plantago lanceolata	1	1	1
Poa sp., not *P. annua*	–	1	–
Poaceae, div. species	–	11	–
Polygonum aviculare	–	1	1
Rumex acetosella	3	6	5
Rumex sp.	–	1	1
Scleranthus annuus	2	5	2
Setaria pumila	–	5	9
Spergula arvensis	–	2	–
Thlaspi arvense	–	–	1
Vicia hirsuta	5	12	4

Foxtail millet in the Sittard-Geleen granary

Figure 2 depicts the distribution of the carbonized remains over the three postholes. Two of these were filled mainly with the grains and chaff of spelt wheat. Only in posthole 34 is foxtail millet as important as spelt wheat. The pie charts are based on the number of seeds, and it must be kept in mind that as millet grains are much smaller than wheat grains, the share of millet in volume was less. Still, it is clear that foxtail millet was stored as a separate product. The fill of the posthole revealed, apart from the seeds, large sherds of a coarse type of pot (Fig. 3). It is quite possible that the millet was kept in such vessels.

The foxtail millet found in the granary was not the only find of this plant in Sittard-Geleen 'Hof van Limburg'. An Early Iron Age pit, filled with domestic and other waste, yielded 20 foxtail millet grains.

The grains measure 1.28(1.2–1.4) x 1.20(1.0–1.4) x 0.93(0.8–1.1) mm (n = 10). They have an oblong hilum, longer than wide. The scutellum scar reaches to 2/3 of the length of the grain with sides tapering towards an obtuse/acute end (Fig. 4). Several grains are still encased by parts of their palea and lemma. The lemma has an ornamentation of low papillae arranged in transverse rows. The ornamentation of the

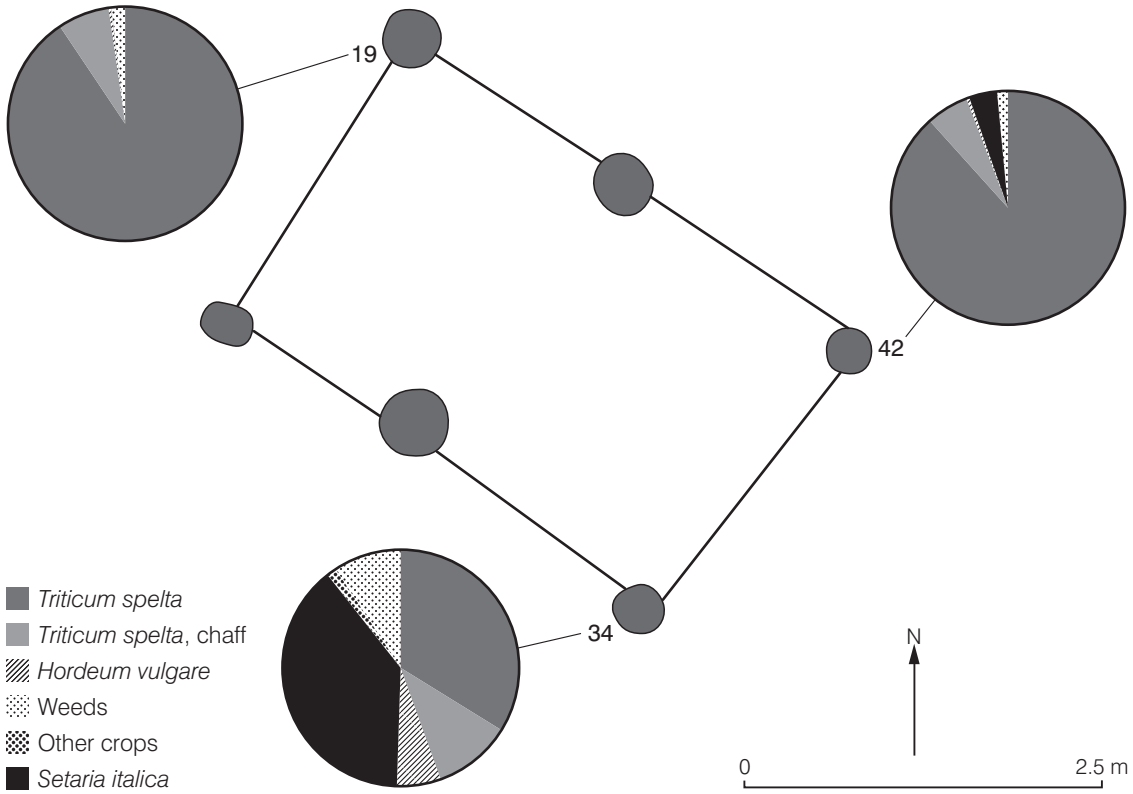

Fig. 2. Sittard-Geleen. The granary and its three posts sampled for macroremains. The pie charts depict their content.

Fig. 3. Sittard-Geleen. Section of posthole 34 with sherds of a coarse type of pot.

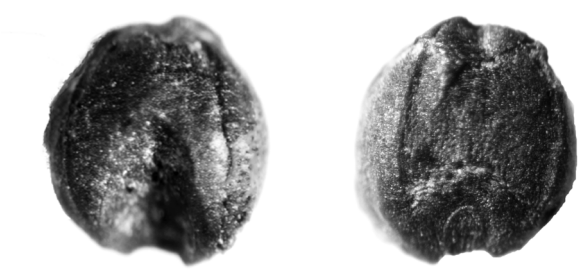

Fig. 4. Sittard-Geleen. Grain of foxtail millet from posthole 34, length 1.35 mm.

palea is less distinct but not smooth. The few specimens of *Setaria pumila* (Poir.) Schult. present in the samples are larger and have a lemma sculpturing of coarse transverse ridges. It was easy to make the separation between the two species.

What is here called foxtail millet might theoretically be green bristle grass (*Setaria viridis* [L.] Beauv.), a weed. The two are very similar and are often considered as subspecies within one single species. They are closely related and crosses are semi-fertile (Jusuf/Pernes 1985). *Setaria viridis* is the wild ancestor of *Setaria italica* (Zohary/Hopf 2000). The problem of a correct attribution is generally recognized, for instance by Knörzer (1971), van Zeist (1983) and more recently Hunt et al. (2008). Grains of *Setaria viridis* are generally more slender, but it

has to be admitted that the way in which the grains appear in the archaeological record is also used to arrive at an identification as cultivar. Grains found in a – for an ordinary weed unusual – concentration and known to exist as cultivar, are considered to represent the crop plant. Single grains are more often designated as wild. However, if a strain of the weed with attractive robust grains should have been gathered, the appearance in the archaeological record would have been the same.

Foxtail millet in western Central Europe

The identification of the *Setaria* discovered at Sittard-Geleen as foxtail millet is supported by the fact that comparable finds had been made in the nearby German Rhineland. The southeastern part of the Netherlands and the Rhineland have always been culturally close. Knörzer described several sites with relatively large amounts of foxtail millet grains. A pit in Köln-Blumenberg revealed 228 grains retrieved from a 2.5 litre sample. The find is dated to Hallstatt C/D, *c.* 800–600 BC (Early Iron Age). The cereal turned up, albeit in low numbers, in many more Early Iron Age pits within this settlement. Knörzer (1992) stresses that foxtail millet was grown as a separate crop, not as an admixture to that other millet, broomcorn millet (*Panicum miliaceum*), also present at the site. The two millets are independent in the finds.

Another concentration, with 267 grains, was retrieved from a pit in Nettesheim/Butzheim. It is also dated to Hallstatt C/D (Knörzer 1971). Slightly younger, but still Early Iron Age, are the Hallstatt D finds from Langweiler, Bergheim and Niedermerz 16 (Knörzer 1973; 1976; 1980). Earlier finds exist as well. They belong to the Urnfield period (Late Bronze Age, 1000–800 BC), but the highest number of grains found amounts to only 13. Still older finds are absent in the records.

The Early Iron Age is the heyday for foxtail millet cultivation in the German Rhineland. The millet was still cultivated in the Middle and Late Iron Age, but its remains are less numerous. The same is true for the Roman period and the Middle Ages. Foxtail millet disappears from rural records in historical times (Knörzer 2007).

The Dutch finds match this history closely, though, except for the Sittard-Geleen site, numbers of grains are low. The earliest find is dated to the Late Bronze Age (1100–1000 BC) and was made in Noordbarge-Hooge Loo. The author van Zeist (1983) hesitated whether these grains truly belong to foxtail millet and decided to remain on the safe side with an attribution to *Setaria viridis*, but in the light of later discoveries they may very well represent *Setaria italica*. Other finds are reported from Breda, Ermelo, Heumen and Maastricht-Airport, all dated to the Early Iron Age, 800–500 BC (Gouw/Kooistra 2006; van Zeist 1968; van Beurden 2003; van Beurden/Kubiak-Martens 2008). Finds from Roman contexts are absent up to now, but finds from medieval and later times are present in the records, though the foxtail millet from AD 1500 and later is restricted to urban contexts. This may be due to the fact that excavations are focused on towns, though it is more plausible that the small millet was no longer cultivated in the Netherlands but imported from elsewhere to be fed to caged birds.

The earliest find in Belgium is dated to the Iron Age. In a pit at Kerkom in Vlaams-Brabant 75 specimens were found (In't Ven et al. 2005). In northern France finds go back to the Late Bronze Age, with sites like Jouy-aux-Arches and Rettel, both Dept. Moselle (de Hingh 2000). Early Iron Age foxtail millet is reported from Dourges, Dept. Nord-Pas-de-Calais (Derreumaux 2012). Malrain et al. (2002) mention the plant for the period 3rd century to 50 BC. In all French cases numbers are low.

In Germany beyond the Rhineland foxtail millet appears also late in Prehistory. Küster (1991) writes regarding Central Europe south of the Danube: present from the Urnfield period (1200–750 BC) onwards. In the central Neckar area the plant was according to Stika (1999) present in the Late Hallstatt/Early La Tène period, but only as secondary crop, or weed. The Hochdorf excavation revealed only one grain, for instance. Kreuz (2004), reporting on Hessen and Mainfranken, has foxtail millet from Hallstatt–Early La Tène onwards, but is not sure whether it was cultivated purposefully. A survey by Boenke (2005) shows once more that foxtail millet was present in the Late Bronze Age and Early Iron Age in western Central Europe, but that it was at most a minor crop.

All surveys suggest that in the regions north of the Alps the millet appeared in the Late Bronze Age and gained some importance in the Iron Age, although it became never truly important. Publications concerned with later periods, not mentioned in detail here, make clear that the crop plant never disappeared entirely. It is tacitly assumed that the Late Bronze Age and Iron Age millet was grown locally. Whether the cereal remained a local product thereafter is open to debate. Historical sources often mention millet, but this is most probably broomcorn millet, a crop that was always of far more importance than foxtail millet in Central Europe. As all publications consulted for this article stress, foxtail millet was a very minor crop, even during its heyday in the Iron Age.

The origin of and the reason for foxtail millet cultivation

The records published so far set the start of foxtail millet cultivation in the Late Bronze Age. However, true proof is still lacking. The problem lies in the difficulty regarding the correct identification of the archaeobotanical material mentioned earlier. This problem was, for instance, encountered by Hunt et al. (2008) when reviewing records from pre-5000 BC sites across the Old World. Many records list finds as *Setaria italica/viridis* or even *Setaria italica/viridis/verticillata*. If concentrations are lacking, the finds may be interpreted as 'weed'. If the taxon is encountered with a high frequency and in larger amounts, it is designated as 'crop plant', which is exactly what happened to the millet from the Late Bronze Age onwards. However, this approach offers no conclusive proof.

Assuming that the late Bronze Age and Early Iron Age millet represents a crop, the question arises where the plant came from. Until quite recently its origin was sought in northern China, where the plant was one of the earliest domesticates, just as broomcorn millet was (Zohary/Hopf 2000). Both small-grained millets are often bracketed together, but their subsequent history is not linked at all as, for instance, Hunt et al. (2008) pointed out.

At present it is not possible to follow the expansion of foxtail millet from its presumed region of origin to Central Europe. This may be a question of absence of suitable excavations in the stretch of land in between, but there is more.

Analysis of the genetic variability in modern foxtail millet demonstrated that this millet does not represent one single genetic group. Chinese millet does differ from European millet, for instance. It is plausible that foxtail millet knew several centres of origin and there are strong indications that one of these is Central Europe (Jusuf/Pernes 1985; Schontz/Rether 1999). This implies that the millet evolved from local green bristle grass. As such, foxtail millet would have followed the same path as oats (*Avena sativa* L.). The incipient cultivation could have taken place in the Late Bronze Age and true cultivation became established in the Early Iron Age. The reason why remains obscure. It is tempting to connect this development with the climatic change which set in around 800 BC (Magny 2004; van Geel et al. 1996; van Geel/Renssen 1998). A direct link seems, however, unlikely: for one thing because domestication started earlier, and for another because the climatic change was one towards the cold and the wet. Foxtail millet is averse to such conditions. Nevertheless, the cultivation of the new crop plant may be connected in an indirect way. If traditional crops failed more often, farmers may have felt the need for an emergency crop, and foxtail millet, spring-sown with a very short growing season, may have fulfilled this need. Yet, the plant never became popular. Why the most numerous finds turn up in the Rhineland and adjacent southeastern Netherlands is not clear. There is no obvious reason why exactly there farmers should have taken up foxtail millet cultivation. Further research is clearly needed.

Conclusion

Grains of the green bristle grass-foxtail millet group (*Setaria viridis/italica*) turn up occasionally in waste left by prehistoric farming communities. From the late Bronze Age onwards finds become more frequent and the number of grains larger, inducing archaeobotanists to attribute them to foxtail millet. Possibly the western Central European millet had no relation to the foxtail millet known as early cultivar in China. The crop plant may have known a domestication history of its own. Why it gained a modest popularity in the Iron Age, especially in its early stage, is not yet clear. If a change in climate was the reason, this change was an indirect trigger only.

Summary

A burnt-down granary in an Early Iron Age settlement excavated in Sittard-Geleen, the Netherlands, gave occasion to a review of foxtail millet occurrences in prehistoric western Central Europe. It turned out that this millet is found from the Late Bronze Age onwards and had its heyday during the Iron Age. The western Central European crop plant may have no connection at all with the cultivar known from China. Why foxtail millet was taken up as a crop is not clear. The climatic change which set in about 800 BC may have played a role, but possibly not a direct one. Foxtail millet may have been sown as an emergency crop when other crops failed.

Zusammenfassung

Ein abgebrannter Getreidespeicher in einer Siedlung der frühen Eisenzeit in Sittard-Geleen (Niederlande) gab Anlass zu einer Neubewertung des Auftretens von Kolbenhirse im westlichen Mitteleuropa in vorgeschichtlicher Zeit.

Es konnte festgestellt werden, dass diese Hirse bereits ab der späten Bronzezeit auftrat, aber erst während der Eisenzeit ihre größte Verbreitung fand. Die west-mitteleuropäische Getreidesorte scheint keine Verwandtschaft zu der aus China bekannten Kulturvarietät zu haben. Es ist nicht ganz eindeutig, warum Kolbenhirse als Getreidesorte aufgenommen wurde. Die klimatischen Veränderungen, die sich um ca. 800 BC einstellten, spielten dabei möglicherweise eine indirekte Rolle. Kolbenhirse könnte als „Notgetreide" gesät worden sein, wenn andere Getreidearten zu Missernten führten.

REFERENCES

van Beurden 2003: L. van Beurden, Heumen-Noord: enkele silo's, waterkuilen en een spieker uit de Midden Bronstijd en Vroege en Midden IJzertijd botanisch onderzoek. Biaxiaal 167, 2003.

van Beurden/Kubiak-Martens 2008: L. van Beurden/L. Kubiak-Martens, m.m.v. [with a contribution by] J. Langer, Maastricht Aachen-Airport, botanische macroresten en resten van teer uit IJzertijdsporen. Biaxiaal 384, 2008.

Boenke 2005: N. Boenke, Ernährung in der Eisenzeit: ein Blick über den Tellerrand. In: R. Karl (ed.), Interpretierte Eisenzeiten. Fallstudien, Methoden, Theorie [Congress Linz 2004]. Stud. Kulturgesch. Oberösterreich 18 (Linz 2005) 241–256.

Brinkkemper/van Wijngaarden-Bakker 2005: O. Brinkkemper/L. van Wijngaarden-Bakker, All-round farming, food production in the Bronze Age and the Iron Age. In: L. P. Louwe Kooijmans/P. W. van den Broeke/H. Fokkens/A. L. van Gijn (eds.), The Prehistory of the Netherlands 2 (Amsterdam 2005) 491–512.

Derreumaux 2012: M. Derreumaux, Du terrain au terroir. Appréhender les systèmes agraires grâce aux grands décapages (Thèse Université de Paris 1, Panthéon-Sorbonne 2012).

van Geel/Renssen 1998: B. van Geel/H. Renssen, Abrupt climate change around 2,650 BP in North-West Europe: evidence for climatic teleconnections and a tentative explanation. In: A. S. Issar/N. Brown (eds.), Water, environment and society in times of climatic change [Symposium Sede Boker, Israel 1996]. Water Science Technology Library 31 (Dordrecht/Boston/London 1998) 21–41.

van Geel et al. 1996: B. van Geel/J. Buurman/H. T. Waterbolk, Archaeological and palaeoecological indications for an abrupt climate change in The Netherlands and evidence for climatological teleconnections around 2650 BP. Journal Quaternary Science 11/6, 1996, 451–460.

Gouw/Kooistra 2006: M. Gouw/L. I. Kooistra, Geologie, bodem en vegetatie. In: P. Kranendonk/P. van der Kroft/J. J. Lanzing/B. H. F. M. Meijlink (eds.), Witte vlekken ingekleurd. Archeologie in het tracé van de HSL-Zuid. Rapportage Arch. Monumentenzorg 113 (Amersfoort 2006) 113–164.

de Hingh 2000: A. E. de Hingh, Food production and food procurement in the Bronze Age and Early Iron Age (2000–500 BC). Arch. Stud. Leiden Univ. 7 (Leiden 2000).

Hunt et al. 2008: H. V. Hunt/M. Vander Linden/X. Liu/G. Motuzaite-Matuzeviciute/S. Colledge/M. K. Jones, Millets across Eurasia: chronology and context of early records of the genera *Panicum* and *Setaria* from archaeological sites in the Old World. Vegetation Hist. and Archaeobot. 17, Suppl. 1, 2008, 5–18.

In't Ven et al. 2005: I. In't Ven/W. Wouters/I. Roovers/T. Debruyne/B. Cooremans, Romeinse gebouwsporen aan de Boskouterstraat in Kerkom (Boutersem, prov. Vlaams-Brabant). In: I. In't Ven/W. De Clercq (eds.), Een lijn door het landschap. Archeologie en het VNT-project 1997–1998, Part 2. Arch. Vlaanderen Monogr. 5 (Brussel 2005) 283–300.

Jusuf/Pernes 1985: M. Jusuf/J. Pernes, Genetic variability of foxtail millet (*Setaria italica* P. Beauv.). Theoretical and Applied Genetics 71/3, 1985, 385–391.

Knörzer 1971: K.-H. Knörzer, Eisenzeitliche Pflanzenfunde im Rheinland. Bonner Jahrb. 171, 1971, 40–58.

Knörzer 1973: K.-H. Knörzer, Die pflanzlichen Großreste. In: W. Göbl/K.-H. Knörzer/J. Schalich/R. Schütrumpf/P. Stehli, Naturwissenschaftliche Untersuchungen an einer späthallstattzeitliche Fundstelle bei Langweiler, Kr. Düren. Bonner Jahrb. 173, 1973, 301–315.

Knörzer 1976: K.-H. Knörzer, Späthallstattzeitliche Pflanzenfunde bei Bergheim, Erftkreis. In: H.-E. Joachim/M. Ludwig (red.), Beiträge zur Urgeschichte des Rheinlandes 2. Rhein. Ausgr. 17 (Köln/Bonn 1976) 151–185.

Knörzer 1980: K.-H. Knörzer, Neue Metallzeitliche Pflanzenfunde im Rheinland. In: G. Bauchhenß (red.), Naturwissenschaftliche Beiträge zur Archäologie 1. Archaeophysika 7 (Köln 1980) 25–34.

Knörzer 1992: K.-H. Knörzer, Pflanzenfunde aus der metallzeitlichen Siedlung Blumenberg (Stadt Köln). Kölner Jahrb. Vor- u. Frühgesch. 25, 1992, 475–487.

Knörzer 2007: K.-H. Knörzer, Geschichte der synanthropen Flora im Niederrheingebiet. Pflanzenfunde aus archäologischen Ausgrabungen. Rhein. Ausgr. 61 (Mainz 2007).

Kreuz 2004: A. Kreuz, Landwirtschaft im Umbruch? Archäobotanische Untersuchungen zu den Jahrhunderten um Christi Geburt in Hessen und Mainfranken. Ber. RGK 85, 2004, 97–292.

Küster 1991: H. Küster, Mitteleuropa südlich der Donau, einschließlich Alpenraum. In: W. van Zeist/K. Wasylikowa/ K.-E. Behre (eds.), Progress in Old World Palaeoethnobotany. A Retrospective view on the occasion of 20 years of the International Work Group for Palaeoethnobotany (Rotterdam/ Brookfield 1991) 179–187.

Magny 2004: M. Magny, Holocene climate variability as reflected by mid-European lake-level fluctuations and its probable impact on prehistoric human settlements. Quaternary Internat. 113, 2004, 65–79.

Malrain et al. 2002: F. Malrain/V. Matterne/P. Méniel, Les Paysans Gaulois (Paris 2002).

Schontz/Rether 1999: D. Schontz/B. Rether, Genetic variability in foxtail millet, *Setaria italica* (L.) P. Beauv. Identification and classification of lines with RAPD markers. Plant Breeding 118, 1999, 190–192.

Stika 1999: H.P. Stika, Approaches to reconstruction of early Celtic land-use in the central Neckar region in southwestern Germany. Vegetation Hist. and Archaeobot. 8, 1999, 95–103.

van Zeist 1968: W. van Zeist, Prehistoric and Early Historic food plants in the Netherlands. Palaeohistoria 14, 1968, 41–173.

van Zeist 1983: W. van Zeist, Plant remains from Iron Age Noordbarge, province of Drenthe, The Netherlands. Palaeohistoria 23, 1983, 169–193.

Zohary/Hopf 2000: D. Zohary/M. Hopf, Domestication of Plants in the Old World. The Origin and Spread of Cultivated Plants in West Asia, Europe and the Nile Valley (Oxford/ New York 2000³).

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