The Grapevine Culture in Georgia on Basis of Palaeobotanical Data
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With this we want to present the first of the series of books – ‘Georgia - Homeland of Wine’ – created under the Project of Mteny Association. The cycle represents the results of compilation of the longstanding and laborious work of Georgian palaeobotanists, folklorists, archaeologists, ethnographers, geographers and other scientists.

Based on the items discovered in the archaeological digs throughout entire Georgia, samples of Georgian folklore, information provided by Georgian historiographs and ethnographical materials, Georgian scientists corroborate the idea that Georgia is the land, where wine takes its origin.

With this cycle of books, we tried to once more demonstrate the historical truth, and we wish Georgia to meritoriously gain the name of the homeland of wine throughout the world.

Maia Khaburzania
The beginning of human civilisations is closely connected to the development of agriculture and the history of cultivated plants. Georgia played a crucial role in this process, being most probably one of the centres of origin of viticulture.

Archaeology is the main tool for discovering the cultural heritage of prehistory. Archaeobotany, the study of plant macroremains such as fruits, seeds and charcoal fragments from archaeological layers, enables the investigation of the history of plant cultivation and development of agriculture. Data collected during archaeobotanical studies can be combined with other sources of information (archaeology, geomorphology, palynology, archaeozoology etc.) for describing paleoeconomical and palaeoecological aspects of past societies. Plant macrofossils as witnesses of past agricultural activities can also be used as material for biomolecular studies, allowing us to understand evolutionary relationships that reflect past migrations of plants, human tribes and ideas.

The importance of archaeobotanical studies is unquestionable. Such research is now performed at many archaeological sites worldwide. Some studies are focused on certain cultivars like vine, wheat, barley, while others look more broadly at diet and agriculture.

These studies of Georgian archaeobotanical materials are important new data for the history of agriculture and cultivated plants.

Dr. Aldona Bieniek
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The history of cultivated plants is strongly connected to human development and economic activities. The development of agricultural economies enabled the formation of the first civilizations. Interest in these issues has increased because of the development of genetics as a tool for examining the origin of species and their phylogenetic links. Recent advances in "DNA fingerprinting" have enabled investigation of the origin of domesticated plants. The progenitors of important crop species, such as einkorn [18] and barley [15], have been identified by DNA molecular analysis.

Alongside botanical-systematic and cytogenetic researches, data on plant remains from archaeological excavations are essential. Such palaeobotanical data provide the sound factual basis for the identification of the origin and introduction of cultivated plants, and evolution of agriculture in ancient civilizations. Besides these, they characterize the relationship between human beings and environment at the various stages of the development of society.

The remarkable number of varieties and forms of cultivated plants which can be observed in Transcaucasia, part of which is Georgia, led many scholars to consider this area as an ancient center of the domestication and diversification of cultivated plants.

Archaeological discoveries in the Middle East confirmed the ideas of N. Vavilov regarding the place of the Near Eastern centre as the earliest centre of cultivated plant origins [5]. Plants domesticated in this region include wheat, barley, some legumes and grapevine. Geographically, Georgia is an indivisible part of Asia Minor and, from this point...
of view, palaeobotanical data from Georgia are highly relevant to studies on the origin of wheat and grapevine.

The hypothesis that the cultivated grapevine takes its origin from wild Vitis sylvestris Gmel species, and, possibly, that domestication processes took place within the different time periods in the Eurasian regions covered by wild grapevine, is widely accepted.

According to the two most accepted hypotheses the grapevine was first domesticated in the Near East region [27;28] or in the Transcaucasian region (22), around the second half of the 4th millennium B.C. Recent genetic studies [16] suggest also secondary centers of vine domestication.

The most reliable information on this is provided by fossilized pips found in various archaeological excavations. The pips, in comparison to other parts of the vine, are better preserved and are characterized by more conservative morphological properties.

According to researchers [12,17], morphologically, wild grape pips significantly differ from the pips of domesticated vine. They are smaller in size, have a rounded and slightly pear-shaped form, with a less developed base (beak). Besides this, the researchers have introduced specific measurements: the ratio between vine seed length and its breadth, or relationship of overall length to the length of the pip. Wild grape index (length/breadth ratio) varies between 1.1 and 1.47, and cultivated grape index—in the range of 1.6-2.5 and above. This is caused by the fact that the pips of cultured vine are longer due to development of their beak.
Pip length is linked to grape grain diameter. As the diameter grows (mainly as a result of artificial selection), the pip length increases. The form and dimensions of the grain allow identification of how early the particular vine breed was cultivated and when it was selected [10].

According to some scholars [23;26] the morphological variability of the pip appears to be linked to the existence of numerous clones, rather than solely to characteristics appearing after cultivation. The methods of Stumer [25] and Mangafa-Kostakis [21] were developed on European material and, until they are confirmed with Near Eastern grape pips, the identification of cultivated Vitis remains problematic and uncertain. [19]

The history of grapevine domestication and origin of viticulture are still not fully solved questions, although there have been many studies. The grape pips found during archaeological excavations in Georgia provide a great deal of data which is in need of systematic presentation. The wide chronological range of the excavated sites – Neolithic, Bronze, Antique, Feudal periods – enables the study of grapevine expansion in the territory of Georgia. The data presented in this paper is thus an important contribution to the viticultural history of the Old World.
Fig. 1. Fossilized pips from Dangreuli Gora
The excavation is located near Village Shulaveri. Dangreuli Gora, together with Shulaveri, Imini and Gadachrili Gora constitute the so called Shulaveri Group and belong to the Neolithic settlements on the Marneuli Plain dated to the VI-IV millennium BC. The settlements of this period are characterized by round architecture. New buildings were constructed directly on the old ruins, which caused settlements to form artificial hills. This is the period when the first copper utensils appear. The viability of these early agricultural settlements was based on a wide assortment of domesticated plants [3].

Among the palaeobotanical materials, along with the cereals, 4 grape pips were discovered. These are not uniform and are represented by round- and pear-shaped seeds. Their length varies between 5.8 and 6.1 mm, breadth – 3.0 and 3.8 mm, beak – 1.3-1.8 mm, ratio equals to 1.61-1.94. The chalaza is rounded and located in the upper segment of the pip. In some cases the chalaza is located at the middle segment. The ventral grooves are deep and almost parallel to each other. Based on the morphological and ampelographical properties, they belong to cultivated variety of grapevine – Vitis vinifera L. (Fig. 1). The materials are discovered in trampled clay soil of the building [1].

To the north of the same building the second group of specimens (4 pips) is found. The length of the pips is within the 5.0-6.0 mm range, breadth – 3.0-3.5 mm, L/B varies between 1.6 and 1.7 mm, and the length of the beak makes 1.0-1.7 mm. Morphologically, the materials are rounded and pear-shaped, the chalaza is closer to the upper segment. Parallel and deep ventral grooves can be observed. In this case, the pips are also characterized by the shape of cultivated vine – Vitis vinifera (Fig. 2).
Fig. 2. Fossilized pips from Dangreuli Gora
Study of the palaeobotanical materials of the other monuments of Shulaveri-Shomutepe culture (Arukhlo, Khramis Didi Gora) revealed highly productive economies. Analyses of the plants showed that farming had a long prehistory here, since the wheat genus is already botanically differentiated and naked forms dominate [24].
Fig. 3. Fossilized pips from Badaani
The Badaani excavation of the Mtkvari-Araks period is located in River Iori valley, Tianeti District, nearby Sioni, at the altitude of 900 m above the sea level. The monument is dated to the third millennium BC [9].

The Mtkvari-Araks culture spread from the second half of IV millennium BC to cover entire South Caucasus. This period is distinguished by the further development of farming, rising of the production, development of copper metallurgy and improvement of living standards of the population [4].

Development of farming in Badaani is also shown by palaeobotanical data. There are pure crops of soft wheat, dika wheat (Triticum carthlicum Nev.) and multi-rowed barley; grapevine was also cultivated [13].

Carbonized vine pips were found in pit 1 of the control section. In total, 4 pips were found, two of them being damaged. Their length was 5.5-5.7 mm, breadth – 3.0, L/B varies within the 1.83-1.90 range, peak length was 1.5 mm. The pips are pear-shaped, with pronounced beak, rounded chalaza located in the depressions and parallel ventral grooves directed towards the base. Morphologically, and according to the dimensions, the pips belong to the Vitis vinifera species (Fig. 3).

The materials are stored in the Interdisciplinary Department of Archaeological Research Centre.
Fig. 4. Fossilized pips from Kvatskhelebi
The Early Bronze Age settlement of Kvatskhelebi is located near Urbnsisi village, and represents a low hill covering 3,500 sq. m. The depth of the cultural layer is 2 m. Along with flint sickles, millstones and antler plough, palaeobotanical materials were also discovered. The existence of wheat and oat seeds evidences quite a high level of farming development. The so called lower layer (C3) contained vine pips, which were found under a small clay cup. The radiocarbon age of the C3 layer is 2800 BC [2].

The pips are missing chalaza; their beak is clearly noticeable, ventral grooves are deep and parallel to each other. Length is 6.5 mm, breadth 4.0 mm, and the length of beak is 2.0 mm. L/B ratio is 1.63.

Based on the mentioned indicators, pips are attributed to cultivated vine species – Vitis vinifera [1] (Fig. 4).

The Kvatskhelebi pips are stored in the Georgian State Museum.
Fig. 5. Fossilized pips from Khizanaant Gora
The Early Bronze Age settlement of Khizanaant Gora is also located near Urbni village, and is dated to the third millennium BC. According to R. Ramishvili, who refers to data provided by S. Nadirashvili, the pips were found in disturbed stratigraphy, but, according to his comments, the error does not exceed the 500-1000 year range. Part of the material has been studied by professors M. and R. Ramishvili, and part by professor N. Negrul [10].

The pips are pear-shaped, the chalaza is clearly noticeable and is located in the upper segments, ventral grooves are parallel and stretch towards the base; the length is 5.5-7.5 mm, breadth – 3.5-4.0 mm, L/B ratio – 1.6-1.9, beak length – 1.0-2.0 mm. Based on these indicators, the pips were attributed to the cultivated vine species – Vitis vinifera (Fig. 5).

Part of the materials is stored in the Georgian State Museum, and part in the Moscow Timiriazev Agricultural Academy.
Fig. 6. Fossilized pips from Khizanaant Gora
The Late Bronze Age excavation of Dighomi village is dated to the XIV-XI centuries BC. It was rich in palaeobotanical materials [13].

In square IIIa of the settlement, in the layer of floor No. 5, fossilized endemic wheat, barley, rye and proso millet seeds, along with the grape pips were found. In total, there were 175 pips, 144 undamaged (Fig. 6).

The average length of pips is 5.75 mm. This indicator is higher than in wild Vitis sylvestris, for which it does not exceed 5 mm. Length variation is significant and lies within the range of 4.2-7.2 mm. The most common length is 6.0 mm (Diagram 1).

Some beak lengths are 0.6-1.2 mm. This range is characteristic for primitive wild species. The greatest number had 1.5-2.0 mm long beaks, typical of cultivated forms (Diagram 2).

The L/B ratio is distributed the following way (Diagram 3): a curve with two peaks - first in 1.6-1.7, second in 1.8-2.0 interval. The index characteristic for the wild species (1.2-1.4) is less than this. This data allows us supposing that the main group of pips belongs to the cultivated species.

If we consider the curves (Diagrams 1, 2 and 3), the species distribution of the pips is uneven: the L/B ratio curve clearly indicates towards existence of two different species - with smaller (length ~5.5 mm, ratio ~1.7) and larger (length ~6.5 mm, ratio ~2.0) pips.

Unevenness of the species distribution can also be detected through morphological properties. We have identified 4 types.
Fig. 7. Distribution of lengths.

Fig. 8. Distribution of pips by the length of the beak.

Fig. 9. Distribution of pips by L/B ratio.
2. The pip is round-shaped, the beak is clearly noticeable, length varies between 1.5 and 2.5 mm. Chalaza is round, located in upper third of the pip. Ventral grooves are deep and parallel. Base of the beak is rectilinear (Fig. 10-I).

II. The pip is oblong-shaped, beak is clearly noticeable, length varies between 1.5 and 2.5 mm. Chalaza is large, located in middle of the pip. Ventral grooves are parallel; base of the beak ends with extension (Fig. 10-II).

III. The pip is pear-shaped, length varies between 1.5 and 2.5 mm, beak – between 0.6-1.2 mm. Chalaza is small, located in center of the pip. Ventral grooves are narrow and make a small angle with each other (Fig. 10-III).

IV. The pip is wide and of rounded shape. The short, but clearly observable beak is 0.8-1.0 mm long and ends up with extension at base. Ventral grooves are wide, and make small acute angle with each other (Fig. 10-IV).

Some pips are also characterized by the intermediary properties. Particularly, they have shorter or longer beaks, or their ventral grooves have various shapes, but all these fall within the range of natural variability.

All the above clearly confirms that grape pips discovered in Dighomi belong to the different species, among which, the species with larger pips prevail. According to the Negrol Correlation Curve (1960), which states the directly proportional relation between pip and grain sizes, the minimal...
Fig. 10. Types of pips discovered in Dighomi
grain size makes 10 mm, average – 165 mm and maximal – 21.5 mm. Diagram 1 clearly shows that medium size pips prevail, and this fact confirms prevalence of wine making varieties at Dighomi settlement, and along with this, table species can also be observed.

The botanical materials are stored in palaeobotanical collection of the Interdisciplinary Department of the Archaeological Research Centre.
Fig. 11. Fossilized pips from Ergeta
The settlement of Argeta (Zugdidi district) is dated to the VII-VI centuries BC [8]. Plant remains were found in segment G7. Grape pips and hazelnuts have been identified. The hazelnut was stored in clay ware, and the pips were found in the cultural layer (three pips in total).

As for the morphological properties, the average length of the pips equals to 4.93 mm, breadth - 3.63 mm, beak length - 0.73 mm, L/B ratio - 1.36. The pips are small; chalaza not clearly noticeable; ventral grooves are superficial, located almost parallel and stretched towards the base. According to the listed characteristics, pips obviously belong to wild grapevine species Vitis sylvestris [13] (Fig. 11).

The botanical materials (vine and hazelnut freely growing in the Kolkheti forests) indicate the existence of the collecting culture.

The materials are stored in the interdisciplinary Department of Archaeological Research Center.
Fig. 12. Types of pips discovered in Gienos
The ancient city of Gienos is located in Ochamchire district and is dated to the VIII-VI centuries BC. Here, plenty of local ceramics were discovered. The settlement is built in typically Colchic manner [7].

The cultural layers of VI century BC contained the following palaeobotanical materials: grape pips, chestnuts and hazelnuts and some representatives of the gourd family (Cucurbitaceae). 18 pips were found. In morphological properties they varied both in beak structure and L/B ratio. According to these parameters both the cultivated and wild species can be identified. The cultivated species (Vitis vinifera) are most common – only four pips belong to wild grapevine (Vitis sylvestris).

Length of the pips varies from 4.0 to 6.5 mm. We have identified as the cultivated species the larger pips with rounded shape, clearly noticeable beak of 1.1-1.5 mm length, deep and parallel ventral grooves. The oval chalaza is located in the middle depression of the pip. (Fig. 12-I-II)

The samples having smaller pips were classified as belonging to the wild species. Their beak is not clearly noticeable. Its length varies between 0.4 and 0.8 mm; ventral grooves are deep and make an angle with each other. Chalaza is rounded and located in the upper third of the pips. (Fig. 12-III-IV)

Therefore, we can assume that, along with the cultivated grapevine, the wild species, which are widely spread over entire western Georgia and in Abkhazian forests, was also harvested. The excavated materials are stored in Sokhumi.
Fig. 13. Pips from Tsikhia Gora
The temple Tsikhia Gora is located in Village Kavtiskhevi, Kaspi district and is dated to the IV-III centuries BC [14]. In room 10 of the temple complex, at the cultural layer of floor level, wheat, barley, proso millet, grape vine, pea and weed seeds were found. There were 3 pips. Their length varied between 4.2 and 5.0 mm, breadth - 2.5 and 3.0 mm, L/B ratio - 1.61-1.68, beak length - 1.0-1.5 mm. They have rounded shape; beak is clearly noticeable; the chalaza is rounded and located in the middle. Ventral grooves are narrow and parallel. Based on the above signs, the pips can be attributed to cultivated Vitis vinifera.

The palaeobotanical materials are stored in the interdisciplinary Department of Archaeological Research Center.
Grape pips found in the Urnisi excavations are dated to the V-VI centuries AD.

There were 5 pips with following average dimensions: length – 6.34 mm, breadth – 3.86 mm, beak length – 1.5 mm, L/B ratio – 1.64. Pear-shaped chalaza is clearly noticeable; ventral grooves are wide and parallel to the base. They belong to cultivated grapevine – Vitis vinifera [1]. In the other case, one pip was discovered at the same place and it is dated to the VII-VIII centuries AD. It has following dimensions: length – 6.5 mm, breadth – 4.1 mm, L/B ratio – 1.6, beak length – 1.4. The pip is rounded; chalaza is located in the middle depression; ventral grooves are wide and parallel. The pip belongs to cultivated Vitis vinifera.

The materials are stored in the Tbilisi S. Janashia State Museum.
Conclusions

As evidenced by the archaeological data, viticulture was widely spread over Georgia in the Neolithic, Bronze, Antique and Medieval ages. This allows us to conclude that this cultivation was continual. The existence of cultivated grapevine in the Neolithic period (VI-IV millennia BC) points towards the primacy of this center of origin, since, according to current data, it is the earliest.

The earliest signs of cultivated grapevine in Middle East were discovered in northern Syria in layers belonging to IV millennium BC [17], and the pips found in Jericho date to 3200 BC and belong to the Early Bronze Age [28].

It should also be mentioned that discovery of table varieties in the Bronze Age (Khizaant Gora, Dighorni) indicates the next stage of civilization.

In spite of the early domestication of the grapevine, the wild grape species in the Kolkheti forests are still important, since their collection continued even in the Antique period.

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