EVI MARGARITIS*

STORAGE, GATHERING AND *LATHYRISM*? AT DISPILIO

This paper[1] will focus on the plant remains retrieved from archaeological layers of the first occupation phase of the settlement of Dispilio, which is dated in the Middle Neolithic period (5459-5082 BC, Fakorellis & Maniatis 2002), although the site continues to be in use not only in the Late Neolithic and through the Bronze Age but also in the much later Classical period. According to data deriving from both excavation and soil micromorphological analysis it is evident that during the middle Neolithic the houses were located on a wooden platform, which was built near and above the water (Karkanas 2002). The material discussed in this paper derives from the recently excavated east sector of the excavation in the trenches represented in Fig. 1. This early phase (Phase C in the site phasing) is represented in depths between 1.60-2.20m. The samples discussed here originate from layers 9 and 10 at depths from 1.85m to 2.17m. The debris of these occupation layers consists of building material, complete waterlogged wooden posts *in situ*, a wealth of archaeological finds and large quantities of organic material such as fish and animal bones. The quantity of burnt material in the form not only of charcoal but also of charred seeds is

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1 I would like to thank Prof. Chourmouziadis for our cooperation all these years and Dr. Marina Sofronidou for fruitful conversations. However, I am more than surprised with Prof. Chourmouziadis views, expressed at *Anaskamma* 1, referring to the training and further education of, mostly, the environmental specialists of his team. After being one of the first academics in Greece incorporating environmental studies at the interpretation of the material culture at Dispilio, it is very difficult for me to accept or even imagine that he really thinks that way. I am confident, however, that all our discussions on site are much more important than the lines written in that paper and I am going to keep that in my mind when I finalise my study of the plant remains. Part of the study of the plant remains from Dispilio was funded by the Wiener Laboratory, American School of Classical Studies at Athens and the Institute for Aegean Prehistory (INSTAP). I also want to thank Theano Dova, Giorgo Koutsobo, Natasha Pouliou, Taso Georgota and Katerina Rangou, who assisted with the flotation and sorting. The text is written in English in order to initiate dialogue and set the results within the context of other lake settlements in Central and Northern Europe.

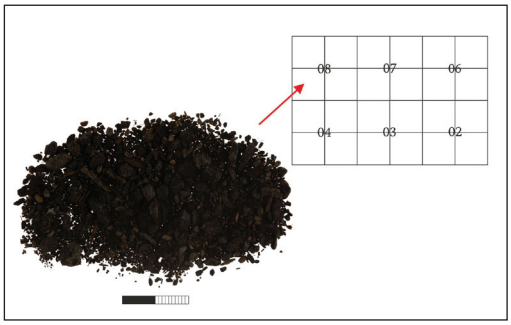

Fig. 1: Large concentration of emmer wheat.

Fig. 2: Part of an emmer ear.

impressive, suggesting a destruction episode by fire (see below). Sampling at Dispilio was intensive and the soil samples were processed by water flotation using a single 300μ sieve[2]. Eighty five samples have been taken from these layers, but the discussion will be based on about 40 samples each of which contained on average more than 50 identifiable plant remains. In the meantime, more samples have been collected and processed but not yet studied from the area under study, so results are preliminary, although the main conclusions are unlikely to alter significantly.

The east sector of the site is the only area so far excavated to this depth. Most of the year the archaeological levels are submerged under the water of the lake, and it is possible to excavate only when the water levels are low or with the use of pumps, which is no easy task. However, this situation offers a unique opportunity for analysis as we recover not only charred plant remains, which is the usual mode of preservation in Greek excavations, but also waterlogged materials. In this state, complete wooden posts and other wooden parts of the houses have been preserved and analysed (Chatzitoulousis 2008), representing a unique find in Greek archaeology. It is important to discuss how the material in these layers came to be preserved. The organic material, both bones and plant remains, were retrieved in a charred, highly compact horizon which consisted of a combination of burnt material and unidentifiable, miniscule, waterlogged wood fragments, which gave the impression during study of resulting from decomposition of the waterlogged posts. Waterlogged seeds were only found in trenches Δ8β, Δ8γ and Δ7γ.

As mentioned, both macroscopic inspection (during the excavation) and microscopic analysis (by soil micromorphology, Karkanas 2002), suggested that this early phase of the site was destroyed by fire. Phoca-Cosmetatou (2008), however, based on the analysis of the animal bones, confirms that the bones retrieved from the early occupation layers were not actually burned. This apparent contradiction might be explained by a destruction episode which was not too long or involved temperatures too low for the bones to be affected. The charred plant material suggests that the fire would not have exceeded 450°C nor have lasted for a very long time as otherwise the plant remains would have been turned to ash and would be per-

[2] A single sieve only was used, in contrast with other achaeobotanical techniques still favouring two sieves of different mesh size, following the practical routines developed by the Pitt-Rivers Laboratory team at Cambridge. The material was studied at the Wiener Laboratory during the course of the offered Environmental Fellowship and the Fitch Laboratory, British School at Athens.

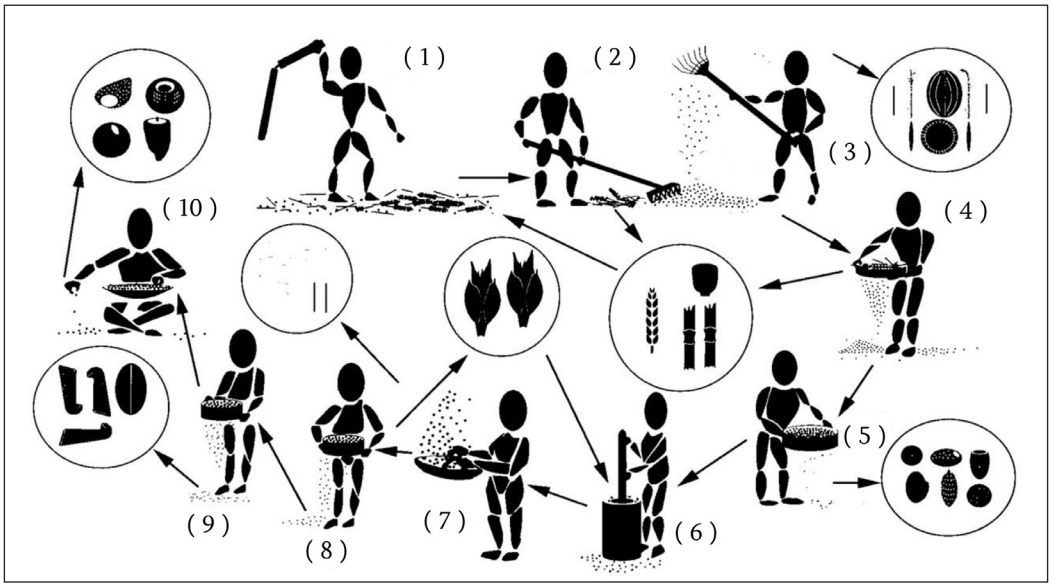

Fig. 3: Crop processing activities, after Stevens 2003

manently lost (for temperatures and charring conditions of plant remains see Boardman & Jones 1990). Collapse of the platforms into the water would have extinguished the fire, allowing also some seed remains to be preserved in waterlogged conditions (see below).

The bone assemblage also suggested that the material was found *in situ* based on number of elements found in articulation (Phoca-Cosmetatou 2008). Therefore, the layers in question have suffered minimal post depositional destruction.

Three main topics will be discussed in this paper:

- The storage practice of glume wheats at Dispilio and the significance of their spatial distribution;
- The storage of grass pea, *Lathyrus sativus* and
- The presence of high quantities of waterlogged blackberry seeds (*Rubus fruticosus)*

THE STORAGE OF GLUME WHEATS

The plant remains retrieved from trenches Δ8δ and Δ8γ are of great interest as they consist of three two-seeded emmer ears (Fig. 2), large numbers of complete spikelets, spikelet forks and glume bases in a ratio that indicates the release of the spikelets from the grains during carbonisation and post deposition. Some of the material in trench Δ8δ had dark red stains on its surface, possibly due to exposure to waterlogged conditions after charring and deposition. The same staining pattern has been also observed in the surface of the animal bones (Phoca-Cosmetatou 2008).

Ethnographic studies have been a valuable resource in the reconstruction of agricultural production processes as well as in the understanding of taphonomical aspects, assisting in the interpretation of archaeobotanical samples (Hillman 1981, 1984). These studies suggest that, as emmer is a hulled wheat and the grains are enclosed in a tough glume, this requires much more work to thresh and further process than naked wheats. After threshing, when the cereal ear actually breaks up into spikelets, in order to remove the chaff and produce a clean product specific steps must be followed such as raking, winnowing, coarse and light sieving, pounding and hand sorting, all necessary if the cereal is meant for human consump-

tion (Stevens 2003, Fig. 3). The find of a few parts of compete ears at Dispilio shows inefficient threshing of emmer wheat, which is normal when large quantities are processed. Storing complete spikelets indicates that the removal of the chaff and some of the weed seeds would have been done progressively during the year and hence the agricultural labour would have been spread. In addition, storage in spikelets protects the seed from fungal attack, especially in wet areas such as Dispilio. In the present case, the processing sequence has stopped before the pounding of the spikelets to remove the chaff but after sieving for the removal of some of the weed seeds, as indicated by a lack of weed seeds, apart from a very low presence of *Lolium temulentum* (darnel) (Hillman 1984). There is also the possibility that we are dealing with fields with low percentage of weed development. The presence of darnel indicates that the stored product has not been through hand sorting for the removal of weed seeds of a similar size to cereal grains, or just that the grain bulk was not thoroughly cleaned. Complete spikelets have been found at Mandalo and Dikili Tash (Valamoti 2004) and inferred at other sites on the basis of the presence of de-husking by products (Jones 1983; Valamoti 1992) but the Dispilio find is the only one of complete ears recovered from Neolithic Greece.

The grain-rich concentrations of emmer at Dispilio indicate a stored product[3]. Storage and processing of a crop suggest its use for human consumption (Valamoti 2005). In addition, it is possible the emmer ears and spikelets could have been kept in this form for sowing in the next season, kept in their glumes for better protection.

By contrast, in trenches Δ4β and Δ4δ einkorn grains are the only find, while in Δ4γ a concentration of both emmer and einkorn grains, in combination with lentils, has been located, possibly as cooking refuse. Further east, in trenches Δ7γ Δ2δ, Δ3α, Δ6δ, Δ6β, Δ7α, and Δ7β the situation is different again and the vast majority of the plant remains are represented by spikelet forks and glume bases of mostly einkorn with some emmer wheat[4] while there is an almost complete lack or very low representation of cereal grains or weed seeds. The large numbers of chaff of einkorn and emmer wheat suggests the presence of the by-products of fine sieving and the storage of the grain as spikelets. These samples, therefore, correspond to a step further in the crop processing sequence where the wheats have been de-husked and further cleaned (Hillman 1981, 1984; Jones 1987; Chocarro 1999), representing either refuse or deliberate storage for fodder, building material or fuel. Valamoti and Charles (2005) have put forward an alternative suggestion for chaff-rich samples. They have suggested that they can represent the remains of wheat spikelets or crop-processing by products, fed to animals and preserved as the remnant of dung burned for fuel. This scenario has been suggested for sites in Neolithic Greece such as Makriyalos and Makri, where chaff-rich samples have been discovered in association with fig seeds. It is possible for grain in the form of whole spikelets to be fed to animals in cases of need such as lactation or bad weather conditions that would make grazing difficult or impossible (Halstead 1999).

This possibility perhaps should not be dismissed for Dispilio, although it should be noted that the chaff-rich samples are not connected with any other plant remains, such as figs for example or any weed seeds. Dung would have been an important source for fuel in cooking, although wood resources were

[3] Very large quantities of emmer wheat have been recovered from the Neolithic site of Avgi, excavated by Dr. G. Stratouli, situated only 10km southwest of Lake Orestis, where Dispilio is located. At Avgi, emmer was stored in a pit as clean product although its by products were found throughout the site (Margaritis under study)

[4] Samples from these trenches have been studied by the author but also by the late M. Mangafa (2002).

not scarce around Dispilio (Ntinou 2010). Dung also produces a lot of smoke (Barnard & Kristoferson 1985) but its use or not depends on where the cooking facilities/areas are located, namely inside or outside the houses. The presence of dung in the site is testified by the phytolith study (Tsartsidou 2010).

As mentioned, einkorn and emmer have been found together mostly as chaff concentrations in various trenches. This can indicate that either they were grown in the same field or they were disposed of in the same areas as a result of their common processing. Emmer is more productive than einkorn (Marinova 2009) while einkorn is considered very resistant against rain damage. The yield of einkorn is almost half of that of emmer (van der Veen & Palmer 1997). In addition, the lower tillage rate of einkorn allows more weeds to grow in the fields in relation to emmer (Kreuz *et al*. 2005). Einkorn is also more winter hardy than emmer while it is not considered to be best quality wheat for bread but is used for porridge or as cooked grain, as well as animal fodder (Zohary & Hopf 2000). Both species have their advantages but einkorn seems to prevail over emmer in Neolithic northern Greece as it is the predominant crop in most of the analysed sites of the period (Valamoti 2004). At Dispilio, as already stated, einkorn is present in many samples in the form of chaff, in the majority of the cases together with emmer, but also as a single grain concentration (see above). Emmer has also found as sole concentrations and possibly both wheats could have been also grown in separate fields.

THE GRASS PEA CONCENTRATION

The finds of grass pea in trenches Δ4γ and Δ4δ are of importance as they represent pure concentrations of a crop other than glume wheats in the horizons under study. It is also important because the consumption and use of grass pea is not as straight forward as other crops.

Grass pea is thought to derive from the wild progenitor chickling-vetch *Lathyrus cicera* L., which is indigenous to Greece, occurring both as fodder crop but also as weed species (Podimatas 1990). Grass pea is well known for its tolerance to harsh environmental conditions and that is why today it is cultivated in Ethiopia and in the Indian sub-continent (Hanbury *et al.* 2000). Concentrations indicative of storage have been found at other sites in Northern Greece such as Mandalo and Servia (Valamoti & Jones 2003), Arkadikos and Dikili Tash (Valamoti 2004), as well as Geraki in Laconia (Cappers & Mulder 2002); lesser quantities have been found in excavations all over Greece from prehistory onwards (Hansen 2000; Margaritis 2006). It is also found in the prehistoric Balkans such as in southern Bulgaria but is lacking from Serbia and Romania (Marinova 2009). Grass pea, as with other pulses like bitter vetch for example, is toxic; an acid is accumulated during the ripening of the seeds resulting in the seeds being toxic for animals and humans. Therefore it is mainly used as fodder, although in recent times it has also been used as the food by the poor or in cases of famine. The degree of the acid in the seeds depends on both environmental and genetic circumstances, and toxicity rises under conditions of drought (Butler *et al*. 1999). According to Pliny (HN 27.95) and modern observations if the seeds are soaked in the water, baking, roasting, boiling help in their detoxification (Cappers and Mulder 2002). Under certain conditions, eating large amounts of grass pea with little or no other variety in the diet can result in a nervous paralysis of the lower limbs in humans and some animals, *Lathyrism*, known from Second World War Europe and Greece. The condition, which seems to affect young male adults, is reversible to some extent only if caught early (Flint-Hamilton 1999). At Dispilio, these two concentrations represent the only case of grass pea being the sole component of a sample, while during the later peri-

ods of the site it occurs together with other pulses such as lentil and bitter vetch, as a minor component and in a limited number of samples. It was most probably used as animal fodder although its use for human consumption is certainly a possibility during the Neolithic (Valamoti 2004). Valamoti *et al*. (2011) have suggested that it is possible to discriminate in larger samples of grass pea between those processed for human consumption and those intended for fodder; such attempt has not been made for the assemblage of Dispilio and will be the focus of a future study.

GATHERING OF *RUBUS FRUTICOSUS* (BLACKBERRIES)

Living close to any source of water has been and still is very advantageous, impacting not only the practicalities of their everyday life, represented in the material culture (boat shape pottery, fishing implements), but also the thoughts, feelings and ideology of the inhabitants of such a settlement.

Although its resources were not quite 'domesticated' in the sense applied to the agricultural resources exploited at the site, the intensive exploitation of the lake is well attested on the basis of the fish bones in all the phases of the site, clearly showing a great expertise with the more ''wild'' fish resources (Theodoropoulou 2008).

Familiarity with the lake and its surrounding ''wild'' environment can also be evident in the archaeobotanical record. The adjacent environment would provide different vegetation zones creating a perfect setting for utilization and management by the Neolithic population, especially during the early occupation phase (Ntinou 2010). They could make the best out of different natural resources and combine gathering with agriculture**.** As suggested for Neolithic Italy**,** gathering could have been a gendered task in regular excursions or could be a more casual phenomenon of just gathering whatever was useful on the way back of hunting trips (Robb 2007).

People could gather wood for fuel and construction, as suggested by the charcoal analysis (Ntinou 2010), as well as herbs, nuts and fruits which are rich in vitamins. They would also acquire other raw materials from plants for their use as spices, medicines, for dying or for the production of fibres and clothing (Jacomet 2009). This kind of exploration of the surrounding of lake settlements has been attributed to similar sites in Central Europe and has been described as ''low level food production'' in comparison with indigenous populations of North America (Robb 2007). These communities exploited an exceedingly wide range of resources available and adapted very well to the prevailing environmental settings. However, the vast majority of the potential resources have a very poor chance in surviving the archaeobotanical record. Gathering of herbs, fruits and nuts is not as well attested as the information for the cultivated plants such as cereals and pulses. It is unusual for them to be preserved by charring, as usually they are eaten fresh and only when stored, especially dried, have they a chance of surviving in large quantities during a fire destruction. The preservation of some plant remains by waterlogging at Dispilio offers some insights normally lacking at other sites. It should be also noted, however, that given the location of the settlement by the lake, the survival of the archaeobotanical material in a waterlogged condition is not as great as it is the case at the lake settlements of Central and Northern Europe.

Trench Δ8β has revealed thousands of waterlogged blackberry seeds and hazelnut fragments as a minute component. Trenches Δ8γ and Δ7γ have also revealed waterlogged blackberries in co-occurrence with einkorn and emmer chaff, which however are charred. The presence of hazelnut trees and species of the *Rosaceae* family in the surrounding environment is attested by charcoal analysis (Ntinou 2010). Blackberries have been found

previously at Dispilio in all phases studied (Mangafa 2002) but as an uncommon find; now the waterlogged state allows large numbers of the fruit seeds to be preserved. Blackberries are commonly found in Greek excavations from prehistory (Valamoti 2004 for a review of the evidence) to the Classical period and Hellenistic period (Margaritis 2006) but, in most cases, in low quantities. Blackberries are edible by both humans and animals and in some cases, such as Mandalo (Valamoti & Jones 2003) have been connected with consumption by animals through their recovery as part of a dung assemblage.

In the case of Dispilio, it is of interest to discuss the fact that *Rubus* seeds and hazelnut nut fragments are the only waterlogged plant material found in the early occupation phase and question why other plant remains have not survived. I suggest that the preservation pathway of the blackberries and the hazelnut is the result of their robust outer coat, which slows down deterioration and can survive fluctuating water levels. The site or this part of the site where the material comes from could never have been completely buried under the water for a very long period of time. The fluctuations in the water level from wetter to drier or even dry conditions would not have necessarily been the best situation for high levels of preservation. It is only the more tough plant remains that could have survived this variation not only during deposition but also at a post-depositional stage. The untransformed seeds could be modern and intrusive but most likely represent archaeological survival, as demonstrated by radiocarbon dating of untransformed elder seeds by Monckton (1999) in another case study.

The concentration of berries in trench Δ8β could represent a stored product of fruits, of which the more sensitive flesh and juicy mass of the berries would possibly not survive the depositional changes, leaving only the more robust seeds behind.

On the other hand, if the seeds were deposited as part of animal dung remains, other plant components would potentially be expected, given the waterlogging conditions and the chance of a better preservation. It is, however, again probable that other plant remains could have been originally part of a dung assemblage but with the fluctuations of the water level during the millennia did not survive.

It is also possible that the concentration of blackberries represent human excrement which ended up in waste locations such as under or next to the houses. With the collapse of the platforms during destruction they would have been in a sealed context and thus be preserved.

DISCUSSION

The early habitation phase at Dispilio has, thus far, the highest potential for archaeobotanical analysis due to the larger quantities of plant remains when compared with the later phases (author's observation). The plant remains will provide information focusing not only on diet and subsistence, but also the patterning of activities and refuse.

The samples can be distinguished between those indicative of storage or cooking refuse and those indicative of crop processing activities (e.g. chaff and weeds). The connection of refuse and storage with specific areas in the site can provide insights towards the relationship of society and refuse disposal, the relationship between refuse and space (Valamoti 2005). The location of storage inside or outside the household or the choice of communal storage and its management can also be related to the social and economic organisation of the site as a whole (Halstead 1999).

The presence of *Lathyrus* could suggest its use both as animal fodder and for human consumption; in the latter case it could suggest a period of distress, which is not suggested by the rest of the archaeobotanical data (e.g. size of seeds that would propose hard agricultural

conditions) or the variety of crops found. We should also consider, however, the possibility that prehistoric people have not necessarily been highly aware the ''bad qualities'' of grass pea, especially since humans are affected only if they consume high quantities and their diet consists mainly of this legume. As the ethnographic record from Ethiopia has shown grass pea toxicity can be reduced with various methods (Butler *et al.* 1999) and the legume can be consumed without problems for human health. It is, therefore, possible that at Dispilio grass pea represented an important component of the diet, an attractive source of nourishment, resistant to many pests, including those of storage (Mahler-Slasky & Kislev 2010).

Although to be expected, the significant concentrations of *Rubus* suggest an intensive exploitation of the natural environment, which, although previously suggested for the Neolithic, has never been proven by evidence for fruits and nuts, due to adverse preservation conditions.

Charcoal evidence has suggested that the surrounding vegetation of the site included open areas with species like *Prunus*, *Roseceae*, *Juniperus* and *Pistacia*, which could be associated with the maintenance of small fields in the periphery of the village (Ntinou 2010). This is in accordance with the suggestion of an ''intensive'' model of cultivation at Dispilio (Mangafa 2002). In order to further validate this suggestion, however, it would be best to retrieve more weed seeds from the assemblage, indicative of this type of cultivation and the location of the fields (Jones 1992), data thus far lacking at least for the early habitation phase. In this line of thought it is, however, important to consider that there is no major impact on woodland vegetation further away from the site (Ntinou 2010) for the creation of new and possibly bigger fields for cultivation, suggesting a small scale agricultural regime at the site.

Dispilio should also be viewed in a wider site-type context. The large body of archaeobotanical data from Neolithic sites in northern Greece has allowed comparisons between sites and their plant remains (Valamoti 2004). Tell and extended sites have been compared and it has been tentatively suggested that there is a connection between grain rich deposits at the former and chaff-rich material at the latter. Dispilio does not belong to the usual site types of the Neolithic period in Northern Greece, and not only due to its location; both types of archaeobotanical material (grain and chaff rich) are present in the same horizons and in different contexts of the site, but certainly more samples should be studied before trying to draw any conclusions, in order to make valuable comparisons with the other Neolithic sites.

Wheats and legumes are very important not only in that they actually form the basis of the diet of the Neolithic people and it is important to connect the ''natural'' with the 'cultural'', their processing for edibility and their preparation into actual food takes up a lot of energy and time and entails the creation of suitable implements connected with them, as suggested by widely found objects: cooking installations, blades, sickles, mortars, large storage vessels and a large variety of cooking pots, disposal areas, indoor and outdoor activities. It is essential to connect all the information available from the archaeological material[5], the plant remains and the other organic material, such as the remains of fish processing for example in order to understand the use of space and reconstruct human activities at Dispilio. A fully contextualised understanding of the processing, production and distribution of food will not only shed light on the economic and social organisation of the site but it will also reveal significant variation from other Neolithic sites in Northern Greece.

[5] This task cannot be contemplated at this point as different specialist studies are at different stages of completion.

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Περίληψη

Αποθήκευση, καρποσυλλογή και καλλιέργεια λαθουριού στο Δισπηλιό
Εύη Μαργαρίτη

Η μελέτη των αρχαιοβοτανικών δεδομένων για την παρούσα μελέτη επικεντρώθηκε σε στρώματα που χρονολογούνται στη Μέση Νεολιθική περίοδο. Στον ανατολικό τομέα της ανασκαφής έχουν βρεθεί μεγάλες ποσότητες δίκοκκου σιταριού, αποθηκευμένου με τα λέπυρα, έναν τρόπο αποθήκευσης που έχει προταθεί και για άλλες θέσεις, αλλά η ανεύρεση ολόκληρων σταχυδίων δεν αποτελεί κοινό εύρημα στον ελλαδικό χώρο. Εκτός από το σιτάρι, σπόροι λαθουριού βρέθηκαν επίσης σε μεγάλες ποσότητες, προσθέτωντας δεδομένα και προβληματισμούς για τη χρήση του φυτού.

Όλα τα φυτικά κατάλοιπα του Δισπηλιού έχουν διατηρηθεί απανθρακωμένα εκτός από τη μεγάλη συγκέντρωση σπόρων βατόμουρου που σώθηκαν λόγω των αναερόβιων συνθηκών που δημιούργησε η επικάλυψη του οικισμού από το νερό της λίμνης. Τα αρχαιοβοτανικά δεδομένα υποδηλώνουν εντατικό τρόπο καλλιέργειας κοντά στον οικισμό και συμφωνούν με τις πληροφορίες που προέρχονται από την ανάλυση του ξυλάνθρακα και των φυτολίθων.