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The First Farmers of Ukraine: an Archaeobotanical Investigation and AMS Dating of Wheat Grains from the Ratniv-2 Site

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This paper presents the results of archaeobotanical investigations performed during excavations of a Linear Pottery Culture (LBK) site in western Ukraine. The collection of cultivated plants and weeds found in the hearth of the LBK dwelling fits well with what was grown by LBK inhabitants elsewhere in Europe. The direct dating of cereal grains reveals the existence of early-stage LBK in Ukraine during a much earlier timeframe than previously thought. The new archaeobotanical results and their dates exclude other previously postulated theories on the timing and geographical origins of agriculture in Ukraine, pointing towards the western LBK phenomenon as the earliest carrier of crop cultivation to Ukraine.

Keywords: Linear Pottery Culture (LBK), early cereal cultivation, spread of agriculture, the first farmers of Ukraine, Neolithic.

Šiame straipsnyje pateikiami archeobotaninių tyrimų rezultatai iš Ratniv-2 archeologinio objekto, esančio Vakarų Ukrainoje, priklausančio linijinės juostinės keramikos kultūrai. Augintų kultūrinių augalų ir piktžolių įvairovė atspindi įprastą linijinės juostinės keramikos kultūros gyventojų augintų augalų racioną, kuris labai panašus visuose šios kultūros paplitimo regionuose. Datavimas gautas tiesiogiai tiriant kultūrinius augalus, aptiktus Ratniv-2 objekte, parodė, kad ši kultūra išplito iki pat Ukrainos jau pirmoje savo stadijoje, tai yra gerokai anksčiau nei prieš tai manyta. Nauji archeobotaniniai duomenys ir datavimo rezultatai, pristatyti šiame straipsnyje, padėjo eliminuoti anksčiau pateiktas teorijas apie žemdirbystės laikotarpį ir geografinę kilmę Ukrainoje. Tikėtiniausia, kad linijinės juostinės keramikos kultūros gyventojai yra pirmieji, vertęsi žemdirbyste Ukrainos teritorijoje.

Reikšminiai žodžiai: linijinės juostinės keramikos kultūra, ankstyviausių kultūrinių augalų auginimas, žemdirbystės plitimas, pirmieji Ukrainos ūkininkai, neolitas.

INTRODUCTION

The spread of agriculture across the eastern part of the European continent has been less intensively studied than that of the western one (Milisauskas, 1986; Whittle, 1996; Gronenborn, 2003; Dolukhanov *et al.*, 2005), even though during prehistory, the eastern region constituted an important "crossroads" for interaction between Europe, the Caucasus and central Asia (Anthony, 2007; Rassamakin, 1999; Motuzaite Matuzeviciute *et al.* 2009).

Different theories on the origins of agriculture in Ukraine have been previously proposed. Researchers cannot agree on the timing of the adoption of agriculture by the prehistoric populations of Ukraine, or even what the geographical origins of the cultivated crops actually are, because the understanding of the earliest appearance of agriculture in Ukraine has been constructed not on the direct radiocarbon dates of cereal crops, but on the secondary evidence such as the microscopic analysis of flint tools, the investigation of cereal impressions in pottery, along with palynological, zooarchaeological data or stable isotope analysis (e.g., Kotova, 2002, 2003; Kremenetski, 1999; Kuzminova *et al.*, 1998; Kuzminova and Petrenko, 1989; Lillie and Budd, 2011; Lillie and Richards, 2000; Pashkevich, 1984, 1989, 1997, 2003, 2004, 2005, 2007; Yanushevich, 1976, 1978, 1980, 1984, 1986, 1989). One theory on the timing and the geographical origins of agriculture in Ukraine suggests that a variety of crop species, domesticated in China, such as buckwheat and millets (*Panicum miliaceum* and *Setaria italica*) arrived in Europe by possibly following the steppe corridor across the territory of Ukraine, possibly already during the Neolithic period (Janik, 2002; Jones, 2004; Hunt *et al.*, 2008). While some proposed a theory that crop cultivation and the formation of domestic animal husbandries in Ukraine arrived from the Caucaso-Caspian corridor (Bezusko *et al.*, 2000; Kotova, 2003; Kotova, 2009; Kotova and Makhortykh,

Fig. 1. The location of Ratniv-2 site (copyrights of freeworldmaps.net)
1 pav. *Ratniv-2 objekto vieta (freeworldmaps.net nuosavybės teisė)*

2010; Levkovskaya *et al.*, 2003; Jacobs, 1993; Jacobs, 1994a; Jacobs, 1994b; Shnirelman, 1989, 1992).

The earliest Neolithic archaeological culture in Ukraine is considered the Bug-Dniester (Telegin *et al.*, 2003) that formed under the influence of the first agricultural communities in the Balkans (Gaskevich, 2007; Kotova, 2003). Some groups of Balkan populations adopted farming around the second half of the 7th millennium BC (Colledge and Conolly, 2007; Bailey, 2000; Bailey, 2007; Pashkevich and Videiko, 2006; Whittle, 1996). These farming communities started spreading eastwards along river valleys into the Carpathian basin, and subsequently influenced the beginning of domestic cereal cultivation in Moldova (Dergachev *et al.*, 1991; Dergachev and Dolukhanov, 2007; Kuzminova *et al.*, 1998; Markevich, 1974; Monah, 2007). In Ukraine, however, the populations of the Bug-Dnieper culture followed hunter-fisher-forager subsistence strategies, and adopted only some domestic animal species from the populations of the Criş culture (Whittle, 1996; Zvelebil and Lillie, 2000). Telegin et al. (2003:458) have argued that the "securely attributed adoption of domesticates in the Bug-Dniester culture occurred in the later stages of its evolution" under the influence of LBK culture. In contrast, Pashkevich identified a few cereal impressions in pottery shards belonging to the Early Bug-Dniester culture sites situated along the Southern Bug River (Kotova, 2003; Pashkevich, 2003).

Previous research by Motuzaite-Matuzeviciute (2012) has shown that there is no substantial evidence to support the presence of early Bug-Dniester agriculture in Ukraine, concluding that the earliest agriculture did not come into play in Ukraine until ca 5000 BC with the LBK pottery culture, thus outlining the importance of direct dating of cereal remains from archaeological sites. The LBK culture arose from Körös, Starčevo, and Çris cultures between 5500 to 5000 cal BC. (Bánffy, 2004; Bickle and Whittle, 2013) and it was believed that only in the second or third stages of its spread it reached the eastern regions of Europe and the territory of western Ukraine (Bickel and Whittle 2013; Okhrimenko and Lokaichuk, 2007; Okhrimenko, 2002).

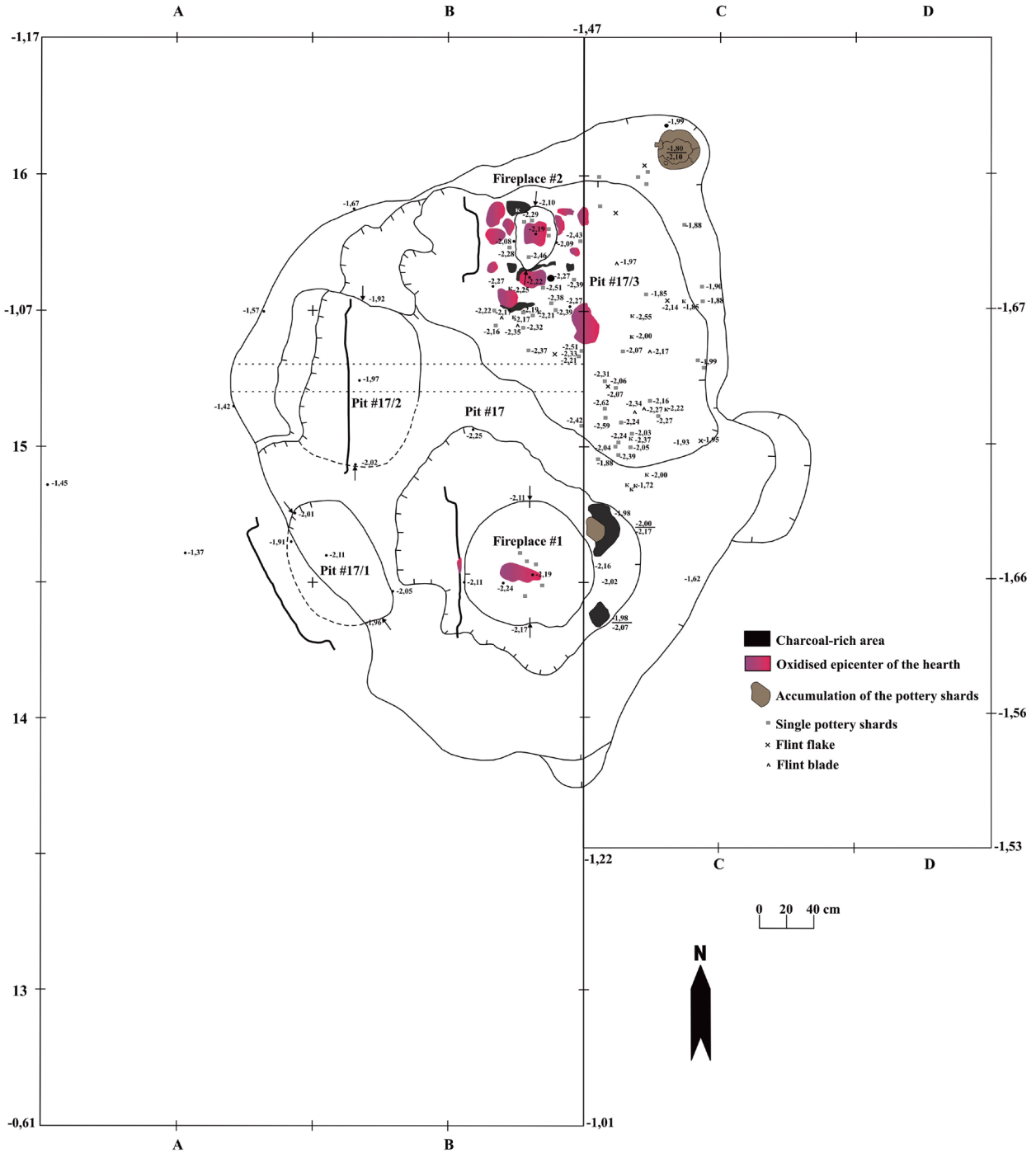

Fig. 2. The plan of the Linear Pottery Culture house under discussion in this paper. The archaeobotanical analysis was done from the fireplace 1 marked on the pit-house plan. Drawing by S. Telishenko.

2 pav. *Linijinės juostinės keramikos kultūros įgilintos konstrukcijos namo planas. Ugniavietė Nr. 1, iš kurios buvo paimti archeobotaniniai mėginiai, pažymėta šiame plane. S. Telishenko brėžinys*

In this paper, we present the archaeobotanical research results from the LBK Ratniv-2 site in western Ukraine and the radiocarbon dates of cereal grain that have been made from the Neolithic sites in Ukraine for the first time. Our research results suggest that LBK farmers were probably the first carriers of agriculture into Ukraine also showing that these processes took place during a much earlier timeframe than previously thought.

BACKGROUND ON RATNIV-2

The LBK settlements in Ukraine are situated mostly on the Volyn Plateau (Chernysh, 1962) and are almost all exclusively distributed on podzolized chernozem soils, shallow chernozems, and gray-forest podzols in the present forest-steppe region of Ukraine (Larina and Okhrimenko, 2007).

The Ratniv-2 site is located in western Ukraine, about 10 km southwest from Lutsk, next to the river Chornohuzka (Fig. 1). The Ratniv-2 site is situated on the forest-steppe environmental zone of Ukraine that stretches from the west to the northeast in a narrow belt distributed on loess parent material. The dominating soil types here are light to dark grey forest soils, leached, medium or low humus content chernozem soils, podsolatedloesstic and shallow chernozem or dark podzols (Platonova, 1989).

The investigation of the Neolithic Ratniv-2 site took place in summer 2014, during the registration work of cultural heritage sites in Volyn district. The Ratniv-2 site is distributed in a plowing field that contains finds of the Neolithic period that are scattered across a 520 × 240 m area. Small-scale excavations took place of a round shaped pit house about 4 × 5 m in size (object no. 17) with two fireplaces and four pits (Fig. 2). The house contained pottery vessels and a flint inventory of blade sickles that are characteristics of the LBK pottery style (Figs. 3, 4) (Telizhenko and Yanish, 2015). The pottery types consisted of spherical, conical and high bowls and pots that are found in neighboring Poland and attributed to LBK culture (e.g., Czekaj-Zastawny, 2008). A previous zooarchaeological analysis of Ratniv-2 osteological material has shown a typical to LBK animal species assemblage where the domesticated animal species show predominance over the wild one (Tringham, 1969). In the Ratniv-2 site, the dominating animal species were cattle (*Bos taurus*) followed by pig (*Sus scrofa domestica*) sheep (*Ovis aries*) and goat (*Capra hircus*) (Telizhenko and Yanish, 2015).

ARCHAEOBOTANICAL AND AMS DATING RESULTS

The archaeobotanical analysis of hearth/fireplace No. 1 within the pit house was conducted, a total 70 l of sediments were floated. The flotation was done during the fieldwork using a 0.3 mm size mesh, while archaeobotanical identification was conducted at the Bioarchaeology Center of Vilnius University, Lithuania.

The taphonomic conditions at the site strongly affected the preservation of the charred plant remains. Most of them are very fragmented, making it difficult to identify and ascribe to a species level. Nevertheless, the archaeobotanical analysis resulted in a range of cultivated crops accompanied by weeds. The dominant crops were hulled wheat species. From the grain shape and chaff (Fig. 5), it is clear that the archaeobotanical assemblage consists of at least two hulled-wheat types, includes einkorn (*Triticum monococcum*) (Fig. 6), emmer wheat (*Triticum dicoccum*) (Fig. 7) and probably the "new glume wheat type" (*Triticum timopheevii*) (Table 1). The former wheat species is extinct and no longer cultivated in the world. Among other cultivated plants, the seeds of flax (*Linum usitatissimum/catharticum*)*, hulled barley* (*Hordeum vulgare), lentil* (*Lens culinaris*) and *pea* (*Pisum sativum*) were identified. Many caryopses parts of cereals were too fragmented, making it hard to confidently attribute them to species; therefore, the majority of grain fragments were classified as *Tritucum/Hordeum* sp.

The weed species constituted of grass family plants, such as *Bromus* sp. and yellow millet (*Setaria pumila*), with knotweed (*Polygonum* sp.)*,* medick/clover (*Medicago/Trifolium*) family plants. A few seeds of timothy-grass (*Phleum pretense*) were also identified. These are a few species of a typical assortment of weeds found in most of the LBK sites (Kreuz *et al.* 2005; Kreuz and Schäfer, 2011).

Two hulled wheat grains from fireplace No. 1 were selected for AMS ^{14}C dating and submitted to the CHRONO Centre for Climate, the Environment, and Chronology, Queen's University Belfast. The ^{14}C age mean and standard deviation of the samples were calculated using the Libby half-life (5568 yr), following the conventions of Stuiver and Polach (1977). Calibration of the ^{14}C dates was undertaken using the IntCal013 calibration curve (Reimer *et al.,* 2013). All calibrated ^{14}C ages are given at ± 95.4%, i.e. ± 2σ probability (OxCal 4.2).

Radiocarbon dates received from two single wheat grains resulted in a radiocarbon age of 5471–5230 cal BC at 95.4 % (6366 ± 41 BP) [UBA-30429] and

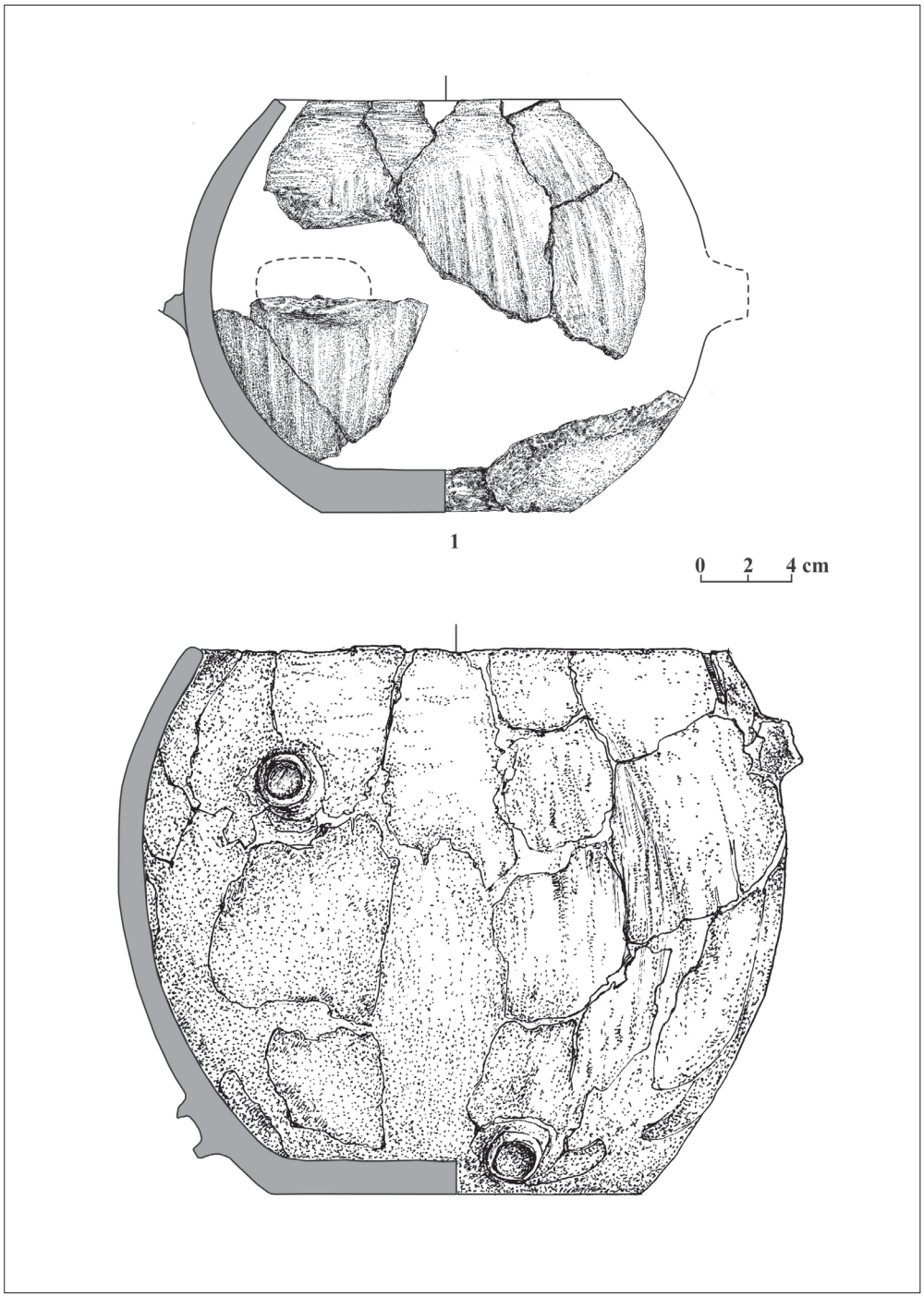

Fig. 3. Some examples of the Linear Pottery Culture pottery vessels found in the pit house; the image scaling bar divisions are 1 mm. Drawing by S. Telishenko.

3 pav. *Keli linijinės juostinės keramikos puodų pavyzdžiai, surasti įgilintos konstrukcijos pastate. Skalė nuotraukoje yra 1 mm ilgio. S. Telishenko piešinys*

Table 1. AMS dates of wheat grains from the LBK Ratniv-2 site in Ukraine

1 lentelė. *AMS radioaktyviosios anglies datos, gautos tiriant kviečių grūdus, aptiktus Ratniv-2 objekte, priklausančiame linijinės juostinės keramikos kultūrai*

Lab code	Dated material	Conventional ^{14}C age BP (±1s)	±	Calibrated age (cal. BC 95.4% hpd range) 4.2
UBA-30429	Emmer wheat grain	6366	41	5471–5230
UBA-27678	Emmer wheat grain	6299	33	5341–5215

5341–5215 cal BC at 95.4 % (6299 ± 33 BP) [UBA-27678] (Table 2). The two radiocarbon dates represent the earliest evidence of domestic crop species in Ukraine.

DISCUSSION

Previous research that reported the presence of charred cereal macrofossils at the LBK sites of Ukraine are coming from the Nezvisko settlement. These include charred wheat (*Triticum dicoccum, Triticum aestivum, Triticum durum*) and peas (*Pisum sativum/arvense*) (Chernysh, 1962; Passek and Chernysh, 1970). The charred grains were found in two pottery vessels placed in a human burial (Passek and Chernysh, 1970). Besides these two vessels containing cereal grains, a grinding stone, stone mattocks, 16 additional ceramic vessels, flint, and bone tools were also placed in the burial (ibid.). There are no radiocarbon dates from the Nezvisko site, but judging from flint and pottery typology, it was previously attributed to the last stage of LBK phenomenon stretching to the 5th millennium BC.

The only charred cereal grain assemblage reported from Moldova is coming from the Criș culture site of Sakarovka-1 (Kuzminova *et al.*, 1998), and the LBK culture sites of Floresht-1 and Denchen-1, dated to the middle/second half of the 6th millennium BC (Kuzminova *et al.*, 1998; Larina, 1994; Larina, 1999; Yanushevich, 1989; Quitta and Kohl, 1969). Unfortunately, none of the dates of these archaeobotanical records were obtained from direct dating of charred cereal grains either. Due to the lack of radiocarbon dates or dating inaccuracies of the LBK material at the Kiev's radiocarbon conventional laboratory (Motuzaitė Matuzevičiūtė, 2013), previous researchers could not agree on the timing of the LBK phenomenon in Ukraine (e.g., Kotova, 2003; Chernysh, 1962; Dolukhanov, 2008).

Table 2. Cultivated plant species and weeds from the Fireplace 1 at Ratniv-2 LBK site.

2 lentelė. *Kultūriniai augalai ir piktžolės iš ugniavietės 1 Ratniv-2 objekte, priklausančiame linijinės juostinės keramikos kultūrai*

Cultivated crop species	Number of seeds
Hordeum vulgare	1
Lens culinaris	1
Linum usitatissimum/catharticum	15
Pisumsativum	2
*Tritucum/Hordeum*sp.	72
Triticum monococcum	8
Triticum dicoccum	7
Triticum dicoccum/ "new type" glume wheat	13
Glume bases of hulled wheat	28
Weed species	
Bromus sp.	3
Setaria pumila	1
Medicago/Trifolium	1
Polygonum sp.	1
Phleum pratense	2
Unidentified plant seed	5

The dating results received from Ratniv-2 site are in line with a chronology of the LBK culture in both Moldova and Poland (e.g., Kirkovski, 1990; Kukawka *et al.* 1990; Milisauskas, 1973), showing the rapid spread of the LBK population across Europe reaching as far east as Ukraine by already 5471–5230 cal BC. This timeframe link the western territory of Ukraine with the eastwards spread of the LBK farming phenomenon in its earliest stage. The research results at the Ratniv-2 site are also in agreement with the predominant current synthesis of scientific evidence and some aspects of the material culture in Ukraine that points towards the appearance of the earliest cereal cultivation and its subsequent expansion in Ukraine only with the expansion of LBK farmers into the re-

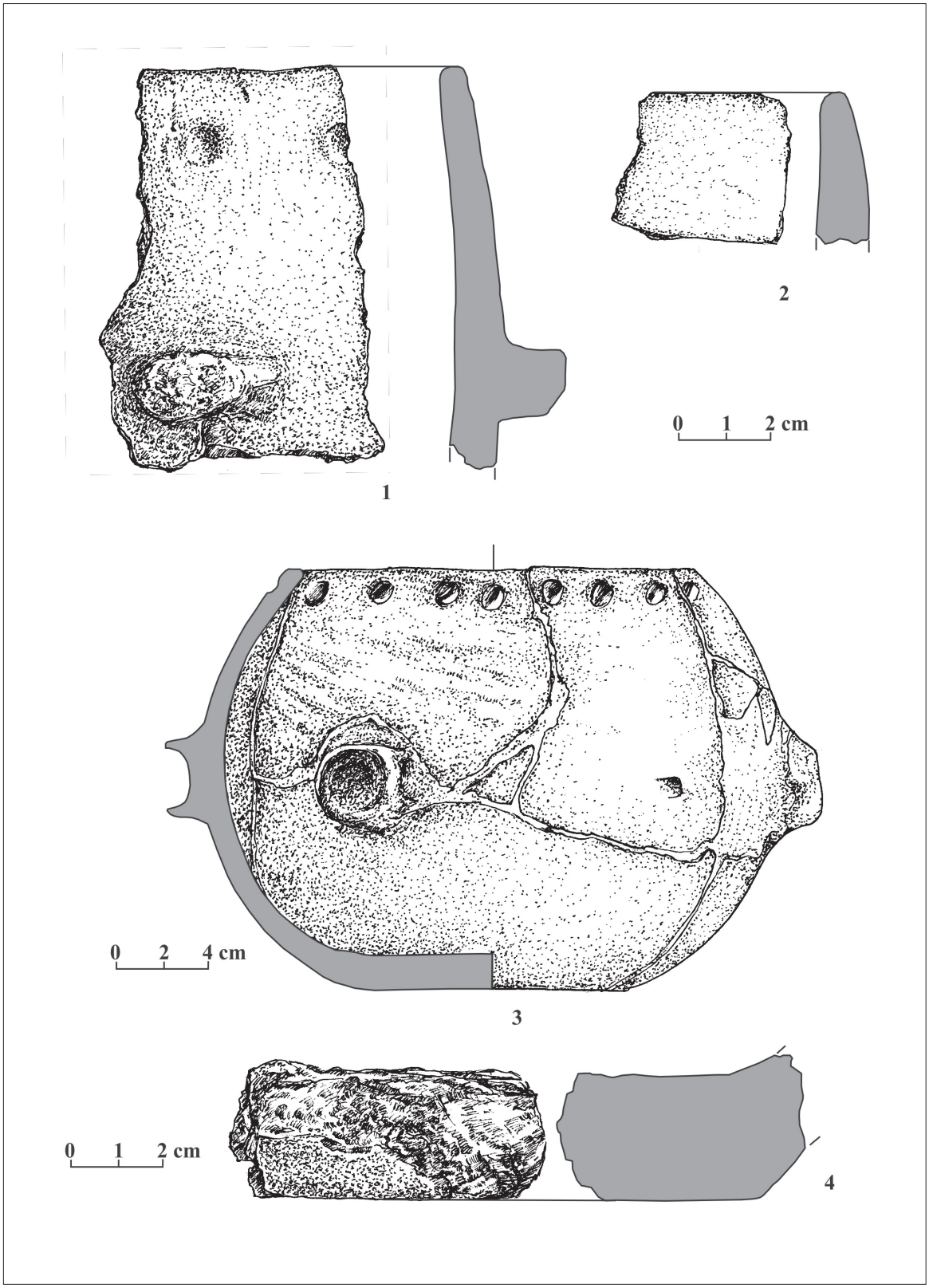

Fig. 4. Some examples of the Linear Pottery Culture vessel found in the pit house; the image scaling bar divisions are 1 mm. Drawing by S. Telishenko.

4 pav. *Keli linijinės juostinės keramikos puodų pavyzdžiai, surasti įgilintos konstrukcijos pastate. Skalė nuotraukoje yra 1 mm ilgio. S. Telishenko piešinys*

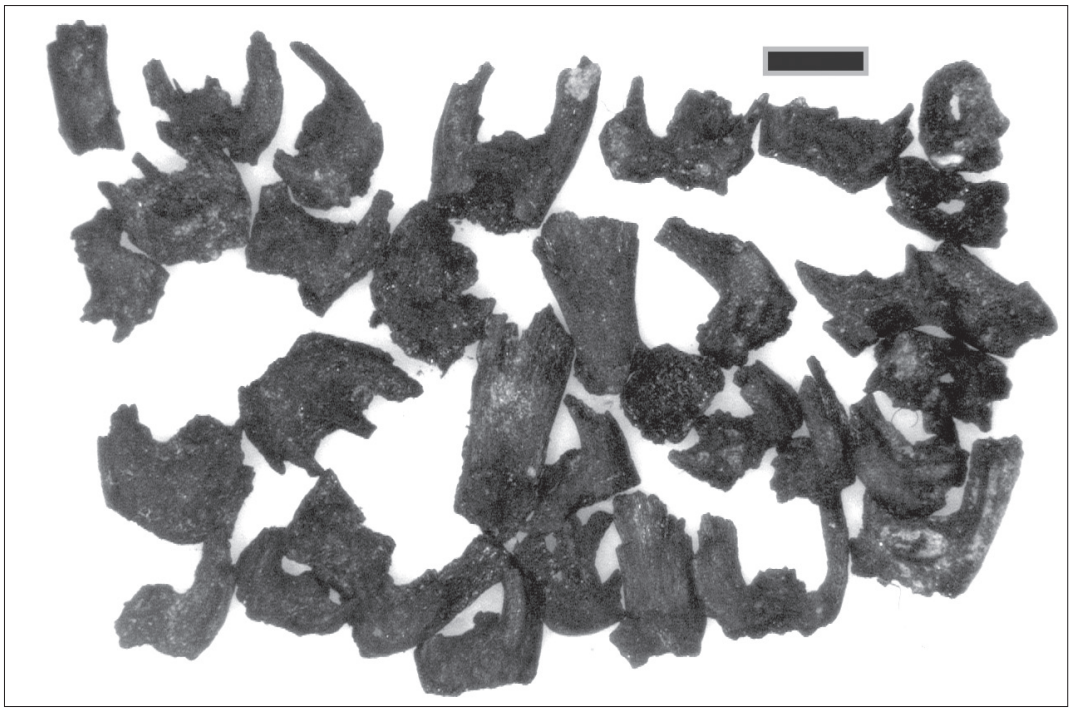

Fig. 5. The glume bases of hulled wheats from the Ratniv-2 house, fireplace 1. Photo by S. Telishenko.
5 pav. *Kietųjų kviečių šakučių dalys iš Ratniv-2 pastato, ugniavietės Nr. 1. S. Telishenko nuotrauka*

Fig. 6. The dorsal, ventral, and lateral views of *Tritucum monococcum* wheat grain from the Ratniv-2 site.
Photo by S. Telishenko.
6 pav. *Triticum monococcum kviečio grūdas iš Ratniv-2 objekto nugarine, pilvine ir šonine puse.*
S. Telishenko nuotrauka

Fig. 7. The dorsal, ventral, and lateral views of *Tritucum dicoccum* wheat grain from the Ratniv-2 site.
Photo by S. Telishenko.
7 pav. *Triticum dicoccum kviečio grūdas iš Ratniv-2 objekto nugarine, pilvine ir šonine puse.*
S. Telishenko nuotrauka

gion (cf., Anthony, 1995, Chernysh, 1962; Dolukhanov, 2008; Dolukhanov and Shilik, 2007; Zvelebil, 1989; Zvelebil and Dolukhanov, 1991; Zvelebil and Lillie, 2000). During the period of gradual LBK expansion, some changes are recognizable in the Bug-Dniester societies, such as population increase, intensification of cattle breeding, the appearance of soil cultivation and cereal processing tools, LBK pottery imports at Bug-Dniester sites etc. (e.g., Tovkailo 2005, Danilenko 1969). The familiarity of the local Late Bug-Dniester population with agriculture probably contributed to the subsequent farmer expansion from the Balkans-Lower Danube regions into the territory of Ukraine, forming the Tripolye culture. Tripolye

farmer groups later spread all the way to the Dnieper River, following the forest-steppe belt of Ukraine, during the second half of the 5th millennium BC.

CONCLUSION

The archaeobotanical investigation and the direct radiocarbon dates of two wheat grains from the Ratniv-2 site represent at this stage the earliest dates derived from cereal grain from all the territory of Ukraine. The crops were consisting of hulled wheat grains and chaff, including einkorn (*Triticum monococcum*), emmer wheat (*Triticum dicoccum*) and probably the "new glume type wheat" (*Triticum timopheevii*). Among other cultivated plants, the seeds of flax (*Linum usitatissimum/catharticum), hulled barley (Hordeum vulgare), lentil (Lens culinaris) and pea (Pisum sativum) were identified.* The cereal grain were recovered from the house that contained pottery and flint inventory typical of LBK phenomenon found among the wide swaths of southeastern and central Europe. The radiocarbon dates show the presence of LBK culture in Ukraine in its earliest stage, which is much earlier than previously thought. These early evidence for cereal cultivation in western Ukraine link the western territory of Ukraine with the eastwards spread of the LBK farming populations along the northern and southeastern slopes of the Carpathian Mountains in its earliest stages of expansion. The research result presented in this publication to date represent the earliest evidence of appearance and the subsequent geographical spared of domesticated crop species in Ukraine.

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PIRMIEJI UKRAINOS ŽEMDIRBIAI: RATNIV-2 OBJEKTO ARCHEOBOTANINIAI TYRIMAI IR KVIEČIŲ GRŪDŲ DATAVIMAS RADIOAKTYVIOSIOS ANGLIES METODU (AMS)

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Santrauka

Šiame straipsnyje pristatomi linijinės juostinės keramikos kultūros Ratniv-2 gyvenvietės, esančios vakarinėje Ukrainos dalyje, naujausių archeobotaninių tyrimų duomenys. Archeobotaniniai duomenys atspindi šios kultūros gyventojams būdingą augintų kultūrinių augalų spektrą, kurį sudarė kelios kietųjų kviečių rūšys, miežiai, žirniai, lešiai ir linai. Keli kviečių grūdai buvo datuoti radioaktyviosios anglies metodu. Radioaktyviosios anglies datos parodė, kad linijinės juostinės keramikos gyvenvietė egzistavo 5471–5215 cal pr. m. e. laikotarpiu. Tai yra pirmosios ir seniausios datos Ukrainoje, gautos datuojant neolitinius kultūrinius augalus. Šios datos ir archeobotaniniai tyrimai rodo, kad seniausi, vertęsi žemdirbyste Ukrainos teritorijoje, buvo linijinės juostinės keramikos atstovai, kurie atkeliavo į dabartinę Ukrainos teritoriją gerokai anksčiau nei manyta prieš tai. Ankstesni tyrinėtojai siejo linijinės juostinės kultūros pradžią Ukrainoje tik su šios kultūros trečiąja banga 5 tūkstantmečio pirmoje pusėje, tačiau radioaktyviosios anglies datos iš Ratniv-2 gyvenvietės parodė, kad linijinės juostinės keramikos kultūros gyventojai išplito po Centrinę bei Rytų Europą gerokai greičiau ir pasiekė Ukrainą jau pirmajame etape – 6 tūkstm. pr. m. e. viduryje.

Tyrimai, pristatyti šiame straipsnyje, yra svarbūs ir todėl, kad padeda eliminuoti kitas anksčiau egzistavusias teorijas apie žemdirbystės pradžią Ukrainoje, kurios buvo siejamos su šiaurinio Kaukazo, stepių keliais ar su Bugo-Dniestro kultūros gyventojais, atnešusiais ankstyviausius kultūrinius augalus į Ukrainos teritoriją.

Įteikta 2016 m. gruodžio mėn.