THE HISTORY OF BROOMCORN MILLET (*Panicum miliaceum* L.) IN THECARPATHIAN-BASININTHEMIRROROFARCHAEOBOTANICAL REMAINS I. FROM THE BEGINNING UNTIL THE ROMAN AGE

Ferenc GYULAI

Szent István University, MKK KTI Department of Nature Conservation and Landscape Ecology, H-2103 Gödölő; E-mail: Gyulai.Ferenc@kti.szie.hu

Abstract

The domestication of broomcorn millet based on latest archaeobotanical investigations occurred in the arid areas of North China and in same time in Central Asia. The knowledge of cultivation of broomcorn millet the Carpathian Basin before the 6th thousand BC. Since this time in all archaeological ages are available but in different frequency. Broomcorn millet was a widespread and favoured cereal. Knowing the eating habits of nomadic and semi-nomadic people, this find is expected, as broomcorn millet is a favoured cereal with a short growing season and rapid development requiring relatively little tending. This is expected as broomcorn millet was a key crop for Hungarians in the Middle Ages. A significant amount was grown traditionally by Hungarians through time until the appearance of maize, the new gruel plant. In the first part will be present the history of broomcorn millet in the Carpathian Basin from the beginning until the Roman Age.

Keywords: broomcorn millet, archaeobotany, macroremains, Carpathian-Basin, prehistorical ages

Material and Method

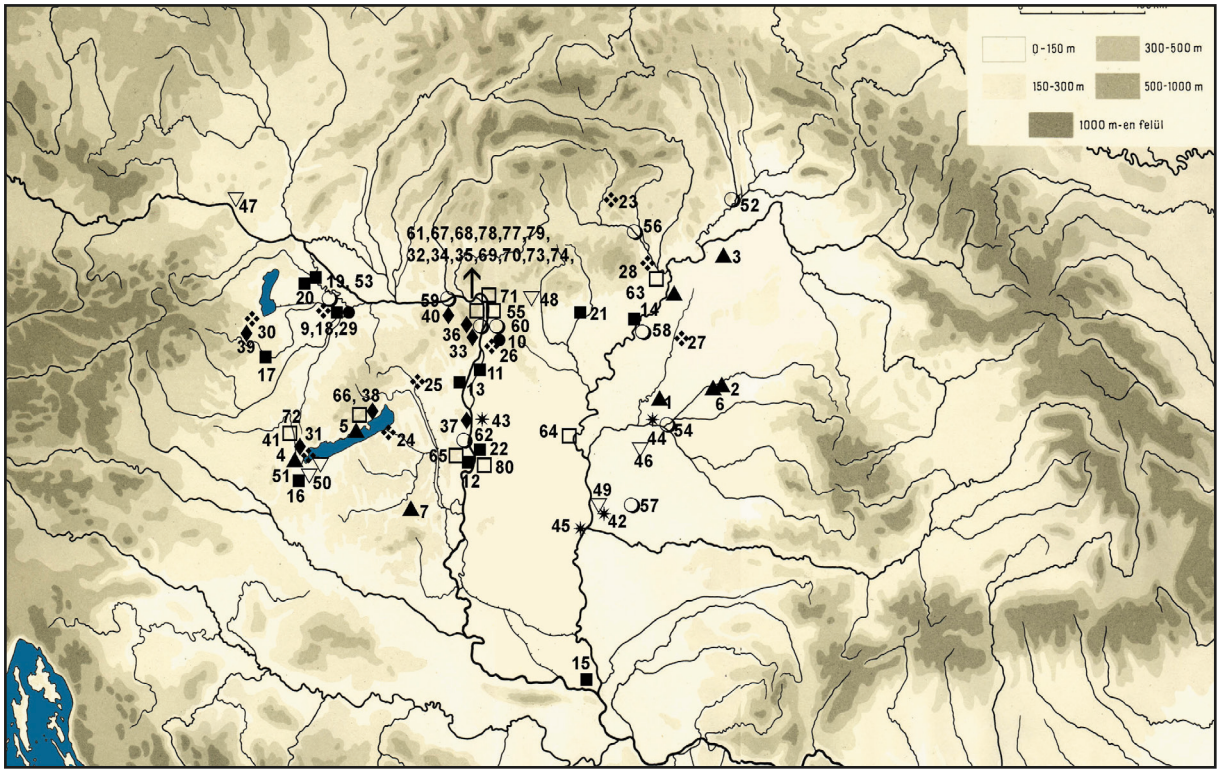
Archaeobotany or palaeo-ethnobotany is the science of the identification of plant remains and plant products. Its main area of investigation is the history of plant cultivation. It studies the relationship between human beings and flora especially as they relate to human economic activities. In addition to the identification of cultivated plant remains, it monitors the transformation of wild species into cultivated plants and the spread of plant cultivation and agriculture in general. Furthermore, it evaluates the images of plants originating from various eras, the decultivation of plant species and the data of the various social sciences associated with plants. Archaeobotany, as the study of plant macrofossils (seeds and fruits) obtained from archaeological excavations, becomes particularly important when there is very little or no archaeological artifacts related to agriculture, written or iconographical material available about the cultivation of plants found. This is particularly the case in relation to prehistoric cultures of the Carpathian Basin.

Archaeobotany is a branch of botany. All the elements of botany, i.e. morphology, taxonomy, anatomy and geobotany are used in the course of identification of the materials from archaeological excavations. In addition, it plays a „bridging" role within the system of sciences as it is intimately connected with the science of archaeology as well.

Archaeobotanical investigation has demonstrated convincingly that the Carpathian Basin is one of the longest inhabited parts of Europe. Cultivated plants arrived in the Carpathian Basin with the first Neolithic agrarian culture some eight thousand years ago. Archaeobotanical investigation has demonstrated convincingly that the Carpathian Basin is one of the longest inhabited parts of Europe. Cultivated plants arrived in the Carpathian Basin with the first Neolithic agrarian culture some eight thousand years ago.

Archaeobotany is an interdisciplinary scientific field, an important tool for understanding prehistoric ways of life, indeed the only source of agricultural history until the Roman Age. Plant remains allow us to infer botanical knowledge, methods of farming, dietary habits and environments of people of those periods. Plant remains are rarely found in the excavation of archaeological sites. Such organic materials are unstable and in natural conditions they are decomposed very quickly by microorganisms. However, they may be preserved in extraordinary

Fig 1. Broomcorn millet sites in the Carpathian Basin



Neolithic (6000-4300 BC) ▲
▲ 1 Ecsegfalva
▲2 Berettyóújfalu Nagy Bócs-dűlő
▲3 Ibrány-Nagyerdő Huda-tábla
▲4 Alsópáhok-Kátyánalja dűlő
▲5 Zánka Vasútállomás
▲6 Berettyóújfalu-Herpály
▲7 Lengyel
▲8 Polgár-Csőszhalom

Eneolithic or Copper Age (4300-3000 BC) ●
● 9 Győr-Szabadrétdomb
● 10 Rákoskeresztúr-Újmajor

Bronze Age (3000-900 BC) ■
■ 11 Szigetszentmiklós Vízmű
■ 12 Bölcske-Vörösgyír
■ 13 Százhalombatta-Földvár
■ 14 Poroszló-Aponhát
■ 15 Mošorin-Feudvár
■ 16 Balatonmagyaród-Hídvégpuszta
■ 17 Gór-Kápolnadomb
■ 18 Börcs-Paphomlok
■ 19 Mosonmagyaróvár-Németbánya
■ 20 Mosonmagyaróvár-Németdűlő
■ 21 Ludas, Varjú-dűlő
■ 22 Solt-Tételhegy

Iron Age (900 BC-1st Century AD) ❖
23 ❖ Aggtelek-Baradla barlang
24 ❖Siófok-Balatonszéplak
25 ❖ Fehérvárcsurgó-Eresztvény erdő
26 ❖ Rákoskeresztúr-Újmajor
27 ❖ Ebes Zsong-völgy
28 ❖ Miskolc-Hejő
29 ❖ Mosonszentmiklós-Pálmajor
30 ❖ Sopron-Krautacker
31 ❖ Keszthely-Fenékpuszta

Roman Age (1st-5th Century AD) ♦
32 ♦ Budakalász-Luppa csárda
33 ♦ Budapest-Körte Street
34 ♦ Leányfalu-Móricz Zsigmond Street
35 ♦ Óbuda, Bécsi Street 38–42
36 ♦ Óbuda Corvin Square
37 ♦ Dunaújváros,
38 ♦ Nemesvámos-Balácapuszta
39 ♦ Sopron-Beloiannisz Square and Városház Street
40 ♦ Tokod
41 ♦ Keszthely-Fenékpuszta

Barbaricum (1st-5th Century AD) ✶
42 ✶ Hódmezővásárhely-Solt Palé
43 ✶ Szalkaszentmárton-Dögtemető
44 ✶ Endrőd No. 170.
45 ✶ Kiskundorozsma-Nagyszék

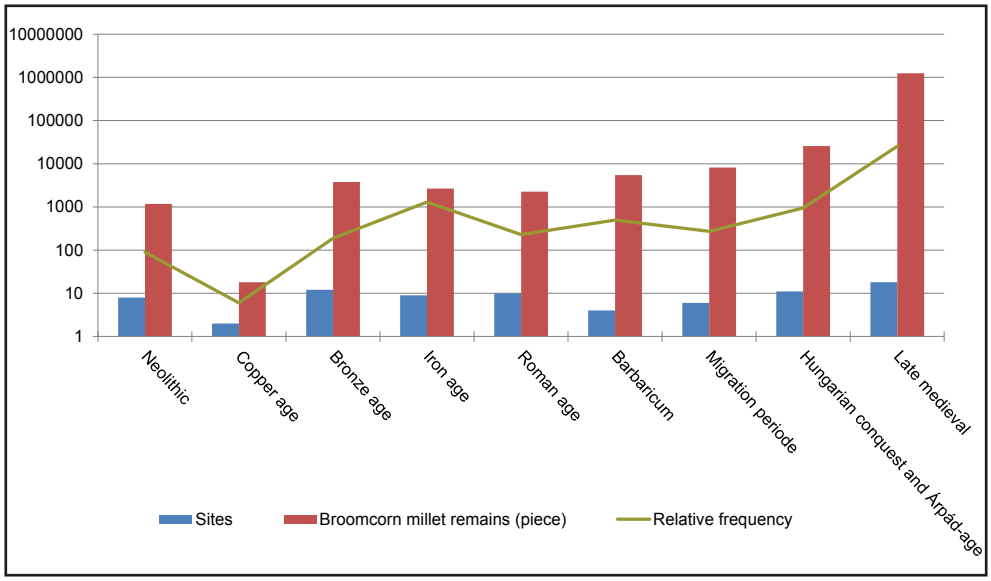
Migration Period (5th-9th Century AD) ▽
46 ▽ Eperjes-Csikóstábla
47 ▽ Devín (Dévény)
48 ▽ Szirák
49 ▽ Szegvár-Oromdűlő
50 ▽ Fonyód-Bélatelep
51 ▽ Zalavár-Vársziget

Hungarian Conquest time and Arpad-Age (9th-13th Century AD) ❍
52 ❍ Zemplin (Zemplén)
53 ❍ Lébény-Billedomb
54 ❍ Gyomaendrőd
55 ❍ Rákospalota-Újmajor
56 ❍ Edelény-Földvár
57 ❍ Kardoskút
58 ❍ Tiszaörvény
59 ❍ Esztergom-Kovácsi
60 ❍ Rákospalota-Újmajor
61 ❍ Budapest I. Hunyadi Street 22.
62 ❍ Solt-Tételhegy

Late Medieval Age (13th-17th C. AD) ☐
63 ☐ Muhi
64 ☐ Lászlófalva-Szentkirály
65 ☐ Dunaföldvár-Öregtorony
66 ☐ Nagyvázsony-Csepely
67 ☐ Budapest I. Dísz tér 10.
68 ☐ Budapest I. Úri utca 40.
69 ☐ Budapest I. Dísz tér 8.
70 ☐ Budapest I. Hunyadi utca 22.
71 ☐ Vác Piac utca
72 ☐ Sümeg-Sarvaly
73 ☐ Budapest I. Színház utca
74 ☐ Budapest II. Medve utca
75 ☐ Nagyvázsony-Csepely
76 ☐ Baj Öregkovács hegy
77 ☐ Budapest I. Military Headquarters (volt Honvédelmi Főparancsnokság)
78 ☐ Budapest I. Teleki palota
79 ☐ Budapest I. Kapucinusok utca
80 ☐ Solt-Tételhegy

 DOI: 10.18380/SZIE.COLUM.2014.1.1.29

Fig. 2. The most important date of broomcorn millet in the Carpathian-Basin.



conditions (e.g., charring by fire, immersion in water, extremely dry microclimates). Furthermore, the recognition of such remains requires extensive experience, systematic sampling, accurate flotation and identification. The archaeobotanical research in Hungary more than 150 years goes back. During this long time 50 researchers were activ in this topic and 500 archaeological sites have been processed. 10 million piece seeds of 700 plant taxons (mostly species) were identified from the neolithic to the Middle Ages in the Carpathian Basin.

During this time up to now 1,294,209 piece broomcorm millet were found in 80 settlements from the Neolithic until Late Medieval (Fig. 1). But these distribution by ages are different. (Fig. 2).

Results and Discussion

Phylogenetics of broomcorn millet

The origin and place of domestication of broomcorn millet (*Panicum miliaceum* L.) are yet to be established. Its wild form has not been determined with certainty. It may have descended from the *P. spontaneum* Lyssev ex Zhuk. species that occurs in Kazakhstan, Mongolia, Northern China and Afghanistan (de Candolle 1894; Soó 1973).

Following Mansfeld (1986), the broomcorn millet genus is divided into three groups (in: Bányai 1971):

1. wide-clustered broomcorn millets (*Panicum miliaceum* L. convar. *effusum* Alef., -> *Panicum miliaceum* L. var. *effusum* Alef.
2. side-curving, banner-clustered broomcorn millets (*Panicum miliaceum* L. convar. *contractum* Alef.,
3. compact-clustered broomcorn millets (*Panicum miliaceum* L. convar. *compactum* Koern.

In addition the Multilingual Multiscript Plant Name Database distinguishes in the Broomborn Millet Group the following items:

- *Panicum miliaceum* L. convar. ‚*Aureum*' Alef.
- *Panicum miliaceum* L. convar. ‚*Sanguineum*' Alef.
- *Panicum miliaceum* L. subsp. *agricola Scholz & Mikolás*
- *Panicum miliaceum* L. subsp. *miliaceum* sensu Tsvelev.
- *Panicum miliaceum* L. subsp. *ruderale* (Kitag.) Tzvelev.
- *Panicum miliaceum* L. var. *flavum* Schur.

They can also be classified on the basis of the colour of their hulls: white, yellow, red, brown, grey.

Broomcorn millet is a tetraploid (2n=36), self-fertilizing cultivated plant. Its growing season is very short (60–90 days). It is sown in the spring, but a second, summer sowing also ripens. It tolerates extreme conditions (heat, poor soils, drought) well. During threshing and cleaning, the buds often break off. It is characteristic of the seed that the socket of the scutellum is shorter than half the length of the seed (Schermann 1966). Today, broomcorn millet has lost much of its significance. It has more or less disappeared from Europe. It is primarily cultivated in Eastern and Central Asia, India and parts of the Middle East.

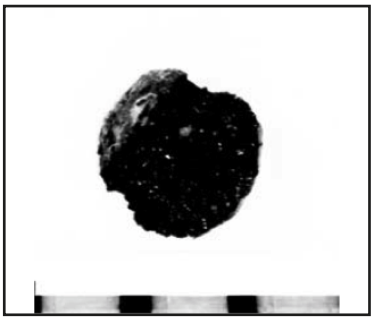
According to recent research in Cishan sites of Central Asian (9th –7th thousands BC) P. miliaceum phytolith residues were found (Hunt et al. 2008). Consequently the cultivation of millet can be started in northeastern China and the Loess Plateau before the beginning of 8th thousand BC (Crawford 2009; Lu et al., 2009). Knowledge of their production spread around the Yellow River valley and mountain areas around 6th thousand BC (Zhao 2005; Crawford et al., 2006; Liu et al., 2009). Before 5th thousand BC in China, Caucasus, Syria, Egypt, East- and Middle Europe already from 41 sites are know the remains of the genus Panicum (*P. miliaceum, P. cf. miliaceum, Panicum sp., Panicum type, P. capillare* (?), *P. turgidum*) (Hunt et al. 2008). Anachronistics that the appear of broomcorn millet in Middle-Asia and East- and Middle-Europe overlapping his appear in China. It is therefore likely that the domestication of millet occurred in the same time in Yellow River region and in Middle-Asia region (Lisitsina 1984; Zohary, Hopf & Weiss 2012).

The oldest remains of broomcorn millet are from Eastern and Central Europe: Chokl/Dagestan (beginnigs of 7–6th thousands BC) (Amirkhanov 1987), Arukhlo/Georgia (8000-7150 cal BP) (Lisitsina 1984), Sacarovka/Ukraine (Starčevo-Körös culture, 7600-7500 cal BP) (Janushevich 1984). Some millet grains were also found in Luca Vrublevecaja and Soroki/Ukrajna (Tripolje culture) (Janushevich 1976), Blahutovice/Czech Republic (Tempír 1979) and Eizenberg/Thuringia (5th millennium BC) (Rothmaler & Natho 1957), Gomolava/Jugoslavia (4th millennium BC) (van Zeist 1975), Northern Italy (3rd millennium BC) (Villaret-von Rochow 1958). Broomcorn millet has been shown to have existed in Central Asia since the 3rd millennium Bronze Age (Lisitsina & Prisepenko 1977). More recently it has been found at the Shortungha site in Afghanistan (end of 3rd, beginning of 2nd millennium BC) (Willcox 1991). Other uncertain finds may be broomcorn millet: Tepe Yahya/Iran (5th millennium BC) (Costantini & Costantini-Biasini 1985), Georgia (Neolithic: 5th–4th millennium BC) (Lisitsina 1984), Northern China (Neolithic, Yang-Shao culture: 4th millennium BC) (Ho 1977).

History of broomcorn millet from the beginning until Roman Age

In case of the early archaeobotanical founds the knowledge of cultivation of broomcorn millet reached the Carpathian-Basen at the beginning of 6th thousand BC. Evidence for this one that millet appear in the sites of Criş (Körös) culture in the beginning of 6th thousand BC (Glăvăneştii Vechi) and also be present in Vădastra (second half of 6th thousand BC) (Comşa 1996). But the spread of millet towards Europe our country has played an important role. The Körös sites (6th thousand BC) are the earliest occurrence of broomcorn millet in Hungary (Gyulai 2010a). Only one millet grain was found in Ecsegfalva (Békés county) in excavations campaign between 1999¬-2001 (Bogaard, Bending & Jones 2007). In Berettyóújfalu Nagy Bócs-dűlő Körös site two grain millet were available in the year 2004-2005 (Dani et al. 2006). In this case Ibrány-Nagyerdő Huda-tábla Körös sites was a surprise. Here were

Figure 3. Broomcorn millet grain from Ibrány-Nagyerdő Photo: Á. Kenéz



DOI: 10.18380/SZIE.COLUM.2014.1.1.29

found in 2008 10 piece millet grain (Domboróczki & Raczky 2010; Gyulai 2010b) (Fig. 3).

The material from the so-called Transdanubian group of Middle Neolithic Linearband Ceramic culture (LBK) is closely related to the cultural region covering Western and Central Europe (Füzes 1990). In 1966, during the construction of a new road connecting Alsópáhok and Felsőpáhok, in the part called the Alsópáhok-Kátyánalja dűlő, mud-flakes were collected as the construction cut into a pit from the more recent phase of the Transdanubian linear band pottery population (Bakay, Kalicz & Sági 1966, site 1/20). The surface of the mud-flakes from the bottom of the pit showed imprints of broomcorn millet. In 1964, during the reconstruction of the train station at Zánka, a number of Neolithic pits were unearthed (Bakay, Kalicz & Sági 1966, site 60/10) (Fig. 4). Unexpectedly large quantities of carbonised remains of many cereals including broomcorn millet were found (Hartyányi, Nováki & Patay 1967/68).

Figure 4. Broomcorn millet naked grains from the Linearbandceramic culture settlement in Zánka. After Füzes 1990.

In addition to hulled wheats (einkorn, emmer), broomcorn millet was also found at the Middle Neolithic Berettyóújfalu-Herpály site (Nándor Kalicz and Pál Raczky's excavation 1978–82). According to 14C testing, the estimated date of the Berettyóújfalu-Herpály site is 6570–6270 BP (Hertelendi et al., 1997).

Late Neolithic sites in Hungary are relatively rich in broomcorn millet remains. These archaeobotanical finds are generally carbonised recovered from burnt-out houses and various waste or grain storage pits.

Plant remains from sites associated with the Lengyel culture in the Transdanubian region indicate that the population still cultivated plants, but less intensively than in the previous era. At the Lengyel site, which gave the culture its name, Mór Wosinsky conducted several excavations between 1885 and 1890.

The dating of the findings raised several subsequent problems (Hartyányi, Nováki & Patay 1967/68). In 1890, Imre Deininger himself collected seeds there. His identification of the seeds from the vicinity of fireplaces, pits and from pots was published in 1892. He found here broomcorn millet as well.

All botanical samples from the tell settlements of Tisza-Herpály-Berettyóvölgy contain broomcorn millet. At the 1995 excavation, led by Pál Raczky, we collected a large number of soil samples from the floor levels of houses and various pits found in the Late Neolithic tell and in the settlement around the tell. According to radiocarbon dating, the estimated date of the Polgár-Csőszhalom site is 6700–6370 BP (Hertelendi et al. 1997). Sporadic occurrences of broomcorn millet grains were also found.

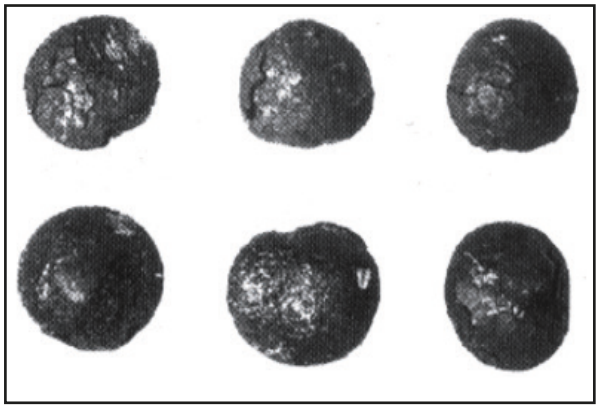
During an archaeological survey between 1991 and 1994 prior to the extension of the M1 motorway around Győr, András Figler found a site containing material from several periods of the Copper Age (in: Gyulai 2010a). The samples from Győr-Szabadrétdomb of the Ludanice – Balaton-Lasinja culture contained plant remains indicating that the cultivation of cereals was restricted to two species during that era, barley and broomcorn millet. Material recovered from the Bolerazi layer of Győr-Szabadrétdomb contains many more cereal remains. Broomcorn millet was an important meal plant.

During the excavation of the Rákoskeresztúr-Újmajor site, the soil samples from the Ludanice culture pits only yielded a few dozen seeds

(excavation by Zoltán Bencze and Zsuzsa M. Virág 1995–96). Yet barley and fast growing, spring-sown and rather modest broomcorn millet was still possible and important in those conditions.

The extreme, cool and rainy climate improved in the Late Copper Age. Probably for the bad climatic conditions of the Late Copper age broomcorn millet still missing in the Baden culture. As a result of recent research, we are now able to report more botanical finds associated with the Early Bronze Age Bell-Baker Culture (2600-2200 BC) population. In 1999, Anna Endrődi found a new site containing bell-shaped pottery in the area of the Szigetszentmiklós Waterworks. We flotated the soil samples and recovered grains of broomcorn millet (Gyulai 2003). Broomcorn millet only occurs in two Middle Bronze Age sites: Bölcske-Vörösgyír

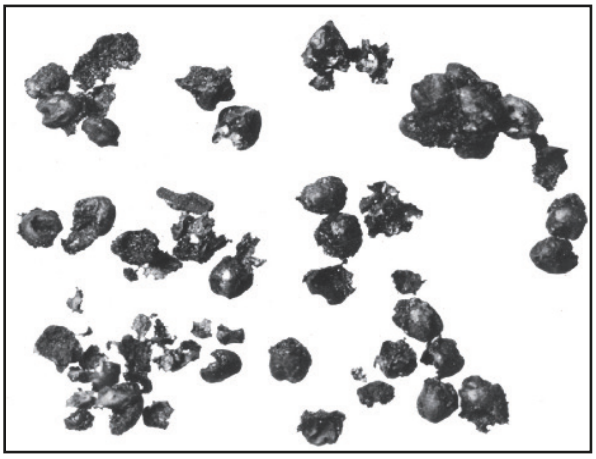
Figure 5. Broomcorn millet naked grains from the Bölcske-Vörösgyír Middle Bronze Age tell settlement. Photograph by T. Kádas.



and Százhalombatta-Földvár (Gyulai 1996a). That was the Vatya culture period in which the cultivation of broomcorn millet began to spread in the Carpathian Basin (Fig. 5).

The Late Bronze Age Urnfield culture was a cultural trend and a material culture that extended to a large part of Europe (Harding 1987). Agriculture was the foundation of an efficient production method. Plant species from the environment of the site indicate a warm, continental climate of the Subatlantic phases which is similar to today's climate. People conducted self-sufficient crop production. As the flour of broomcorn millet is unsuitable for making bread, those cereals were primarily used to make meal.

Figure 6. Broomcorn millet naked grains from Poroszló-Aponhát, Inventory of the Hungarian Agricultural Museum, Budapest.

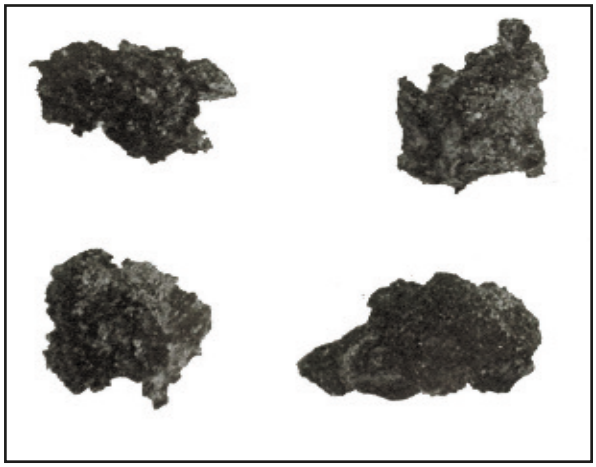


According to seeds found at the Poroszló-Aponhát site of the Gáva culture, hulled wheats (einkorn, emmer) and broomcorn millet continued to play an important role in the Great Plain (Hartyányi, Nováki & Patay 1967/68) (Fig. 6).

Seeds, found in the middle Urngrave layer (12th to 9th centuries BC) of the Mošorin-Feudvár tell settlement near the Tisza River, provide an excellent picture of the plant cultivation culture of the Late Bronze Age – Early Iron Age (Kroll 1990). In addition to barley, rye, wheat, broomcorn millet were also cultivated. In 1987, during the excavation of the Tumulus culture settlement of Balatonmagyaród-Hídvégpuszta, organic remains, seeds, including broomcorn millet grains fragments were found at the bottom of a refuse pit. Beside this, millet gruel remains and gruel crumbs consisting of a few naked, i.e. husked, millet grains were found. Based on recovered pottery fragments, the archaeologist László Horváth dated the remains to around 1200 BC. Organic materials floated from the Late Bronze Age refuse pit were identified as leftover foods including broomcorn millet meal remains (Gyulai 1996b) (Fig. 7).

DOI: 10.18380/SZIE.COLUM.2014.1.1.29

Figure 7. Millet porrige from a waste pit of the Late Bronze Age settlement of Balatonmagyaród-Hídvégpuszta. Photograph by T. Kádas.



During processing of the finds we found several slightly porous carbonised fragments of variable size from a single larger food item.

Archaeobotanical processing, the macroscopic analyses of Max Währen and the microscopic studies of Benno Richter as well as the instrumental analytical investigation performed by János Csapó (macro- and trace elements, amino acids and fatty acids) drew the conclusion that the fragments are remnants of a wild strawberry cake made using baking industry standard bread wheat and broomcorn millet flour with the addition of pig fat.

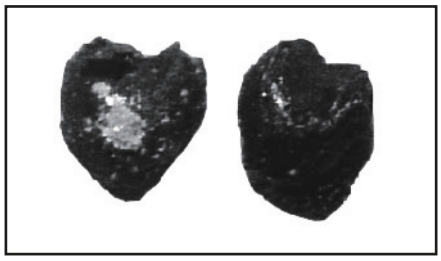
From 1989 to 1993, we floated a significant quantity of Late Bronze Age botanical material at an excavation by Gábor Ilon at Gór-Kápolnadomb (Gyulai & Torma 1993). The inhabitants of the settlement lived in a varied environment and conducted lively agricultural activities. A small number of broomcorn millet seeds indicates that it was not a very significant cereal. Naked, i.e. hulled broomcorn millet grains indicate that it was also processed.

Between 1994 and 1996, during an archaeological survey preceding the extension of the M1 motorway near Győr, several Late Bronze Age sites were excavated under the management of András Figler: Börcs-Paphomlok, Mosonmagyaróvár-Németbánya, Mosonmagyaróvár-Németdűlő. Quantity of cereal grains occurred in the following ranking: emmer, six-rowed barley, broomcorn millet, bread wheat. Broomcorn millet in Late Bronze Age settlements occurs in the largest quantity, but barley is also present. Excavation of a prehistoric settlement covering several tens of hectares began in 2001 at the Ludas, Varjú-dűlő site (Gyulai 2012a). The majority of objects found during the excavation led by László Domboróczky, Csilla Ács, Károly Tankó and Simon Gall belong to the Late Bronze Age Kyjatice culture. Fewer samples were taken from fireplaces. Obviously, broomcorn millet and emmer grains found there must have fallen down the side of the fireplaces during cooking and were slowly carbonised by the radiating heat. Millet gruel fragments consisting of a few pieces of grains.

Cereal remains from Early Iron Age Hallstatt sites in Hungary indicate that plant cultivation culture was by no means uniform. They cultivated six-rowed barley, emmer, spelt, common and club wheat and broomcorn millet. They grew significant quantities of broomcorn millet. The exact ages of archaeological layers explored at different places in the Aggtelek-Baradla cave system between 1876 and 1877 are almost impossible to determine. According to Hartyányi, Nováki & Patay (1967/68), graves in the "Bone house" and "Corridor" and the seeds found therein are from the Early Iron Age. Their opinion is based on radiocarbon tests of broomcorn millet: 2560 BP ± 75 years (a report by Mebus A. Geyh from 1967 in: Hartyányi, Nováki & Patay 1967/68). Imre Deininger (1881) classified seeds these contexts into ten cultivars; such as, common bread wheat, einkorn, broomcorn millet, naked barley. Miklós Füzes collected a few grains of broomcorn millet from the Early Iron Age burnt layer at Siófok-Balatonszéplak (in: Hartyányi, Nováki & Patay 1967/68). Éva F. Petres, Béla Jungbert and Tibor Kovács excavated nine Early Iron Age barrow graves in the territory of the Fehérvárcsurgó-Eresztvény forest between 1983–87. Earth samples collected there were processed in 1996 (Gyulai 2012b).

The burnt graves contained mainly carbonised grains of cereals: six-rowed barley, emmer bread wheat and broomcorn millet found likewise characterise Early Iron Age culture in Hungary. The broomcorn millet is in all scythian settlements available. The Rákoskeresztúr-Újmajor site excavated in 1996 by Anna Endrődi, has thus far provided the Scythian botanical findings from the Carpathian Basin (in: Gyulai 2010a). The most important cereal identified was six-rowed barley followed by broomcorn millet. It must be noted that the dominance of barley and broomcorn millet appears to be a typical feature of migrating, quickly moving nomadic peoples dealing with animal husbandry. Several soil samples were collected in 2003 from settlements of the Scythians in Ebes Zsong-völgy was excavated by János Dani. The number of broomcorn millet grains were three times more that of wheat grains. The same location also yielded fragments of milletgruel (Gyulai unpublished data). Melinda Hajdú conducted an excavation by Miskolc-Hejő in 2012. According to radiocarbon dating, the estimated date of the settlement is 490–390 BP. In the mud of one well broomcorn millet grain was found as well (Pósa et al. in print). All this demonstrates that the Scythians, although they did use wheats and grew them in a kind of ancient mixed grain, were preoccupied with the production of barley and broomcorn millet that better suited their way of life and traditions (Fig. 8).

Figure 8. Broomcorn millet naked grains from the Scythian settlement of Rákoskeresztúr-Újmajor. Photograph by the author.



It was also stated with regard to the botanical finds from Mosonszentmiklós-Pálmajor (András Figler's excavation 1993–94) that the composition of grain crops changed in the Celtic Period. Hulled wheat varieties were „neglected", and aside from six-rowed barley, common bread wheat and broomcorn millet are the staple crop. The samples taken from one of the farm buildings and a grave in Sopron-Krautacker from the Late La Tène (LT/C2-D) proved to be extremely rich in species. Sporadically, broomcorn millet is also found (Gyulai 2010a). Also Celtic samples collected and floated by Miklós Füzes in 1983 at Fenékpuszta, on the site excavated by István Erdélyi, containing a significant amount of carbonised grains with some broomcorn millet grains (Gyulai & Lakatos 2013).

References

Amirkhanov, K. A. (1987): Chokhskoe poselenie: chelovek i ego kultura v mezolite i neolite gornogo Dagestana. (Chokh settlement: man and his culture in the Mesolithic and Neolithic of mountainous Dagestan, in Russian). Nauka, Moscow.

Bakay, K., Kalicz, N. & Sági, K. (1966): Veszprém megye régészeti topográfiája. (The archaeological topography of Veszprém County). A keszthelyi és a tapolcai járás. In: Magyarország régészeti topográfiája 1, 60/10. Budapest.

Bányai, L. (1971): Kölesfajták agrobotanikai vizsgálata. Agrobotanika 11: 39-60.

Bogaard, A., Bending, J. & Jones, G. (2007): Archaeobotanical evidence for plant husbandry and use. In Whittle, A. (ed.): The Early Neolithic on the Great Hungarian Plain: investigations of the Körös culture site of Ecsegfalva 23, Co. Békés. Varia Archaeologica Hungarica 21: 421–445. DOI: http://dx.doi.org/10.1017/S0003598X00097507

de Candolle, A. (1894): Termesztett növényeink eredete. Budapest.

Comşa, E. (1996): Viaţa oamenilor din spaţiul Carpato-Danubiana-Pontic în mileniile 7–4î hr (The life of people in the Carpatho-Danubian-Pontic region in the 7th–4th millennia b.c., in Romanian). Ed didactică şi pedagogică,

DOI: 10.18380/SZIE.COLUM.2014.1.1.29

Bucharest.

Costantini & Costantini, L. & Costantini-Biasini, L. (1985): Agriculture in Baluchistan between the 7th and the 3rd millennium BC. Newsletter of Baluchistan Studies (Instituto Universitario Orientale, Naples) 2: 16-30.

Crawford, G. W. (2009): Agricultural origins in North China pushed back to the Pleistocene-Holocene boundary. Proceedings of the National Academy of Sciences of the United States of America 106: 7271-7272. DOI: 10.1073/pnas.0903375106

Crawford, G. W., Chen, X. & Wang, J. (2006): Houli culture rice from the Yuezhuang site, Jinan. Dongfang Kapgu. East Asia Archaeology 3: 247-251.

Dani, J., Szilágyi, K. A., Szelekovszky, M., Czifra, Sz. & Kisjuhász, V. (2006): Preliminary report of the excavations preceding investment at the Berettyóújfalu, Nagy Bócs-dűlő site in 2004-2005. Régészeti kutatások Magyarországon 2005, 5–31.

Deininger, I. (1881): Deiniger Imre jelentése. In: Nyáry J.: Az Aggteleki barlang, mint őskori temető. Budapest, 55-64.

Deininger, I. (1892): Adatok kultúrnövényeink történetéhez. A Lengyel-i őskori telep növénymaradványai. Keszthelyi Magyar Királyi Gazdasági Tanintézet Évkönyve 1891, 1–31. Nagykanizsa.

Domboróczki, L. & Raczky, P. (2010): Excavations at Ibrány–Nagyerdő and the northern most distribution of the Körös culture in Hungary. In Kozlowski J. K. & Raczky P. (eds): Neolithization of the Carpathian Basin: Northern most distribution of the Starčevo/Körös culture. Kraków–Budapest, 191–218.

Füzes, M. (1990): A földmívelés kezdeti szakaszának (neolitikum és rézkor) növényleletei Magyarországon (Archaeobotanikai vázlat). Tapolcai Városi Múz. Közlem. 1: 139-238.

Gyulai, F. (1996a): Előzetes jelentés Százhalombatta középső bronzkori tell 1991. évi ásatás növényleleteinek vizsgálatáról. In: Poroszlai I. (ed.): Ásatások Százhalombattán. Százhalombatta, 55 p., 16-24.

Gyulai, F. (1996b): Balatonmagyaród-Hídvégpuszta késő bronzkori település növényleletei és élelmiszermaradványai. Zalai Múzeumok 6: 169-195.

Gyulai, F. (2003): Archaeobotanical remains and environment of Bell Beaker Csepel-Group. In: Czebreszuk J. & Szmyt, M. (eds.): The Norteast Frontier of Bell Beakers. Proceedings of the symposium held at the Adam Mickiewicz University, Poznań (Poland), May 26-29 2002. BAR International Series 1155: 277-282.

Gyulai, F. (2010a): Archaeobotany in Hungary. Seed, Fruit, Food and Beverages Remains in the Carpathian Basin: an Archaeobotanical Investigation of Plant Cultivation and Ecology from the Neolithic until the Late Middle Ages. Archaeolingua, Budapest, 479 p.

Gyulai, F. (2010b): Archaeobotanical research at the Körös Culture site of Ibrány–Nagyerdő and its relationship to plant remains from contemporaneous sites in Hungary. In: Kozlowski, J. K. & Raczky, P.: Neolithization of the Carpathian Basin: Northernmost Distribution of the Starčevo/Körös Culture. Polish Academy of Arts & Sciences Krakow & Institute of Archaeological Sciences of The Eötvös Loránd University Budapest, 364 p., 219-237.

Gyulai, F. (2012a): L'examen archéobotanique de la nécropole celtique de Ludas – Varjú-dűlő In: Szabó, M. (ed.): La Nécropole Celtique â Ludas – Varjú-dűlő. L'Harmattan, Budapest, 2012, 380 p., 279-297. DOI: 10.1556/AArch.57.2006.4.3

Gyulai, F. (2012b): Kora vaskori fejedelmi sirok archaeobotanikai maradványai Fehérvárcsurgóról. In: Kreiter A., Pető Á. & Tugya B. (eds): Környezet–Ember–Kultúra. A természettudományok és a régészet párbeszéde. Magyar Nemzeti Múzeum Nemzeti Örökségvédelmi Központ 2010. október 6–8-án megrendezett konferenciájának tanulmánykötete. Magyar Nemzeti Múzeum Nemzeti Örökségvédelmi Központ, Budapest, 163-172.

Gyulai, F. & Lakatos, B. (2013): La Tène archaeobotanical remains from Keszthely-Fenékpuszta. In: Heinrich-Tamáska, O. (ed.): Keszthely-Fenékpuszta: Katalog der Befunde und Ausgewählter Funde sowie neue Forschungsergebnisse. Castellum Pannonicum Pelsonense Vol. 3. Verlag Marie Leindorf GmbH, Budapest–Leipzig–Keszthely–Rahden/Westf., 2013. 716 p., 647-652.

Gyulai, F. & Torma, A. (1993): Az urnasíros kultúra góri településének növényleletei. Nyugat-Dunántúl bronzkora. Pápai Múzeumi Értesítő (Acta Musei Papensis) 6: 277-286.

Harding, A. F. (1987): Social and Economic Factors in the Origin and Development of the Urnfields Cultures. Symposium Liblice 21.-25.10.1985. Die Urnenfelderkulturen Mittel-Europas. Praha, 37-41.

Hartyányi, B., Nováki, Gy. & Patay, Á. (1967/68): Növényi mag- és terméslelletek Magyarországon az újkőkortól a XVIII. sz.-ig I.. Magy. Mezőg. Múz. Közlem. 1968, 5-85.

DOI: 10.18380/SZIE.COLUM.2014.1.1.29

Hertelendi, E., Svingor, É., Raczky, P., Horváth, F., Futó, I., Bartosiewicz, L. & Molnár, M. (1997): Radiocarbon chronology of the neolithic and time span of tell settlements in Eastern Hungary based on calibrated radiocarbon dates. In: Költő L. & Bartosiewicz L. (eds.): Archaeometrical Research in Hungary II. Budapest, Hungarian National Museum, 61-70.

Ho, Ping-Ti (1977): The indigenous origins of Chinese agriculture. In: Reed, C. A. (ed.): Origens of agriculture, Mouton, 413-483. DOI: 10.1515/9783110813487

Hunt, V. H., Linden, V. M., Liu, X., Motuzaite-Matuzeviciute, G., Colledge, S. & Jones, K. M. (2008): Millets across Eurasia: chronology and context of early records of the genera Panicum and Setaria from ar chaeological sites in the Old World. Vegetation History and Archaeobotany 17: (Suppl 1), 5–18. DOI: 10.1007/s00334-008-0187-1

Janushevich, Z. V. (1976): Kulturnije rastenija jugu-sapada SSSR po paleobotanicheskim issledovanijam (Cultivated plants in south western USSR according to paleobotanical investigations). Akad. Nauk Moldavskoi SSR, Botan. Sad., 1-213.

Janushevich, Z. V. (1984) The specific composition of wheat finds from ancient agricultural centres in the USSR. In: van Zeist, W. & Casparie, W. A. (eds.): Plants and ancient man: studies in palaeo-ethnobotany. Balkema, Rotterdam, 267–276.

Kroll, H. (1990): Melde von Feudvar, Vojvodina. Praehistorische Zeitschrift 65, 46-48. DOI: 10.1515/pz-1990-0104

Lisitsina, G. N. & Prisepenko, L. V. (1977): Paleo-etnobotanicseszkie nahodki Kavkaza i Blizsnevo Vosztoka. Moszkva.

Lisitsina, G. N. (1984): The Caucasus: a centre of ancient farming in Eurasia. In: Zeist, W. van & Casparie, W. A. (eds.): Plants and ancient man. Rotterdam, 285-292.

Liu, X., Hunt, H. V. & Jones, M. K. (2009): River valleys and foothills: changing archaeological perceptions of North Chinas earliest farms. Antiquity 83: 82-95. DOI: http://dx.doi.org/10.1017/S0003598X00098100

Lu, H., Zhang, J., Liu, K., Wu, N., Li, Y. et al. (2009): Earliest domestication of broomcorn millet (Panicum miliaceum) in East Asia extended to 10,000 years ago. Proceedings of the National Academy of Science of the United States of America 106: 7367-72. DOI: 10.1073/pnas.0900158106

Mansfeld, R. (1986): Verzeichnis landwirtschaftlicher und gärtnerischer Kulturpflanzen (ohne Zierpflanzen) I-IV, (ed. Schultze-Motel, J.), Berlin, Heidelberg, New York & Tokyo, 1998. DOI: http://dx.doi.org/10.1017/S0014479700015817

Pósa, P., Emődi, A., Schellenberger, J., Mravcsik, Z., Hajdú, M. & Gyulai F. (in print): Előzetes jelentés a Miskolc-Hejő melletti szkíta kori kút növényi maradványainak feldolgozásáról. In: Kulcsár P. (ed.). Gesta.

Rothmaler, W. & Natho, I. (1957): Bandkeramische Kulturpflanzenreste aus Thüringen und Sachsen. Beitr. Frühgesch. d. Landwirtsch. 3: 73-98.

Schermann, Sz. (1966): Magismeret I-II. Akad. Kiadó, Budapest, 1070.

Soó, R. (1973): A magyar flóra és vegetáció rendszertani-növényföldrajzi kézikönyve V. Budapest.

Tempír, Z. (1979): Kulturpflanzen im Neolithikum und Äneolithikum auf dem Gebiet von Böhmen und Mähren. Archaeo-Physika 8: 302-308.

Villaret- von Rochow, E. (1958): Die Pflanzenreste der bronzezeitlichen Pfahlbauten von Valeggio am Mincio. Berich über das Geobot. Forschungsinst. Rübel in Zürich für das Jahr 1957, 96-144.

Willcox, G. (1991): Carbonised plant remains from Shortughai, Afghanistan. In: Renfrew, J. (ed.): New light on early farming. Recent Developments in Palaeoetnobotany. Edinburgh, 395., 277-279.

Zeist, W. van (1975): Preliminary report on the botany of Gomolava. J. Archaeol. Sci. 2: 315-325.

Zhao, Z. H. (2005): Zhiwu kaoguxue jiqi xin jinzhan (Archaeobotany and its recent progress, in Chinese). Kaogu (Archaeology) 454: 522–529.

Zohary, D., Hopf., M. & Weiss, E. (2012): Domestication of Plants in the Old World. University Press, Oxford, 243. DOI: 10.1006/anbo.2001.1505

 DOI: 10.18380/SZIE.COLUM.2014.1.1.29