

Evaluating prehistoric finds of *Arrhenatherum elatius* var. *bulbosum* in north-western and central Europe with an emphasis on the first Neolithic finds in Northern Germany

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Abstract The swollen basal internodes of the grass species *Arrhenatherum elatius* var. *bulbosum* (tuber oat grass) are recorded here for the first time for Neolithic Germany. These charred bulbs occurred in the Late Neolithic soil mantle of the megalithic tomb of Albersdorf-Brutkamp LA 5. They are interpreted as most probably originating from the natural vegetation on and around the grave mound. The bulbs were possibly charred in the course of a ritual fire. However, their use as gathered plants and their intentional deposition in a secondary burial ritual during the Late Neolithic cannot be excluded with any certainty. Identification criteria for *Arrhenatherum* bulbs as well as the ecological requirements of the species are introduced here. Furthermore, prehistoric bulb finds from north-western and central Europe, and different interpretations concerning the occurrence of *Arrhenatherum* in different archaeological contexts, are discussed. The compilation of finds from literature and excavation reports shows that bulbs of *Arrhenatherum* were found rather infrequently in the Neolithic. Most commonly, charred bulbs of *A. elatius* var. *bulbosum* are detected in Bronze Age cremation graves. In the Iron Age, however, they mainly occur in domestic sites. This shows that the interpretation of the plant remains is dependent on their archaeological context. A ritual meaning of the bulbs has to be considered in the interpretation, but they may also have contributed to people's daily diet. This evaluation of bulb finds in prehistoric and historic contexts contributes to

the debate on the relevance of plant gathering in early economies and in ritual activities.

Keywords *Arrhenatherum elatius* var. *bulbosum* · Bronze Age · Late Neolithic · Northern Germany

Introduction

In archaeobotanical research on plant macro-remains, seeds and fruits are commonly the focus of investigation, as they appear prevalently and are easy to determine. However, in some cases, the vegetative parts of plants are also preserved in a charred condition and can thus be categorized. Research has been conducted with a focus on the determinability of vegetative parenchymatous organs like roots, tubers, corms, rhizomes and bulbs (e.g. Hather 1991, 1993; Kubiak-Martens 2002).

Tuber oat grass (*Arrhenatherum elatius* var. *bulbosum* [(L.) P. Beauv. ex J. Presl & C. Presl] (after Erhardt et al. 2002), for example, shows swollen basal internodes that feature distinct characteristics for determination. These bulbs were detected at several prehistoric sites over western, central and northern Europe during conventional archaeobotanical investigations of floated soil samples. Since these swollen basal internodes have now been detected for the first time at a megalithic tomb site in Northern Germany, it is important to more closely examine different aspects of *Arrhenatherum*, such as morphological characteristics, ecology, and the archaeological context of occurrence. Here, we compile European finds of *Arrhenatherum* from different archaeological sites and periods with their manifold interpretations in order to attain understanding of the reasons for the occurrence of the bulbs in archaeobotanical samples.

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Description of *A. elatius*

Oat grass (*A. elatius*) can be separated into two subspecies or varieties: *A. elatius elatius* (false oat grass or tall oat grass) and *A. elatius bulbosum* (tuber oat grass or onion couch grass). Only *A. elatius* var. *bulbosum* develops bulbs 5–11 mm in diameter at the basal stem internodes (Bond et al. 2007). They are pear or fig shaped and longitudinal marks can be seen on the epidermis, even in charred material (Fig. 1a). As the bulbs are vegetative reproductive organs, they contain high amounts of starch. There are often three to five successive internodes involved and a chain of bulbs may develop (Fig. 1b). These chains are readily separated by harrowing and each bulb is capable of growing into a separate plant (Ayres 1977; Engelmark 1984). Young bulbs are small and white and turn brown as they mature. They usually form under the surface but may also grow

above the soil and turn green when the crown is shallow (Bond et al. 2007). In semi-natural grasslands, both subspecies occur together. The bulb formation is hereditary and independent of habitat; soil types only modify the degree of bulb development. Crossbreeding of the two forms results in hybrids that are less bulbous than the parental plants (Bond et al. 2007).

Ecology of *A. elatius*

A. elatius is a perennial grass up to 150 cm tall. The grass is very common in the temperate regions of Europe on moderately fertile soils. Today, the northernmost limit of continuous distribution is the south of England and northern Germany. It also occurs sporadically in ruderal habitats in southern Scandinavia (Engelmark 1984, p. 88). Today, the bulbous form seems to be extinct in some places where it evidently grew in prehistoric times, as is the case in Switzerland (Akeret and Geith-Chauviere 2011, p. 65).

A. elatius occurs as a component of semi-natural grassland, on unmown verges, and in light forest areas within the arable land. Since it is intolerant to trampling, cutting and grazing, it is absent from heavily trodden and pastured areas. In grasslands, *A. elatius* tends to be very persistent but is not particularly competitive or invasive and therefore remains very local. This grass species is sensitive to shade and cannot withstand low temperatures or exposure to wind (Bond et al. 2007; Petersen 1981).

A. elatius var. *bulbosum* can also emerge as an invasive weed in arable fields, especially among winter crops. After establishment, it is impossible to reduce its numbers through intensive tillage or similar churning techniques. This would, on the contrary, promote the spread due to its vegetative propagation. In order to eliminate *A. elatius* var. *bulbosum*, it is necessary to burn the soil surface and the uprooted plants. In addition, a change from winter to spring cropping, combined with winter ploughing, can reduce the quantity of *Arrhenatherum* (Bond et al. 2007).

First Neolithic finds of *A. elatius* var. *bulbosum* in Northern Germany

Until now, bulbs of *Arrhenatherum* were discovered in Germany only at Pre-Roman Iron Age and Roman period sites (Table 2). Now, for the first time, finds of swollen basal internodes of *A. elatius* var. *bulbosum* have been discovered at a megalithic tomb site in Northern Germany. The extended polygonal dolmen Albersdorf-Brutkamp LA 5 is situated in the Albersdorf commune in the Dithmarschen district of Schleswig-Holstein (Kelm 2006; Arnold and Kelm 2004). In summer 2009, the entrance area of the grave on the narrow south-eastern side was excavated within an east

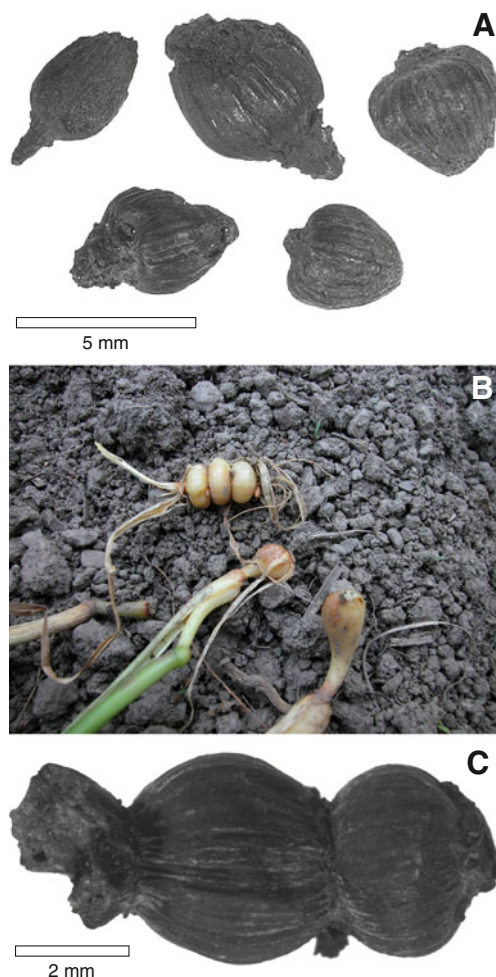
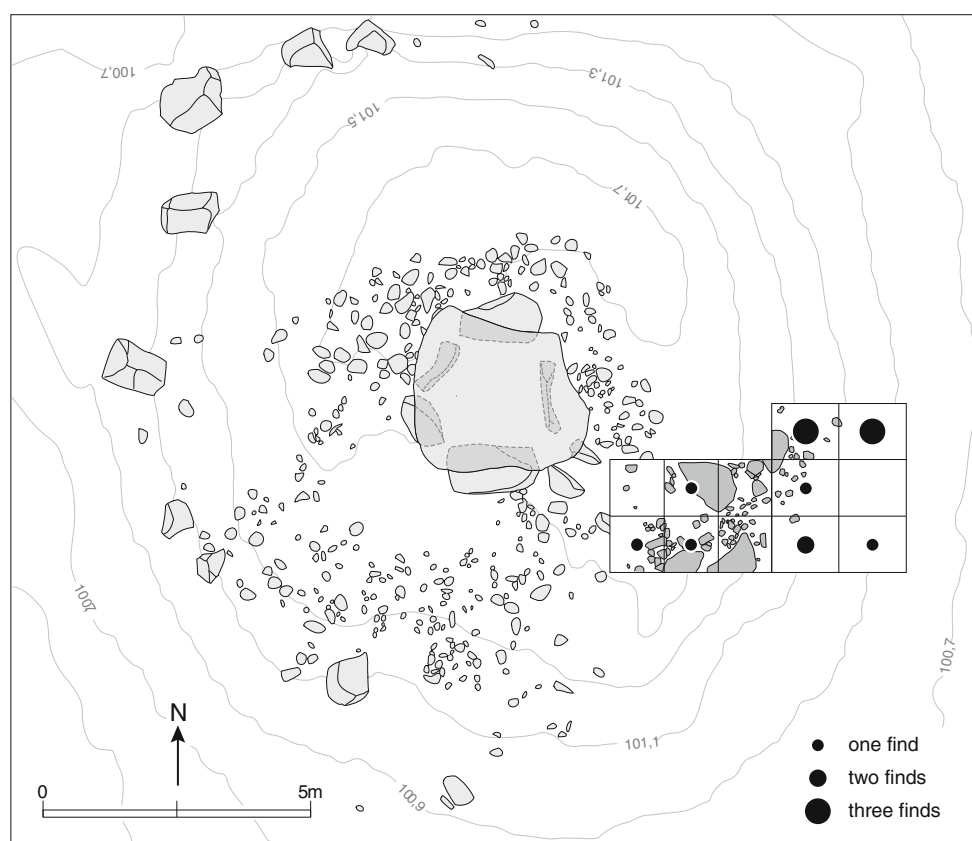


Fig. 1 **a** Charred bulbs of *Arrhenatherum* from the megalithic tomb of Albersdorf-Brutkamp LA 5, Germany (photograph: H. Röhrs). **b** Recent bulbs of *Arrhenatherum* that grew as weed in an arable spelt field in Asturias, northern Spain (after Jacomet and Brombacher 2009, Fig. 21). **c** Chain of bulbs of *Arrhenatherum* from the non-megalithic long barrow in Frydenlund, Denmark (photograph: H. Röhrs)

Fig. 2 Excavation map from the megalithic tomb Albersdorf Brutkamp, campaign 2009, with findings of charred *Arrhenatherum* bulbs



western orientated grid of 12 quadrants (Fig. 2) (Dibbern and Hage 2010). The area inside the boundary of the grave was included in the investigation, along with the area outside.

Radiocarbon dates indicate that the construction of the dolmen occurred in the Early to Middle Neolithic (Funnel-beaker Culture), between 3630–3530 cal BC (Mischka and Demnick 2011). During a re-opening episode in Late Neolithic times, the contents of the burial chamber were presumably cleared into the entrance area (Dibbern and Hage 2010; Müller 2011, p. 40). This could be confirmed through radiocarbon dates from *Arrhenatherum* bulbs, which point to approximately 2250–2000 cal BC (Table 1). The original soil mantle of the grave mound was found under the top-soil, which was scarcely impacted by modern disturbances (Dibbern and Hage 2010).

Although secondary burials could be verified for the Late Neolithic (Kühn 1979, pp. 16–17), in the case of Albersdorf-Brutkamp it is not certain whether a secondary

burial took place. Despite the fact that inhumation is the common burial practise at Funnel Beaker and Late Neolithic groups, no bones were preserved due to dry soil conditions at the site. In addition, the grave chamber was probably affected by modern disturbances. Only charred plant material has been preserved, and this showed a predominance of collected plants (Kirleis et al. 2012; Röhrs 2012). Due to radiocarbon dating, the remains could be separated into an Early to Middle Neolithic group (77 remains) and a Late Neolithic group (43 remains) (Röhrs 2012). In the samples dating to the Late Neolithic, a surprisingly high percentage (30 %) of all plant remains was composed of bulbs of onion couch grass (*A. elatius* var. *bulbosum*). Ten of the bulbs were located outside of the stone perimeter in the soil mantle, with three located on the inside. Two radiocarbon dates indicate that the bulbs were brought into the grave context concurrent with dagger fragments during the Late Neolithic (2250–2000 cal BC) and are therefore not contemporaneous with the construction phase of the megalithic

Table 1 Results of radiocarbon dating of two bulbs of *Arrhenatherum elatius* var. *bulbosum* from Albersdorf-Brutkamp LA 5

Lab code	Radiocarbon age in BP	2 σ -range in cal BC (probability in %)	Archaeobotanical lab code	Quadrant	Depth (m)
KIA 42398 (07.2012)	3,714 $\pm$ 35	2,204–2,019 (93.5 %)	10,162	12	0.4–0.6
KIA 42399 (07.2012)	3,743 $\pm$ 39	2,233–2,032 (86.8 %)	10,030	1	0.2–0.4

Calibration of the dates was calculated with “CALIB rev 5.01”, data set: IntCal04 (Reimer et al. 2004)

tomb. As there are no finds of *Arrhenatherum* contemporary to those from Albersdorf-Brutkamp and no interpretations from Germany until now, supra-regional comparisons are necessary.

Compilation of prehistoric finds of *A. elatius* var. *bulbosum* in North-western and Central Europe

Evidence of fossil bulbs of *A. elatius* var. *bulbosum*

The first evidence of charred bulbs of *A. elatius* var. *bulbosum* in archaeobotanical samples was recorded in Great Britain in 1949 (Allison and Godwin 1949). In 1984, more finds were noted in Swedish grave contexts, leading to ritual interpretations (Engelmark 1984). This early recognition of *Arrhenatherum* resulted in intensified recording of this finds category in Great Britain as well as in Scandinavia. A literature review for north-western and central Europe reveals that British and Swedish finds of *Arrhenatherum* bulbs were represented in the highest numbers in comparison to other countries. Only a few finds are recorded in Belgium, Netherlands, Switzerland, Finland and Poland (Fig. 5). Inclusion of the online database from Moesgård Museum (2012) and unpublished reports from French, Danish and German colleagues resulted, however, in a high number of additional sites with evidence for *A. elatius* var. *bulbosum*, which resulted in an overall predominance of Danish finds of *Arrhenatherum*. This compilation of finds is certainly biased and depends above all on knowledge regarding the identification of these bulbs, as well as on the spread of active archaeobotanical working groups throughout Europe, and the varying emphases of different archaeological research projects in different countries. Nevertheless, the evidence for bulb finds which most probably were not intentionally grown but occurred as weed species in crop fields or belonged to the (semi-)natural vegetation, is worth systematic review. This evaluation of bulb finds in prehistoric and historic contexts contributes to the debate on the relevance of plant gathering in early economies and in ritual activities.

As the modern artificial national boundaries did not exist in their current form throughout the different prehistoric and historic periods, they only complicate a comprehensive evaluation. Hence, the following supra-regional overview considers mainly different archaeological periods and contexts (Fig. 3). Furthermore, our classification of sites with evidence of charred bulbs of *Arrhenatherum* is not based on absolute dating but depends on regional periodisations that differ slightly between the countries.

Archaeological context

While finds from grave sites dominate the published evidence, following the aforementioned detailed compilation

the finds from settlement sites make up nearly 60 % of all known records. It has to be noted that the French sites have mostly been excavated within the scope of one project; this led to an intensive but settlement-focused investigation of certain sites from certain times in a limited area, which may explain the emphasis on finds from settlement sites, especially in the Pre-Roman Iron Age (Table 2, Fig. 3). Through continued archaeobotanical survey during investigations on Danish rescue excavations, all periods were recorded equally but more settlement sites were able to be recognized. The high number of finds from settlement contexts in France and Denmark led to an apparent general European imbalance in the total number of finds from graves and from settlements, with settlements predominating (Fig. 4).

Archaeological periodisation

In Great Britain, most sites with charred bulbs of *Arrhenatherum* date to the Neolithic and the Bronze Age (Fig. 3). In contrast, nearly all relevant sites dating from the Migration Period to the Middle Ages are recorded in Scandinavia: Denmark, Sweden and Finland. In Great Britain and Sweden, periods with high numbers of *Arrhenatherum* finds in graves from the Bronze Age and the Migration Period/Middle Ages are prevalent; consequently, in both countries the charred bulbs are mainly grave finds (Fig. 4). In Denmark, all time periods are represented more or less equally as a consequence of regular investigation of archaeobotanical samples from different rescue excavations (Fig. 5), with the same tendency also visible in the French material. One exception to this pattern is the finds of *Arrhenatherum* from the excavation of a Bronze Age arable field recorded in Denmark.

General outline

When considering all finds of *Arrhenatherum* irrespective of national boundaries, the highest number of sites with finds of charred bulbs of *Arrhenatherum* date to the Bronze Age ($n=40$). For the Neolithic, the Pre-Roman Iron Age and the Roman Iron Age, approximately 20 sites are recorded for each period. From the Migration Period to the Middle Ages, and especially for the Viking period, 16 sites could be recognised (Fig. 6). In the Bronze Age, graves are more frequently represented than settlements although in the other time periods finds from settlements are predominant, particularly in the Pre-Roman Iron Age. Despite regional differences cremation burials occur in general from the Pre-Roman Iron Age to the Roman Iron Age, as well as in Middle and Late Bronze Age times. Hence, the appearance of *Arrhenatherum* in these periods cannot be dependent on a change in funerary rites. Only in Neolithic and Early Bronze Age times were inhumation burials the common practice.

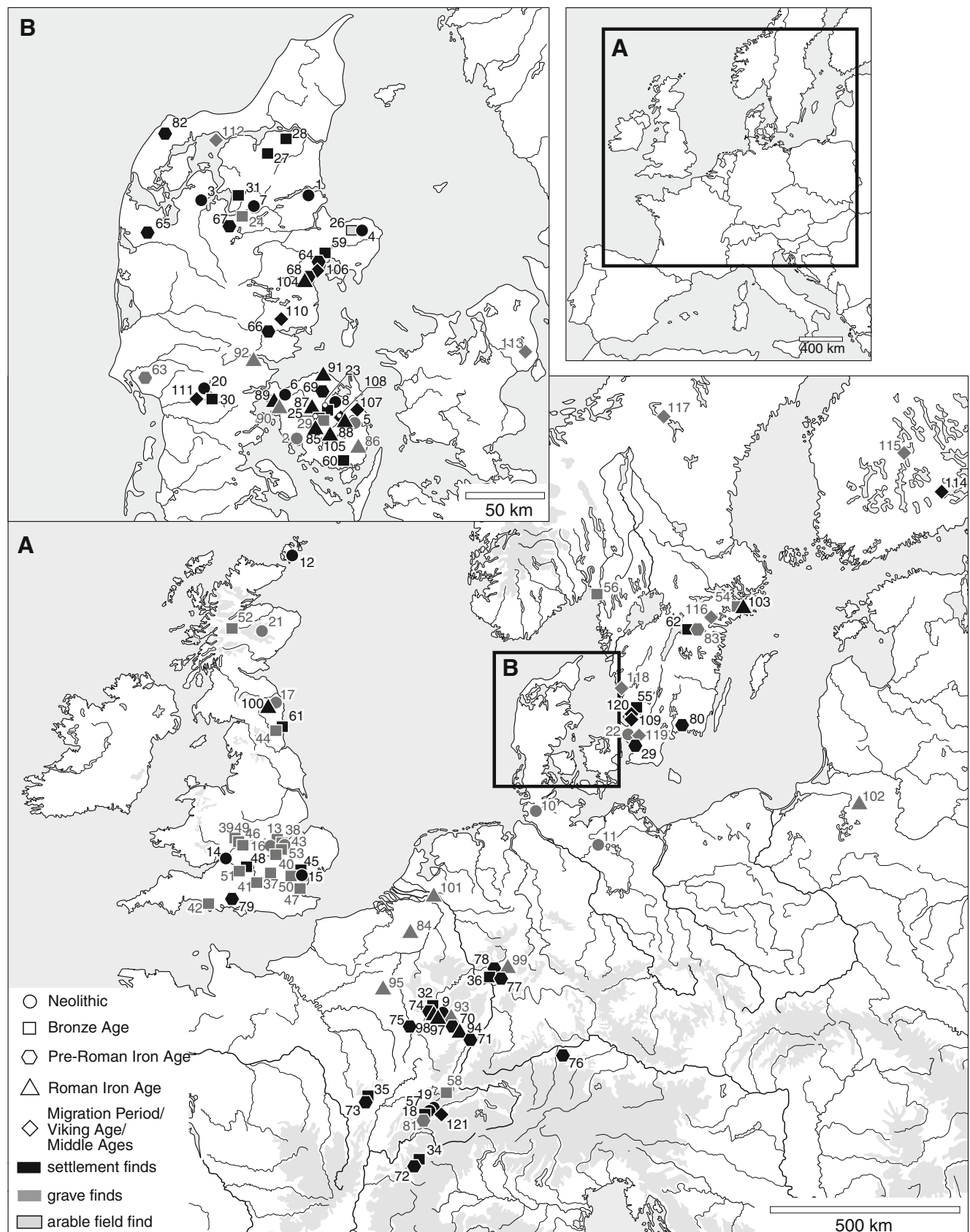


Fig. 3 Map of sites with evidence for charred bulbs of *A. elatius* var. *bulbosum* in north-western and central Europe (see Table 2)

Table 2 Compilation of *Arrhenatherum* bulb evidence from north-western and central Europe

	Period	Country	Site name	Type of site	Dating information	Number of bulbs	Interpretation	Reference
1	Neolithic	Denmark	Ajstrup Krat	Settlement	Pitted Ware Culture	1	–	Moesgård Museum (2012)
2	Neolithic	Denmark	Frydenlund I	Megalithic grave	–	1	–	Moesgård Museum (2012)
3	Neolithic	Denmark	Glattrup VI	Settlement	Late Neolithic	1	–	Moesgård Museum (2012)
4	Neolithic	Denmark	Hemmed plantage	Settlement	Late Neolithic, about 1800 BC	1	Weed and ruderal plant	Henriksen (2000)
5	Neolithic	Denmark	Ibjerg	Megalithic grave	Funnel Beaker Culture	1	–	Moesgård Museum (2012)
6	Neolithic	Denmark	Industrivej	Settlement	Funnel Beaker Culture, MNA Ib	3	–	Moesgård Museum (2012)
7	Neolithic	Denmark	Rishøj	Settlement	–	1	–	Moesgård Museum (2012)
8	Neolithic	Denmark	Tietgenbyen Nordvest	Settlement	–	3	–	Moesgård Museum (2012)
9	Neolithic	France	Flévy	Storage	Bell Beaker Culture	9	–	J. Wietbold (personal communication)
10	Neolithic	Germany	Albersdorf-Brutkamp LA 5	Grave	Late Neolithic, 2250–2000 BC	14	–	Presented in this article
11	Neolithic	Germany	Friedrichsruhe	Grave	–	1	–	Own preliminary research
12	Neolithic	Great Britain	Bamhouse	Settlement	3500–3000 BC	3	Fuel or gathered food	Hinton (2005, p. 341)
13	Neolithic	Great Britain	Bunyan Centre, Bedfordshire	Grave	Late Neolithic	A few	–	Scaife (1999)
14	Neolithic	Great Britain	Hazleton North	Settlement	Early Neolithic, 2970±56 uncal BC	Some	Ungrazed grassland and abandoned arable land	Straker (1990, p. 216)
15	Neolithic	Great Britain	The Stumble	Settlement	–	A few	–	Murphy (1989, pp. 21–22)
16	Neolithic	Great Britain	Valley Bottom, Raunds	Grave	4330–3990 Cal BC (5,325±50 BP)	19	–	Campbell and Robinson (2007, pp. 22–23) and Campbell (2011)
17	Neolithic	Great Britain	Whitton Hill	Cremation grave	Late Neolithic	A few	–	van der Veen (1985, p. 207)
18	Neolithic	Switzerland	Bevaix/Treytel-À Sugiez	Settlement	Endneolithic	3	–	Akeret and Geith-Chauviere (2011, pp. 311–321)
19	Neolithic	Switzerland	Cortailod/Sur les Rochettes-Est	Settlement	Bell Beaker Culture	10	–	Akeret (2005, p. 281)
20	Late Neolithic/Early Bronze Age	Denmark	Mannehojgård	Settlement	–	At least 2	Edible	Moesgård Museum (2012)
21	Neolithic/Bronze Age	Great Britain	Caimwell, Portlethen	Cremation grave	–	6	–	Holden (1997)
22	Late Neolithic/Early Bronze Age	Sweden	Häljarp (SU2)	Grave	–	2	–	Regnell and Sjögren (2006)
23	Bronze Age	Denmark	C. F. Tietgenboulevard	Settlement	–	3–5	–	Moesgård Museum (2012)
24	Bronze Age	Denmark	Duehøj Syd	Cremation grave	–	10	–	Moesgård Museum (2012)
25	Bronze Age	Denmark	Energivej	Settlement	250–0 cal BC	2	–	Moesgård Museum (2012) and Jensen (2010a)
26	Bronze Age	Denmark	Glesborg	Arable field	–	25	Weed	Henriksen (2000)
27	Bronze Age	Denmark	Juelstrupparken	Settlement	–	1	–	Moesgård Museum (2012)
28	Bronze Age	Denmark	Kildalsgård	Settlement	Early Bronze Age	1	–	Moesgård Museum (2012) and Jensen (2007)
29	Bronze Age	Denmark	Kildehuse II	Cremation grave	700–500 cal BC	Approx. 50	Ritual	Jensen et al. (2010)

Table 2 (continued)

Period	Country	Site name	Type of site	Dating information	Number of bulbs	Interpretation	Reference
Bronze Age	Denmark	Kongehøj II	Settlement	–	4	–	Moesgård Museum (2012)
Bronze Age	Denmark	Langmosegård	Settlement	–	1	–	
Bronze Age	France	Basse-Ham	Settlement pit	–	2	–	J. Wiethold (personal communication)
Bronze Age	France	Camp d'Alba, Réalville	Cremation grave	–	A few	–	Preiss et al. (2005, p. 370)
Bronze Age	France	Passy/Véron	Settlement and storage	–	1	–	Wiethold (2009a)
Bronze Age	France	Varois-et-Chaignot	Settlement and pit	–	2	–	Wiethold (2007)
Bronze Age	Germany	Emmerich, Runkel	Settlement pit	Hallstatt C	1	–	Kreuz and Schäfer (2008)
Bronze Age	Great Britain	Ashville Trading Estate, Abingdon, Oxfordshire	Cremation grave	–	4	–	Jones (1978, p. 101)
Bronze Age	Great Britain	Barleycroft Farm	Cremation grave	–	A few	–	Evans and Knight (2001)
Bronze Age	Great Britain	Barrow Hills, Radley	Cremation grave	–	A few	–	Moffett (1999)
Bronze Age	Great Britain	Briar Hill	Grave	–	A few	–	Perry (1985)
Bronze Age	Great Britain	Burghfield, Berkshire	Grave	–	6	Tinder and open grass indicator	Carruthers (1992, p. 63)
Bronze Age	Great Britain	Down Farm	Cremation grave	–	A few	–	Robinson (1988)
Bronze Age	Great Britain	Irlhamborough	Cremation grave	–	A few	–	Robinson (1988)
Bronze Age	Great Britain	Kingsborough, Isle of Sheppey	Cremation grave	1430–920 BC	High amount	Tinder	Stevens (2008, p. 296)
Bronze Age	Great Britain	Lofts Farm	Settlement	–	1	–	Murphy (1991, p. 342)
Bronze Age	Great Britain	Mount Farm	Cremation grave	–	A few	–	Robinson (1988)
Bronze Age	Great Britain	North Shoebury	Cremation grave	–	A few	–	Murphy (1991, p. 331)
Bronze Age	Great Britain	Rockley Down, Wiltshire	Settlement	–	Approx. 50	Weed and possibly diet	Allison and Godwin (1949)
Bronze Age	Great Britain	Rollright Site 4	Cremation grave	–	A few	No food and tinder	Robinson (1988)
Bronze Age	Great Britain	Rush Green	Cremation grave	–	A few	–	Murphy (1991, p. 331)
Bronze Age	Great Britain	Shorncliffe Quarry	Cremation grave	–	1	Tinder	Robinson (1995, p. 46)
Bronze Age	Great Britain	Sketewan, Balhaguard, Scotland	Cremation grave	–	2	–	Dickson (1997)
Bronze Age	Great Britain	Valley Bottom, Raunds	Cremation grave	1370–1000 cal BC (2950±50 BP)	5	–	Campbell and Robinson (2007, pp. 27–28 and Campbell (2011)
Bronze Age	Sweden	Annelöv (SU13)	Grave	–	1	–	Regnell and Sjögren (2006)
Bronze Age	Sweden	Fosie near Malmö	Settlement	–	Approx. 20	–	Gustafsson (1995, p. 382)
Bronze Age	Sweden	Vitlycke, Tanum, Bohuslän	Cremation grave	–	A few	–	Gustafsson (1995) and Viklund (2002, Table 4)
Bronze Age	Switzerland	Bevaix/Les Maladières	Settlement and posthole	Early Bronze Age	4	–	Akeret and Geith-Chauviere (2011, pp. 311–321)
Bronze Age	Switzerland	Delémont En la Pran	Cremation grave	–	11	Weed in winter crops	Jacomiet and Brombacher (2009, p. 62)
Younger Bronze Age/Pre-Roman Iron Age	Denmark	Grenåvej, Skødstrup	Settlement	–	1	–	Moesgård Museum (2012)

Table 2 (continued)

	Period	Country	Site name	Type of site	Dating information	Number of bulbs	Interpretation	Reference
60	Younger Bronze Age/Pre-Roman Iron Age	Denmark	Hellegård I	Settlement	–	At least 2	–	Moesgård Museum (2012)
61	Bronze Age/Iron Age	Great Britain	Kingsborough, Isle of Sheppey	Settlement	–	A few	Natural vegetation	Stevens (2008, p. 296)
62	Younger Bronze Age/Pre-Roman Iron Age	Sweden	Vistad near Väderstad socken, Östergötland	Settlement	–	A few	–	Gustafsson (1995, pp. 382–383)
63	Pre-Roman Iron Age	Denmark	Årre	Cremation grave	–	2	–	Moesgård Museum (2012)
64	Pre-Roman Iron Age	Denmark	Elmhøjssager II	Settlement	200–0 cal BC	13	Ritual, postholes of entrance area	Jensen et al. 2010
65	Pre-Roman Iron Age	Denmark	Kirketoft	Settlement	–	1	–	Moesgård Museum (2012)
66	Pre-Roman Iron Age	Denmark	Kværnbækgård	Settlement	–	1	–	Moesgård Museum (2012)
67	Pre-Roman Iron Age	Denmark	Tapdrup Vest	Settlement	–	1	–	Moesgård Museum (2012)
68	Pre-Roman Iron Age	Denmark	Terp Kirkesti	Settlement	–	A few	–	Moesgård Museum (2012)
69	Pre-Roman Iron Age	Denmark	Tyrsbjergvej	Settlement	–	At least 2	–	Moesgård Museum (2012)
70	Pre-Roman Iron Age	France	Bourseheid, Dép. Moselle, Lorraine	Settlement	Latène	1	–	Wiethold (2010a)
71	Pre-Roman Iron Age	France	Eckbolsheim	Settlement pit	Hallstatt C	2	–	Wiethold (2008a)
72	Pre-Roman Iron Age	France	Passy/Véron	Settlement; Storage	Hallstatt C–D1	1	–	Wiethold (2009a)
73	Pre-Roman Iron Age	France	Varois-et-Chaignot	Storage	Hallstatt C–D	1	–	Wiethold (2005)
74	Pre-Roman Iron Age	France	Vitry-sur-Orne	Settlement	Latène	1	–	Wiethold (2004)
75	Pre-Roman Iron Age	France	Void Vacon	Storage	Hallstatt D	2	–	Wiethold (2008b)
76	Pre-Roman Iron Age	Germany	Friedberg	Settlement pit	Latène 1	1	–	A. Kreuz (personal communication)
77	Pre-Roman Iron Age	Germany	Glauberg-Klaus II	Storage	Latène 1	3	–	Kreuz and Schäfer (2008)
78	Pre-Roman Iron Age	Germany	Mardorf, Amöneburg	Settlement pit	Latène 2	4	–	Kreuz and Schäfer (2008)
79	Pre-Roman Iron Age	Great Britain	Nettlebank Copse	Settlement	–	70	Weed and evidence for uprooting crops	Campbell (2000)
80	Pre-Roman Iron Age	Sweden	Linga near Överjärna socken, Södermanland	Settlement	–	–	–	Gustafsson (1995)
81	Pre-Roman Iron Age	Switzerland	Cortailod/ Petit Ruz	Funeral pyre	Late Latène	76	–	Akeret and Geith-Chauviere (2010)
82	Pre-Roman Iron Age/Roman Iron Age	Denmark	Smedegård, Thy	Settlement	120 BC–200 AD	29	Weed and ruderal plant	Henriksen and Harild (2002)
83	Pre-Roman Iron Age/Roman Iron Age	Sweden	Linköping, Östergötland	Cremation grave	500 BC–200 AD	2	Grave good and food	Engelmark (1984)
84	Roman Iron Age	Belgium	Tienen	Cremation grave	–	–	Vegetation on the cemetery and used possibly as tinder	Cooremans (2006)
85	Roman Iron Age	Denmark	Bolteskov II	Settlement	–	At least 3	–	Moesgård Museum (2012) and Andreassen (2010)
86	Roman Iron Age	Denmark	Budager Mark	Cremation grave	–	At least 6	–	–

Table 2 (continued)

	Period	Country	Site name	Type of site	Dating information	Number of bulbs	Interpretation	Reference
87	Roman Iron Age	Denmark	Dragebjerggård Vest	Settlement	–	1	Symbolic, ritual, fertility and regeneration	Mikkelsen and Bartholin (2009, p. 274)
88	Roman Iron Age	Denmark	Kielbjergvej	Settlement	–	1	–	Moesgård Museum (2012)
89	Roman Iron Age	Denmark	Kremmerled	Settlement	–	3	–	Moesgård Museum (2012) and Grabowski (2009a)
90	Roman Iron Age	Denmark	Kremmerled	Cremation grave	–	1	–	Moesgård Museum (2012) and Jensen (2010b)
91	Roman Iron Age	Denmark	Tokkendrup	Settlement	–	24	Gathered food	Jensen (2009) and Jensen et al. (2010)
92	Roman Iron Age	Denmark	Vinding, Silkeborg	Cremation grave	–	38	Weed in rye and grave good	Robinson (1992, p. 4)
93	Roman Iron Age	France	Faulquemont	Grave	–	5	–	Preiss et al. (2005, p. 365)
94	Roman Iron Age	France	Herange	Settlement pit	100–300 AD	1	–	J. Wiethold (personal communication)
95	Roman Iron Age	France	La Trussonerie	Funeral pyre	50–100 AD	3	–	Wiethold (2010b)
96	Roman Iron Age	France	Lozère, site Javols	Cremation rave	First-century AD	A few	–	Preiss et al. (2005, p. 370)
97	Roman Iron Age	France	Lucy	Settlement; pit	200–300 AD	1	Together with remains of funeral pyre	Wiethold (2009b)
98	Roman Iron Age	France	Metz	Settlement pit	400–500 AD	1	–	J. Wiethold (personal communication)
99	Roman Iron Age	Germany	Wohnbach, Wölfersheim	Grave	–	32	–	A. Kreuz (personal communication)
100	Roman Iron Age	Great Britain	Dod Law	Settlement	100–200 AD	1	Weed seeds	van der Veen (1992, p. 37, Table 4.6)
101	Roman Iron Age	Netherlands	Cuijk-Grotestraat	Cremation grave	–	A few	–	Bakels (2005)
102	Roman Iron Age	Poland	Bergbezinkbassin Paprotki	Grave	–	4	–	Karczewski et al. (2009)
103	Roman Iron Age	Sweden	Annelöv (SU14W)	Settlement	–	1	–	Regnell and Sjögren (2006)
104	Roman Iron Age/Migration Period	Denmark	Nødskov	Settlement	–	A few	–	Moesgård Museum (2012)
105	Roman Iron Age/Migration Period	Denmark	Odensevej	Settlement	–	1	–	Moesgård Museum (2012) and Grabowski (2009b)
106	Migration Period/Middle Ages	Denmark	Campus	Settlement	–	At least 6	–	Moesgård Museum (2012)
107	Migration Period/Middle Ages	Denmark	Hjulby	Settlement	Viking period	2	–	Moesgård Museum (2012)
108	Migration Period/Middle Ages	Kielbjergvej Nordvest	Settlement	–	At least 18	–	–	Moesgård Museum (2012)

Table 2 (continued)

Period	Country	Site name	Type of site	Dating information	Number of bulbs	Interpretation	Reference
109 Migration period/ Middle Ages	Sweden	Gåharp near Ängelholm, Skåne	Settlement	Vendel period, 300–700 AD	A few	–	Gustafsson (1995, p. 383)
110 Middle Ages	Denmark	Hatting	Settlement	Viking period	1	–	Moesgård Museum (2012)
111 Middle Ages	Denmark	Havgård	Settlement	Viking period, 700–1000 AD	1	Food	Harild (1999)
112 Middle Ages	Denmark	Næsby	Grave	Viking period	A few	Presumably ritual function	Moesgård Museum (2012)
113 Middle Ages	Denmark	Rubjerg	Grave	Viking period	A few	Grave good together with barley, food source	Robinson (1992, 1994, pp. 545–547)
114 Middle Ages	Finland	Mikkeli Orjäärvi Kihlinselto	Settlement	1021–1173 AD	32	–	Vanhanen (2009, p. 20)
115 Middle Ages	Finland	Vainionmäki	Grave	Merovingian period	5	Offering pit with charred remains of cultivated plants and weeds	Aalto (1996, p. 177) and Söyriinki-Harmo (1996, p. 115)
116 Middle Ages	Sweden	Åby, Huddinge, Sörmland	Grave	Viking period	A few	–	Viklund (2002, Table 4)
117 Middle Ages	Sweden	Aminge, Uppland	Cremation grave	Viking period	A few	–	Viklund (2002, Table 4)
118 Middle Ages	Sweden	Kumla, Trosa-Vagnhärad	Cremation grave	Viking period (800–1050 AD)	5	Grave good and food	Engelmark (1984)
119 Middle Ages	Sweden	Samagård, Vinbergs, Halland	Grave	Viking period	64	Ritual food for time after death	Gustafsson (1995) and Regnell and Sjögren (2006, p. 91)
120 Middle Ages	Sweden	Toftanäs near Malmö, Skåne	Settlement	–	A few	–	Gustafsson (1995, p. 383)
121 Middle Ages	Switzerland	Boudry/Les Buchilles	Settlement pit	High Middle Ages	1	–	Akeret and Geith-Chauviere (2010)

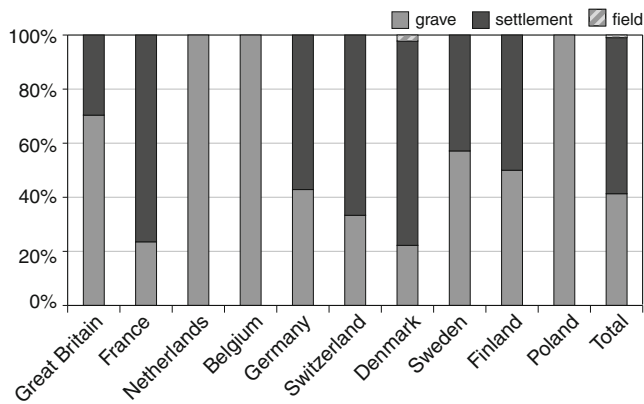


Fig. 4 Percentage of sites with *Arrhenatherum* bulbs in different archaeological contexts

The later changes from cremation graves to inhumation happen parallel to the adoption of Christian religion. In Scandinavia both rites were used during the Viking period, which may increase the probability of finding *Arrhenatherum* from that period.

Interpretations of the occurrence of charred bulb finds in archaeological contexts

The bulbs of *A. elatius* var. *bulbosum* were found in different archaeological contexts; in graves as well as in settlements. Consequently, there are various approaches concerning their interpretation.

Food resource

The utilization of *Arrhenatherum* bulbs as a food source is considered by Engelmark (1984) because they are rich in starch and taste like raw potatoes. This interpretation is

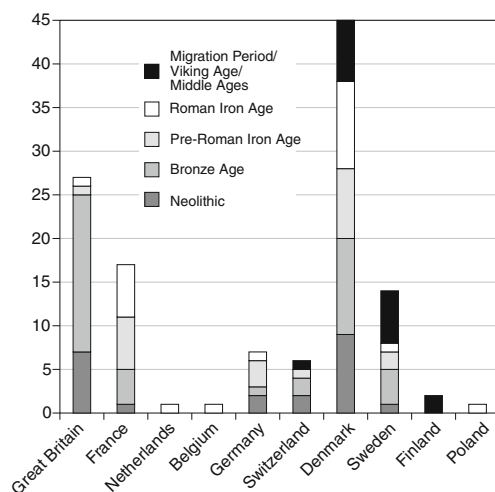


Fig. 5 Evidence of charred bulbs of *Arrhenatherum* in different archaeological periods in different countries of north-western and central Europe

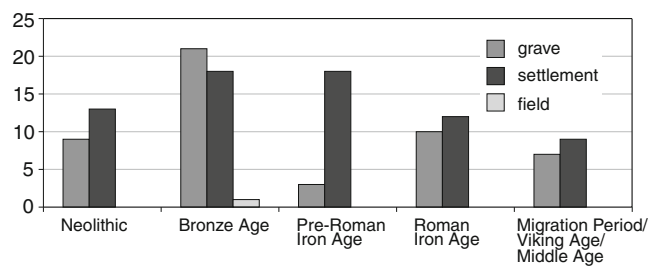


Fig. 6 Numbers of grave and settlement sites with *Arrhenatherum* bulbs in different archaeological periods

based on an analogy with the root tubers from *Filipendula vulgaris*, as their use as food, at least as a side-dish, has been noted by many authors (Engelmark 1984, p. 88; Hjelmqvist 1955, p. 156). According to Engelmark (1984, p. 91), a possible cultivation of *A. elatius* var. *bulbosum* through vegetative propagation seems to offer an explanation for why the tuberous variation of oat grass did not become extinct in competition with the non-tuberous plants, as is obviously the case today.

Other authors contradict the usage of the bulbs as food, claiming that the effort required to gain edible material from the inferior material would be too high (Robinson 1988). Recent research regarding potential ancient plant foods also deems *Arrhenatherum* tubers to be quite inedible (Mears and Hillman 2007).

As the bulbous form of *A. elatius* cannot always be distinguished from tall oat grass by means of their above-ground plant parts, it may in general be difficult to collect the starchy bulbs. On the other hand, potential stands with a high occurrence of the bulbs could have been known to the people and this knowledge passed on to others (Preiss et al. 2005). Although large amounts of wild seeds, fruits and other plant parts may have been used as food sources in prehistoric times, so far archaeobotanical evidence is present in only a few cases (Behre 2008).

Ritual importance

The first bulbs of *Arrhenatherum* in Sweden were found within grave contexts, together with an even larger amount of charred bulbs of dropwort (*F. vulgaris*) (Engelmark 1984). As grave sites are predominant in the list of finds from this region until now (Table 2; Fig. 4) and as the plant remains were found within the burial urns or in their immediate proximity, Engelmark assumed a connection between the bulbs and grave rituals or death cult activities. He drew parallels to ancient Greece, where root bulbs of *Asphodelus* sp. were used as grave goods. Other Swedish authors like Artelius (1999, 2000) and Viklund (2002) also followed these suggestions. The occurrence of the bulbs inside small pits and under stones amongst the cremation material may

indicate intentional deposition in connection with grave rituals. Artelius (1999, 2000) argues that the bulbs, which are organs of vegetative reproduction, were used as ritual symbols for spontaneous growth and regeneration. Analogous to the possibility of utilization of *Arrhenatherum* bulbs as a food source, they may also have served as a ritual deposit of food for the last journey (Viklund 2002; Regnell and Sjögren 2006; Robinson 1994). Archaeologically speaking, it appears difficult to prove the deposition of *Arrhenatherum* bulbs as a burial gift, especially when only a small number can be found and they are not combined with other verifiable gifts or food resources.

Tinder for the funeral pyre

Another, more practical, approach was proposed by Robinson (1988). Since he discovered charred bulbs of *Arrhenatherum* in contexts with cremation graves from the Bronze Age, he interpreted them as material which was used as tinder for the funeral pyre. The grasses could easily be gathered from the surroundings of the burial areas by uprooting. Due to the superior humidity ratio of the bulbs, their preservation in a charred state is more probable than that of the stems, which easily burn to ash. It is imaginable that the burial sites were established near abandoned agricultural land or were built on grasslands from which animals were excluded, thus, on land where *Arrhenatherum* was widespread (Robinson 1988). As *Arrhenatherum* grows in clusters, big bundles of roots and soil can easily be removed just by pulling. Thus, Stevens (2008) concludes that the whole top-soil layer containing *Arrhenatherum* plants could have been removed in the creation of a fire barrier and afterwards added to the pyre, which would have resulted in charring of the bulbs. Stevens's theory is based on finds of charred remains of roots and stems in addition to the bulbs (Stevens 2008). In cases where the plant assemblages contain no cereal grains, weed seeds or fruits, it is highly probable that the *Arrhenatherum* remains derive from the natural surroundings and may have been used as tinder for some kind of fire.

Weed in cereal fields

In some cases the circumstances of the occurrence of *A. elatius* var. *bulbosum* evidently demonstrates its origin as a weed in crop fields. In Glesborg, Denmark, several samples from a Bronze Age arable field layer were investigated. Amongst some cereal finds, the charred remains of several bulbs of *Arrhenatherum*, several weed seeds, and fruits as well as stems were recognized. On this basis, it can be assumed that the layer represents the remains of an arable field which was burned after harvest (Henriksen 2000, p. 14, Table 2). At the settlement of Nettlebank Copse, Great

Britain, the bulbs occur in the Pre-Roman Iron Age together with culm nodes and rhizomes. Here, cereals may have been harvested and uprooted by hand, which would have included weeds as well (Campbell 2000, p. 126). If the bulbs occur in combination with cereal remains, the interpretation of *Arrhenatherum* as a weed plant in arable fields is the most credible.

Grass on abandoned land

More difficult to interpret is the occurrence of charred *Arrhenatherum* bulbs in grave contexts where inhumation was practised instead of cremation. This is the case in megalithic monuments and other Neolithic graves. Even if it is not clear how or why the bulbs were burned, their appearance serves as an indicator for open, uncultivated, and above all not grazed grassland in the immediate surroundings of the graves and as a sign for a thinning of the forest around the sites (Straker 1990).

Conclusions

The interpretation of *Arrhenatherum* as a ritual grave good or as tinder does not apply for Albersdorf-Brutkamp, because cremations did not take place at megalithic graves in the Middle nor in the Late Neolithic, as was commonly the case in Neolithic times (Kühn 1979, p. 22). The scattered occurrence of *Arrhenatherum* within the upper soil mantle implies no direct connection between the bulbs and the cleared-out grave inventory, so their presence as gift or ritual symbol can be excluded.

The occurrence of *A. elatius* var. *bulbosum* surely shows that the surroundings of the grave during the Late Neolithic were an open landscape, where derelict land developed that was used neither for pasture nor for agriculture. The bulbs of *Arrhenatherum* could have been either brought into the grave complex together with the soil material for the mantle after burning of the grass at the place of extraction, or *Arrhenatherum* was growing on the grave mound itself during the Late Neolithic and was burned before a possible re-opening of the entrance in connection with a secondary burial or other ritual activities.

As *Arrhenatherum* occurs on various types of site and in many different periods, the interpretation of its presence should generally be dependent on the different archaeological contexts of its discovery. Before deciding on one interpretation, the type of site, the time period, and the macro-remain composition should all be considered. From Neolithic times to the Middle Ages, *Arrhenatherum* can be found within settlement sites. An increase in finds from settlements can especially be noted in the Pre-Roman Iron Age (Fig. 6), where the number of weeds occurring is generally

rising in comparison to the Bronze Age; possibly due to changes or acceleration in agriculture (Willerding 1986). The larger number of nutritious bulbs from *Arrhenatherum* in settlement contexts suggests their possible use as a gathered plant and for consumption. The emergence of *Arrhenatherum* as a weed in arable fields could have enhanced this utilization throughout all periods.

However, the occurrence of *Arrhenatherum* in graves may hint to a ritual meaning of the bulbs where they are evidently part of the grave inventory. The use of *Arrhenatherum* as tinder material can be assumed if cremation has taken place or the bulbs were found in context with a funeral pyre. This could be an explanation for why finds from Bronze Age graves are the most frequent within our compilation. In cases like Albersdorf-Brutkamp, however, an ecological explanation may be closer to reality.

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