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The adoption of agriculture: archaeobotanical studies and the earliest evidence for domesticated plants

Giedre Motuzaitė Matuzevičiūtė

This chapter considers the existing archaeobotanical evidence for crop cultivation in Ukraine. Using new research the author attempts to define the most likely scenarios for the geographical origins and the timing of crop cultivation in this region.

Introduction

Consideration of the spread of agriculture into Europe has concentrated, predominantly, on the western and central portions of the continent spanning the longitudes from the Atlantic seaboard to the western edge of the Black Sea. In this respect, two dispersal routes have been well documented with both having their origins in the Near East; a coastal route, marked out by the presence of shell-impressed (Cardial) pottery, and an inland route along the lower Danube basin, marked by the Starčevo-Körös-Criș Cultures and subsequent Linear Pottery Culture/Linearbandkeramik (LBK) expansion. In geographical terms however, Europe extends eastward to the Ural Mountains. The spread of agriculture across the eastern half of the European continent has been less intensively studied than that of the western half (Milisauskas 1986; Whittle 1996; Gronenborn 2003; Dolukhanov *et al.* 2005), even though, during prehistory, the eastern region constituted a ‘crossroads’ for interaction between Europe, the Caucasus and central Asia (Rassamakin 1999; Anthony 2007; Motuzaitė Matuzevičiūtė *et al.* 2009). A variety of crop species domesticated in central Asia or China possibly arrived in Europe by following the steppe corridor across the territory of Ukraine (Janik 2002; Jones 2004; Hunt *et al.* 2008). However, to date, researchers cannot agree on the timing of the adoption of agriculture by the prehistoric populations of Ukraine.

It has been suggested that the Bug-Dniester culture represents the earliest Neolithic archaeological culture in Ukraine (Telegin *et al.* 2003), that formed under the influence of the first agricultural communities in the Balkans

(Kotova 2003; Gaskevich 2007) (see also Chapter 4). Some groups of Balkan populations adopted farming around the second half of the 7th millennium BC (Whittle 1996; Bailey 2000; 2007; Pashkevich and Videiko 2006; Colledge and Conolly 2007). These farming communities started spreading eastwards along river valleys into the Carpathian basin, and subsequently influenced the beginning of domestic cereal cultivation in Moldova (Markevich 1974; Dergachev *et al.* 1991; Kuzminova *et al.* 1998; Dergachev and Dolukhanov 2007; Monah 2007). In Ukraine, however, the populations of the Bug-Dniester culture followed hunter-fisher-forager subsistence strategies, and adopted only some domestic animal species from the populations of the Criș 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 occurs in the later stages of its evolution” under the influence of the LBK Culture. By contrast however, Pashkevich (2003) identified a few cereal impressions in pottery sherds thought to belong to the early Bug-Dniester Culture sites situated along the Southern Bug River (Kotova 2003; Pashkevich 2003). However, no charred cereal remains that could be directly dated have been found, so far, from Bug-Dniester Culture sites of any period, thus these claims cannot be verified and are still open to question (Motuzaitė-Matuzevičiūtė 2012).

The theory most often postulated for the earliest appearance and spread of cereal cultivation in Ukraine states that this phenomenon is connected with the west to east LBK and later Trypillia farmer expansions during the period

of the middle 6th–5th millennia BC (Chernysh 1962; Zvelebil 1989; Zvelebil and Dolukhanov 1991; Anthony 1995; Dolukhanov and Shilik 2007; Dolukhanov 2008). The newest archaeobotanical research results on the LBK Ratniv-2 site in western Ukraine have indeed confirmed that agricultural expansion into western Ukraine is linked with LBK groups; the direct AMS dates of cultivated wheat grains have confirmed that the earliest crops identified in Ukraine are dated to middle of the 6th millennium BC (Motuzaitė Matuzevičiūtė and Telizhenko 2016). The agricultural expansion into the central territories of Ukraine was undertaken by farmer groups from the Cucuteni-Tripolye (Trypillia) Culture, who followed the forest-steppe belt to the Dnieper River no earlier than the first half of the 5th millennium BC (Anthony 1995; Dolukhanov 1986; Whittle 1996; Zvelebil and Lillie 2000; Sanzharov *et al.* 2000; Telegin *et al.* 2003; Pashkevich 2003; Davison *et al.* 2006). Zvelebil and Dolukhanov (1991) divided the development and further economical expansion of the Trypillia culture into two periods: substitution and consolidation. According to these authors, the contacts between the Dnieper-Donets forager cultures and the Trypillia farmer populations are marked by the appearance of Trypillia pottery imports, the occurrence of cereals and some domesticated animal remains (Telegin 1968).

Dolukhanov and Shilik (2007) concluded that the farming populations of the Gumelnița Culture established themselves in the steppe zone of the lower Dniester valley of southwestern Ukraine and southern Moldova during the 5th millennium BC (4900–4000 cal BC). Future macrobotanical investigations in the territory of the southwestern steppe part of Ukraine might result in much earlier evidence of agriculture in this region.

The subsequent eastward spread of cereal cultivation to the other half of Ukraine (eastwards from the Dnieper River), as well as to the south, did not occur until “4500–3000 BP” (*e.g.* Velichko *et al.* 2009: 7). However, the cereal impressions identified by Pashkevich (2003) on pottery from the steppe region of central Ukraine have been dated by chronological affiliation to the first half of the 5th millennium BC (Kotova 2003). In the boreal forest zone cereal cultivation did not begin until the middle of the 5th millennium BC (Ochrimenko 2002).

In contrast to a Danubian route for agricultural dispersals into Ukraine, some researchers have envisaged impulses of crop cultivation, and the formation of domestic animal husbandries, arriving from the opposite direction, *i.e.* the Caucaso-Caspian corridor (*e.g.* Shnirelman 1989; 1992; Jacobs 1993; 1994; Kotova 2003; 2009; Kotova and Makhortykh 2010), these researchers suggested a possible independent and pre-Danubian route of cereal cultivation in central Ukraine, which arrived via the corridor between the Black and Caspian Seas. Another early Eurasian steppe belt route of agricultural dispersal was suggested by Jones

(2004) with the arrival of common millet crops (*Panicum miliaceum*) into Neolithic Ukraine from the east.

The main aim of this chapter is to collate and review the existing archaeobotanical evidence and its dating (Table 9.1). In addition to the author’s own archaeobotanical research results for Ukraine this chapter will endeavour to define the most likely scenarios of the timeline and geographical origins of spread of crop cultivation traditions across Ukraine.

Past research and some remarks on methodology

At present our understanding of the earliest appearance of agriculture in Ukraine has been constructed mainly on the basis of material culture remains, the microscopic analysis of flint tools and the investigation of cereal impressions in pottery and daub, along with palynological, anthropological, zooarchaeological and isotope analysis. However, traditionally, the origin of agriculture in Ukraine has often been interpreted primarily on the basis of the artefactual evidence. The presence of stone or antler hoes, mattocks, grinding stones and flint sickles has usually served as an indication that humans were cultivating and processing domesticated crops at a site. This evidence has also often been supported by the identification of domestic animal species in association.

On the basis of these criteria, coupled with observations of the change in flint blade production techniques and the appearance of Criș pottery imports, Danilenko (1969) interpreted the beginnings of agriculture in western Ukraine as having appeared during the ‘Pecherskaya’ stage of the Bug-Dniester Culture (around the middle of the 6th millennium BC). Following the same set of observations Sanzharov *et al.* (2000) did not find any evidence of cereal cultivation in eastern Ukraine during the Neolithic period while Gurin (1998) had claimed the opposite. However, the possession of grinding stones, antler mattocks and/or domestic animals by the semi-sedentary, pottery-making inhabitants in Ukraine does not necessary prove the existence of cultivated cereals since such artefacts could also have been used to process and store wild plant foods.

Archaeobotanical work from Neolithic sites in Ukraine has concentrated, almost exclusively, on the analysis of cereal impressions in pottery which is usually dated according to pottery typology (Yanushevich 1976; 1978; 1980; 1984; 1986; 1989; Pashkevich 1984; 1989; 1997; 2003; 2004; 2005; 2007; Kuzminova and Petrenko 1989; Kuzminova *et al.* 1998; Kotova 2002; 2003; Pashkevich and Videiko 2006). Based on pottery impressions, the earliest evidence of agriculture in Ukraine has been reported from Bug-Dniester Culture sites dated to the second half of the 7th millennium BC (*e.g.* Kotova 2003).

However, the analysis of cereal impressions in pottery has many limitations in the absence of cereal chaff imprints or clearly visible grain features, especially if the cereal

Table 9.1: Records of crops from the Neolithic and Chalcolithic cultures in Moldova and Ukraine (excluding Cucuteni-Tripolye Culture sites)

Location	Culture	Site name	Date (cal BC), references & details	Details	References for archaeobotanical records
Moldova (N)	Criș	Sakarovka-I	5644–5486 ¹ (1 date) Yanushevich 1986	<i>Hordeum vulgare</i> var. <i>nudum</i> 71 (PI), <i>Hordeum vulgare</i> 72 (PI) <i>Panicum miliaceum</i> 97 (PI) <i>Triticum spelta</i> 59 (PI and charred), <i>Triticum aestivum</i> / <i>durum</i> 171 (PI), <i>Triticum monococcum</i> 93 (PI), <i>T. dicoccum</i> 145 (PI) and 2 charred grains and spikelet forks <i>Avena</i> sp. 17 (PI) <i>Pisum</i> sp. 34 (PI)	Yanushevich 1986 Larina 1999 Kuzminova <i>et al.</i> 1998 Yanushevich 1989
Moldova (central)	LBK	Denchen-I	End of the 6th millennium ² Larina 1999	<i>Hordeum vulgare</i> 7 (PI) <i>Panicum miliaceum</i> 60 (PI as chaff & grain) <i>Triticum spelta</i> 1, <i>T. dicoccum</i> 48, <i>T. monococcum</i> 58, <i>T. aestivum</i> 9 (charred grains) <i>Pisum sativum</i> 10 (charred grains) <i>Vicia ervilia</i> 6 (charred grains) <i>Avena sativa</i> <i>Cannabis sativa</i> 9 (PI)	Larina 1999 Yanushevich 1989
Moldova (central)	LBK	Durlesht-I	Late 6th–early 5th millennium ² Larina 1999	cf. <i>Hordeum vulgare</i> 1 (PI) <i>Panicum miliaceum</i> 1 (PI) <i>Triticum dicoccum</i> 1 (PI)	Larina 1999 Kuzminova <i>et al.</i> 1998
Moldova (N)	LBK/Early Tripolye	Floresht-I	5400–5000 ² Monah 2007	<i>Triticum monococcum</i> 7 (charred grains)	Larina 1999
Moldova (central)	LBK	Novye Ruseshty-I	4685–4233 ¹ (1 date) Quitta and Kohl 1969	<i>Triticum dicoccum</i> , <i>T. spelta</i> (PI)	Yanushevich 1976
Moldova (central)	LBK	Novye Ruseshty-II	5400–5000 ² Monah 2007	<i>Triticum dicoccum</i> , <i>T. spelta</i> (PI) <i>Avena</i> sp. (PI)	Yanushevich, 1976
Moldova (NE)	LBK/Cucuteni	Rogozhen-II	4694–4375 ¹ (1 date) Mantu 1998	<i>Hordeum vulgare</i> var. <i>nudum</i> (PI) <i>Triticum monococcum</i> , <i>T. dicoccum</i> , <i>T. spelta</i> (PI)	Larina 1999
Moldova (E-central)	LBK	Braneshty-I	5400–5000 ² Monah, 2007	<i>Panicum miliaceum</i> 1 <i>Triticum spelta</i> 4 (PI)	Yanushevich 1976
Moldova (NE)	Bug-Dniester	Soroki-I	6000–4800/4700 ^{2*} Gaskevich 2007	cf. <i>Hordeum vulgare</i> (PI) cf. <i>Panicum miliaceum</i> 1 (PI) <i>Triticum spelta</i> (PI)	Yanushevich 1976
Moldova (NE)	Bug-Dniester	Soroki-II	5994–5488 ¹ (1 date from layer I) Quitta and Kohl 1969	<i>Triticum monococcum</i> , <i>T. dicoccum</i> ,	Yanushevich 1976
Moldova (NE)	Bug-Dniester	Soroki-III	5841–5487 ¹ (1 date) Yanushevich 1989	<i>Triticum monococcum</i> , <i>T. dicoccum</i> , <i>T. spelta</i> (PI)	Yanushevich 1976: Yanushevich 1989

(Continued)

Table 9.1: Records of crops from the Neolithic and Chalcolithic cultures in Moldova and Ukraine (excluding Cucuteni-Tripolye Culture sites) (Continued)

Location	Culture	Site name	Date (cal BC), references & details	Details	References for archaeobotanical records
Moldova (NE)	Bug-Dniester	Soroki-V	5631–5232 ¹ (1 date) Quitta and Kohl 1969	<i>Triticum monococcum</i> , <i>T. dicoccum</i> , <i>T. spelta</i> (PI)	Yanushevich 1976
Moldova (NE)	LBK	Gura-Kamenka	5400–5000 ² Monah 2007	<i>Triticum dicoccum</i> 2, cf. <i>T. spelta</i> (PI)	Yanushevich 1976
Moldova (NE)	Bug-Dniester/ Criș	Ruptura	5976–5560 ¹ (1 date) Yanushevich 1989	cf. <i>Panicum miliaceum</i> 1 (PI) <i>Triticum monococcum</i> , <i>T. dicoccum</i> , <i>T. spelta</i> (PI)	Yanushevich 1989
Russia (SW)	Sreny-Stog	Rakushechny Yar	5471–3365 ¹ (7 dates)* Timoveev <i>et al.</i> 2004	<i>Triticum</i> spp. (PI) (layer 2) cf. <i>Linum usitatissimum</i> (layer 2) <i>Triticum spelta</i> (layer 2) <i>Triticum</i> spp. (layer 3) <i>Hordeum vulgare</i> (layer 4) cf. <i>Panicum miliaceum</i> (layer 4) <i>Triticum</i> cf. <i>aestivum</i> (layer 4)	Primary source
Ukraine (W)	Bug-Dniester	Zankovtsy	5600–4800/4700 ² Gaskevich 2007	<i>Triticum dicoccum</i> (ear imprint) (2 nd period)	Kotova 2003; Pashkevich 2003
Ukraine (central)	Dnieper- Donets: Kiev- Cherkasy	Uspenka	First half 5th millennium ² Telegin and Titova 1998	<i>Hordeum vulgare</i> var. <i>nudum</i> 1, <i>H. vulgare</i> 1 (PI) (1st period)	Kotova 2003; Pashkevich 2003
Ukraine (central)	Dnieper- Donets: Kiev- Cherkasy	Buzki	First half 5th millennium ² Telegin and Titova 1998	<i>Hordeum vulgare</i> 3 (PI) (1st period) <i>Triticum monococcum</i> 1 (PI) (1st period)	Kotova 2003; Pashkevich 2003
Ukraine (central)	Dnieper- Donets: Kiev- Cherkasy	Vita Litovskaya	Second half 5th millennium ² Telegin and Titova 1998	<i>Hordeum vulgare</i> 2 (PI) (2nd period)	Kotova 2003
Ukraine (central)	Dnieper- Donets: Kiev- Cherkasy	Grini	Second half 5th millennium ² Telegin and Titova 1998	<i>Hordeum vulgare</i> 1 (PI) (2nd period) <i>Panicum miliaceum</i> 3 (PI) (2nd period) <i>Triticum dicoccum</i> , cf. <i>T. aestivum</i> 1 (PI) (2nd period) cf. <i>Pisum sativum</i> <i>Vicia ervilia</i> (PI) (2nd period)	Kotova 2003; Pashkevich 2003
Ukraine (central)	Dnieper- Donets: Kiev- Cherkasy	Pischiki	Second half 5th millennium ² Telegin and Titova 1998	<i>Pisum sativum</i> (PI) (2nd period)	Kotova 2003
Ukraine (central)	Dnieper- Donets: Volyn	Roznychi	Second half 5th millennium Okhrimenko and Lokaichuk 2007	<i>Triticum monococcum</i> 1 (PI) (1st period)	Kotova 2003; Pashkevich 2003
Ukraine (central)	Sredny-Stog	Molyukhov Bugor	3764–3641 (1 date) Lillie <i>et al.</i> 2009	<i>Triticum monococcum</i> , <i>T. compactum</i> <i>Hordeum vulgare</i> <i>Panicum miliaceum</i> <i>Vicia</i> sp.	Rassamakin 1999

(Continued)

Table 9.1: (Continued)

Location	Culture	Site name	Date (cal BC), references & details	Details	References for archaeobotanical records
Ukraine (central)	Sredny-Stog	Dereivka	4549–2631 ¹ (6 dates)* Rassamakin 1999	cf. <i>Hordeum vulgare</i> (PI) cf. <i>Secale cereale</i>	Rassamakin 1999
Ukraine (E)	Dnieper- Donets: Donets	Serebryanskoe	5208–4260 ¹ (1 date) Sanzharov <i>et al.</i> 2000	<i>Hordeum vulgare</i> 1 (PI) (1 st period)	Kotova 2003; Pashkevich 2003
Ukraine (E)	Sredny-Stog	Zanovskoe	4462–3525 ¹ (3 dates) Manko 2003	<i>Hordeum vulgare</i> var. <i>nudum</i> , <i>Hordeum vulgare</i> <i>Triticum</i> sp. (PI)	Primary source
Ukraine (N)	Dnieper- Donets: Volyn	Pustynka	Second half 5th millennium (late period) Telegin and Titova 1998	<i>Hordeum vulgare</i> (PI) <i>Panicum miliaceum</i> (PI) <i>Triticum dicoccum</i> (1 ears), cf. <i>T. monococcum</i> 1 (PI)	Pashkevich 2003
Ukraine (N)	Dnieper- Donets: Kiev- Cherkasy	Kamenka	Second half 5th millennium Telegin and Titova 1998	<i>Hordeum vulgare</i> 1 (PI) (2nd period) <i>Triticum dicoccum</i> (2 ear imprints), <i>T. monococcum</i> 1 (PI) (2nd period)	Pashkevich 2003; Kotova 2003
Ukraine (N)	Dnieper- Donets: Volyn	Krushniki	Second half 5th millennium Okhrimenko and Lokaichuk 2007	<i>Panicum miliaceum</i> 2 (PI) (2nd period) <i>Triticum dicoccum</i> 1 (PI) (2nd period) <i>Pisum sativum</i> 1 (PI)	Kotova 2003; Pashkevich 2003
Ukraine (NW)	Dnieper- Donets: Volyn	Mala Osnytsa	Second half 5th millennium Okhrimenko and Lokaichuk 2007	<i>Panicum miliaceum</i> 1 (PI) (1st period) <i>Triticum dicoccum</i> 1 (PI) (1st period)	Kotova 2003; Pashkevich 2003
Ukraine (NW)	Dnieper- Donets: Volyn	Obolon	Second half 5th millennium	<i>Panicum miliaceum</i> 1 (PI) (1st period)	Kotova 2003
Ukraine (NW)	Dnieper- Donets: Volyn	Konik	Second half 5th millennium Okhrimenko 1993; Okhrimenko and Lokaichuk 2007	<i>Vicia ervilia</i> (PI) (2nd period)	Kotova 2003; Pashkevich 2003
Ukraine (NW)	Dnieper- Donets: Volyn	Novoselki	Second half 5th millennium Okhrimenko and Lokaichuk 2007	<i>Triticum aestivum</i> 1 (PI) <i>Pisum sativum</i> (PI) (2nd period)	Kotova 2003; Pashkevich 2003
Ukraine (central)	Dnieper- Donets: Azov- Dnieper	Nikolskoye cemetery	5002–4806 ¹ (1 date) Lillie <i>et al.</i> 2008	<i>Hordeum vulgare</i> var. <i>nudum</i> 1 (PI) (2nd period)	Kotova 2003
Ukraine (central)	Dnieper- Donets: Mariupol- Azov-Dnieper	Vovnigi	5500–4000 ^{2*} Telegin <i>et al.</i> 2003	<i>Hordeum vulgare</i> cf. var. <i>nudum</i> -1 (PI) (2nd period) <i>Triticum dicoccum</i> -1 (PI) (period 1b)	Kotova 2003
Ukraine (central)	Dnieper- Donets: Mariupol- Azov-Dnieper	Strilcha Skelya	First half of the 5th millennium Kotova 2003	<i>Triticum dicoccum</i> -1 (PI) (2nd period)	Kotova 2003

(Continued)

Table 9.1: Records of crops from the Neolithic and Chalcolithic cultures in Moldova and Ukraine (excluding Cucuteni-Tripolye Culture sites) (Continued)

Location	Culture	Site name	Date (cal BC), references & details	Details	References for archaeobotanical records
Ukraine (central)	Dnieper- Donets: Mariupol- Azov-Dnieper	Lysaya Gora cemetery	4942–4559 ¹ Kotova 2003	<i>Triticum</i> cf. <i>monococcum</i> 2, <i>T. dicoccum</i> 1 (PI) (2nd period)	Kotova 2003
Ukraine (W)	Bug-Dniester	Mikolina Broyaka	5618–5358 ¹ (1 date) Kotova 2002	<i>Hordeum vulgare</i> 2 (PI) (2nd period)	Pashkevich 2003
Ukraine (W)	Bug-Dniester	Shumilovo	5600–4800/4700 ² Gaskevich 2007	<i>Hordeum vulgare</i> 1 (PI) (2nd period)	Pashkevich 2003; Kotova 2003
Ukraine (W)	Bug-Dniester	Bazkov Ostrov	5736–5374 ¹ (2 dates) Kotova 2002	<i>Hordeum vulgare</i> 3 (PI) <i>Triticum dicoccum</i> 1, <i>T.</i> <i>monococcum</i> 3 (PI) (2nd period) <i>Linum usitatissimum</i> 1 (PI)	Pashkevich 2003
Ukraine (W)	Bug-Dniester	Shimanovskoye	5600–4800/4700 ² Gaskevich 2007	<i>Triticum spelta</i> 1 (PI) (2nd period)	Kotova 2003
Ukraine (W)	Bug-Dniester	Sokoltsy-II	6438–6101 ¹ (2 dates) Telegin <i>et al.</i> 2003	<i>Hordeum vulgare</i> 1 (PI) (1st period) <i>Panicum miliaceum</i> 1 (PI) (1st period) cf. <i>Linum usitatissimum</i> 2 (PI) (1st period)	Kotova 2003; Pashkevich 2003
Ukraine (W)	Bug-Dniester	Sokoltsy-VI	6000–4800/4700 ^{2*} Gaskevich 2007	<i>Hordeum vulgare</i> 1 (PI) (1st or 2nd period)	Kotova 2003
Ukraine (NW)	LBK	Golovna	5550–4650 ² Kotova 2003	<i>Triticum monococcum</i> (PI)	Pashkevich 2003
Ukraine (NW)	LBK	Litovii	5550–4650 ² Kotova 2003	<i>Pisum sativum</i> 1 (PI)	Pashkevich 2003
Ukraine (NW)	LBK	Rovno	5629–5306 ¹ (2 dates) Kotova <i>et al.</i> 2007	<i>Hordeum vulgare</i> var. <i>nudum</i> 9, <i>H. vulgare</i> 2 (PI) (1st period) <i>Panicum miliaceum</i> 2 (PI) (1st period) <i>Setaria</i> sp. 2 (PI) <i>Triticum dicoccum</i> 5; <i>T. aestivum</i> 1 (PI) (1st period) <i>Pisum sativum</i> 3 (PI) (1st period)	Kotova 2003; Pashkevich 2003
Ukraine (NW)	LBK	Golyshev	5425–4938 ¹ (4 dates) Kotova <i>et al.</i> 2007	<i>Hordeum vulgare</i> var. <i>nudum</i> 4, <i>Hordeum vulgare</i> 2 (PI) (2nd period) <i>Triticum dicoccum</i> 1 <i>T. monococcum</i> 2 <i>T. aestivum</i> 1 (PI) (2nd period)	Kotova 2003; Pashkevich 2003
Ukraine (NW)	LBK	Girka Polonka	5049–4618 ¹ (1 date) Kotova <i>et al.</i> 2007	<i>Hordeum vulgare</i> var. <i>nudum</i> 2, <i>H. vulgare</i> 3 (PI) (2nd period) <i>Triticum dicoccum</i> 1 (PI) (2nd period) <i>Secale</i> sp. (PI)	Okhrimenko and Lotaichuk 2007
Ukraine (NW)	LBK	Gnidava	4902–4462 ¹ (1 date) Kotova <i>et al.</i> 2007	<i>Hordeum vulgare</i> 1, <i>H. vulgare</i> var. <i>nudum</i> 2 (PI) (3rd period) <i>Triticum dicoccum</i> 1, <i>T. aestivum</i> 1 (PI) (3rd period) <i>Secale</i> sp. (PI)	Kotova 2003; Pashkevich, 2003

(Continued)

Table 9.1: (Continued)

Location	Culture	Site name	Date (cal BC), references & details	Details	References for archaeobotanical records
Ukraine (W)	LBK	Nezvisko	Later period of LBK Passek and Chernysh 1970	<i>Triticum dicoccum</i> (charred grains) <i>Triticum aestivum</i> (charred grains) <i>Triticum durum</i> (charred grains) <i>Pisum sativum/arvense</i> (charred pulses)	Chernysh 1962; Passek and Chernysh 1970
Ukraine (NW)	LBK	Zimne	1st half 5th millennium Kotova <i>et al.</i> 2007	<i>Triticum dicoccum</i> 2 (PI) <i>Avena</i> sp. (PI) <i>Vicia ervilia</i> 1 (PI) <i>Cannabis</i> sp. 1 (PI)	Pashkevich 2003
Ukraine (NW)	LBK	Iosipovka-I	2nd half 6th millennium Chernovol <i>et al.</i> 2009	<i>Hordeum vulgare</i> var. <i>nudum</i> (early period) (daub impressions)	Chernovol <i>et al.</i> 2009; Pashkevich 2007
Ukraine (W)	LBK	Ratniv-2	5471–5230; 5341–5215) dates of cereal Motuzaitė Matuzeviciute and Telizhenko 2016	<i>Triticum monococcum</i> , <i>T.</i> <i>dicoccum</i> , <i>T. timopheevii</i> (?), <i>Linum usitatissimum</i> / <i>catharticum</i> , <i>Hordeum vulgare</i> , <i>Lens culinaris</i> , <i>Pisum sativum</i> (all charred grains)	Motuzaitė Matuzeviciute and Telizhenko 2016

In the case of pottery impressions (PI) the number of records is indicated when available in the source text.

Chronological sources: ¹Date and estimate from source text using OxCal 4.1 date range (95.4%)(Bronk Ramsey 2009) of published uncalibrated date; ²Date range of archaeological culture; *If only the attribution to the culture is known or the range of the radiocarbon dates is very wide.

species were identified from solitary grain impressions. The existence of cereal impressions is biased by the methods in pottery production and primarily only reflects cereal cultivation activities among those societies who used cereal-threshing residue as clay temper. A lack of pottery impressions, therefore, does not necessarily imply the absence of cereal cultivation, since some groups used alternative materials (to cereal chaff) as clay temper. Renfrew (1973) has argued that grain impressions in daub are much more reliable than impressions in pottery due to the fact that most pottery vessels are fired and the impressed grains thereby distorted, whereas daub is usually sun-dried and therefore cereal impressions remain more intact. However, in the case of sites where clay daub was not used or bricks were not made or were not preserved, the resulting evidence is obtained only from impressions in pottery vessels.

Finally, archaeological sites in Ukraine are often located in deep valleys on floodplains where archaeological artefact displacement might take place by active bioturbation and geological processes such as solifluction, clay shrinkage and vertical (desiccation) cracking. Therefore, pottery possessing cereal impressions could be mixed into lower sections of the stratigraphy after displacement from upper layers; a state of affairs which is hard to prove due to the difficulties extant in dating pottery directly (Motuzaitė-Matuzeviciute 2012).

Alternative approaches to the identification of the beginnings of agriculture in Ukraine, in this example using pollen records, have been undertaken by a number of researchers (Levkovskaya 1992; Gerasimenko 1997; Kremenetski *et al.* 1999; Bezusko *et al.* 2000; Levkovskaya *et al.* 2003). Pollen belonging to Cerealia, *Fagopyrum* sp. and crop weeds such as *Plantago lanceolata* and *Centaurea cyanus* have been detected in Moldova only during the second half of the Atlantic period (5–4th millennia BC) (Kremenetski 1997) while at sites along the northern Azov Sea coast Cerealia pollen was reported as early as the 7th–6th millennium BC (Krizhevskaya 1992; 1998; Bezusko *et al.* 2000).

Importantly, the investigation of charred plant remains at archaeological sites not only shows whether people were involved in agriculture or not but also allows for their direct dating and the construction of an accurate chronology. The charred macrofossils have to be directly radiocarbon dated, or alternatively come from a discrete archaeological context (such as a vessel) in order to be considered secure (see below).

Collation of archaeobotanical data

Domestic crops in Ukraine began to be cultivated to a significant degree among ‘fully developed farming economies’

belonging to the Trypillian Culture of western Ukraine (Dolukhanov and Shilik, 2007: 313); no researcher has attempted to question the involvement of the Trypillia Culture in agricultural terms and its geographical origin in the Carpathian basin is generally accepted. During the Chalcolithic period (starting from the 5th millennium BC) Trypillian populations grew a wide range of Southwest Asian domesticates, which have been found in archaeological sites not only as impressions or charred grains, but also as depictions on pottery (Nikolova and Pashkevich 2003; Pashkevich and Videiko 2006). However, the archaeobotanical evidence encompassing the timeframe and geographical origins of pre-Trypillia cereal cultivation in different regions of Ukraine is still a cause for debate.

Western Ukraine and Moldova

The earliest evidence for crops in Ukraine comes from the western regions of the country. 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 (at 5471–5230 cal BC and 5341–5215 cal BC at 95.4 % confidence [UBA-30429 and UBA-27678 – 6366±41 and 6299±33 uncal BP respectively]) (Motuzaitė Matuzevičiūtė and Telizhenko 2016: 105). The crops consisted of hulled wheat grains and chaff, including einkorn (*Triticum monococcum*) and emmer wheat (*T. dicoccum*) (Fig. 9.1a–d) and probably a ‘new glume type wheat’ (*T. timopheevii*) (Fig. 9.1e–f) (Motuzaitė Matuzevičiūtė and Telizhenko 2016: 108). Among other cultivated plants the seeds of flax (*Linum usitatissimum/catharticum*), hulled barley (*Hordeum vulgare*), lentil (*Lens culinaris*) and pea (*Pisum sativum*) were identified (Motuzaitė Matuzevičiūtė and Telizhenko 2016). The cereal grains were recovered from a house that contained pottery and a flint inventory typical of LBK assemblages that is found across wide swaths of south-eastern and central Europe. In addition, charred cereal macrofossils are also found in western Ukraine, at the Nezvisko settlement sites, attributed to the later periods of the LBK culture. The crop assemblages show a wide range of taxa including emmer, bread and durum wheat and peas (Chernysh 1962; Passek and Chernysh 1970). The charred grains from the Nesvisko site 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 (Passek and Chernysh 1970).

The attribution of the earliest evidence for cereal cultivation in western Ukraine to the LBK Culture coincides with the earliest evidence of agriculture in the territories of southern Belarus and eastern Poland (Milisauskas 1973). This evidence links the western territory of Ukraine with the eastwards spread of the LBK farming populations along the northern and southeastern slopes of the Carpathian

Mountains. The only charred cereal grains reported from Moldova are from the Criș Culture site of Sakarovka-I (Kuzminova *et al.* 1998), and the LBK culture sites of Floresht-I and Denchen-I and these are dated to the middle/second half of the 6th millennium BC (Yanushevich 1989; Larina 1994; Kuzminova *et al.* 1998). The remaining evidence for cereal cultivation in both Ukraine and Moldova comes only from grain and cereal chaff impressions in pottery and daub and this is where the evidence becomes more ambiguous and perhaps even unconvincing (Table 9.1).

The existing evidence for cereal grain and chaff impressions in pottery and daub from specific taxa of domesticated plants in Ukraine and Moldova includes evidence of einkorn (*Triticum monococcum*), emmer (*T. dicoccum*), spelt (*T. spelta*) and bread wheat (*T. aestivum*), hulled and naked barley (*Hordeum vulgare* and *H. vulgare* var. *nudum*), millet (specifically common millet (*Panicum miliaceum*)), flax (*Linum usitatissimum*), pea (*Pisum sativum*), bitter vetch (*Vicia ervilia*) and hemp (*Cannabis sativa*) (Yanushevich 1989; Kotova 2003; Levovskaya *et al.* 2003; Pashkevich 2003). The earliest cereal impressions in pottery have been reported from the southwestern regions of Ukraine and northeastern regions of Moldova. The impressions are attributed to the early stages of the Bug-Dniester Culture (*e.g.* Yahushevich 1989; Pashkevich 2003), dated to *ca.* 6000–5500/5400 cal BC (Gaskevich 2007). Among the records of domesticated plants in the Bug-Dniester Culture of Ukraine, the earliest recorded evidence is for barley, common millet and flax (Kotova 2003; Pashkevich 2003). Imprints of these crops in pottery from sites possessing radiocarbon dates has only been found at Sokoltsy-II, where animal bone from the same layer were dated at the Kiev Radiocarbon Laboratory (KRL) to the second half of the 7th millennium BC at *ca.* 6440–6090 cal BC (Ki-6697 and Ki-6698: 7470±60 and 7405±55 uncal BP respectively) (Telegin *et al.* 2003: 460). It is very important to point out that these dates are not reported with information indicating whether the pottery sherds containing cereal impressions were actually recovered from the same layer as the one that was dated.

Other early hulled barley, einkorn wheat and flax impressions have also been found at the Bug-Dniester Culture site of Bazkov Ostriv (at 5736–5374 cal BC Ki-8166: 7410±65 BP; Ki-8167: 7270±70 BP) (Kotova 2003). Unfortunately, in this instance the researchers did not specify whether the cereal impressions were found on Bug-Dniester pottery sherds or on imported Criș pottery sherds. At Bug-Dniester sites in Moldova wheat is found among the oldest assemblages of crops. Grain impressions of einkorn, emmer and spelt wheat from the Bug-Dniester Culture sites of Soroki-II and III and Ruptura are associated with an occupation phase that has been dated to the first half of the 6th millennium BC (Quitta and Kohl 1969; Yanushevich 1976; 1989). The Bug-Dniester/Criș Culture site of Ruptura (5976–5560 BC) also contained an impression of a common millet seed (Yanushevich 1989).

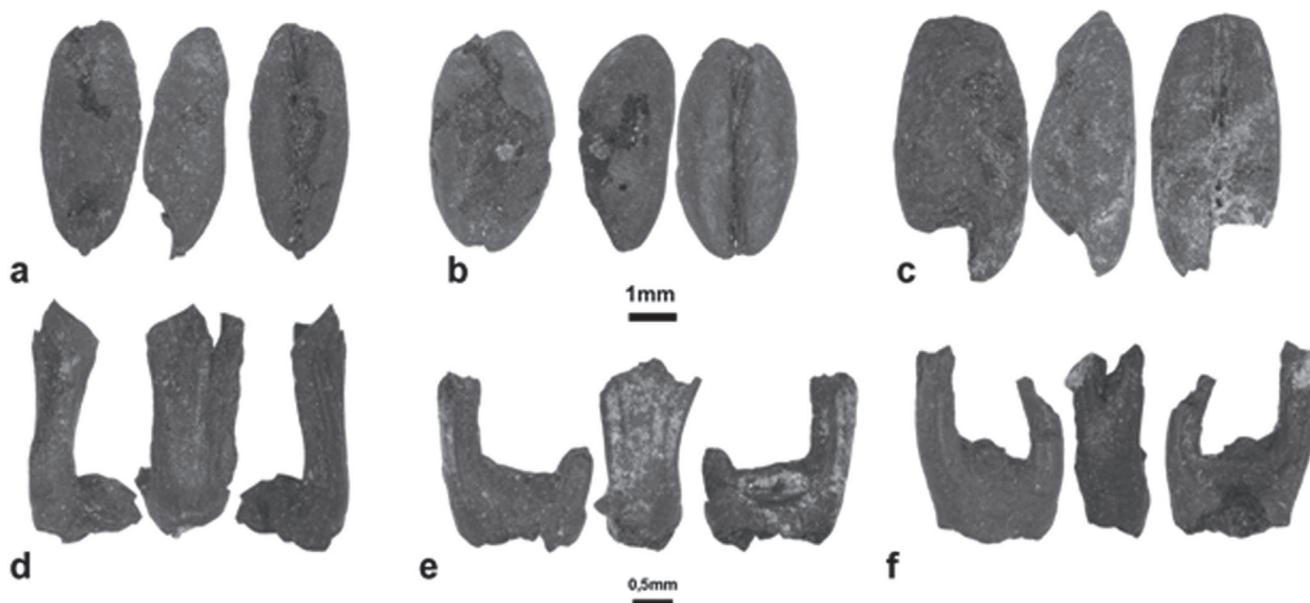


Figure 9.1: Cereal and chaff from the Ratniv-2 site directly dated to 5471–5230 cal BC; a–c: dorsal, ventral and lateral views of *Triticum diococcum* wheat grains; d–f: glume bases of hulled wheats.

Early cereal discoveries have been reported from Criș Culture sites in northern Moldova, dated to the first half of the 6th millennium BC (Monah 2007). One of the best studied sites of the Criș culture is Sakarovka-I (Dergachev *et al.* 1991), dated to mid-6th millennium BC (Yanushevich 1986). At this site a large quantity of cereal impressions have been reported; constituting hulled and naked barley, spelt, bread, einkorn wheat varieties, oat, and pulses. The most abundant crop at this site was common millet (*Panicum miliaceum*). In total, 97 common millet seed impressions in pottery have been reported from the site of Sakarovka-I, (Yanushevich 1986; Kuzminova *et al.* 1998; Larina 1999). However, again, one cannot be sure about the dating of the site and the criteria and methodology used to identify cereal impressions to species. Only one radiocarbon date is known from this site and the actual date attributed to the cereal evidence could conceivably be much later, as Criș Culture sites often have later period occupations superimposed upon them.

During the author's investigations at the early Bug-Dniester sites of Gard (located at the Southern Bug River and excavated by M.T. Tovkailo) and Pechera (in the northern Bug River and excavated by D. Gatskevich) no evidence of cereal use was found. The flotation method was used for the retrieval of macrobotanical plant remains within the area of the Bug-Dniester Culture pit house at the Gard site where 917 litres of sediments were floated; at the Pechera site the context of the flotation samples was less clear because the site is situated on the alluvial plain and has very active bioturbation processes in evidence. In total 382 litres of sediment were floated from the site; this

material did not have any carbonised plant remains and only modern *Chenopodium* genus seeds were recovered.

All macrofossil plant remains from the flotation samples at the Gard site were associated with wild plant species. Only two cereal grains, of probably free-threshing wheat (*Triticum aestivum*) and broomcorn millet (*Panicum miliaceum*), were found in a pit within a house structure at this site. However, as the radiocarbon dating of the one wheat seed demonstrated (480 ± 35 uncal BP [Ua-36996]; AD 1310–1618), this cereal represents a contaminated sample, which intruded into the Neolithic layer from the medieval layers of the stratigraphy. Furthermore, this late date demonstrates the particular importance of using AMS radiocarbon dating on archaeobotanical samples such as cereal grains, especially from samples containing indications of bioturbation such as modern rootlets, seeds and rodent burrows.

In western Ukraine and central Moldova the other group of reported cereal impressions on pottery sherds are associated with LBK sites dated to the second half of the 6th millennium BC. The cereal impressions from the LBK sites possess a higher abundance and a wider variety of species. The presence of einkorn, emmer, spelt wheat, hulled and naked barley, common millet, oats and a variety of pulses have been reported (*e.g.* Larina 1999; Kotova 2003). Seed impressions from a range of wheat species have been the most frequently identified of all impressions from the LBK culture sites in Moldova and Ukraine. Among the wheat species identified, spelt wheat (*Triticum spelta*) is frequently identified in Moldova (Yanushevich 1976; 1980) whereas, in Ukraine, it has only been reported from the later period of the Bug-Dniester Culture site of Shimanovskoye (Kotova

2003; Pashkevich 2003). Similarly for the Criş Culture in Moldova one of the important crops after wheat, identified at the LBK Culture sites in Ukraine and Moldova is common millet (*Panicum miliaceum*) (Yanushevich 1989; Kuzminova *et al.* 1998).

Yanushevich (1989: 611) notes that common millet was found in “large quantities, preserved not only as a grain but also as chaff winnowed free of the grain and used as clay temper” at the LBK sites. Sixty imprints were identified from Denchen-I (Yanushevich 1986), which is attributed by Larina (1999) to the end of the 6th millennium BC (Table 9.1). It is important to note that common millet together with hemp (*Cannabis sativa*), both of which were identified at the LBK sites of Denchen-I in Moldova and the Zimne site in Ukraine (Larina 1999; Pashkevich 1989; 2003), are representative of non-Near Eastern crop species (Zohary and Hopf 2000). Unfortunately, not much is known about the security of the contexts producing the pottery on which impressions were found or what criteria were used in attributing the impressions to the common millet species.

Yanushevich (1976: 153) notes that impressions of common millet in pottery and daub at both the Neolithic and Early Chalcolithic sites in Moldova are not very clear, and that “possibly some of them belong to *Setaria glauca*, *Setaria viridis* or *Echinochloa crus-galli* species”. Previous research by Motuzaite Matuzeviciute *et al.* (2013) of such early millet grains, reported at Neolithic sites across Europe, have shown that they all belong to much later periods, such as the Bronze Age and later. On the basis of both macrofossils and impressions Pashkevich (1984; 1997; 2003; 2004; 2005) and Yanushevich (1989) concluded that the cultivation of common millet dramatically increased only among the Bronze and Iron Age cultures of the steppe region. During the 1st millennium BC common millet cultivation played an important role throughout Europe as millet became one of the major crops in Romania, Bulgaria and Slovakia (Gorbanenko 2007).

Northern Ukraine

In the northern and northwestern regions (the Boreal zone) of Ukraine discoveries of cereal impressions are primarily dated to the second half of the 5th millennium BC (Telegin and Titova 1998; Okhrimenko and Lotaichuk 2007). The spread of agriculture among the Volyn Culture of the Dnieper-Donets cultural region is associated with the northwards expansion of LBK populations (Okhrimenko 2002). Cereal crop assemblages similar to those identified at LBK Culture sites have been found at Volyn Culture sites (*e.g.* Pashkevich 2003).

Central Ukraine

The eastwards spread of agriculture to the Kiev-Cherkassy Culture of central Ukraine is linked with the consequent expansion of the Trypillia (Tripolye) culture from western

Ukraine during the first half of the 5th millennium BC (Kotova 2003). At the Kiev-Cherkassy sites, hulled barley is the most frequently identified crop (Pashkevich 2003; Kotova 2003). A few radiocarbon dates from sites with cereal impressions in pottery have been obtained from the steppe region of the Dnieper Rapids, *e.g.* at Strilcha Skelya (Kotova 2003), Nikolskoye (Lillie *et al.* 2009) and the Lysaya Gora cemetery (Kotova 2003) and the majority of the dates fall into the period of the first half of the 5th millennium BC. The pottery from these sites contained solitary impressions of emmer wheat (*Triticum dicoccum*) and naked barley (*Hordeum vulgare* var. *nudum*) (Kotova 2003). It can be noted that the stable isotope analysis of Neolithic and Chalcolithic period humans buried along the Dnieper River in central Ukraine suggests that dietary change linked with crop consumption is not visible but, rather, an intensive exploitation of freshwater resources is prominent (Lillie and Budd 2011; see Chapter 8). Therefore, if the dates of cereal impressions from the central regions of Ukraine are correct, crop cultivation in this region during the 5th millennium BC played only a minor role in the diets of the local populations.

Southeastern Ukraine and the eastern Sea of Azov region

Evidence for early farming from southeastern Ukraine comes from sites dated to the end of the 7th–beginning of the 6th millennium BC. These sites are attributed to the Surskaya and Azov-Dnieper Cultures and are distributed in the area along the northern Azov Sea coast (Kotova 2003; 2009; Kotova and Makhortykh 2010). The data consist only of domestic animal bone finds and palynological records. At most of the excavated sites in this region a few animal bones from bovines, equines and ovicaprid are identified as domesticated species (*e.g.* Kotova 2003) without any justification or scientific methodology presented to prove their domestic status. Pollen attributed to domesticated cereals has been identified from a cultural layer at the Chepaevka settlement, dated very broadly to the 6th millennium BC. The site is situated on the Molochnaya River, northwest of the Azov Sea (Bezusko *et al.* 2000). However, long distance pollen grain transportation, translocation, bioturbation possibilities and ‘Cereale’ type pollen misidentification is likely, therefore the identification of an agricultural presence on the basis of a few pollen grains is very problematic (Grikpēdis and Motuzaite Matuzeviciute 2017).

Archaeobotanical investigations of plant macrofossil remains were conducted by the author at the site of Rasdorskoe-II in 2008 after the plant remains were collected by V. Tsybrii during site excavation. Rasdorskoe-II is a well-known multi-layered site in the steppe region of southwest Russia and the earliest phase of occupation is dated to the end of the 7th millennium BC (Tsybrii 2008). Samples for flotation were obtained from the Early Neolithic layers of this site at depths of 195–205 cm and

200–210 cm; 12 samples (12 litres each for 144 litres in total) were collected from two hearths and one mollusc midden. The flotation samples contained a large quantity of charcoal, which was mostly from woody plant species with only a very low quantity of charred wild plant seeds. The flotation samples also contained a large amount of charred and uncharred bone remains, consisting mostly of fish and various micro-fauna (Motuzaitė-Matuzevičiūtė 2012). The quantities of fish scales, bones, teeth and vertebra parts were sometimes more numerous than the wood charcoal. The preservation of charcoal at the site is quite good and as such the very limited presence of plant seeds cannot be explained only by taphonomic processes; rather, this is an indicator of the population's passive plant gathering and their activities directed towards the exploitation of freshwater resources.

The earliest evidence of cereal cultivation in southwest Russia comes from the Sredny-Stog Culture horizon of Rakushechny Yar site where cereals and their chaff impressions were identified in layers that are possibly dated to the first half of the 4th millennium BC (Motuzaitė-Matuzevičiūtė 2012). The author conducted archaeobotanical investigation of the site by analysing pottery for cereal impressions. In total, over 1000 pottery sherds were analysed from the Rakushechny Yar site, layers 23–15/14 and 5–1. Just a few cereal species were identified from the grain and chaff impressions in pottery sherds from layers 2–4. The cereals belong to hulled and naked barley, spelt and bread wheat, probably flax, and also possibly common millet. The identification of some cereal species in pottery impressions is considered reliable in this context because both chaff and grain were present. Some cereals such as spelt wheat have very characteristic glume bases and these could be confidently identified at Rakushechny Yar (Fig. 9.2) (Motuzaitė-Matuzevičiūtė 2012). On the other hand, the identification of broomcorn millet plant to species level requires the use of silicon casts and their subsequent study under an SEM microscope. Unfortunately, such methodology was not applied at the Rakushechny Yar site thus questioning the reliability of identification. Moreover, the accuracy in chronology at the site might also be challenged as those pottery sherds with cereal impressions are dated only by pottery typology while the accuracy of a few radiocarbon dates from this site, due to a reservoir effect causing radiocarbon age errors, have been questioned (Motuzaitė-Matuzevičiūtė *et al.* 2015).

Eastern Ukraine

The earliest records for cereal impressions in pottery in eastern Ukraine are reported from the Serebryanskoe site on the Donets River. Here, a single hulled barley impression in pottery has been found (Pashkevich 2003). A pottery sherd with crushed molluscs from the archaeological layer was radiocarbon dated at KRL to 5208–4260 cal BC (Ki-8288: 5780±200 BP) (Sanzharov *et al.* 2000). However, this date

should not be considered to be reliable as mollusc carbon in pottery temper may be affected by a freshwater reservoir effect resulting in a much older age (Motuzaitė-Matuzevičiūtė *et al.* 2015). Furthermore, it is again not clear if the pottery with cereal impressions can be attributed to the dated layer.

Two Neolithic period sites in eastern Ukraine, Starobelsk-I (first half of the 6th millennium BC) and Novoselovka-III (end of the 6th millennium BC) were investigated for macrobotanical remains by conducting flotation at the site during the archaeological excavations led by S. Telizhenko (Motuzaitė-Matuzevičiūtė 2012). At Starobelsk-I 1704 litres of sediments were floated from the hearths at the settlement; at the Novoselovka-III 1060 litres of sediment were floated from a mollusc midden and a hearth. The macrobotanical remains from both sites contained only wild plant species with no indication of cereal exploitation either from the material culture remains or from the plant assemblage.

The presence of domesticated cereal species and their chaff from the eastern part of Ukraine has been identified by

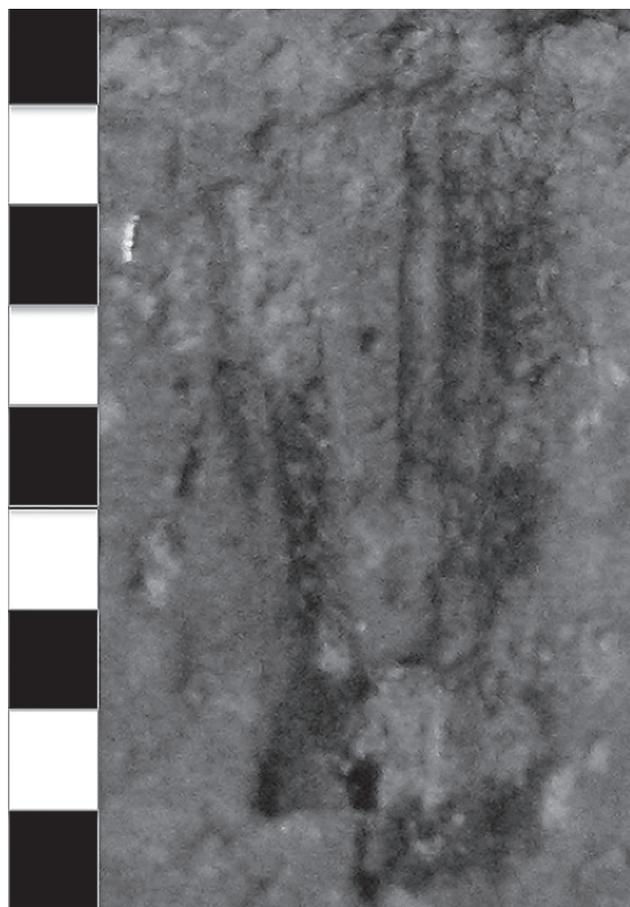


Figure 9.2: Glume base of spelt wheat (*cf. Triticum spelta*) from the Rakushechny Yar site in southwest Russia, dated by pottery affiliation to the 3rd millennium BC.

the author as dating to the 5th–4th millennia BC at the Sredny Stog Culture site of Zanolovskoe. Cereal impressions were identified on a few pottery sherds with an organic temper from the Chalcolithic horizon, at a depth of 50–60 cm in square 320. This layer has been dated to 4462–3525 cal BC (Ki-8257: 5460±90 BP; Ki-8258: 5420±80 BP; Ki-9245: 4910±80 BP; Manko and Telizhenko 2002). More precise, microscopic analysis, of these sherds has shown that the clay used to make these pots contained cereal chaff temper. The cereal impressions represent naked and hulled barley (*Hordeum vulgare* var. *nudum* and *H. vulgare*), as well as different parts of the cereal chaff, probably of the *Triticum* genus (Motuzaitė-Matuzevičiūtė 2012).

Crimean peninsula

The question of the earliest appearance of agriculture in Crimea has not been extensively studied and archaeobotanical studies from archaeological sites are almost absent from the Neolithic period in this region. Judging from the material culture remains most researchers agree that, during the Neolithic, people were not involved in agriculture. Investigation of plant macrofossil remains from Buran Kaya-IV was conducted by the author during archaeological excavations led by A. Yanevich in 2008. The Buran-Kaya-IV site is a small cave (grotto-like shelter) located on the border where the Crimean Mountains meet the steppe lowland; 297 litres of sediment from the Neolithic (6th millennium BC) layers were floated. Both macrobotanical and phytolith research from the Neolithic Buran Kaya site resulted in the identification of wild plant taxa (Salavert *et al.* 2015).

The economy of the Buran Kaya-IV inhabitants was based on the exploitation of wild plant and animal resources as seen from the recovery of a charred nutshell of Italian pine, pieces of berries and parenchyma fragments. The other wild plant seeds retrieved were from non-edible plants and were probably transferred to the site with firewood or were growing *in situ*. The good preservation and abundance of charred wood remains demonstrates that the absence of domesticated plant seeds is not due to taphonomic factors but to the absence of activities involving the use of cereals by the population. It is worth mentioning that the Neolithic layers of Buran-Kaya-IV, fireplace No. 4, layer II 1B0, contained samples of charred common millet (*Panicum miliaceum*) and wheat (*Triticum* sp.) grains which were identified by the author. The only radiocarbon date obtained from the wheat grain produced a date of 605±30 uncal BP; Ua-37503: AD 1295–1406). Again, this date shows the importance of direct radiocarbon dating the cereal grain despite the fact that the dated grain appeared to come from a secure context with no obvious evidence of bioturbation.

Archaeobotanical investigations were conducted by the author at the Chalcolithic site of Ardych-Burun, located on the southeastern coast of the Crimean peninsula. The

investigations at the chronologically younger open-air Ardych-Burun site in southern Crimea have revealed human subsistence strategies that differ to those of Buran-Kaya-IV. The discovery of cultivated wheat grains at Ardych-Burun represents the oldest cereals discovered in the Crimean peninsula, which were dated by AMS to around the middle of the 4th millennium BC (3652–3105 cal BC; Ua-38548, 4629±36 BP; Ua-38549, 4574±35 BP; Ua-38550, 4772±51 BP) (Motuzaitė Matuzevičiūtė *et al.* 2013). Prior to the investigations at the Ardych-Burun site, the oldest known evidence for cereal cultivation in the Crimean peninsula was reported from a burial site near the village of Bolotnoye. A tomb at this site, with human remains attributed to the Catacomb Culture (Shishlina 2002; Yanushevich 1984), contained a sack with ears of wheat in association (*Triticum dicoccum* and *T. monococcum*); the date of this culture is 3000–2200 cal BC (Mallory and Adams 1997).

Discussion and conclusions

The archaeobotanical work conducted by the author is in agreement with the predominant current synthesis of scientific evidence and some aspects of the material culture in Ukraine which points towards the western origins of the appearance of the earliest cereal cultivation in Ukraine dating back to the middle–second half of the 6th millennium BC. Only from this timeframe has the first solid evidence for cereal cultivation been found in Ukraine, coming from cereal grain macrofossils and direct radiocarbon dates, which place them in the earliest stage of the LBK culture. Furthermore, it seems that from the beginning of the LBK period agriculture is established at sites of this culture. This probably indicates the movement of people rather than a gradual adoption of agriculture by the local inhabitants.

During the gradual LBK expansion into Ukraine some changes are recognisable in the Bug-Dniester societies (second half of the 6th millennium BC) such as population increase, intensification of cattle breeding in the economy, the appearance of soil cultivation and cereal processing tools, LBK pottery imports, etc. Only under the influence of the LBK does the Bug-Dniester Culture transition to food production, however, the extent of this influence remains unknown. It can be concluded that previously published data for the discovery of pottery sherds with cereal (barley, flax and common millet) impressions from the earliest horizons of the Bug-Dniester Culture, *e.g.* by Pashkevich (2003) and Kotova (2003) has not been confirmed by macrobotanical data from the relevant contexts and is disregarded as evidence of agriculture by the author. The earliest solid evidence for broomcorn millet cultivation in Ukraine comes only from the 2nd millennium BC sites. It is more likely that this crop had reached Ukraine from the Balkans rather than from eastern steppe as currently the earliest reliable evidence of millet cultivation to the east of

Ukraine only occurs at the 8th century BC site of Guamsky Grot in the northwest Caucasus (Trifonov *et al.* 2017).

The familiarity of the local Late Bug-Dniester population with agriculture under LBK culture influences probably contributed to the subsequent farmer expansion from the Balkans-Lower Danube regions into the territory of western and southwestern Ukraine, eventually forming the Tripolye (Trypillia) culture. Trypillia 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 (Pashkevich and Videiko 2006).

Attempts to find archaeobotanical data of charred plant remains and cereal impressions in pottery at 6th millennium BC sites, and older, in eastern Ukraine and southwestern Russia have not been successful. The current research has shown that, prior to the 4th millennium BC, the populations of eastern Ukraine and southwestern Russia were mostly fisher-hunter-foragers (or varying combinations of these subsistence strategies), exhibiting some questionable evidence of domestic cattle breeding. Clear impressions of cereal in pottery in eastern Ukraine and south-western Russia come only from the Chalcolithic period, dated to the 4th millennia BC and are attributed to the Sredny-Stog Culture. The identified domesticated crop species belong to spelt and bread wheat, naked and hulled barley, possibly common millet and flax. These discoveries constitute the earliest known evidence for the presence of domestic cereal in eastern Ukraine and southwestern Russia, although the chronology of the impressions is yet to be backed up with direct radiocarbon dates derived from cultivated cereals.

In the Crimean peninsula archaeobotanical investigations were conducted at two Late Neolithic–Chalcolithic sites. The earliest evidence for cereal cultivation was discovered at the site of Ardych-Burun on the Black Sea coast in the mountainous region of southern Crimea. The dating of charred cereal macrofossils has shown that agriculture in the region appeared no later than the mid-4th millennium BC. The results of the archaeobotanical analysis undertaken on the chronologically earlier Buran-Kaya-IV site in Crimea support the previously stated hypotheses; namely that, during the later stages of the Neolithic and the Early Chalcolithic periods, people occupying cave sites practised ‘two types of economy’: cattle breeding and hunting and gathering.

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