

ARCHAEOBOTANICAL OVERVIEW OF RYE (*Secale cereale* L.) IN THE CARPATHIAN-BASIN II. FROM THE MIGRATION PERIOD UNTIL THE LATE MEDIEVAL AGE

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Abstract

It seems that rye is a twice domesticated cereal. Then, in the course of the Early Iron Age in Central or Eastern Europe, it is again transformed from weed to crop plant. We summarized the development of rye and his spread in the Carpathian Basin based on archaeobotanical data. The grains of the rye were found always in charcoal form. The rye appeared in Carpathian Basin during the Neolithic Age. Sporadic occurrences of rye were also found in Early Bronze Age Bell Beaker-Csepel Group and Early Iron age Scythian cultures. The prehistoric grains were small and longshaped. In the Prehistoric Ages rye should be exist as weed of hulled wheats. His cultivation started in the Roman Age. The grains found in roman sites are always big and reel shaped like recently. Only a few grains were found in the Migration Period. Among cereals of the conquering Hungarians rye is present. Rye became common product in the Late Medieval Ages. It was grown in a big quantity everywhere, but not independently, but mixed with the wheat.

Keywords: rye, archaeobotany, macroremains, Carpathian-Basin

Rye in Carpathian-Basin during the Early Medieval Ages

Contrary to the common bread wheat that was dominant in Pannonia but required an advanced level of agrotechniques, people in the Barbaricum continued to grow hulled wheat varieties such as einkorn and emmer. We believe that, rather than derived directly from eastern traditions, this reflects the cereal crop production heritage of earlier prehistoric peoples that once lived in the Great Hungarian Plain. Barley was found only at the sand pit of Szirmabesnyő-Sajópart. Here, rye was encountered as well (Hartyányi et al. 1967-68).

Further significant results of Sarmatian archaeobotany were obtained by Cs. Szalontai and K. Tóth in 1998 and 1999 at the Kiskundorozsma-Nagyszék site dated to the 3rd–4th centuries AD. Surprisingly, many grain species were encountered, however, only a few of them are of any significance. Their most important cereals were six-rowed barley and common millet, reflecting doubtlessly a continuation of their nomadic traditions. Of the naked grain common bread wheat and the

characteristically cornered club wheat grains hardly any were found. Other grain types were also known, yet they played only a subordinate role: naked barley, two-rowed barley and rye. Many relict species from meadows and pastures suggest livestock grazing in the vicinity of the settlement. This meadow and pasture, having mainly typical habitat characteristics, could be effectively arid in some places, as shown by e.g. wild rye (Gyulai 2003).

In other Sarmatian deposits if not in large quantities, but rye also occurs in the following sites: Garadna (excavation by Á. Salamon 1974; Skoflek & Árendás 1971), Zalkod (excavation by Á. Salamon 1970; Skoflek & Árendás 1971), Gyomaendrőd (excavation by D. B. Jankovich 1987-‘90; Gyulai 2011), Budapest, Paskál park (excavation by A. Endrődi 2003), Mezőszemere-Kismari-Fenek (excavation by Cs. Ács 2002), Polgár-Kenderföld (excavation by P. Raczky 2001), Ebes-Zsong-völgy (excavation by J. Dani 2003), Szeged-Homokbánya (excavation by L. Bende and G. Lőrinczy 2004). The Sarmatians were characterized by the production of a mixture of grain and rye in it as well. In this site M0 East Pécel 02. (excavation by B. Maráz 2005-‘6)

among the grains some germinated rye grains were available. In the site M0 East Budapest 06. Péceli Street (excavation by A. Korom 2005-'6) near four hundred small and elongated rye grain were detected.

Characteristics of such ancient prehistoric types of rye are known from the sites: Szeged-Kiskundorozsma, Daruhalom-dűlő (excavation by G. Lőrinczy et al. 2005) and Hajdú-Bihar county excavations by K. Szilágyi et al. 2003-'8 (Balmazújváros-Darucsorda, Debrecen-Józsa-Klastrompart, Debrecen-Józsa-Józsaplaza, Debrecen-Repülőtér, Ebes-Zsong-völgy, Berettyóújfalú-Nagy Bócs-dűlő). The latter site more than 400 rye grain were available. It is interesting that some wild rye was found as well, which is understandable because it is sandy steppe elements.

Unfortunately no ethnic identity is given to the 5–6th-century site in Sopron-Városháza street, yet species-rich crop grains and legumes were encountered here in great numbers (Hartyányi et al. 1967-68). Two type of rye were found equally among the half a liter of macroremains: “small, long and thin shaped” and “small and squat shaped”.

In 1986 excavations were carried out in Devín, near Bratislava, Slovakia, along the limes at the time, at a settlement dated to the 5th century AD, populated by Danube Germans or maybe Kvads. A carbonized grain layer, a completely intact bread and several pieces of bread were found among pot fragments in the demolished remains of a fireplace (Pieta 1988; Pieta & Plachá 1989). The composition of the cereals obviously stocked for kitchen use shows an advanced level of agriculture: 66% rye, 21% common bread wheat, 11% barley, 1.6% common millet.

The rye from the Early and Middle Avar Age still missing. But from the Late Avar Age a significant number of remains were known. The spread of rye in the Migration Period refers to Debrecen-Bordás-tanya site (excavation by K. Szilágyi et al. 2003) as well. L. Bende and G. Lőrinczy conducted an excavation 2003-ban in the Kistelek site in 2003. In addition

to many rowed barley only rye was found. Interestingly, the wheat does not occur in the remains. Also some rye grains were found in Dunaszentgyörgy-Fadd Avar Age site (excavations by L. Szabó 2008).

Excavations in the planned cabbage deposit site of Felgyő-Kettőshalmi-dűlő led by G. Lőrinczy et al in the Avar Age samples can be found both type of rye: the big grains and small but elongated grains like in the prehistoric ages. This is the evidence of the presense of two different ecotypes or varieties. From the little grains his independent cultivation seems uncertain, but mixed with wheat is also conceivable. From the ratio of wheat and rye founded in the site Budapest, Csepel-Sewage (excavation by A. Horváth 2006) may indicate their mixed cultivation.

One of the most important botanical findings in Hungarian archaeobotanical research was uncovered from the late Migration Period Fonyód-Bélatelep site, the excavation of Béla Horváth in 1964 (Gyulai et al. 1992). Based on ¹⁴C tests, the age of the settlement, made up of lake dwellings, can be dated from the second half of the 7th century to the end of the 9th century. According to evidence provided by these plant macrofossils, the inhabitants of the lake dwellings pursued extensive farming activities. The main crops of the inhabitants were barley, common bread wheat, club wheat, common millet, rye and common oat. Two thousand seeds of rye found here at Fonyód-Bélatelep are mostly of a larger type, yet the shape of the seeds puts them in the “squat” class, while a smaller proportion of the seeds are smaller and of a “narrow” type. The two types imply two varieties. The measurement data (length, width and height of grains) seem to indicate that there may have been several classes (ecotyp or variety) of the rye including wild rye recovered (Gyulai et al. 2014) (Figs. 1-3.).

Decades of excavations, led by Á. Ritoók and B. M. Szőke, of a parking lot exposing the 9th century site of Zalavár-Vársziget, initiated

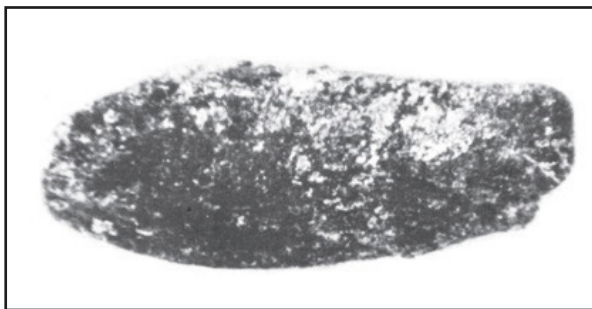
Figure 1. Rye (*Secale cereale*) short (wide) grains from Fonyód-Bélatelep. Late Migration Period lake dwelling settlement. Photograph by the author



Figure 2. Rye (*Secale cereale*) thin and large grains from Fonyód-Bélatelep. Late Migration Period lake dwelling settlement. Photograph by the author.



Figure 3. Wild rye (*Secale sylvestre*) naked grain from the Fonyód-Bélatelep Late Migration Period settlement. Photograph by the author.



long and thin shaped” and “small and squat shaped” (Hartyányi et al. 1967-68).

collection and flotation of soil samples for botanical remains in 1994 (Gyulai 1998). This was the first time that botanical macro remains, seeds and fruits, were recovered. According to historical data, the Carolingian court centre was populated by common people of mixed ethnic composition. Most seeds and fruit remains come from the fill of a “well”, which was probably a planked storage pit. The carbonised diaspores were possibly deposited during the cleaning process after the burning of the settlement at the time. The botanical material is dominated by cultivated plants and their weeds. The most important crops were common millet, six-rowed barley and common bread wheat while. Rye was present only sporadically.

Crop yields were not any higher in other parts of Europe. Valuable data have survived from Carolingian times. According to these, the yield was twice the amount sown in spelt, 1.6 times in rye, and 2.2 times in barley. Would it be possible that village people constantly lived at the verge of famine? According to the statement made by Füzes (1977), production yields of grains increased from the Neolithic to the middle 19th century not more than 15–20 percent in weight (acceleration percent), which is due to metric increase in grain size.

The near two hundred rye grains were found in presumably Late Avar Age level of Sopron Városháza Street were also different: “small,

Rye in Carpathian-Basin during the Medieval Ages

The Hungarian word “rozs” is of Slavic origin occurring first in a document dated to 1292 as a place name (Molnár 1961). In the Hungarian Diploma Dictionary, a different date can be found: “Roswago” – 1478 (Szamota & Zolnai 1902-1906).

The botanical find from the age of the Hungarian conquest (beginning of the 10th century) comes from Lébény-Billedomb, the 1993 excavation of Miklós Takács. Several soil samples were collected from settlements of the conquering Hungarians. A great number of seeds and fruit remains of 30 different plant species were found (Gyulai 1997). Hulled wheat types, typical in

prehistoric ages, were not grown at all, only the more advanced naked grain common wheat are found. In addition to six-rowed barley, albeit to a smaller extent, two-rowed barley and naked barley grains were also found. An important gruel plant was common millet, as unearthed carbonised common millet gruel pieces show. It has to be noted in connection with recovered rye grains that they can be sown separately or mixed with wheat (abajdoc, maslin).

About seven thousand rye grain were found in Edelény-Borsodi földvár (motte) settlement from the Conquest Period 10th century (excavation by M. Wolf 1987-'92). The rye was here the second most important cereal behind the wheat (A. Torma personal communication). The ratio of the common wheat and rye are 3:1. When exploring Edelény-Borsodi földvár in 1998, Mária Wolf found clay pots placed on their sides near the oven of a burnt house from the 10th century. On the side of one of the pots burnt food remains were discovered. They had homogenous structures mixed evenly. Neither grains, nor other kind of seeds or grists were distinguishable in them. They were made of evenly mixed, fine middling like cereal meals. The mixture thus prepared was not fermented but cooked right away. No traces of leavening of the dough, in other words lactic acid fermentation, were found. Microscopic examinations confirmed the observations. Indeed, a large number of flour particles were found in the aleuron layer of the grains. It was also possible to determine the material of the flour or rather the grist particles: they included common bread wheat epidermis and phytolith fragments, rye phytoliths (Gyulai 2014a).

Relatively more evidence has been recovered from the period (10th-11th centuries) after the conquest (Hartyányi et al. 1967-68; Hartyányi & Nováki 1973-74). In Kardoskút, during excavation of a 10th-13th century village, cereal grains were found among burnt straw under an oven. Numerically, the most important grain was common millet followed by bread wheat and rye. Adjacent to the Roman church at Esztergom-Kovácsi, 11th century graves provided botanical

materials characterised by common bread wheat and rye, both having longer growing seasons. A carbonised grain layer was found during the excavation at the 10th-11th century castle of a count at Hont (Hartyányi 1981-83). The sample from this layer contained a small amount of rye and common bread wheat, together with a very high level of weed infestation (Fig. 4.). Also in the 10th-11th centuries level of Ebes-Zsong-völgy

Figure 4. Rye (*Secale cereale*) thin and large grains from Hont-Ispánsági vár, Hungarian, second half of the 10th century. After Hartyányi 1981-83



(10-11. century) rye was present. More than hundred rye grains were found in the above mentioned Kiskundorozsma-Nagyszék Early Arpad Period level. Extremely much nearly seven thousand rye were identified in the Győr-ECE Late Arpad Period site (excavation by Sz. Bíró 2004, 2006). The ratio of the rye and common wheat from a storage pit of former grain trader were 3:1. It is very likely that they have been grown together.

In the archaeobotanical finds of Early Árpadian Period houses and pits explored in Gyomaendrőd, Barley remained an important kind of grain (excavation by Dénes B. Jankovich, 1987-'90). Rye production was insignificant. Notwithstanding this, the production of cereals requiring a more advanced level agriculture was also started (Gyulai 2011).

When one compares the earliest finds of the period after the conquest, the conclusion is that common millet played an important role mainly in the Great Plain, while common bread wheat and rye did the same in Transdanubia.

The finds from the Plain support the notion of limited nomadic patterns in the period after the conquest. The finds from Transdanubia and from the northern part of the country suggest a sedentary lifestyle and a more advanced level of agriculture. The Danube River, which is a historical as well as floristic boundary, also divided the country into two major areas of different crop production: the Great Plain, producing more archaic plants and Transdanubia, a more advanced region integrating the traditions of Roman agriculture.

Grain finds from later excavations in the Late Árpadian Period (12th-13th centuries) in the Great Plain start to show similarities with those found in Transdanubia both in terms of species composition and their relative importance (Hartyányi et al. 1973-'74). The alteration of sowing seeds, representing a quality change in crop production, was completed by this time. Growing high nutrient common bread wheat and rye became customary. Considerable amounts of carbonised common bread wheat grains and somewhat fewer rye grains were found in the Early Árpadian Period graveyard of Cegléd-Madarászhalom.

From the Árpád Period objects (pits, fireplaces and houses) of Solt-Tételhegy near by two thousand pieces of rye are available. The grains look characteristic spindle-shape. It is also conceivable that some of them or all of them can be grown together with wheat (Gyulai 2014b).

In 1995–1996, in the northern sector of the M0 highway under construction at Rákospalota-Újmajor site No 1, an Early-Late Árpadian Period village, the long forgotten former Sikátor, was explored under the leadership of Zoltán Bencze and Anna Gyuricza. The large majority of the carbonised diaspores unearthed from the waste pits and external or internal ovens dated to the 12th-13th centuries were cereals (Gyulai 1999). Corresponding to other sites from the Árpadian Period, six-rowed barley, common and club wheat, rye and certainly the inevitable gruel-plant, common millet, were also found here.

In 1996 at the Rákospalota-Újmajor site, most probably another segment of Sikátor village, was excavated by A. Gyuricza. This time, a well, dated to the 13th-14th centuries, rich in plant residues was also identified. According to the archaeobotanical finds recovered, the number of crops in cultivation in the Late Árpadian Period was further increased. The number of club wheat grains, like that of common millet grains, is low, both of them being typical for the Middle Ages in Hungary. There is somewhat more rye. The ratio between the grains of common bread wheat and rye is 3:1. This raises the possibility of their joint production (*Triticum mixtum*, abajdoc, abenas, maslin). Combine cultivation and harvesting of rye and wheat and joint preparation for bread was the medieval tradition and in the Great Plains until the mid-19th century remained.

During the excavation carried out at the outskirts of the city of Hajdúböszörmény-Téglagyár in 2011 (excavator: L. Szolnoki) the remains of a 12-13th century settlement part have been

Figure 5. Rye (*Secale cereale*) grains from the Ismaelites's Árpád-era town Hajdúböszörmény-Téglagyár. Photograph by the author.



found. Linguistic and historical research have already presumed the Ismaelites's Árpád-era town in the northern part of the city. Most of the seeds came from wells and pits, the least amount came from houses. Most of the remains were rye and barley (Fig. 5.). Common wheat,

broomcorn millet and common oat were presented in much lower numbers. Comparing the identified plant remains and their composition to the other already known cultivated plant remains from the 12-13th century Árpád-era (Cegléd-Madarászhalom, Győr Gabona Square, Rákoskeresztúr-Újmajor, Kapuvár-Feketevár, Esztergom Kossuth Street, Vác Széchenyi Street, Lébény-Billedomb, Budapest-Csepel-Sewage, Debrecen Kölcsey Cultural Center, Ebes-Zsongvölgy, Solt-Tételhegy), we can find several peculiarities: in the city of Hajdúböszörmény fewer cereal species have been found, and their composition was different as well. Barley and rye was the most frequently found remain here not the common wheat (Gyulai et al. 2013).

In 1998, A. Endrődi and A. Horváth explored a Late Árpadian Period (12th-13th centuries) settlement segment in Budapest-Csepel Rákóczi Ferenc Street (ditches, open fireplaces/ovens, waste pits). Although the botanical material is poor, it indicates cultivation. Three quarters of the species are grain crops: six-rowed barley, rye and common bread wheat. The finds are dominated by six-rowed barley. A third of it is rye, and less common bread wheat.

Rye was found in Szigetszentmiklós-Waterworks as well, where A. Endrődi made a rescue excavation in 1999 before the construction of a MOL gas pipeline and explored some Árpadian Period structures. Grain remains coming from here correspond to the species composition found at other sites of 12th century Hungary and the data of written sources from the time: the main crops were six rowed barley, common bread wheat and rye. Remains of rye are known from the archaeological sites of surrounding of Debrecen: Balmazújváros-Darucsorda és Debrecen-Józsa-Józsapláza. The latter took place more than 800 charred rye grains were found. Also some rye were found in Balatonmagyaród, Alsókolon-dűlő, Gencsapáti-sziget, Cegléd sites.

The consolidated feudal order formed a uniform crop production system in Hungary. More or less the same plants (e.g. rye) were grown

everywhere. To spread of rye was favored the cold and wet climate of the Medieval Little Ice Age (14th-19th centuries) (Rácz 1993). Also was necessary to carry out the lesser quality soils with the adaptive rye to meet the needs of still growing population.

This can be demonstrated by a number of archaeobotanical finds. Late medieval plantremains come usually from privies, wells, waste pits, i.e., places where the waste of households goes. Roads, cisterns and sewers, in particular, preserved seeds and fruit remains in good condition. Diaspores coming from here were conserved as a result of anaerobic conditions, although in certain instances surface corrosion can be significant. The seeds processed by I. Deininger, originating from Torna-Szádelő-sziget (today Slovakia) represent the heroic stage of archaeobotanical research (in: Lehoczky 1883). An approximately three centimetre thick cereal layer, consisting of mainly rye and to a smaller extent common wheat and barley, is dated to the Mongol invasion.

Important evidence for a uniform medieval crop production culture is seen in the late medieval botanical material of Muhi. Although the samples collected in 1995 at the Muhi medieval excavation site led by J. Laszlovszky and T. Pusztai. The cereals identified so far (common bread wheat, club wheat, rye, six-rowed barley, common millet) confirm the level of farming typical for the Middle Age (Gyulai 2010).

All cereals typical for the Hungarian Middle Ages were found in the samples taken from the medieval manor house excavation site in the forest beside Baj-Öregkovács-hegy (excavation by S. Petényi 1998): common bread wheat, six-rowed barley, rye, common millet.

In 1998 at Szarvasgede, at the excavation led by M. Takács and I. Paszternák, similar kinds of cereals were found. Archaeobotanical examinations indicated that intensive agricultural activities were carried out here in the middle 15th century. Along with common bread wheat, rye and sixrowed barley were also grown.

In the late-medieval period (cca. 15th century) dated archaeological level of Solt-Tételhegy is the most majority of six-rowed barley, which is understandable, because in this era of barley was used as fodder plants. This is followed rye, common or sowing wheat and millet (Fig. 6.). The combined production of common wheat and rye is possible. Involved of his processing (threshing, cleaning) ear spindle fragments are available as well (Gyulai 2014b).

Figure 6. Rye (*Secale cereale*) grains from late medieval site Solt-Tételhegy. Photograph by the author



In the course of the exploration and reconstruction of Buda castle over the past fifty years, archaeologists found a number of wells: Several earth and mud samples were taken for archaeobotanical examinations from two wells explored in the yard of the former Military Headquarters (Dísz Square No. 17) (excavations by Z. Bencze et al. 1999-2000) of Buda Castle in 1999 and Budapest, Szent György Square ex Teleki palace, well No.8. Kút (excavations by T. B. Nyékhelyi 1999-2000). Carbonised rye grains were found in all settlements, but not to much, because there kitchen trash. In the well of Debrecen Kölcsey Cultural Center site (excavation by Zs. Hajdú, et al. 2004) only a few rye was available, because the situation was the same (Gyulai 2010).

Led by András Horváth Pálóczi, archaeologist at the Agricultural Museum, several wells were explored at the late medieval Cuman settlement in 1984-87 at Lászlófalva-Szentkirály. It is not known whether six-rowed barley, a grain crop that occurred most frequently in the finds, was grown as fodder or was intended for human consumption. Common bread wheat and rye grain ratio is close to one to one. This raises the possibility of their mixed cropping (Pálóczi et al. 1996).

The rye was cultivated in the Medieval Europe sometimes separated but mostly mixed with wheat (*Triticum mixtum*, rye-wheat maslin, abajdoc in Hungary, suražica or napolica in Vojvodina) (Jones és Halstead 1995, Borojević 2005).

Mixed growing of these two cereals was typical in the Hungarian Middle Ages. As early as in the Árpáadian Period, joint production of bread wheat and rye was widespread. "Abajdoc (abenác, abajdos)" means a mixed crop. It was also called "maslin", "triticum mixtum", or "cerealiam promiscuam". King Ladislaus I provided for the taking of the tithe separately and not in the maslin: "In annona vero commixtum non accipiat, sed separatim". Wheat and rye were not mixed subsequently but sown together. Allegedly, this was done for security purposes. This way, even if one of the species would not ripen, the other still might bear a yield. An interesting observation is that maslin was still grown at the beginning of the 19th century (Gaál 1978).

Not only archaeobotanical finds, but also written sources confirm the notion that the mixed cropping of common bread wheat and rye (called abajdoc, meslin, *Triticum mixtum*) was common as early as the Árpáadian Period and continued through the Middle Ages until the modern times (Szamota & Zolnai 1902-1906).

Wheat and rye were not mixed subsequently, but sown and harvested, milled and used this way. It is also possible that abajdoc was grown for security purposes. This way, even if one of the species would not ripen, the other still might bear a yield. A further advantage is seen in the stalks

being more resistant in maslin to being blown over. In our view, joint production of bread wheat and rye provided more advantages than simple harvest safety. Stalks of maslin are more resistant to being blown over. It is also possible that people realised at that time, also demonstrated in recent East-German crop production experiments, that mixed production of different cereal species results in more uniform stock, higher yields (stimulating effect), and more resistant to plants pests (host hiatus) (Á. Mesterházy personal communication). The grain crop production boom was stopped by the Turks. The country was torn into three parts and the constant warfare did not favour

Figure 7. Rye (*Secale cereale*) grains from the 16th century settlement layer at Vác. Photograph by T. Kádas



crop production. The size of land left fallow increased and production yields fluctuated. A number of settlements were abandoned.

Turkish landlord taxes, collected in the part of the country under Turkish occupation, were as follows: wheat tithe, maslin (“mahlut” = mixed crop) tithe, must tithe, pasture benefit, wild cabbage tithe, barrel levy, and fruit tithe. The population – albeit suffering from the taxes – continued agricultural production. In the 16th century, tithe censuses mention lentil, pea, flax, buckwheat, cabbage, beetroot, onion and garlic, also fruits (apple, pear, grape) (Káldy-Nagy 1970).

Quite often common wheat and rye production was abandoned altogether in settlements dominated by the Turks, and only oat was

grown, albeit in a limited manner. All this means spring crops, that is, less work and safer yields. This was obviously encouraged by the fact that autumn sowing cereals had a higher tax levied on them. The same conclusion could be drawn from examination of grain residues from the Turkish Period found in downtown Vác Széchenyi Street (Gyulai 1995) (Fig. 7.). A significant amount of seeds and fruit remains unearthed from excavations carried out in downtown Vác during the seventies and eighties represents well crop production in the Middle Ages. The archaeobotanical material

Figure 8. Rye (*Secale cereale*) grains from Nagyvázsony-Csepely (15th–16th centuries), Inventory of the Hungarian Agricultural Museum, Budapest



collected at excavations carried by Zs. Miklós between 1986 and 1992 originated from different centuries of the Middle Ages, thus opportunity to record changes in crop production spanning centuries at one special location. In the 13th century, albeit in small amounts, barley, common wheat and rye were still produced in nearly equal amounts. These species were accompanied by club wheat, six-rowed barley and common oat in the 15th–16th centuries. Regression of crop production stopped only after the Turks were driven out in the 18th century.

Charred rye seeds found in the 15th–16th century houses at Nagyvázsony-Csepely (excavation by J. Kovalovszky 1957–58) are also of two types, a longer squat and a shorter narrow type (Hartyányi et al. 1967–68) (Fig. 8.). They may

Figure 9. Germinated rye (*Secale cereale*) grains from Dunaföldvár-Öregtorony, 17th century, Inventory of the Hungarian Agricultural Museum, Budapest



furnish evidence for the use of varieties in the Middle Ages. While in Gencsapáti-sziget not more than two dozen grain of rye were found until then in Sümeg-Sarvaly more than one liter charred rye. Devastation layers from the Turkish Period are relatively well researched from a botanical point of view. Plant remains of the Pogányszentpéter monastery, destroyed in the 16th century (excavation by R. Müller 1967), included many common bread wheat and rye grains, in other word “maslin” (Füzes 1972). Between 1969 and 1974 I. Holl and N. Parádi led the excavation of a village razed during the Turkish era in the 16th century in Sümeg-Sarvaly. Botanical finds from six houses devastated and burned during the Turkish Period and adjacent debris were processed by I. Skoflek (1984–85) and B. P. Hartyányi (in: Nováki 1984-85). Beside grains and seeds of carbonised common bread wheat, rye, common millet and weeds, fruit remains were also encountered. Prevalence of rye refers to Debrecen-Józsa Józsaplaza and Komádi-Gigánytó-dűlő sites (excavations by K. Szilágyi et al. 2003-‘8).

Half of the archaeobotanical material found at Dunaföldvár-Öregtorony site (ruins of a 17th century house) consist of rye, somewhat less of common wheat and even less of common millet (Hartyányi & Patay 1970) (Fig. 9). In the 16th-17th century layer of Hollókő-Castle, bread wheat and rye occurred in almost identical

Figure 10. Rye (*Secale cereale*) grains from the gate of Hollókő castle, 17th century, Inventory of the Hungarian Agricultural Museum, Budapest.



amounts (Hartyányi & Nováki 1973-74) (Fig. 10.). Sometimes rye surpassed the amount of wheat from the 16th-17th centuries, found at Kaposvár-Kaposszentjakab (excavation by Nagy, E. 1962), Pécs-Sebészeti Clinic (excavation by F. Fülep 1964), Szécsény-Plébániatemplom (excavation by K. F. Bodnár 1988-’93), Debrecen Kölcsey Cultural Center (excavation by Zs. Hajdú, et al. 2004).

Analysing the soilsamples from a 17th century Cannon Foundry of II. György Rákóczi of Sárospatak Castle (excavation by I. Ringer 2006) took nearly one and a half thousand, spindle-shaped charred rye grains found. Behind the common wheat rye was the second important cereals. Joint cultivation is very likely (Gyulai et al. 2012).

Makkai (1968) has shown that in contrast to the slash and burn method practiced earlier on, which depleted soil quite quickly, the heavy plough used in the Árpadian Period conserved the fertility of the soil. “Crop yields were grown by the possibility to grow plants with a higher nutrient content. The typical grain of slash and burn farming, common millet, which prefers freshly cleared land, was pushed back gradually in favour of the more valuable but more demanding wheat, rye and barley”. In this period of the Middle Ages, a two-course rotation system was practiced. One part (campus) remained fallow, the other was ploughed three times using a plough draught by six oxen.

Mainly wheat, maslin (wheat and rye), barley and oat were produced. Twice as much autumn sowing grain was grown than spring sown. Sometimes only autumn sown grain crop was produced. Harvesting and threshing were done manually. We do not know the average yields of medieval cereals. Yet, one can draw some conclusions by assessing the evolution of ploughing methods in the Middle Ages combined with average yields of the 16th century as reconstructed from documented data. Accordingly, in the interval ranging over thirty years of duty registers, the following ratio can be applied to peasant farming: three times the amount sown in wheat, twice that of barley, five times as much in rye and three times as much in oats (Kirilly 1968).

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