UDC: 581.524.44(497.11 Leskovac)

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LATE BRONZE AGE PLANT ECONOMY AT THE EARLY IRON AGE HILL FORT SETTLEMENT HISSAR?

Abstract: This paper describes the results of the archaeobotanical examination of occupation levels of the Late Bronze Age–Early Iron Age–transitional period (Brnjica cultural group, 14th–10th cent. B.C.), Early Iron Age and Roman period at the fortified hill fort settlement Hissar in Leskovac, south Serbia. The original vegetation of Hissar area was warm and well-lit oak forest and riverine forest in the Valley of Veternica River. Through all Brnjica phases, barley, wheat and broomcorn millet were staple crops. Pulse crops, especially pea and bitter vetch, but also broad been and lentil played prominent role in the diet of Hissar's inhabitants. The main source of plant oil was provided by gold of pleasure (*Camelina sativa* [L.] Cr.), while flax (linseed) and *Lallemantia* were cultivated as distinct crops. The fruits identified from Hissar could, with some exceptions, have been collected from the wild. The exceptions concern pistachio, at the beginning, and walnut, at the end of Brnjica period. Viticulture seams to be plausible at Hissar throughout all Brnjica phases. A single record of safflower (cf. *Carthamus tinctorius* L.) indicates its cultivation for dying purposes. The flora of arable fields and waste places is represented by many taxa, but with meagre record amount.

Key words: archaeobotany, Brnjica cultural group, Serbia, charred and mineralized seeds and fruit stones, cultivated and wild plants, wood charcoal

INTRODUCTION

THE SITE

The fortified hill fort settlement Hissar[1] in Leskovac is a multilevel settlement of the Brnjica cultural group, 1,350–1,000 B.C., Iron Age I in the Morava valley (Stojić 2006a; 2006b, Stojić et al. 2007). The site is very important for the precise chronological determination of transitional period from the Late Bronze Age to the Iron Age in the Balkans. Besides, the earliest occupation at Hissar is attributed to Neolithic cultures, Starčevo and Vinča. Hissar was continuously inhabited throughout Eneolithic, Bronze Age, Iron Age, Roman period, Byzantine period, Serbian medieval period and Turkish period. The hill (341 m alt.) is in a strategic position at the crossing points of roads leading along the Jablanica and Veternica River's valleys and along the Morava River valley (Fig. 1 and 2). The settlement was the most representative one and undoubtedly the main settlement of the Brnjica community, the largest and the only one artificially fortified settlement within the whole central Balkan region during the last centuries of the second millennium B.C. The Brnjica community was one of the first communities in Europe that mastered the iron metallurgy and handicrafts based on this metal from ca. 1350 BC.

Figure 1.
Location of the fortified hill fort settlement Hissar in Leskovac and the location of "conteporary" sites at the Axios/Vardar-Morava-Danube River's trade route.
Sl. 1.
Položaj utvrđenog gradinskog naselja Hisar u Leskovcu i izabranih „istovremenih" naselja na trgovačkom koridoru Vardar–Morava–Dunav.

NATURAL ENVIRONMENT

Soil and Climate

Almost two thirds of the Leskovac municipality area is hilly. The rest is flat, which, in broader sense, constitutes the so called Leskovac valley (210–240 m alt). The valley is 50 km long and 45 km wide. Today, the soil is highly acid (Ličina et al. 2011), while the content of humus is low, with a moderate share of physiologically active phosphorus and potassium. The climate is complex, where the main, typically continental conditions are mingling with the Mediterranean influences coming from the south, up the valley of the river Vardar and deeper into the hills and mountains of the south-central Balkans, where Leskovac is situated. Average annual temperature is 11.4°C. Inadequate precipitation as well as a low level of the total precipitation during a one year period (600–800 L/m^2) presents the most important condition for agricultural production.

Figure 2. Hissar hill and its surroundings:
a) Hissar, a view from the east,
b) western part of Leskovac, view from top of the hill.
Sl. 2. Brdo Hisar sa okolinom:
a) pogled na Hisar sa istoka,
b) zapadni Leskovac, pogled sa vrha brda.
Photo: Vladimir, Wikimedia commons.

Inside the territory of Hissar site (5 km radius) most abundant soil types are brown forest soils (Antonović 1970) – cambisols (European Soil Bureau Network 2005): shallow calcareous brown soil on sandstone, shallow brown acid soil on sandstone, shallow brown acid soil on andesite, brown soil on limestone and calcareous loamy alluvial deposits along Veternica River. Cambisols are the most widely distributed soil of the Mediterranean delimiting the semi-arid climatic regions of the area. Cambisols cover 12 % of Europe. The eutric cambisol (Fig. 3) is used for the cultivation of all kinds of crops. Fluvisols are highly productive soil types and are allocated mainly to cash crop production, such as vegetables, cotton, maize, sunflowers and, when the climate is a little wetter, cereals.

Vegetation and biodiversity

The Hisar hill coveres an area of 10.6 hectare. Today, it is a park and picnic area of. Its cover is pine forest. This doesn't match the natural vegetation of the region

The Hungarian oak-Turkey oak forest (*Quercetum frainetto-cerris* Rud.) is the most widespread association of oak in the Balkans, which is also the most common forest type in Serbia (Janković et al. 1984). The main factor of its occurrence at a particular site is the soil. It is specially adapted to heavy acidic soils (cambisols and vertisols), typical of Serbia, Bulgaria and Romania. Understory trees and shrubs in this forest consist mainly of field maple (*Acer campestre* L.), Tatar maple (*Acer tataricum* L.), white beam (*Sorbus aria* L.), wild peer (*Pyrus pyraster* [L.] Burgsd.), elm (*Ulmus* L.), single-seeded hawthorn (*Crataegus monogyna* Jacq.), blackthorn (*Prunus spinosa* L.), common dogwood (*Cornus sanguinea* L.), rose (*Rosa* L.) and eurasian smoketree (*Rhus cotinus* L.). In south-eastern and southern parts of Serbia this forest type includes also hornbeam (*Carpinus orientalis* Mill.) and downy oak (*Quercus pubescens* Willd.). (Fig. 4).

This region of South Serbia is extremely rich in plant biodiversity, making a continuum stretching from Asia Minor, over southern Bulgaria to the northern Albania and southern Montenegrin coast, with numerous crop wild relatives such as wild cereals and legumes. Considering the latter, it is only in the south, ranging from Niš, over Leskovac to Vranje, where wild pea (*Pi-*

sum sativum subsp. *elatius* [Steven ex M. Bieb.] Asch. & Graebn.) can be found in abundance in the whole Serbia, as well as wild lentil (*Lens nigricans* (M. Bieb.) Godr.) and numerous wild vetch species (Bojan Zlatković and Aleksandar Mikić pers. comm.).

MATERIAL AND METHODS

The site Hissar was sampled by archaeologists for plant remains since 1999 (Medović 2005). Volume of the subjectively took samples was up to 10 litres (average 7 L) of earth substrate. The earth with charred and mineralized plant remains was packed in the plastic bags, deposited in Museum of Leskovac and than transported to the Museum of Vojvodina, Novi Sad. The flotation took place in years 2004 (Institute of Field and Vegetable Crops, Novi Sad) and 2006 (Museum of Vojvodina, Novi Sad). The sieve with mesh size of 0.25 mm was used for the hand flotation. Samples were dried in a shade and then packed in paper bags. The identification work was done by A. Medović in 2004 and 2006 in the Museum of Vojvodina.

RESULTS

A total of 12,643 charred plant items were found in the 64 samples (Table 1). Pulses make almost the half of all finds, 6,079. Of these the most dominant were bitter vetch (*Vicia ervilia* [L.] Willd.) and pea (*Pisum sativum* L.). The most frequent finds in the material, however, were those of cereals and millets. Other discovered taxa were represented by relatively meagre record amount. They were divided in several functional groups: oil/fibre plants, potential medicinal plants, potential vegetables/condiments, dye plants, fruits and weeds/ruderals. Charred wood was also singled out from the samples and identified. Uncharred (mineralized) plant items are represented by many taxa. Their records were by far less numerous than of chared archaeobotanical finds. The find-richest phase was Brnjica II a (21 sample), followed by Brnjica I a (26 samples), Brnjica I b, Brnjica IIb. Early Iron Age sample and sample from Roman period are less representative.

Pulses

Although pea is one of the first crops cultivated by man, a lucky find of 2,572 pea seeds in only one sample from Hissar represents a unique example in the archaeobotany of South East Europe. Pea from Hissar was a distinct crop, stored separately from other crops (Fig. 5). Archaeobotanically, the bulk of the peas recovered at 11th cent. B.C.^{2} settlement Hissar belongs to the cultivated pea. Several morphological characteristics indicate this: smooth surface of the seed coat, "coffee-bean-shaped"

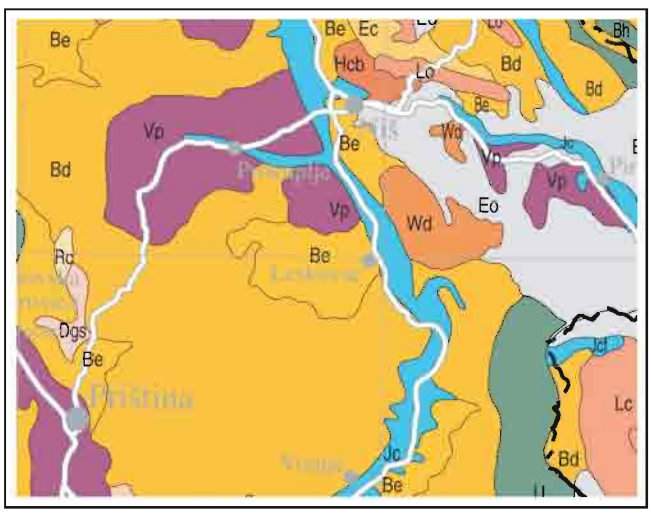

Figure 3. The Soil of Leskovac area (European Soil Bureau Network 2005): Be Eutric Cambisol; Jc Calcaric Fluvisol; Bd Dystric Cambisol; Vp Pellic Vertisol.

Sl. 3. Pedološka karta okoline Leskovca: Be parapodzolaste gajnjače i gajnjače; Jc Recentni aluvijalni nanosi; Bd rankeri, kisela smeđa i parapodzolasta tla na silikatima; Vp smonice.

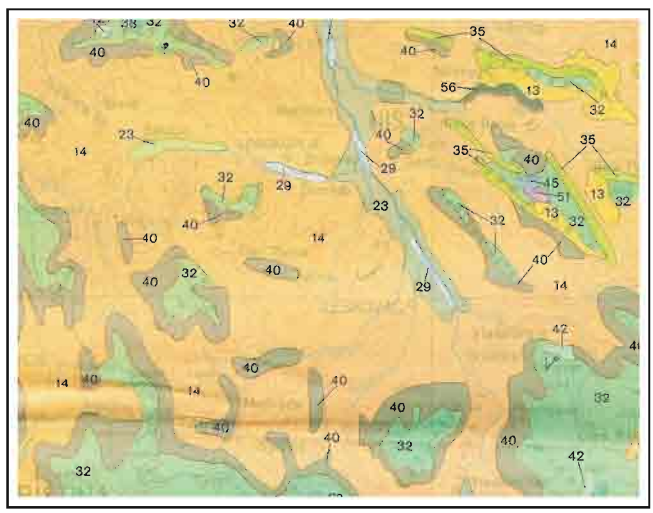

Figure 4. Map of natural potential vegetation of Leskovac area (Fukarek and Jovanović 1983): 14 Quercetum frainetto–cerris s. lat.; 23 Genisto–Quercetum roboris s. lat.; 29 Salici–Populetum s. lat.

Sl. 4. Karta prirodne potencijalne vegetacije okoline Leskovca (Fukarek and Jovanović 1983): 14 šuma hrastova sladuna i cera; 23 šuma lužnjaka i žutilovke; 29 šuma topola i vrba.

hilum, broad ellipsoid seed shape, small size range difference between seeds and high 1,000-grain weight of charred seeds. Also, the relative late period after the "Neolithic agricultural revolution", as well as the high technological standards of Brnjica cultural group (iron metallurgy and handicrafts based on this metal), could only go in favour of cultivation of domesticated pea species. High 1,000-grain weight of pea and considerable infestation by pea beetle (Table 1) seem to confirm the intense crop production.

Figure 5. Pisum sativum (Brnjica II a phase, 11th cent B.C.): scale 1 mm, a drawing by A. Medović.

Sl. 5. Grašak (Brnjica II a faza, 11. vek p. n. e.),razmermik 1 mm, crtež A. Medović.

On the other hand, it exist uncertainty about the determination of 4/5 of "naked" pea seeds in the sample. As wild or semi-wild pea species grow in the area it could be assumed that some of their seeds have jumped out of from wild into the culture. The cultivation of sole wild, tall pea is highly unprofitable: high net yield loss due to poor establishment caused by wild-type low germination rates and due to pod dehiscence. Thus, we may assume that material of our study was not wild pea, rather than it represents early pea domesticates (Jovanović et al. 2011; Medović et al. 2010; 2011; in press).

The other rich pulse sample from Hissar yielded 3,031 charred seeds of bitter vetch (Fig. 6). It is dated to Brnjica IIa phase. Bitter vetch is represented in three of four Brnjica phases. Its frequency is the highest during the 13th century – its seeds are represented in every second sample. Just like pea from the same site, the bitter vetch from Hissar was cultivated as one of the main crops and stored separately from the other pulse crops (Medović et al. 2011). In the rich *ervilia* sample from Hissar many seeds were defiled by seed beetles.

The spectrum of other cultivated pulses at Hissar include broad bean (*Vicia faba* L.) and lentil (*Lens culinaris* [M. Bieb.] Godr.).

Leskovac and its region is one of the last ancient European grain legume refugia in Serbia, where crops such as bitter vetch have been cultivated for forage and grain until relatively recently and where others such as broad bean still persist and vetches are the most popular annual forage crop.

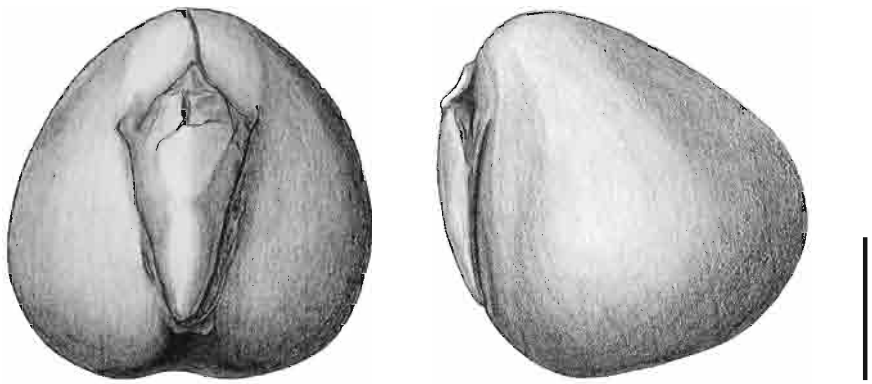

Figure 6. Vicia ervilia (Brnjica II a phase, 11th cent B.C.): scale 1 mm, a drawing by A. Medović.
Sl. 6. Urov (Brnjica II a faza, 11. vek p. n. e.), razmernik 1 mm, crtež A. Medović.

Cereals

The main cereals cultivated at Hissar in Leskovac were lax eared six-row barley (*Hordeum vulgare* L. subsp. *vulgare*), einkorn (*Triticum monococcum* L.), spelt wheat (*Triticum spelta* L.) (Fig. 7), bread wheat (*Triticum aestivum* L.) and emmer (*Triticum dicoccon* Schrank). Broomcorn millet (*Panicum miliaceum* L.) played a significant role in the diet of the inhabitants of the site through all Brnjica phases. One single record of hulless, or "naked" barley (*Hordeum vulgare* L. subsp. *nudum*) was made in our material. The hulless barley--gene is present since ancient times in the barley genetic stock. It testifies the importance of naked barley as one of major crops of the last millennia. Although foxtail millet (*Setaria italica* [L.] P. Beauvois) is an ancient crop, it seems that it was a weed in broomcorn millet fields. During archaeobotanical examination a particular attention has been paid to the occurrence of "new" glume wheat. Although, some fragments of unidentified wheat grains and spikelet forks were counted in our material no positive match could have been made. Some small, slender grains from layer of Brnjica II a phase grabbed our attention. It was the "weedy rye" described and illustrated by Kroll at Bronze Age Kastanas (1983) and at Bronze and Iron Age Feudvar (1998). Weedy rye was also found at Iron Age Gomolava (van Zeist 2001/2002) and Iron Age Gradina na Bosutu (Medović and Mikić 2010; Medović 2011). At Bronze Age Stillfried an der March (Kohler-Schneider 2001) the single find of *Secale cereale* match the description of our *weedy Secale*. The seeds of typical, cultivated rye couldn't have been identified in our material. Therefore, our form of rye is considered to have occurred as a weed in the cornfields of Hissar farmers.

Barley is the principal crop at Hissar, while einkorn is the most important wheat during the Bronze Age not only at Hissar, but in the southeast Europe (Kroll 1983; 1991a; 1998). The spelt wheat holds the third position by counting cereal grains. It doesn't reach the high frequencies of Kastanas (50 %), but in the Brnjica I b phase the values exceed 42 %. Spelt grains were identified in all Brnjica phases (Tab. 1). The same can be told for bread wheat, whit one its highest occurrences in the samples do not cross 30 %. Although the number of the identified emmer wheat grains is the same as bread wheat, it frequencies are much higher than of those of spelt or bread wheat. Therefore, it's ranking and the importance in the agriculture at Hissar is underrepresented in the charred material.

Oil plants

Oil plants played an important role in the plant production of the site (Table 1). As for much smaller amount of identified seeds of oil plants in our record, it should be taken into account that during carbonization process the oleaginous seeds get easily destroyed. Gold-of-pleasure (*Camelina sativa* [L.] Cr.) was the main oil plant through all phases of Brnjica culture. In its later phases linseed or flax (*Linum usitatissimum*) has gained in importance. Flax may have grown primarily for its seeds, from which oil is extracted for consumption. It is also possible that the fibres, obtained from the stem of the plants and used for the manufacture of linen cloth, were also objective of its cultivation.

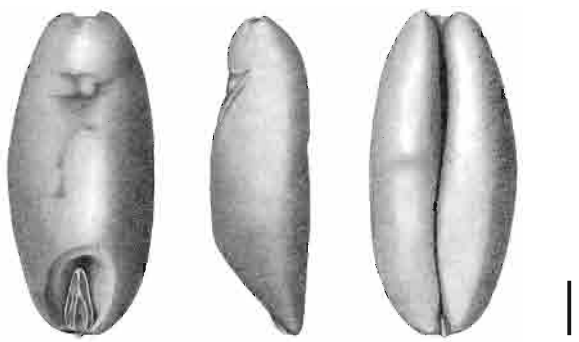

Figure 7. Triticum spelta (Brnjica II a phase, 11th cent B.C.): scale 1 mm, a drawing by A. Medović.

Sl. 7. Krupnik (Brnjica II a faza, 11. vek p. n. e.), razmernik 1 mm, crtež A. Medović.

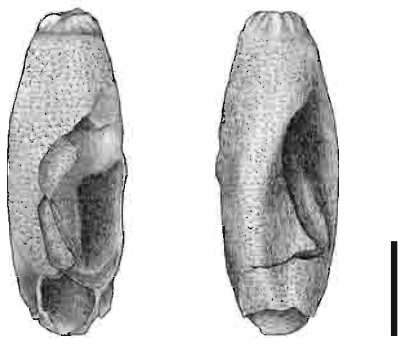

Figure 8. Lallemantia iberica (Brnjica II a phase, 11th cent B.C.): scale 1 mm, a drawing by A. Medović.

Sl. 8. Lalemancija (Brnjica II a faza, 11. vek p. n. e.), razmernik 1 mm, crtež A. Medović.

But, our attention was attracted by 26 records of a recently identified oleaginous plant, *Lallemantia* at Bronze Age sites in the Macedonia region of northern Greece and the Blakans (Fig. 8).

Lallemantia has a natural distribution lying outside Europe, in regions ranging from Iran to Anatolia, Jordan, Palestine, and Israel. The possible routes through which *Lallemantia* arrived in northern Greece are considered in relation to evidence for Bronze Age trade in metals, in particular tin (Valamoti and Jones 2010). This plant, "exotic" for the Balkans, was probably introduced from Anatolia to Greece in the early Bronze Age and then cultivated locally (Jones and Valamoti 2005). Recently, archaeobotanical finds of *Lallemantia* are accumulating. It was found at Bronze Age Feudvar and Židovar in Serbia, but under the name "Nr. 188" (Kroll 1998; Medović 2003). A total of 889 charred seeds were found in the 2000 samples from Feudvar. In Židovar this number was much lower. Only six seeds in only one of 21 samples could be identified (Kišgeci and Medović 2006). Both sites are located in the fertile plain of the Vojvodina region, while this is the first record of this oil plant in hilly and woody central Serbia. However, most data of charred fruits of *Lallemantia* come from diverse Bronze Age sites in northern Greece (Jones and Valamoti 2005, Becker and Kroll 2008).

The "Mediterranean touch"

From the earliest Brnjica phase (Brnjica I a, 14th cent B.C.) four semi-charred ("angekohlt") whole nut-shells of *Pistacia vera* L. (pistachio) were retrieved from one sample (Fig. 9). The nut-shells were rather small: 5.7 x 3.3 x 2.2 mm. D. Zohary, M. Hopf and E. Weiss (2012) clam, that there are no clear signs of *P. vera* cultivation in south-west Asia or in southern Europe before classical times. Nevertheless, three finds of *P. vera* shells from Thessaly, two from late Neolithic Sesklo and Pefkakia (Renfrew 1973; Kroll 1983, Abb. 17; 1991a) and one from Middle Bronze Age Pefkakia, indicate its early cultivation in northern Greece. Although, the contamination possibility of our Metal Age material with Roman plant material exists, we are tending to believe that the inhabitants of Hissar were either growing pistachio trees in their orchards, or the nuts were imported via well developed Bronze Age trade routes (see Fig. 1). Both scenarios are possible, but the second one seems more plausible. Growth conditions for pistachio are optimal at Hissar. If it was grown in local orchards we would expect more finds of hard-shelled nuts in at least two phases of the Brnjica culture.

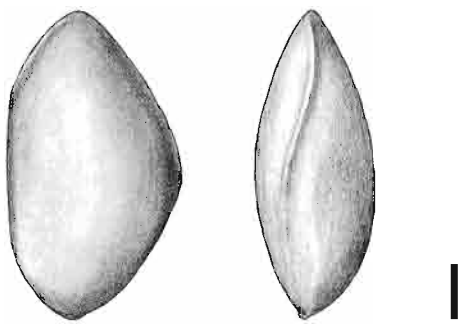

Figure 9. Pistacia vera (Brnjica I a phase, 14th cent B.C.): scale 1 mm, a drawing by A. Medović.

Sl. 9. Pistaći (Brnjica I a faza, 14. vek p. n. e.), razmernik 1 mm, crtež A. Medović.

On the other hand, in our material single charred nut shells of walnut (*Juglans regia* L.) could be identified in two different samples. One sample is dated to Brnjica II a (11th cent B.C.) and one was retrieved from layer which belongs to Roman period. It is widely accepted that *J. regia* archaeobotanical remains became more common in Europe from Roman times onwards (Zohary et al. 2012, http://www.archaeobotany.de/database.html). Walnut cultivation started probably before Roman times. In the Balkans walnuts were reintroduced by humans, after its disappearance after last glaciation, as recently as the Bronze Age.

Both charred and mineralized kernels of *Vitis vinifera* could be identified in three of four different phases of Brnjica culture. No records of *Vitis* could have been made in the latest Brnjica phase (Brnjica II a), Early Iron Age and in the Roman deposits. The main reason for this is that only a single sample was archaeobotanicaly examined per layer. The most charred *Vitis* fragments (11) were found in Brnjica I a layer. It was not possible to determine if the kernels belong to wild grape (*Vitis vinifera* L. ssp. *sylvestris* [C.C. Gmel.] Hegi) or cultivated grape (*Vitis vinifera* L. ssp. *vinifera*). Viticulture seams to be plausible at Hissar throughout all Brnjica phases. On one hand the evidence of vine cultivation exists at contemporary Kastanas and Agios Mamas (Becker and Kroll 2008; Kroll 1983), but also at Stillfried an der March in Austria (Kohler-Schneider 2001). On the other hand a hiatus in vine production is evident in north Serbian province of Vojvodina. There

could be only identified small number of wild grape kernels (Kroll 1998; Medović 2002; 2011). This region is traditionally beer consuming region (see also Kroll 1991b).

Spectrum of the wild fruits

We found charred remains of *Prunus spinosa* L. (blackthorn), *Prunus* non spinosa (stone fruit, not blackthorn), *Rose* (rose), *Cornus mas* L. (cornelian cherry) (Fig. 10), *Fragaria vesca* L. (wild strawberry), *Sambucus ebulus* L. (danewort), *Sambucus nigra* L. (elder), *Rubus fruticosus* L. agg. (blackberry), but also mineralized plant remains of *Sambucus ebulus* L. (danewort), *Sambucus nigra* L. (elder), *Rubus fruticosus* L. agg. (blackberry).

Dye Plants

One single record of (most probably) safflower (cf. *Carthamus tinctorius* L.) was counted in a sample from Brnjica II a phase. Archaeobotanical finds of safflower when charred are poorly preserved because of their high oil content, making it difficult to determine (Marinova and Riehl 2009). The earliest safflower ?nds in south-eastern Europe originate from the last third of the early Bronze Age in the eastern part of the Thracian plain, at Tell Karanovo at about 2800–2600 cal B.C (Marinova 2004). Other finds comes from Middle Bronze Age Feudvar, Serbia (Kroll 1990; 1998) and late Bronze Age Turkeve-Terehalom in Hungary (Gyulai 1993). A find of safflower at Hissar indicates its cultivation for dying purposes. Two dying pigments from the plant, safflower yellow and safflower carmine are known from ancient times.

Thousand grain weight

In our material we found enough charred seeds to obtain 1,000-grain weight only for four taxa. Only in case of broomcorn millet we could measure this parameter twice. The most 1,000-grian weights were obtained from Brnjica II a levels (Table 1).

The thousand grain weight of pea seeds is 24.4 g. The thousand grain weight of pea seeds in Feudvar was calculated in only one sample, 19.25 g (H. Kroll, pers. comm.). It was 5 g lighter than the one from Hissar! At the archaeological sites of Židovar (north Serbia) or Kastanas and Agios Mamas (north Greece), there were not enough peas in material to calculate thousand grain weight.

The thousand grain weight of bitter vetch seeds is 11.74 g. In contrast to pea, it is possible to compare these values with other sites in the region. At Agios Mamas, the 1000 *ervilia* seeds weigh normally under 10 g (Becker and Kroll 2008), while at Feudvar they weigh as *lens* seeds, only 6.02 g (H. Kroll, pers. comm.). The weight of bitter vetch from Hissar fits into the range values from Kastanas, with 10–13 g (Kroll 1983).

The thousand grain weight of *Triticum spelta* is 12.76 g. At Early Iron Age Gradina na Bosutu (north Serbia) 1000 *spelta* seeds weigh 13.32 (Bosut IV a, 850–750 B.C.) and 11.08 g (Bosut IV c, 500–250 B.C.) (Medović 2011).

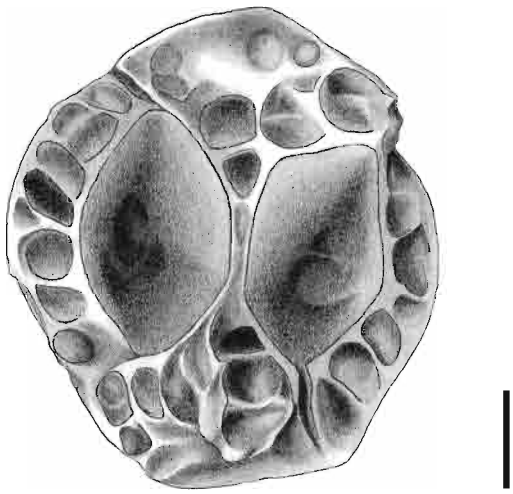

Figure 10. Cornus mas (Brnjica I b phase, 13th cent B.C.): scale 1 mm, a drawing by A. Medović.

Sl. 10. Dren (Brnjica I b faza, 13. vek p. n. e.), razmermik 1 mm, crtež A. Medović.

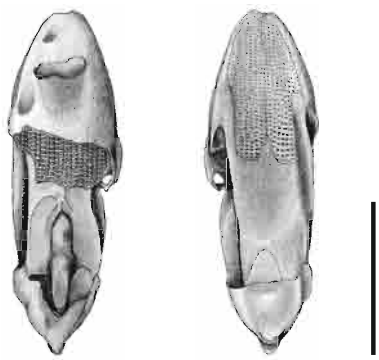

Figure 11. Digitaria sanguinalis (Brnjica I b phase, 13th cent B.C.): scale 1 mm, a drawing by A. Medović.

Sl. 11. Crvena svračica (Brnjica I b faza, 13. vek p. n. e.), razmermik 1 mm, crtež A. Medović.

It was possible to weigh 100 seeds of *Panicum miliaceum* in two samples from Hissar: 1.92 (Brnjica Ia, 14th cent B.C.) and 1.73 (Brnjica II a, 11th cent. B.C.). These values are much higher than values obtained at Early Iron Age Gradina na Bosutu (1.48, 1.31 and 1.57 g; Medović 2011) or of Late Bronze Age levels and transitional period from Bronze Age to Early Iron Age at Kastanas (1.24 g min, 1.58 g max; Kroll 1983)!

Flora of arable fields

The flora of arable fields and waste places is represented by many taxa, but with meagre record amount. Archaeobotanical records of common purslane (*Portulaca oleracea* L.), green foxtail (*Setaria viridis* [L.] P. Beauv.), black nightshade (*Solanum nigrum* L.), hairy crabgrass (*Digitaria sanguinalis* [L.] Scop.) (Fig. 11), common barnyard grass (*Echinochloa crus-galli* [L.] P. Beauv.) and yellow foxtail (*Setaria glauca* [L.] P. Beauv.) are represented in the Brnjica culture material. In Kastanas, H. Kroll (1983) has separated this group of weeds as broomcorn millets group. All the taxa have the same development cycle in the fields. In the broomcorn millets they find optimal growth conditions. As the growth conditions in wheat and barley differ from those of *P. miliaceum* the presence of this group can only confirm the status of broomcorn millet as prominent crop and its advanced cultivation in all Brnjica phases.

Archaobotanical record of blue woodruff (*Asperula arvensis* L.), larkspur (*Consolida regalis* S.F. Gray), false cleavers (*Galium spurium* L.), ballmustard (*Neslia paniculata* [L.] Desv.), but also *Plycnemum* and *Ranunculus*, and sun spurge (*Euphorbia helioscopia* L.) in the archaeobotanical material indicates the presence of arable-weed order *Papaveretalia rhoeadis* (Hüppe et Hofmeister 1990). This is the weed community of plants growing on carbonate- and base-rich loam or clay soils (pH 7–8). Therefore, the crop-fields must have been located at the foot of the hill, in the fertile Veternica River valley (see also Fig. 2 b). The sole record of common sheep sorrel (*Rumex acetosella* L.), a soil-acidity indicator, points out only the heterogeneity of soils used for agricultural purposes.

Charred wood record

The majority of the hand-picked samples include charred wood. Wood identification was done by the author of this paper on the material from the campaign 2005. The charred wood record at Hissar include seven taxa: oak (*Quercus*) – 32; maple (*Acer*) – 5; elm (*Ulmus*) – 5; ash (*Fraxinus*) – 3; apple subfamily (Maloideae) – 1; dicotyledonous wood, diffuse porous wood – 2 and coniferous wood without resin canals (*Abies*, *Juniperus*, *Taxus*) – 1.

The taxa represented by wood charcoal fit almost like glow in the description of the natural environment – well-lit warm Hungarian oak-Turkey oak forest-type of south Serbia. The charred wood of Ash (*Fraxinus*) may be brought into the settlement from the riparian and floodplain forests of Veternica river. The predominance of oak (*Quercus*) on the other hand can be explained with fact that the majority of wood was used as timber in the construction of the houses and other buildings.

SOME "CONTEPORARY" SITES AT THE AXIOS/VARDAR – MORAVA – DANUBE RIVER'S TRADE ROUTE

Kastanas and Agios Mamas, north Greece, Macedonia, Bronze Age

In the Late Bronze Age Kastanas (Fig. 1) it may be assumed that gold-of-pleasure, poppy and foxtail millet were distinct crops. Broomcorn millet suddenly gained in importance at the beginning of the Late Bronze Age. Together with bitter vetch and einkorn, *P. miliaceum* was the principle crop grown by the inhabitants of the site. The finds from Agios Mamas confirm its development from rare crop at the Middle Bronze Age to a staple crop at the Late Bronze Age. Various pulse crops have the same importance in the diet of both sites as the cereals. At both sites the change of main oil plants, from flax to poppy, from early to later periods of Bronze Age can be tracked. *Lalamentia* was only of minor importance at Agios Mamas.

Židovar, north Serbia, middle Bronze Age, Vatin culture (Pančevo-Omoljica phase)

The main cereals cultivated at Židovar (Fig. 1) were naked wheat and einkorn, hulled lax eared six-row barley and emmer. Spelt wheat and broomcorn millet were of only minor importance at middle Bronze Age Židovar. Pulses were represented by lentil and pea. Bitter vetch occurred in minor quantities. Gold-of-pleasure seems to be main cultivated oil plant in the settlement. Six carbonized one seeded nutlets of dragon's head (*Lallemantia iberica*) found at Židovar may suggest that *Lallemantia* was locally cultivated by its inhabitants at the beginning of middle Bronze Age.

Feudvar (Bronze/Early Iron Age) and Gradina na Bosutu (Early Iron Age), north Serbia

In the Late Bronze Age plant economy of Vojvodina the main agricultural products are einkorn and broomcorn millet. Various pulse and oil/fibre crops compliment plant production. Two "new" oil/fibre plants were identified: *Lallemantia* (No. 188) and hedge mustard (*Sisymbrium officinale* (L.) Scop.). It is the same type of plant economy as seen in north Greece – Kastanas/Assiros (Kroll 1991a). At Gradina na Bosutu this type of economy seems to last also throughout the Early Iron Age of Vojvodina. In both sits "new" glume wheat could have been identified. There is no evidence of increase of spelt, or bread wheat during Early Iron Age at Gradina na Bosutu.

Stillfried an der March, eastern Austria, Late Bronze Age, Urnenfelder Kultur (819–1031 cal. B.C.)

Stillfried (Fig. 1) is located on the so called "amber road", not far from its crossing with the Danube trade route. The dominant cereals in the settlement were spelt wheat, broomcorn millet), einkorn and barley, while emmer and bread wheat occurred in archaeobotanical record only in minor quantities. Pulses were represented by broad bean, pea and lentil; oil seeds by *Papaver somniferum* L. (opium poppy) and gold-of-pleasure. Beyond those familiar components of a central European Bronze Age crop assemblage, the Stillfried spectrum shows certain connection to Mediterranean region due to the occurrence of bitter vetch and cultivated grape. A remarkable feature in the material at Stillfreid was the abundance of foxtail millet (Kohler-Schneider 2001; 2003).

CONCLUSION

To conclude, the comparison of the material from Hissar with other "contemporary" sites at the at the Axios/Vardar–Morava–Danube–River's trade route shows that spectrum of cereals (together with millets), pulses, oil plants do not differ from other Late Bronze Age sites. Especially the finds of *Lallemantia*, safflower and bitter vetch in the samples point out the Bronze Age character of the agriculture at Hissar. Also, viticulture and orcharding (pistachio, walnut) better fits into the picture of the luxuriant agriculture of early phases of the Late Bronze Age. The number of finds, as well high frequencies of broomcorn millet, accompanied by seeds of its distinguished weed flora throughout all Brnjica phases, indicate that we are dealing with late periods of Bronze Age. This confirms also the status and the importance of gold-of-pleasure in the Hissar's plant economy. A further evidence of the Late Bronze Age agriculture gives the high status of spelt wheat. On the other hand, our finds at Hissar, with some important exceptions (viticulture and fruit tree growing), are reflected in the material from Early Iron Age Gradina na Bosutu.

NOTES

[1] The word "hissar" derives from Turkish and means "fortress".

[2] We would like to apologise for the mistake made in previous manusripts (Medović et al. 2010; 2011) in which Brnjica II a phase was dated to 12th cent B.C.

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Table 1. (Next Page)
Fortified hill fort settlement Hissar in Leskovac, south Serbia (excavations 1999–2005). Macrofossil plant remains; charred and mineralized seeds and one-seeded fruits.

Tabela 1. (Sledeća strana)
Utvrđeno gradinsko naselje Hisar u Leskovcu, južna Srbija (arheološka istraživanja 1999–2005). Makrofosilni ostaci biljaka, ugljenisana i mineralizovana semena i koštice.

Period	Middle Danubian Bronze Age / Iron Age I in the Morava Valley							Early Iron Age	Roman	
Phase	Brnjica Cultural Group I a		Brnjica Cultural Group I b		Brnjica Cultural Group II a		Brnjica Cultural Group II b			Sum
Century B.C.	14th		13th		11th		10th	5th		
Number of Samples	26		14		21		1	1	1	64
Charred plant items	Quantity (No.)	Freq. (%)	Quantity (No.)	Freq. (%)	Quantity (No.)	Freq. (%)	Quantity (No.)	Quantity (No.)	Quantity (No.)	
Cereals										
Triticum aestivum s.l.	2	7,69	209	28,57	14	9,52	2			227
cf. *T. aestivum* s.l.	14	7,69	9	21,43	10	28,57				33
T. aestivum s.l., rachis internodes			2	14,29	1	4,76				3
Triticum dicoccon	30	30,77	95	57,14	99	33,33				224
cf. *T. dicoccon*	1	3,85	6	21,43	4	9,52				11
T. dicoccon, spikelet forks	3	7,69	13	42,86	13	14,29				29
Triticum monococcum	45	38,46	156	78,57	119	61,90	2	1		323
T. monococcum, spikelet forks	16	34,62	12	42,86	15	33,33	1	1		45
Hordeum vulgare vulgare	198	88,46	206	100,00	443	90,48	3	8		858
Hordeum, rachis internodes					1	4,76				1
Hordeum vulgare nudum					1	4,76				1
Triticum spelta	25	11,54	235	42,86	50	23,81	6			316
cf. *T. spelta*			3	14,29	1	4,76				4
T. spelta, spikelet forks	4	7,69	20	35,71	3	9,52				27
Triticum			23	14,29	4	14,29				27
Triticum, spikelet forks			2	7,14	3	9,52				5
Cerealia indeterminata	81	80,77	166	78,57	219	76,19	6	2		474
Millets										
Panicum miliaceum	1443	84,62	766	100,00	1071	90,48	24		1	3305
Setaria italica	1	3,85	3	7,14	7	14,29				11
Pulses										
Pisum sativum	1	3,85			2653	9,52				2654
cf. *P. sativum*	2	7,69								2
Vicia faba	90	26,92	11	21,43	36	42,86				137
cf. *V. faba*	1	3,85	1	7,14	1	4,76				3
Lens culinaris	26	38,46	5	28,57	45	57,14				76
Vicia ervilia	38	26,92	28	50,00	3054	33,33				3120
cf. *V. ervilia*	1	3,85			1	4,76				2
Leguminosae sativae indeterminatae	7	15,38	3	21,43	12	38,10	1			23
Oil/Fibre plants										
Camelina sativa	47	57,69	16	50,00	49	42,86	7			119
C. sativa, pod			1	7,14	3	4,76				4
Linum usitatissimum			2	14,29	24	14,29	17			43
cf. *L. usitatissimum*					2	4,76				2
Lallemantia iberica					21	9,52	4			25
cf. *L. iberica*					1	4,76				1
Potential Medicinal plants										
Verbena officinalis	1	3,85			1	4,76				2
V. officinalis, fruit			4	7,14						4
Potential Vegetables/Condiments										
Anethum-type					1	4,76				1
Dye plants										
cf. *Carthamus tinctorius*					1	4,76				1
Fruits										
Vitis vinifera	11	3,85	1	7,14	3	4,76				15
Juglans regia					1	4,76				1
cf. *J. regia*									1	1
Prunus spinosa	2	7,69			1	4,76				3
Prunus non *spinosa*	5	19,23			4	14,29				9
Rosa	1	3,85								1
Cornus mas			5	14,29	3	14,29				8
Fragaria vesca	4	7,69	2	14,29	1	4,76				7
Sambucus ebulus	4	11,54	1	7,14	17	14,29				22
Sambucus nigra					1	4,76				1
Sambucus					1	4,76				1
Rubus fruticosus			1	7,14	1	4,76				2
Rubus					1	4,76				1
Weeds/Ruderals										
Agrostemma githago	2	3,85								2
cf. *Amaranthus*			1	7,14						1
Asperula arvenisis					2	4,76				2
cf. *Asperula arvensis*	1	3,85								1
Bromus arvensis			1	7,14	1	4,76				2
Bromus secalinus			4	14,29	3	9,52				7
Bromus sterilis-type			1	7,14	4	9,52				5

Carex, sect. Eucarex					1	4,76				1
Chenopodium album	16	34,62	11	35,71	58	57,14	1			86
Chenopodium hybridum					1	4,76				1
Convolvulus arvensis					16	4,76				16
cf. *Consolida regalis*	1	3,85								1
Digitaria sanguinalis	8	23,08	8	50,00	5	23,81				21
Echinochloa crus-galli	6	19,23	8	50,00	14	28,57				28
Euphorbia helioscopia					1	4,76				1
Fallopia convolvulus	4	11,54	4	28,57	34	57,14				42
Galium aparine	5	11,54			7	28,57				12
Galium spurium	6	19,23	14	35,71	9	28,57				29
Galium					1	4,76				1
Lactuca	1	3,85			2	9,52				3
Lolium temulentum					2	9,52				2
Lolium	1	3,85								1
Mediocago					1	4,76				1
Neslia paniculata					1	4,76				1
Plantago lanceolata	1	3,85			1	4,76				2
Polycnemum			1	7,14						1
Polygonum aviculare	1	3,85	2	14,29			1			4
cf. *P. aviculare*					1	4,76				1
Polygonum persicaria-type			1	7,14	2	9,52				3
Portulaca oleracea	3	7,69	2	14,29	1	4,76				6
Ranunculus					2	4,76				2
Rumex crispus-type			1	7,14	3	9,52				4
Rumex acetosella					1	4,76				1
weedy *Secale*	3	7,69			28	9,52				31
cf. weedy *Secale*					2	9,52				2
weedy *Secale*, rachis internodes					1	4,76				1
cf. *Setaria glauca*					1	4,76				1
Setaria viridis	11	19,23	10	28,57	7	23,81				28
Silene-type	1	3,85								1
Solanum nigrum	9	11,54	1	7,14	2	9,52				12
Teucrium chamaedrys	1	3,85								1
Trifolium-type	2	7,69			2	9,52				4
Vicia-type	7	15,38	7	7,14	7	14,29				21
Plant families										
Asteraceae	2	3,85								2
Fabaceae					1	4,76				1
Poaceae	3	11,54	1	7,14	6	28,57				10
Polygonaceae					1	4,76				1
Lamiaceae			2	7,14	2	9,52				4
Other finds										
Insecta, larva					1	4,76				1
Sum	2215	100	2087	100	8252	100	75	12	2	12643

Thousand grain weight (g)										
Triticum spelta			12,76							12,76
Pisum sativum					24,4					24,4
Panicum miliaceum	1,92				1,73					3,65
Vicia ervilia					11,74					11,74

Charred wood										
Fraxinus			2	7,14						2
cf. *Fraxinus*			1	7,14						1
Ulmus			2	14,29	3	4,76				5
Acer	3	7,69			2	9,52				5
Quercus	3	7,69	12	21,43	13	23,81			4	32
Maloidae					1	4,76				1
(*Abies, Juniperus, Taxus*)	1	3,85								1
Dicotyled. wood, diffuse porous wood			2	14,29						2
Sum	7	100	19	100	19	100			4	49

Uncharred (mineralized) plant items										
Millets										
Panicum miliaceum					1	4,76				1
Fruits										
Pistacia vera	4	3,85								4
Sambucus ebulus	47	65,38	15	42,86	61	66,67	1	1		125
Sambucus nigra					4	4,76				4
Rubus fruticosus			2	14,29	1	4,76				3
Vitis vinifera					1	4,76				1
Potential Medicinal plants										
Malva					1	4,76				1

Weeds/Ruderals										
Convolvulus arvensis	1	3,85								1
Chenopodium album	3	3,85								3
Echinochloa crus-galli	1	3,85								1
Fumaria	1	3,85								1
Lamium					2	4,76				2
Sum	57	100	17	100	71	100	1	1		147
Uncharred plant items (recent?)										
Neslia paniculata									234	234
Sum									234	

Aleksandar Medović

KASNOBRONZANODOBNA BILJNA PRIVREDA NA RANOGVOZDENODOBNOM GRADINSKOM NASELJU HISAR?

Ovaj rad opisuje rezultate arheobotaničkih istraživanja utvrđenog naselja Hisar u Leskovcu u južnoj Srbiji – u slojevima brnjičke kulturne grupe, iz prelaznog perioda iz kasnog bronzanog doba u rano gvozdeno doba, ranog gvozdenog doba i rimskog perioda. Prirodnu vegetaciju naselja Hisar čine tople i svelte hrastove šume, kao i plavne šume u dolini reke Veternice. U svim fazama brnjičke kulturne grupe su ječam, pšenica i proso predstavljali glavne ratarske useve. Zrnaste mahunarke, pre svih grašak i urov, ali i bob i sočivo, igrale su istaknutu ulogu u ishrani praistorijskih stanovnika na Hisaru. Glavni izvor biljnog ulja potiče od useva lanika, dok se lan i *Lallemantia* takođe uzgajaju kao zasebni usevi. Osim nekoliko izuzetaka, voće identifikovano u arheobotaničkom materijalu sa Hisara ukazuje na to da su stanovnici naselja plodove sakupljali u prirodi. Među izuzetke se ubrajaju nalazi pistacija – u starijoj fazi, i orah – u mlađoj fazi brnjičke kulture. Nalazi vinove loze ukazuju na to da je na području Hisara vinogradarstvo verovatno bilo zastupljeno tokom celog perioda brnjičke kulture. Jedan nalaz šafranike (cf. *Carthamus tinctorius* L.) ukazuje na to da je ova biljka uzgajana i korišćena kao biljni bojadiser. Korovska i ruderalna vegetacija zastupljena je u pretežno ugljenisanom biljnom materijalu sa velikim brojem taksona, ali sa malim brojem pojedinačnih nalaza.