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ARCHAEOBOTANICAL STUDY OF A LATE IRON AGE AGRICULTURAL COMPLEX AT ORIJÄRVI, EASTERN FINLAND

Abstract

Recent years have seen extensive excavations of several superimposed plough zones and settlement layers dated to the Late Iron Age at the site of Orijärvi, near the town of Mikkeli in eastern Finland. In this paper, the results of an archaeobotanical study of soil samples taken from the site is discussed, and the results are compared with those of other contemporaneous sites in northern Europe. The charred plant remains seem to derive from ploughed structures and manure, and cultivated plants consist of barley, rye, bread/club wheat, oat, flax and hemp. Some of the crops had been infested by ergot. Bulbous oat-grass, raspberry, bearberry, wild strawberry and juniper had been collected from the surrounding area. Meadow and wetland plants seem to derive from fodder. The presence of arable weeds suggests that some of the fields were fertilized and cultivation was carried out on different types of soils. The onset of barley, rye and wheat cultivation was dated to the Merovingian Period (c 600–800 AD), and oat is probably of a similar date. The cultivation of hemp began slightly later, during the Viking Age (c 800–1050 AD).

Keywords: archaeobotany, Late Iron Age, ancient fields, taphonomy, cultivation chronology

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INTRODUCTION

The excavations at Orijärvi, eastern Finland, have uncovered an archaeological complex dated to the Late Iron Age and consisting, among other things, of a plough zone and various remains related to Iron Age houses and related structures (Fig. 1). All in all, the excavations (organised since 1999 by the Finnish National Board of Antiquities and directed by Esa Mikkola) have led to the discovery of over 250 features and five fossil fields. The latter form perhaps the most important aspect of the site, being the largest and most thoroughly studied Iron Age field system in Finland so far. Other archaeological material found at the site consists, among other things, of a silver hoard, bronze ornaments, iron artefacts, glass beads, two mill-stone fragments, pottery, daub, and clay loom weights (e.g. Mikkola 2005; 2010; Alenius et al. 2007).

The elongated and bowl-shaped fields were situated on a southward-sloping, terrace-like

plateau located c 300 metres north of Lake Orijärvi, at an altitude of c 102–3 m a.s.l. The sediment of the c 30–40 cm deep cultivation layer consisted mostly of fine sand and silt, and the fields in general were mostly free of any larger stones. The radiocarbon dates acquired from the site range between c 600 and 1600 AD, while the above-mentioned silver coin hoard (found scattered in the fields) can be numismatically dated to the end of the Viking Age (Mikkola 2005; 2010; Alenius et al. 2007). Based on the rich burial sites excavated within the borders of present-day town of Mikkeli, the area has traditionally been interpreted as a central area during the Iron Age, especially the Viking Age (800–1050 AD) and the Crusade Period (1050–1300 AD), although some of the burial finds can be dated already to the so-called Merovingian Period of Finnish prehistory (600–800 AD) and some may be as late as the 14th century AD (Kivikoski 1961: 214; Huurre 1979: 171; Lehtosalo-Hilander 1984: 377; 1988: 190–224; Kirkinen 1996: 21).

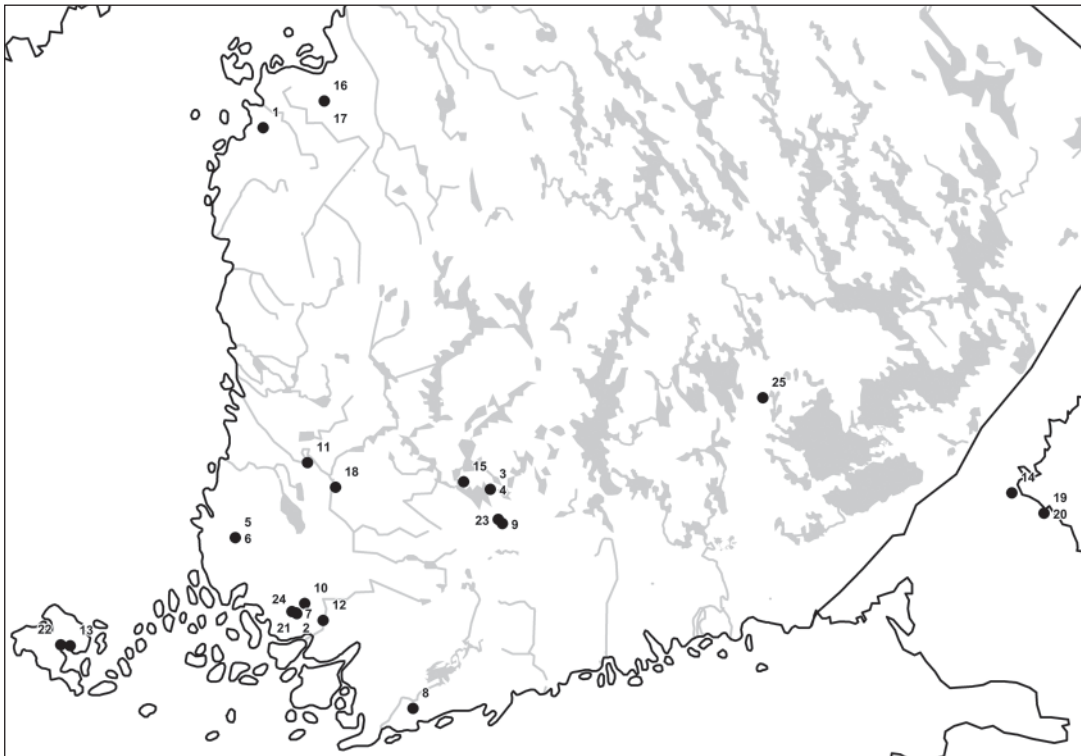


Fig. 1. The locations of sites mentioned in Appendix 1. Orijärvi is marked with number 25. Map drawn by Ville Rohiola and Santeri Vanhanen.

This paper presents the results of an archaeobotanical study conducted from samples taken from the site.¹ Altogether 354 soil samples were studied, shedding new light on the until now poorly known Iron Age agricultural practises and plant use strategies in eastern Finland and particularly the Mikkeli region. Before this study, the Iron Age subsistence strategies of the Mikkeli region have been assessed through artefact finds, the results of two pollen analyses (Simola et al. 1988; Alenius et al. 2007), some osteological analyses (Kirkinen 1994: 21; 1996: 23–4; Schulz 1994: 60–1; Ukkonen 1996: 83–9) and one archaeobotanical analysis (Lempiäinen 2002). These studies have revealed some aspects of the long-term cultivation history of the region, as well as of the types of hunting, fishing and animal husbandry carried out. Although the osteological material found at Orijärvi had not been analysed at the time of writing, both the artefact finds and the results of previous osteological studies in the Mikkeli region show that animal husbandry – including domestic cattle, pig, sheep/goat and horse (Kivikoski 1961: 271; Schulz 1994:

60–1; Kirkinen 1996: 23–4; Ukkonen 1996: 83–9) – was part of the livelihood of the Iron Age communities of the region, making it plausible to assume that domestic animals were kept at Orijärvi as well.

In this paper the archaeobotanical material found at Orijärvi will be presented as a single body of data, because the plough zone horizons consisted of mixed material representing various time periods. The paper is structured as follows. First, the taphonomy of the archaeobotanical remains found at Orijärvi will be discussed, to be followed by a discussion of the various phases of the field system. Then, the results of the archaeobotanical research will be presented, and after this, the cultivation chronology of the site will be sketched based upon the AMS-datings and the results of a pollen analysis made from Lake Orijärvi. The growing conditions of different plants will be discussed, and the plant remains found at Orijärvi will be compared with material from other contemporaneous sites. Finally, the uses of the various plants found in the analysis will be discussed.

TAPHONOMY

In this study, taphonomy refers to the whole process of the plant's use history, from growth to its deposition into an archaeological context. The aerated and humid conditions of the sandy and loamy soils of Orijärvi only enabled the preservation of charred plant remains. In the charring process, which requires temperatures of c 150–400°C, the plant material is reduced to carbon. The charring is more complete when the amount of oxygen is limited and the temperature is not too high. Usually, only solid parts of plants – such as seeds, fruits, nuts and other propagules – are preserved by charring. Charred plant remains commonly retain enough of their original shape to enable identification, although this can be complicated by post-depositional mechanical wear (Renfrew 1973: 9–14; Greig et al. 1989: 16; O'Connor & Evans 2005: 165; Nesbitt 2006: 21).

Charred plant remains found at a site offer information about the site itself, as well as of the off-site areas from which the material may have come from (O'Connor & Evans 2005: 72). The material that ends up being charred has mostly been taken to the site by people; the plants that get collected need to be present in the operational environment. Plants can be cultivated or they can grow in the wild, although it should be noted that wild plants often thrive in anthropogenic habitats (O'Connor & Evans 1999: 137–9). Indeed, charred plant remains found in the dwelling parts of Iron Age house remains in Sweden consist mostly of cultivated plants and weeds, whereas meadow and wetland plants used as fodder are found in the byre parts (Engelmark & Viklund 1991: 37). Thus, because the charred seed assemblage mainly represents material collected through human agency, it is quite obvious that the charred plant material studied in archaeobotanical analysis does not represent the whole range vegetation at the site and its surroundings (O'Connor & Evans 1999: 137–9).

When plants have been collected and taken into a house or other structure, they must be exposed to fire in order to be charred. Van der Veer (2007: 979) suggests that there are five different modes of charring: plants used as fuel, foods (especially cereal grains and pulses) accidentally burned during food preparation, stored foods destroyed by fire in accidents, plants destroyed during the cleaning of grain storage pits using fire, and diseased or

infested crop seeds that have been intentionally burned. Plant species used as fuel and plants that require heat for preparing (baking, cooking, roasting) tend to get charred more often, and are therefore over-represented in charred assemblages (Van der Veer 2007: 977–8). Hearths seem to be the most common places where charring occurs, but because the heat of a hearth is often intense and the environment is rich in oxygen, plant material left in hearths may combust completely. It is also possible to find charred plant material in houses or other structures, where the plant utilisation has taken place, but which have eventually burned down. The clearance of trees and other vegetation to make way for fields may also leave archaeobotanical traces such as charcoal and needles.

It is important that plant remains are not dispersed by wind or water, because if this happens, they will not be found in archaeological contexts. To be incorporated in the sediment, charred plant remains can be taken from hearths and redeposited in rubbish pits, ditches or spread around (Branch et al. 2005: 98, 104). Ashes containing charred plant remains could have been mixed together with household waste and animal manure and used as fertilizer in the fields (Evans 2003: 124–5). This type of use might explain why charred plant remains, charcoal, animal bones and ceramics have been found in the fields of Orijärvi. Animal manure and other organic material would have decomposed, leaving behind more durable matter such as pottery and charred plant remains.

DEVELOPMENT OF THE FIELDS

During the Iron Age, the agricultural population of southern Scandinavia made use of a system of mobile fields, where fields were tilled on top of previously occupied houses and houses were eventually built on top of the previously cultivated fields. This could have been done for a number of reasons, such as to fertilize the soil, get rid of weeds and pests, to claim new land, because of erosion, or a change in the cultivation intensity or social structure (Jensen 1982: 200, 204–27 with references; Göthberg 1995: 102; Pedersen & Widgren 1998: 277–81; Bradley 2003: 18).

At Orijärvi, the possible moving of fields would have been restricted by the occurrence of suitable soils (Kirkinen 1996). Erosion played an important role in Iron Age agriculture, because particularly in the lighter soils, the agricultural

systems were not able to produce an adequate amount of organic matter to the fields (Jensen 1982: 200, 204–27 with references). The amount of organic matter could have been increased by adding manure, household waste and sods. Sods could have been collected from the surrounding heaths, peats, meadows, pastures, water-meadows, salt marshes, waysides, ditch banks, field edges and all kinds of soils (Groenman-Van Waateringe 1979: 57–9). In north-western Germany, this type of fertilization is connected with the cultivation of winter rye.

It seems likely that sods were also used to fertilize the Orijärvi fields. In the pollen study made of Lake Orijärvi, loss on ignition (LOI) peaks around 700–800 AD, with the largest amount of organic material flowing into the lake basin (Alenius et al. 2007: 177). LOI decreases sharply after 800 AD, which indicates that there is more inorganic material flowing into the lake at this period of time. The rise of inorganic material could have been caused by an increase in areas that are prone to erosion, perhaps resulting from the extension of cultivated areas, digging of

ditches, collection of sods, or animal herding. The increase of heaths around Orijärvi can be seen in the occurrence of heather (*Calluna*) in the pollen analysis from 500 BC onwards and continuing until modern times (Alenius et al. 2007: 178). This could have been caused by deforestation. A charred layer of sod and brown organic matter was encountered on the eastern part of one of the fossil fields (Kihlinkuja field, R123) and this has been interpreted as representing the initial phase of the field (Mikkola 2006: 17–8).

According to Mönkkönen (2010) the colluvial plough zone layers of Orijärvi have been formed by tillage and erosion, with the bowl-shaped ancient field layers formed in the concave depressions in the ground (Fig. 2). The original podzol horizons were still visible in the bottom layers of these depressions. The ancient field layers contain archaeological material which is both older and younger than the actual layer. Evidently, the archaeological finds have been transported both horizontally and vertically by the tillage activities, and this seems to have happened also to the archaeobotanical material.

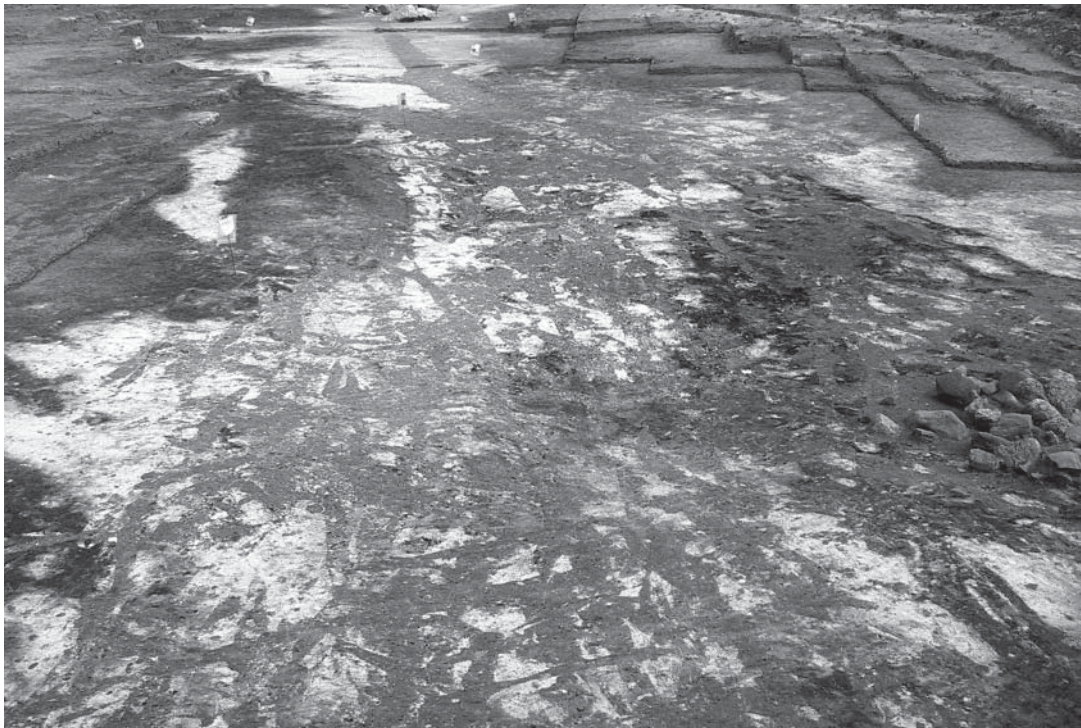


Fig. 2. The lowest levels of a plough zone encountered at the 2005 excavations at Orijärvi. Dark and marks are visible against the lightly coloured eluvial soil. View towards NNW. Photo: Esa Mikkola/ National Board of Antiquities



Fig. 3. Charred plant remains from Orijärvi. Top row: dorsal and ventral views of hulled barley (*Hordeum vulgare* var. *vulgare*), naked barley (*Hordeum vulgare* var. *nudum*), oat (*Avena* sp.) and rye (*Secale cereale*). Second row from the top: two fat-hen (*Chenopodium album*), two false cleavers (*Galium spurium*), four corn spurrey (*Spergula arvensis*) and dorsal and ventral view of rye brome (*Bromus secalinus*). Second row from the bottom: hemp (*Cannabis sativa*), flax (*Linum usitatissimum*) and raspberry (*Rubus idaeus*). Bottom row: meadow buttercup (*Ranunculus acris*), two sedges (*Carex* spp.) and three bulbous oat-grass (*Arrhenatherum elatius* var. *bulbosum*) tubers. Scale bars 1mm. Photo: Santeri Vanhanen.

METHODS USED

The archaeobotanical study comprised an analysis of 354 soil samples, which varied in volume from 1 decilitre to 2 litres. The samples were taken from various contexts, which included plough zone layers, postholes, hearths, grave-like structures, ditches, pits and a well. The majority of the samples, however, derive from plough zone layers. As noted, the plough zone layers are contexts of mixed origin, which should be kept in mind when interpreting the results (Pearsall 1989: 96).

The following information was recorded of each sample: X- and Y-coordinates in the excavation grid system, altitude above sea level, feature code, and excavation level (although not all of this data was recorded in the case of every sample). The samples were floated using the salt water method, with some of the flotation work done already on field and some it done in the course of post-excavation work at the premises of the Finnish National Board of Antiquities in Helsinki. In the flotation method, salt is added to water until it becomes saturated, and the soil samples are then

poured into buckets and mixed with salt water. This mixture of salt water and soil is then stirred for some time and, after about half an hour, the organic material (which, unlike the minerals, stays afloat) is poured through a sieve. In this study, sieves with mesh sizes of 0,125 and 0,25 mm were used. After the flotation, the samples were kept wet and in salt water until they were eventually studied using a stereo microscope. When possible, the plant material was identified to the species level. However, this was not done in the case of sedges and seeds of small grass species.

The initial analysis was conducted by the present author and also by Tanja Tenhunen, MA, an archaeobotanist employed by the National Board of Antiquities at the time. The identification of the plant material consisting mostly of seeds and grains was done based on published literature and a small reference collection, with the assistance of Terttu Lempiäinen, an adjunct professor at the University of Turku. Later on, the material was re-identified by the author in the Environmental Archaeological Laboratory at the University of Umeå, with the help of a larger reference collec-

Plant macrofossil	n
<i>Cultivated plants</i>	
hulled barley (<i>Hordeum vulgare</i> var. <i>vulgare</i>)	44
naked barley (<i>Hordeum vulgare</i> var. <i>nudum</i>)	6
barley (<i>Hordeum vulgare</i>)	86
oat (<i>Avena</i> sp.)	30
rye (<i>Secale cereale</i>)	20
wheat (<i>Triticum aestivum</i> s.l.)	5
cereals (<i>Cerealia</i>)	183
hemp (<i>Cannabis sativa</i>)	1
flax (<i>Linum usitatissimum</i>)	1
<i>Subtotal</i>	376
<i>Collected plants</i>	
bulbous oat-grass (<i>Arrhenatherum elatius</i> var. <i>bulbosum</i>), tuber	32
raspberry (<i>Rubus idaeus</i>)	20
wild strawberry (<i>Fragaria vesca</i>)	5
bearberry (<i>Arctostaphylos uva-ursi</i>)	3
juniper (<i>Juniperus communis</i>)	3
cf. bearberry (cf. <i>Arctostaphylos uva-ursi</i>), leaf	1
<i>Subtotal</i>	64
<i>Weeds</i>	
fat-hen (<i>Chenopodium album</i>)	62
corn spurrey (<i>Spergula arvensis</i>)	22
false cleavers (<i>Galium spurium</i>)	18
common chickweed (<i>Stellaria media</i>)	9
hemp-nettle (<i>Galeopsis</i> sp.)	8
rye brome (<i>Bromus secalinus</i>)	8
pale persicaria (<i>Persicaria lapathifolia</i>)	7
field/wild pansy (<i>Viola arvensis/tricolor</i>)	6
cf. smooth tare (<i>Vicia</i> cf. <i>tetrasperma</i>)	6
many-seeded goosefoot (<i>Chenopodium polyspermum</i>)	2
black bindweed (<i>Fallopia convolvulus</i>)	2
common knotgrass (<i>Polygonum aviculare</i>)	1
sheep's sorrel (<i>Rumex acetosella</i>)	1
annual knawel (<i>Scleranthus annuus</i>)	1
<i>Subtotal</i>	153
<i>Meadow and wetland plants</i>	
sedges (<i>Carex</i> spp.)	82
grasses (Poaceae)	77
meadow buttercup (<i>Ranunculus acris</i>)	25
common sorrel (<i>Rumex acetosa</i>)	4
buttercups (<i>Ranunculus</i> sp.)	3
lesser stichwort (<i>Stellaria graminea</i>)	2
meadow vetchling (<i>Lathyrus pratensis</i>)	1
<i>Persicaria foliosa</i>	1
selfheal (<i>Prunella vulgaris</i>)	1
Rhinanthus sp.	1
<i>Subtotal</i>	197
<i>Other plants</i>	
<i>Vicia</i> sp.	71
<i>Trifolium</i> sp.	5
<i>Galium</i> sp.	4
Cyperaceae	3
Polygonaceae	3
Fabaceae	2
<i>Polygonum</i> sp.	2
Caryophyllaceae	1
cf. <i>Epilobium</i> sp.	1
spruce (<i>Picea abies</i>)	1
<i>Potentilla</i> sp.	1
<i>Subtotal</i>	94
<i>Other plant parts etc.</i>	
spruce (<i>Picea abies</i>), needle fragment	1392
stalk	38
ergot (<i>Claviceps purpurea</i>)	8
Total	2322

tion, published literature (Cappers et al. 2006), and the kind help of professors Karin Viklund and Roger Engelman. The re-identification altered the list of plant species quite dramatically, as more species were found and the identifications of ones already identified changed.

RESULTS

Charred plant remains

The whole body of charred plant material collected from the Orijärvi site comprised of over 2300 charred plant remains representing 50 different taxons (Fig. 3). The plants are here grouped into the following categories: cultivated plants, weeds, gathered plants and meadow and wetland plants. The results of the archaeobotanical study are presented in Table 1.

Altogether 375 cereal grains were found. Approximately half of the grains could be identified, whereas the rest were identified merely as cereals. Barley (*Hordeum vulgare*) was the main cultivated crop at Orijärvi with 136 grains. In addition 30 oat (*Avena* sp.) grains, 20 rye (*Secale cereale*) grains and five wheat (*Triticum aestivum* s.l.) grains were found. Of the 50 grains of barley, 44 were identified as hulled barley (*Hordeum vulgare* var. *vulgare*) and six as naked barley (*Hordeum vulgare* var. *nudum*). None of the oat grains could be classified as either the cultivated *Avena sativa* or the wild *A. fatua*/*A. strigosa* due to the lack of preserved floret bases. Wheat was identified only as club or bread wheat, as the material was small and fragmented. The eight pieces of charred *sclerotia* of ergot (*Claviceps purpurea*) constituted 2% of the whole cereal material. One seed of both flax (*Linum usitatissimum*) and hemp (*Cannabis sativa*) was found.

Based on this study, the collection of wild plants has also been an established activity at Orijärvi. The remains of gathered plants consisted of 32 finds of bulbous oat-grass (*Arrhenatherum elatius* var. *bulbosum*) tubers, 20 seeds of raspberry (*Rubus idaeus*), five seeds of wild strawberry (*Fragaria vesca*), three seeds of bearberry (*Arctostaphylos uva-ursi*) and three seeds of the juniper tree (*Juniperus communis*).

Table 1. Charred plant remains found at Orijärvi. Unless stated otherwise, all specimens are seeds.

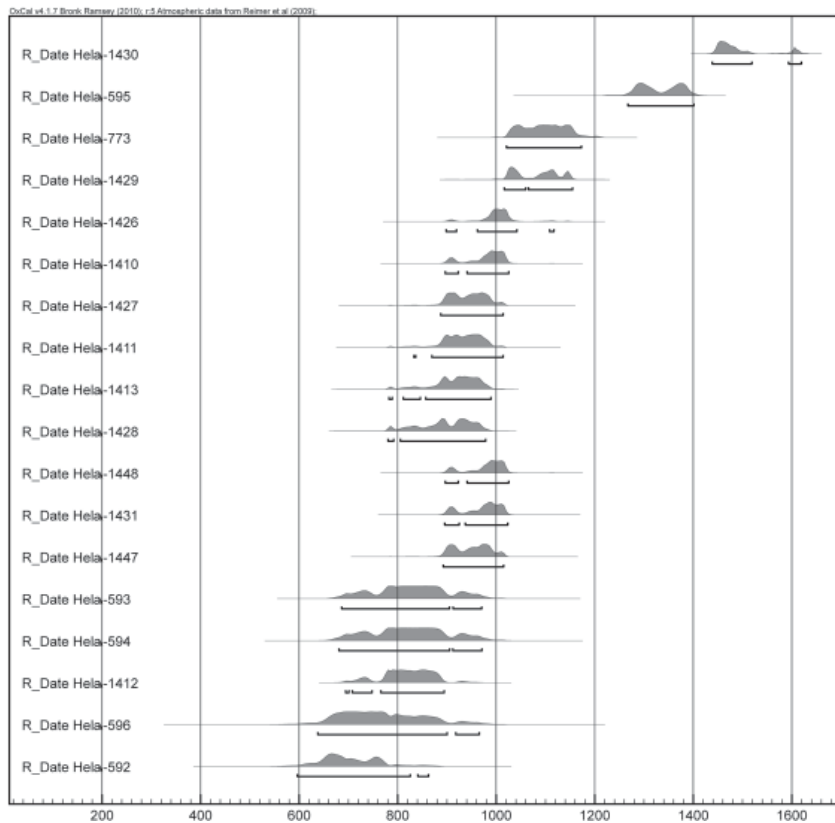


Fig. 4. Calibration curves of AMS-datings. Calibrated using Oxcal v. 4.1.

Weed flora consisted of typical arable weeds. The most common weed was fat hen (*Chenopodium album*), represented by 62 seeds. Other common weed finds consisted of 22 corn spurrey (*Spergula arvensis*) seeds, 18 seeds of false cleavers (*Galium spurium*), nine seeds of common chickweed (*Stellaria media*), eight seeds of hemp-nettle (*Galeopsis* sp.), eight seeds of rye brome (*Bromus secalinus*), seven seeds of pale persicaria (*Persicaria lapathifolia*), six seeds of field/wild pansy (*Viola arvensis/tricolor*) and six seeds of smooth tare (*Vicia* cf. *tetrasperma*).

The most common remains of meadow and wetland vegetation were the 82 sedge (*Carex* sp.) nutlets, followed by 77 grains of various grass species (Poaceae) and 25 seeds of the meadow buttercup (*Ranunculus acris*). It should be noted that sedges and grasses can also thrive on other types of habitats. For example, many grass species grow as weeds on arable lands.

In addition to the plants mentioned above, altogether 71 seeds of vetch (*Vicia* sp.) and 1392 needle fragments of spruce (*Picea abies*) were also found.

AMS-datings and cultivation chronology

As noted, previous studies have offered only limited information regarding the cultivation history of the Mikkeli region. A pollen analysis made from the bay of Kattilanlahti, located c 3.7 km east-north-east of Lake Orijärvi, indicated the cultivation of rye and *Cerealia* dated (imprecisely) to the Crusade Period of c 1050–1300 AD (Simola et al. 1988). A well-preserved rye straw found at the Tuukkala inhumation cemetery has been dated to the same period (Lempiäinen 2002). Possible hemp remains from the Latokallio site have been radiocarbon-dated to c 1450 cal. AD (Schulz 1994: 60), and hemp and flax/nettle fibres dated to the Iron Age had been found in inhumation graves from the Mikkeli region (Lehtosalo-Hilander 1994: 32).

Radiocarbon dating, and especially the AMS-dating of cereal grains, is very useful tool in studying the history of agriculture. Taphonomic reasons related to the nature of the charred plant material made it impossible to decide which plants were cultivated in the various field phases at Orijärvi,

Table 2. AMS-dated material from Orijärvi (after Mikkola 2010). Calibrated using Oxcal v. 4.1.

Code	Date	cal AD (2 σ) ¹	Sample	Other charred material
Hela-592	1335±60	596–862	barley (<i>Hordeum vulgare</i>)	–
Hela-596	1270±80	638–965	club wheat (<i>Triticum compactum</i>)	<i>Cerealia</i> frag. 2
Hela-594	1200±60	681–971	barley (<i>Hordeum vulgare</i>)	<i>Cerealia</i> frag. 1
Hela-593	1195±55	686–970	barley (<i>Hordeum vulgare</i>)	–
Hela-1412	1205±30	694–894	pottery residue	–
Hela-1428	1145±30	780–978	barley (<i>Hordeum vulgare</i>)	<i>Vicia</i> sp. 1
Hela-1413	1130±30	782–989	pottery residue	–
Hela-1411	1115±30	833–1014	piece of a leather belt	–
Hela-1427	1100±30	887–1014	barley (<i>Hordeum vulgare</i>)	<i>Hordeum vulgare</i> var. <i>vulgare</i> 4, <i>Hordeum vulgare</i> 8, <i>Cerealia</i> 3, <i>Fragaria vesca</i> 1, <i>Bromus secalinus</i> 1, <i>Carex</i> sp. 1, <i>Poaceae</i> 1, <i>Picea abies</i> (needle) 6, stalk 1 <i>Cerealia</i> frag. 1, stalk 1
Hela-1447	1090±30	892–1015	rye (<i>Secale cereale</i>)	
Hela-1431	1065±30	895–1023	barley (<i>Hordeum vulgare</i>)	<i>Hordeum vulgare</i> 2, <i>Triticum aestivum</i> s.l. 1, <i>Cerealia</i> 2, <i>Chenopodium album</i> 3
Hela-1448	1055±30	896–1025	barley (<i>Hordeum vulgare</i>)	<i>Picea abies</i> (needle) 14
Hela-1410	1055±30	896–1025	burned bone	¹ <i>Hordeum vulgare</i> 2, <i>Cerealia</i> 2, <i>Chenopodium album</i> 2, <i>Picea abies</i> (needle) 1
Hela-1426	1030±30	898–1117	barley (<i>Hordeum vulgare</i>)	<i>Hordeum vulgare</i> 2, <i>Cerealia</i> 3, <i>Persicaria lapathifolia</i> 1, <i>Galium spurium</i> 1, <i>Chenopodium album</i> 1, <i>Vicia</i> sp. 1,
Hela-1429	970±25	999–1159	rye (<i>Secale cereale</i>)	<i>Hordeum vulgare</i> 2, <i>Cerealia</i> 7, <i>Chenopodium album</i> 3, <i>Galium spurium</i> 1, <i>Chenopodium polyspermum</i> 1, <i>Persicaria foliosa</i> 1, <i>Vicia</i> sp. 2, <i>Poaceae</i> 1
Hela-773	940±35	1021–1173	a piece of wood (cf. <i>Betula</i> sp.)	² <i>Hordeum vulgare</i> var. <i>vulgare</i> 4, <i>Hordeum vulgare</i> 1, <i>Secale cereale</i> 1, <i>Cerealia</i> 1, <i>Galium spurium</i> 1, <i>Polygonaceae</i> 1, <i>Arrhenatherum elatius</i> var. <i>bulbosum</i> (tuber) 1 <i>Cerealia</i> frag. 1
Hela-595	665±50	1267–1401	barley (<i>Hordeum vulgare</i>)	
Hela-1430	400±25	1438–1619	barley (<i>Hordeum vulgare</i>)	<i>Linum usitatissimum</i> 1, <i>Cerealia</i> 6, <i>Chenopodium album</i> 1

All dates have been calibrated with Oxcal 4.1; ¹) Dated material was extracted from a hearth, and not from the same exact place as the macrofossil sample; ²) Date from the wooden structure of a well that gives terminus post quem for the deposition of the plant remains.

but a preliminary chronology of the introduction of different cultivated species can nonetheless be suggested and compared with the results of the pollen analysis made of Lake Orijärvi, which covers the entire Holocene Period. The dating of the plants is based on AMS-dated plant remains (most of the dates have been published in Mikkola 2010) and the context datings of plant remains found in association of other, datable archaeological materials. It should be noted here that the only really reliable datings are those acquired from the charred grains themselves through AMS radiocarbon dating.

Altogether 18 AMS-datings have been obtained from the Orijärvi macrofossil material

so far. The results are presented in Table 2 and Figure 4. Of the dated samples, 13 were charred cereal grains: 10 barley grains, two rye grains and one grain of club wheat. Two datings were made of organic residue on pottery, one of a piece of a leather belt, one of a piece of burned bone and one of a piece of wood. The results of the datings range from c 600 AD to c 1600 AD, with the majority falling within the Viking Age (c 800–1050 AD). Based on the dated archaeobotanical remains, it seems that the phase of intense cultivation at Orijärvi began in the Merovingian Period (c 600–800 AD) and lasted until the beginning of the Crusade Period or c 1050–1300 AD. Based on the AMS-dates,

there may have been hiatuses in the settlement between c 1200 and 1400 cal. AD, but this may also be due to sampling strategies, as no such hiatuses are evident in the palynological data (Alenius et al. 2007).

According to the AMS-datings, the cultivation of barley and wheat at Orijärvi began during the Merovingian Period or c 600–800 AD (see Table 3). The time-span between the first AMS-dated barley grain (596–862 cal. AD) and the first occurrence of barley pollen (1200 AD) is considerable, as the distance between the fields and the pollen-coring site is only c 700 m (Alenius et al. 2007: 182). In modern studies barley pollen has been poorly represented even in the close proximity of fields, because it is autogamous, whereas rye is wind-pollinated (Alenius et al. 2007: 181 with references). As for rye, the palynological data bears evidence of rye cultivation in the surroundings of Lake Orijärvi since the beginning of the Merovingian Period (c 600 AD), but the earliest AMS-dated rye grain is from the Viking Age (c 800–1050 AD). Oat remains were found in the charred assemblage, but have not been radiocarbon dated. The time-span between the earliest dated wheat grain (638–965 cal. AD) and the earliest *Avena/Triticum* pollen (1300 AD) is also quite long. Buckwheat (*Fagopyrum*) was represented by a small amount of pollen dated to the Middle Ages/Modern Period, but not accounted for in the macrofossil samples. The discrepancies in the

macrofossil assemblage and the pollen analysis between the datings of barley, rye, wheat, and some other plant species, are most probably caused by differences in the spread of pollen and the distance of the coring site.

Based on its stratigraphic position, one of the hemp seeds found was dated to the Iron Age. In the palynological study of Lake Orijärvi, pollen of *Cannabis/Humulus* type was first recorded in the pollen assemblage zone dated to c 830–1300 AD. Beginning around 900 AD, there is an increase in the pollen of *Humulus/Cannabis* increases, and this type of pollen clearly increases from c 1090 AD onwards (Alenius et al. 2007: 179–80). The increase of hemp pollen in the basins may be related to hemp retting done at lakes, ponds or mud pits (Kaukonen 1946: 116).

A seed of flax was found in a sample from Orijärvi was dated to the Middle Ages/Modern Period, but no *Linum* pollen was found in the palynological analysis (Alenius et al. 2007). Flax has to be retted in a way similar to that used with hemp, which may result in the deposition of flax pollen (Pedersen & Widgren 1998: 381–2). In the province of Savo, where Orijärvi is located, flax has been traditionally retted at sheltered lake or pond sides (Kaukonen 1946: 98). In my opinion, it is possible that flax was cultivated here in order to produce oil and food, and this might result in the fact that no flax pollen was found at Orijärvi. Alternatively, flax could have been retted in the small pond located approximately

Table 3. The first occurrences of cereals, fibre plants and weeds at Orijärvi based on the direct AMS-datings or material associated with AMS-dated samples.

Macrofossils	Dating ¹	Pollen	Dating ²
barley (<i>Hordeum vulgare</i>)	596–862 AD	<i>Hordeum</i>	1220 AD
wheat (<i>Triticum aestivum</i> s.l.)	638–965 AD	<i>Triticum</i>	1300–1960 AD
vetch (<i>Vicia</i> sp.)	790–978 AD	–	–
hulled barley (<i>Hordeum vulgare</i> var. <i>vulgare</i>)	887–1014 AD	<i>Hordeum</i>	1220 AD
rye brome (<i>Bromus secalinus</i>)	887–1014 AD	–	–
rye (<i>Secale cereale</i>)	892–1015 AD	<i>Secale</i>	615 AD
fat-hen (<i>Chenopodium album</i>)	895–1023 AD	–	–
pale persicaria (<i>Persicaria lapathifolia</i>)	898–1117 AD	–	–
false cleaver (<i>Galium spurium</i>)	898–1117 AD	–	–
many-seeded goosefoot (<i>Chenopodium polyspermum</i>)	999–1159 AD	–	–
flax (<i>Linum usitatissimum</i>)	1438–1619 AD	–	–
hemp (<i>Cannabis sativa</i>)	Iron Age ³	<i>Cannabis</i>	830–1300 AD ⁴
naked barley (<i>Hordeum vulgare</i> var. <i>nudum</i>)	Iron Age ³	<i>Hordeum</i>	1220 AD
oat (<i>Avena</i> sp.)	Iron Age?	<i>Avena</i>	1300–1960 AD
–	–	<i>Fagopyrum</i>	1300–1960 AD

¹ Datings with years are based on radiocarbon datings and the rest is based on stratigraphical considerations. ² Datings are based on paleomagnetic datings (Alenius et al. 2007). ³ These remains come from hearth R129, which is stratigraphically dated to the Iron Age (Esa Mikkola pers. comm). ⁴ Date for the beginning of pollen subzone.

c 550 metres north-west of Orijärvi, or it could have been cultivated elsewhere.

Having considered all the taphonomic factors affecting the results of the different methods, it appears that they complement each other and seem to be consistent. It should be kept in mind, though, that pollen accumulates in the lake sediments through wind and water dispersal, whereas the charred macrofossil material represents mostly collected plants. It should also be noted that the absence of some plant species in the list of identified macrofossils is often caused by the simple reason that no samples bearing remains of a particular species were subjected to radio-carbon dating.

DISCUSSION

Growing conditions of crops and weeds

The macrofossil material collected at Orijärvi can be seen as representing a long period of agricultural activities and settlement ranging from the Merovingian Period until to the Middle Ages and perhaps even later. It should be kept in mind that the plough zone layers are of mixed origin and do not offer the best possible contextual resolution for interpreting the archaeobotanical remains. Samples taken from post holes and other ‘closed contexts’ would better facilitate the interpretation of this type of material.

The agricultural soils used at Orijärvi have had different qualities and the climate has been diverse. Plants have been gathered from the surroundings, which have consisted of meadows and other anthropogenic habitats. During the whole period of use of the site, barley seems to have been the most common cereal cultivated at Orijärvi, with hulled barley being the most common cultivated variety (but small amounts of naked barley were also present). Rye, oat, and bread/club wheat were found in smaller proportions. The remains of arable weeds offer information on the various aspects of agriculture practised, such as the nature of tillage, fertilizing, spring- or autumn-sown crops and the natural soil conditions of the cultivated fields (Viklund 1998: 130). In the following, some of these aspects of the weeds together with the cultivated crops are discussed. It should also be kept in mind that some ‘weed’ species may have been intentionally gathered and consumed in Prehistory (Behre 2008).

Because the various cereals require different growing conditions, it is possible that the different weed species likewise derive from plots where different crops have been grown. Barley, wheat and hemp require a nutrient-rich soil, whereas oat and flax require less nutrients. Oat also requires a lot of rainfall, and thus can be associated with weeds that thrive in moist soils (Grotenfelt 1899: 360–1; Osvald 1959; Renfrew 1973). Rye can grow on relatively poor soils (Behre 1992: 149) and is often cultivated only after barley has stripped the soil of its nutrients (Mikkelsen & Nørbach 2003; Grabowski 2011: 481). Hulled barley responds particularly well to fertilizing (Welinder 1998: 194), which makes it possible to cultivate it on less fertile grounds (Groenman-Van Waateringe 1979: 140–1). Fertilizing can be detected in the archaeobotanical material through the presence of plant species thriving in phosphate-rich habitats (Pedersen & Widgren 1998: 141).

The weed flora shows that different kinds of growing conditions have prevailed at the agricultural plots of Orijärvi (the growing conditions of the plants are based on Korsmo 1926; Svensson et al. 1993; Hämet-Ahti et al. 1998). Fat-hen (*Chenopodium album*), common chickweed (*Stellaria media*), black bindweed (*Fallopia convolvulus*), false cleavers (*Galium spurium*) and smooth tare (*Vicia tetrasperma*) all thrive on nutrient-rich soils, and the presence of these arable weeds can thus be interpreted as indicating the use of fertilizers. They bear no indication of how the fertilizing was done (but see above for a discussion of the various alternatives). On the other hand, annual knawel (*Scleranthus annuus*), corn spurrey (*Spergula arvensis*) and sheep’s sorrel (*Rumex acetosella*) thrive on poor and acidic soils. *Galium spurium* and *Vicia tetrasperma* thrive on more or less basic (i.e. calcareous) soils. The growth of these plants is promoted by the to some extent alkaline bedrock at Orijärvi (see Mikkola 2005: 50 with references). Plants like pale persicaria (*Persicaria lapathifolia*) and *Stellaria media* tend to grow in wet environments, and the ergot fungus (*Claviceps purpurea*) also prefers wet conditions. Rye brome (*Bromus secalinus*), *Vicia tetrasperma* and *Rumex acetosella* often grow together with winter crops, so it is possible that they grew with autumn-sown crops at Orijärvi.

Because the plant material at Orijärvi is mixed, it is difficult to define the cultivation methods more precisely. Some crops could have been cultivated on nutrient-rich plots and some on the less rich ones. Likewise, some of the crops could have been cultivated on the more basic soils, and some on the more acidic ones. Weeds thriving on nutrient-rich habitats indicate the use of fertilisers, which is a basic requirement for the most of the crops. A wet climate is indicated by some of the weeds as well as by the presence of ergot. Because oat, flax and rye require less nutrients than the other crops, they could have been sown on less nutritious soils. The connection between the cereals and weeds is still tentative because most of the samples derive from plough zone layers of mixed origin. Soil properties and cultivation methods can be studied more precisely with archaeobotanical samples that represent single events or undisturbed contexts.

Surrounding vegetation and collected plants

The remains of meadow and wetland vegetation identified in the samples probably represent mostly fodder, even if the majority of the collected plants also thrive on meadows. Sedges (*Carex* spp.) and grasses (Poaceae) have most probably been the main components of the fodder. These could have thrived on the lakeside water-meadows, on the pastures near the settlement and on other anthropogenic habitats. Meadow buttercup (*Ranunculus acris*), common sorrel (*Rumex acetosa*), lesser stitchwort (*Stellaria graminea*), meadow vetchling (*Lathyrus pratensis*) and selfheal (*Prunella vulgaris*) grow on meadows and roadsides. Bulbous oat-grass (*Arrhenatherum elatius* var. *bulbosum*), raspberry (*Rubus idaeus*), wild strawberry (*Fragaria vesca*) and juniper (*Juniperus communis*) thrive on meadows and other man-made habitats and could have been collected from the vicinity of the site. Although both the meadow buttercup and juniper thrive on meadows, they are not consumed by animals when growing on the meadows, but are edible when dried. Bearberry (*Arctostaphylos uva-ursi*) could have been collected from moors or other similar habitats nearby, where spruce (*Picea abies*) could also thrive.

Cultivation chronology compared with contemporary sites

Because of the small amount of archaeobotanical studies conducted in Mikkeli region, a selection of published archaeobotanical analyses and the results of three MA theses on similar materials elsewhere in Finland are summarised in Appendix 1 in order to provide an overview of the cultivated crops used in Finland from the Merovingian Period to the Crusade Period/Middle Ages. The locations of the sites are shown in Figure 1. Three studies from north-western Russia are also included, as they show that barley, rye, oat and wheat have been found also on Iron Age sites of the Karelian Isthmus. The list is based on published material and should be quite comprehensive, although some publications may be missing. In order to make the comparison valid with the research conducted at Orijärvi, only studies involving charred seeds or plant impressions in pottery are included, and only the secure identifications of crops are mentioned. Club wheat (*Triticum compactum*) and bread wheat (*T. aestivum*) are grouped as bread/club wheat (*T. aestivum* s.l.) and *Avena* sp. represents both cultivated (*A. sativa*) or wild forms of oat (*A. fatua/strigosa*). The dating of the plant material is based on the publications and has not been further scrutinised. The number of radiocarbon-dated assemblages is not great, and some of the datings have been made of charcoal found in associated strata. The plant remains derive from cultural layers, graves, ancient fields, a sacrificial mound and grain caches.

Barley (*Hordeum vulgare*) has clearly been the most common cultivated crop of the period. A grain cache from Pahamäki (south-western Finland) dated to the Merovingian Period/Viking Age has barley as its main component, and contains also a great deal of rye and minor proportions of naked wheat, oat and peas.

Rye (*Secale cereale*) has been the second most numerous crop, but it is not clear when rye cultivation actually began. Rye was domesticated early on in south-west Asia, but it has also thrived as a weed alongside other cultivated crops, and its actual cultivation in Europe began during the pre-Roman Iron Age and Roman Period (Behre 1992; Zohary et al. 2012: 59–66). Based on the percentages of the cultivated species represented in macrofossil data, Aalto (1997: 56) maintained

that the amount of rye grains in most Finnish archaeobotanical assemblages of the Iron Age is so small (between 0.6% and 10%) that the plant should be considered as a weed growing in barley fields. She considers the Merovingian Period finds of Retulansaari, southern Finland, where the percentage of rye grains is 14%, as the first signs of actual rye cultivation in Finland. According to Lempiäinen (2006), rye may have been a weed during the Early Iron Age, but during the Late Iron Age it was cultivated as a mixed crop together with barley and wheat. She interprets the occurrence of rye in graves of the Late Iron Age as signifying the introduction of a new, and most probably highly valued, cereal (Lempiäinen 2002; 2006: 36). In the material reviewed here, Late Iron Age assemblages consisting of more than 15 cereal grains show a proportion of rye grains ranging from 0 to 97%, with the highest value being from the Rähälä cache dated to the end of the Viking Age and/or the beginning of the Middle Ages. A cache like this provides undeniable evidence that rye was deliberately cultivated during this period.

Rye is the most numerous cereal also at the Sievola site in south-western Finland, where it amounts for 60% of the charred grains and impressions left in pottery. In the assemblages where rye is less numerous than barley, its proportion amounts from 0.3 to 33% of the charred grains. At the sites of Domargård and Pörnnullbacken, the amount of rye is less than 2%, meaning that at least in these two cases rye should be considered as a weed. Most of the samples derive from mixed cultural layers, which makes interpretation harder than in the case of the grain caches. If the material is interpreted following Aalto (1997), sufficient evidence for rye cultivation may be found at the Iron Age/Medieval sites of Retulansaari (Myllymäki), Pahamäki Pahka, Leikkimäki, Käkisalmlä Fortness (Karelia) and Sievola.

I would sum up the current knowledge so that during the Late Iron Age an intentional rye cultivation is demonstrated just by one cache and one macrofossil assemblage, in which rye is the main component. In some assemblages the amount of rye seems to be so small (less than 2%) that intentional cultivation is not probable. However, the cultivation of rye as a mixed crop is a distinct possibility at several locations, where the proportion of rye grains is 10% or more. When more analyses are conducted and samples with a

better contextual resolution are studied, this issue can be assessed more confidently.

Oat is found in almost all sites, but in minor proportions and it was not clear whether it is in fact a cultivated crop at this time. Aalto (1997: 56) regards oat as being still a weed during the Iron Age. The list of sites with bread/club wheat is smaller, and it is abundant only at Domargård. Emmer wheat (*Triticum dicoccon*) is the least important cereal and it has been found only from four sites. Hulled barley (*H. vulgare* var. *vulgare*), by contrast, seems to be the dominant crop, although the variety is mentioned only in few studies. In the case of Pahamäki the report mentions that the grains mostly resemble four-rowed hulled barley, but the presence of some naked barley cannot be ruled out.

Other cultivated species are represented in minor proportions. These include gold-of-pleasure (*Camelina sativa*), hemp (*Cannabis sativa*), flax (*Linum usitatissimum*), pea (*Pisum sativum*) and horse bean (*Vicia faba*). In addition, hazelnuts (*Corylus avellana*), bog myrtle (*Myrica gale*), henbane (*Hyoscyamus niger*), juniper (*Juniperus communis*), and damson/bullace (*Prunus institia*) have been found in assemblages dated to the period 500–1000 AD (Häkkinen & Lempiäinen 1996: 151). It should be noted that uncharred hemp seeds dated to 1000–1300 AD have been found in the fortress of Käkisalmlä (Lempiäinen 1995) and from the Varikkoniemi site (southern Finland), where they were dated to 900–1300 AD (Lempiäinen 1993). Also, hemp fibres have been found in an inhumation grave dated to c 1100 cal. AD at the Kirkkomäki site near Turku (Lempiäinen 2002). The list presented here does not include all plants collected from the wild, such as raspberry, which is commonly found in archaeobotanical analyses.

Bulbous oat-grass has been found in the Merovingian Period cemetery of Vainionmäki in south-western Finland, where the plant remains were found in a pit filled with charcoal and soot. The pit contained also numerous remains of cereals, pulses, weeds and oil plants (Aalto 1996: 177–8) and has been interpreted as some kind of an offering pit. Bulbous oat-grass has also been found in the Ostrobothnian Iron Age site of Pörnnullbacken, where it was found both in house remains and in graves (Engelmark & Viklund 2002: 15).

As there are many similarities in the charred plant assemblage of Orijärvi and the other Finnish

sites mentioned above, it is highly possible that also legumes and some other plants not recognised at Orijärvi may have been cultivated there.

Plant use

The cultivated cereals have most probably been used in preparing various kinds of dishes and brewing. In Finland the main source of information concerning traditional plant usage are the written sources, but some archaeological finds can also shed light on the issue, such as the loaf of bread made from barley which was found in a grave at Sund on the Åland islands (Lehtosalo-Hilander 1984: 307). In Sweden finds of bread loaves in graves are far more common during the first millennium AD (Bergström 2007). Wheat was considered to be a luxury product during the Iron Age and could have been consumed during special occasions (Grabowski 2011: 492). In the same way, evidence of raspberry consumption was found in Lappeenranta, eastern Finland, where the uncharred seeds found in a grave inside the stomach of corpse were AMS-dated to the Middle Ages/Modern Period (1480–1670 cal. AD) (Lempiäinen 2008: 99).

Hemp fibres can be used for ropes, nets, textiles and warp threads. Viking Age hemp textiles have been found in Norway and Denmark, and indeed pollen analyses conducted in Sweden bear evidence of a strong upswing in hemp cultivation between 600 and 1000 AD (Pedersen & Widgren 1998: 381–2). Hemp seeds could also have been used as food, as in the case of a traditional dish known from the Savo area of eastern Finland (*Fi. apposet*), prepared by roasting hemp seeds in a cauldron and then grinding them and mixing them with salt and buckwheat or rye flour (Kaukonen 1946: 116). Hemp seeds could easily have been charred during such food preparation.

Flax has been cultivated for the fibres that can be used for textiles, and also because of the seeds that are rich in oil. In Sweden the oily seeds were initially more important (during the Bronze Age and the pre-Roman Iron Age), with the importance of textiles rising in the course of the first millennium AD (Viklund 2011). Flax seeds have been used as food in Finland in historical times, for example in the form of a porridge cooked from the seeds in order to make a medicine for humans and animals, believed to

cure abscesses and stomach diseases. There was also a type of bread known in Finnish as *suis-tamolainen*, which was made from ground flax seeds and used as a pie crust (Kaukonen 1946: 91 with references).

Bulbous oat-grass is a type of oat-grass, which has tuberous swellings at the base of the stem. The tubers of this plant can be eaten and it is possible that it was cultivated, although it can also grow as an arable weed, especially with winter crops (Engelmark 1984: 88–91; Welinder 1998: 75; Roehrs et al. 2012). Bulbous oat-grass has been found in various Iron Age sites and graves in the Nordic countries, Central Europe and England, and it has been suggested that its use was associated with burials or other types of ritual deposition, or that it could have been charred in the course of burning of fields (Engelmark 1984; Gustafsson 1995; Aalto 1996; Welinder 1998; Engelmark & Viklund 2002; Preiss et al. 2005; Cooremans 2008; Jensen et al. 2010; Roehrs et al. 2012).

Given the size of ergot in the Orijärvi assemblage, the finds of ergot are most probably connected with the cultivated cereals. Ergot is a parasitic fungus growing most commonly on rye, but it can grow also on wheat, barley and about 40 other grass species. Ergot contains various toxic substances and causes an illness known as ergotism, which affects the nervous system and may result in death. Ergot follows with the cereal harvest and invariably gets mixed with cereals during threshing. It can be only removed from the harvest by picking it by hand. It becomes common when the amount of rainfall is high and has been especially common with rye cultivated with the slash-and-burn method. During the Middle Ages in Finland, the proportions of ergot grains in flour, especially after rainy summers, may have been as high as 6–10% (Cantell & Saarnio 1936: 22–4; Jonsell & Tunón: 2005: 210 with references). Ergot has been also found in a charred cache of rye at Rähälä, southwestern, Finland dated to the 13th century AD (Lempiäinen 1996).

CONCLUSIONS

The charred plant remains found in the fields of Orijärvi represent a long-term continuity of settlement remains, which seem to have been ploughed into the fields in the same manner as in the case of the mobile fields of southern

Scandinavia. It is also possible that some parts of the material derives from the use of fertilizers. The excavations at Orijärvi brought to light various types of archaeological material and features related to houses, such as postholes, hearths, clay daub, and clay slag, but no clear house remains. This has been interpreted so that former houses and settlements were turned into cultivated fields (Mikkola 2006: 27). In Gotland, silver hoards were often dug under the house floors during the Viking Age (Östergren 1989: 235). If the silver hoard found at Orijärvi was similarly once located inside a house, this could be another indication that there were houses at the site of the silver hoard, which was found dispersed in a relatively small area in the fields (Mönkkönen 2010).

All the plant species mentioned in Engellmark's and Viklund's (1991) model for the deposition of plants in Iron Age dwellings and byres were found in the charred assemblage of Orijärvi. Indeed, all of the plant material that could be identified to the species level can be in some way connected to agricultural activities and other plant use. The gathering of bulbous oat-grass, raspberry, bearberry, wild strawberry and juniper indicate that collecting plants from the surroundings was also part of the subsistence. Bulbous oat-grass tubers are interesting finds, because they are associated with graves in several contemporaneous archaeological sites, and could indicate that graves have been ploughed as fields in Orijärvi. It is also possible that the tubers originate from household waste, or they could have been burned on the arable field, as may be the case with spruce needles for example. Finds of charred spruce needles in possible arid marks in south-western Finland, dated to the Viking Age, have been interpreted as remains of clearance burning (Roeck Hansen & Nissinaho 1995: 28).

With the aid of the radiocarbon datings, pollen analysis, and stratigraphical observations, a preliminary chronology for the introduction of certain plant species at Orijärvi was proposed above. In this chronology, the earliest remains of barley, rye, and bread/club wheat were dated to the Merovingian Period. Oat remains probably also date to this time, but there are no radiocarbon datings to support this suggestion. Hemp has been cultivated during the Iron Age and flax has probably been taken into cultivation during

the Middle Ages. The crops resemble material found at contemporary Finnish sites, where the dominant cereal is barley (mostly hulled) and rye is the second most important crop, with bread/club wheat and oat being present only in small quantities. Hemp and flax have also been found from contemporary sites.

The weed flora and cereals indicate the cultivation of different kinds of soils, and spanning different types of climates, during the long period of use of the Orijärvi site. Arable weeds thriving on soils rich in nutrients suggest that the fields have been fertilized. However, there are also weeds thriving on nutrient poor and acidic soils, and some weeds thrive on more basic soils and some often grow together with winter crops.

Although animal bones have been mostly studied only at the neighbouring sites and not Orijärvi itself, it seems highly probable that the same array of domestic animals was kept at Orijärvi. The remains of meadow and wetland vegetation would then represent fodder collected for the animals. Most of the collected natural plants could have also thrived on these types of habitats.

The Iron Age subsistence base in the Mikkeli region, and most probably also at Orijärvi, was diverse. Based on the archaeological and paleoenvironmental studies, it consisted of agriculture, fishing, hunting and gathering. Agriculture consisted of field cultivation – probably slash-and-burn agriculture – and animal husbandry. This paper provides the first discussion of plants gathered in the Iron Age in the Mikkeli region based on the study of charred macrofossil remains.

NOTES

¹ The paper is based upon my Master's thesis, presented at the University of Helsinki, Department of Philosophy, History, Culture and Art Studies (Vanhanen 2010).

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APPENDIX 1.

Charred remains of cultivated plants dated to the Late Iron Age in Finland and Karelia (Russia). The numbering refers to Fig. 1.

Municipality	Site	Date	Dating method	Context	Preservation	Avena sp.	Hordeum vulgare var. vulgare	Hordeum vulgare var. nudum	Hordeum vulgare	Secale cereale	Triticum aestivum s.l.	Triticum dicoccum	Arrhenatherum elatius var. bulbosum	Camelina sativa	Cannabis sativa	Linum usitatissimum	Fisum sativum	Vicia faba	References
1. Maalahti	Kalaisahabrännan	MP	?	cu	ch	3	-	-	42	5	-	-	-	2	-	-	-	-	Engelmark 1991
2. Lieto	Vanhainlinna, Linnavuori	600-800 AD	¹⁴ C	cu	ch	-	-	-	p	-	p	p	-	-	-	-	-	-	Lempiäinen 2009
3. Hattula (Tyrväntö)	Retulansaari, Myllymäki	MP (700-800 AD)	?	gr	ch	23	-	-	205	39	1	1	-	-	-	16	1	1	Aalto 1997
4. Hattula (Tyrväntö)	Retulansaari, Myllymäki	600-650 AD	T	sa	ch	15	-	-	-	-	-	-	-	-	1c	-	-	-	Sarkamo 1970
5. Laitila	Vainionmäki, cemetery A	MP	?	gr	ch	12	-	-	27	5	5	5	5	5	16	3	3	3	Aalto 1996
6. Laitila	Vainionmäki, cemetery A	700-800 AD	T	gr	ch	-	-	-	17	2	-	-	-	-	-	-	-	-	Kovero 1994
7. Lieto	Pahnamäki, Pahka	700-900 AD	?	st	ch	15	-	-	4605	1228	28	-	-	-	-	-	21	-	Onnela et al. 1996
8. Karjaa	Domargård 1	VA (900-1000 AD)	?	cu	ch	2	-	-	119	3	51	-	-	-	-	-	-	-	Mattiskainen 1984
9. Hämeenlinna	Varikkoniemi	900-1300 AD	¹⁴ C	cu	ch	34	-	-	2249	150	-	-	-	-	-	-	-	-	Lempiäinen 1993
10. Lieto	Rähälä	cal AD: 1161±88	¹⁴ C	st	ch	1	4	52	2167	-	-	-	-	-	-	-	-	-	Lempiäinen 1987
11. Kokemäki	Ylistaro, Leikkimäki	cal AD: 814±113	¹⁴ C	gr	ch	-	-	-	3	-	-	-	-	-	-	-	-	-	Lempiäinen 1986
12. Paimio	Sievola	ca. 1000 AD	?	cu	ch&im	1	12	-	35	82	7	-	-	-	-	-	1	-	Seppä-Heikka 1983
13. Sund	Kastelholms Kungsgård	LIA	?	fi&cu	ch	5	-	-	118	-	-	-	-	-	3	1	-	-	Nuñez & Lempiäinen 1992
14. Kaukola (Russia)	Säppää (Säppäinen)	LIA	T	gr	?	-	-	-	1	-	-	-	-	-	-	-	-	-	Lempiäinen 2002
15. Valkeakoski	Rapola	PR-CP	¹⁴ C	fi	ch	1	-	-	18	1	2	-	-	-	-	-	-	-	Vikkula et al. 1994
16. Maalahti	Pörnülbacken	ca. 300-1000 AD	¹⁴ C	cu	ch	7	-	-	656	2	-	-	2	-	-	-	-	-	Engelmark & Viklund 2002
17. Maalahti	Pörnülbacken	ca. 300-1000 AD	¹⁴ C	gr	ch	1	-	-	109	-	-	-	2	-	-	-	-	-	Engelmark & Viklund 2002
18. Huittinen	Loima	575-1000 AD	?	-	im	-	2	1	-	1	-	-	-	-	-	-	-	-	Luoto & Seppä-Heikka 1985
19. Käkisalmi (Russia)	Fortress	1100-1300 AD	¹⁴ C, D	cu	ch	5	-	-	6	6	1	-	-	-	-	-	-	-	Lempiäinen 1995
20. Käkisalmi (Russia)	Suotniemi, Leilumäki	900-1000 AD	¹⁴ C	gr	ch	-	-	1	-	1	-	-	-	-	-	-	-	-	Lempiäinen 1997; 2002
21. Lieto	Vanhainlinna, Linnavuori	1220-1275	¹⁴ C	cu	ch	-	-	-	p	p	-	-	-	-	-	-	-	-	Lempiäinen 2009
22. Finström	Godby	550-1000 AD	T?	gr	ch	-	8	-	-	-	-	-	-	-	-	-	-	-	Seppä-Heikka 1984
23. Hämeenlinna	Kirstula Riihimäki	900-1000 AD	T	gr	ch	-	-	-	18	-	1	2	-	-	-	-	-	-	Tenhunen 2001
24. Maaria	Saramäki Marttila	1000-1100 AD	T	gr	ch	-	-	-	106	7	2	-	-	-	-	-	-	-	Seppä-Heikka 1981
25. Mikkeli	Orijärvi Kihlinpelto	ca. 600-1600 AD	¹⁴ C	fi&cu	ch	30	44	6	86	20	5	-	32	-	1	1	-	-	In this paper.

Key: Date: PR= Pre-Roman Iron Age, MP= Merovingian Period, LIA= Late Iron Age, VA= Viking Age, ¹⁴C= radiocarbon, D= dendrochronology, ?= typology, Context: cu= cultural layer, fi= field
gr= grave, sa=sacrificial place, st= storage, Preservation: ch= charred, im= imprint. Other: c= capsule, p= present.