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Heritage wheats of Georgia

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ABSTRACT

Georgia is characterized by remarkable diversity of the domesticated wheat. Five out of the fifteen wheat species found in Georgia, originate from Georgia and are local endemics. These wheat species are *Triticum carthlicum* Nevski, *Triticum macha* Dekapr. & Menabde, *Triticum palaecolchicum* Menabde, *Triticum timopheevii* (Zhuk.) Zhuk., *Triticum zhukovskyi* Menabde et Eritczjan. *T. carthlicum* Nevski is free-threshing, while the other four wheats are hulled. The history of taxonomic identification, some specific morphological traits and the role they of these species in the ancient agriculture of Georgia are reviewed in the present paper. A traditional method of harvesting hulled wheats is also described and illustrated.

Keywords: *Triticum*, Hulled wheat, Free-threshing wheat, Dika, Zanduri, Makha.

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Introduction

Georgian wheat species represent a special, living museum where the whole diversity of the wheat genus is presented. Hence, the Georgian wheat museum is unique, having an importance of a global scale, the analogues of which nowhere to be encountered. Fifteen species (*s.st.*) of wheat: eight free-threshing and seven domesticated ancient (hulled) wheat species are found in Georgia. Five out of 15 species are endemics to Georgia – one of them is free threshing, while four are hulled. None of the regions of the world has such diversity of wheat species and high level of endemism wheat. Free-threshing wheat is *Triticum carthlicum* (in Georgian Dika). Hulled endems are *T. palaecolchicum* (Kolkhuri asli- in Georgian), *T. macha* (Makha), *T. timopheevii* (Chel-

ta zanduri), *T. zhukovskyi* (Zanduri). The purpose of the present paper is to review the endemic species of wheat of Georgia.

***Triticum carthlicum* Nevski (Karthlian wheat)**

T. carthlicum Nevski (Karthlian wheat) was widely planted in Georgia. Its common name in Georgian is “Dika”. It is a free-threshing (AABB) tetraploid wheat, which is endemic to Georgia. This wheat has been cultivated for at least 8000 years in Georgia according to the data of the Neolithic archeological excavations [1]. Dika, as a highland crop, is well adapted to severe conditions. Supposedly, it was originated in highlands at 1000-2000 meters

above sea level, on the southern slopes of the Greater Caucasus, although its fields could have been encountered both above and below this range, even at heights that severely limit agriculture – 2200-2300 meters. Karthlian wheat is a result of the prolonged farming culture of Georgia. ‘Dika’ is mentioned in the 5th century Georgian historical documents [2-4].

Matsuoka in 2011 noted that *T. carthlicum* is strikingly similar to *T. aestivum* in morphology [5]. Karthlian wheat’s spike morphology resembles more the morphology of common wheat (*T. aestivum*) rather than that of other subspecies of free-threshing tetraploid wheat [6]. Moreover, Kihara, *et al.* in 1950 had showed that the morphology of synthetic hexaploid wheat derived from crosses between *T. turgidum* subsp. *carthlicum* and *Aegilops tauschii* Coss., resembles that of common wheat and considered *T. turgidum* subsp. *carthlicum* as a candidate for the AB-genome donor of common wheat [7].

Karthlian wheat is of spring habit, early maturing, and somewhat resistant to fungus diseases (ergot). It was relatively resistant to frost, lodging and grain shattering. The growth habit of young plant is erect. It has strong yellow to light red stems. Spikes are flexible, tending to lean over. Glumes can be white or red. While several flowers are present in each spikelet only three usually develop kernels. Kernels are free-threshing, flinty, generally red. Dika can be distinguished from *T. aestivum* in the field by its stems which are usually solid below the spike instead of thin-walled and hollow. Also, its grain tends to be hairless on the top, which also differentiates dika from bread wheat. The landrace dika cultivated by farmers contained significant variability for glume and lemma color (white, red and black), glume hairness and grain color (red and white). Dika bread was highly valued by local population for its good taste and long “shelf live”. [8].

Karthlian wheat was first identified by Flaksberger [9] as a variety of bread wheat *T. vulgare* var. *fuliginosum* Alef. (1866) p. p. Later N. Vavilov (1919) determined it as *T. persicum* Vavilov [nomen provisorium] [10]. In 1921 Zhukovskiy found it in Georgia and described as *T. persicum* Vavilov ex Zhuk. 1923 non Aitch & Hemsl. 1888. nom. illeg. [11]. This name [*T. persicum*] is a later homonym of *Triticum persicum* (Boiss.) Aitch. & Hemsl. = *Aegilops persica* Boiss. 1846 and therefore is illegitimate (ICN Art. 53.1). Seed of this wheat was sent to N. Vavilov by a German private company under the name of Persian wheat (“Persischer Weizen”).

However, the German company itself had received the seed from Moscow, not from Iran [2, 12]. According to the “International Code of Nomenclature for algae, fungi, and plants” the earliest legitimate name of this species is *Triticum carthlicum* Nevski (ICN Art. 11.4) [13]. This endemic species was widely cultivated in Georgia and has never been associated with Iran [2].

Karthlian wheat is presented by 11 varieties in Georgia: *T. carthlicum* var. *fuliginosum* (Zhuk.) A. Filat.; *T. carthlicum* var. *nigrirubiginosum* (Flaksb.) A. Filat.; *T. carthlicum* var. *pseudorubiginosum* (Zhuk.) A. Filat.; *T. carthlicum* var. *pseudostramineum* (Flaksb.) A. Filat.; *T. carthlicum* var. *rubiginosum* (Zhuk.) A. Filat.; *T. carthlicum* var. *stramineum* (Zhuk.) A. Filat.; *T. carthlicum* var. *darginicum* (Berg & Muizhn.) A. Filat.; *T. carthlicum* var. *osseticum* (Greb.) A. Filat.; *T. carthlicum* var. *rarisimum* (Flaksb.) Mosul. & al.; *T. x carthlicum* var. *zhukovski* (Flaksb.) Mosul. & al.; *T. carthlicum* var. *dekaprelevichii* (Sicharulidze) Naskidashvili

All eleven varieties of *T. carthlicum*, were found only in Georgia. Eight out of the eleven varieties were found only in Georgia. *T. carthlicum* var. *fuliginosum* was recorded in the adjacent to Georgia mountainous regions of Dagestan, var. *stramineum* in Azerbaijan, while var. *rubiginosum* in Azerbaijan, Armenia and Turkey (on historical territories



Fig.1. *Triticum carthlicum* Nevski
(Karthlian wheat)

of the Kartvelian [Georgian] people). It should be mentioned that Dika” doesn’t have any name in other languages. Pure production fields of ‘Dika’ were registered only in Georgia. In all other countries, Dika is found as impurities in the fields of bread wheat (*T. aestivum*) [2].

***Triticum macha* Dekapr. & Menabde**

T. macha is a hulled hexaploid (AABBDD) wheat, endemic to Georgia. It is called Makha wheat in Georgia. It was a major component of the Makha landrace, mainly cultivated in Racha-Lechkhumi, as well as in Lower Svaneti, Imereti and Samegrelo. The Makha landrace also included *T. palaeocolchicum*, a tetraploid wheat, which is described in the next section.

T. macha is a late-maturing winter wheat with tall, hollow stems. It is characterized by large above-ground phyto-mass and resistance smuts. The bush is semi-prostrate. Spikes vary in density from open to dense, with short awns. Kernels remain in the spikelets after threshing. They are elliptical, red, and intermediate in hardness.

In Makha fields, *T. macha* itself was presented in great variation for spike color (white and red) awnedness (awned, semi-awned and awnless) and hairiness of glumes. The most widespread form was white spike with short awns and without hairs.



Fig. 2. *T. macha* Dekapr. & Menabde
(Makha wheat)

T. macha was described by L. Dekaprevich and V. Menabde from Lechkhumi in 1932. It is one of the oldest cultivated wheat and it was preserved only in Lechkhumi by the 1930-ies. It is characterized by traits of wild and domesticated wheat at the same time. It has brittle rachis and spikes fall down at late stages of maturity. Therefore, it used to be harvested in two steps: spikes were harvested with a local tool ‘shnakvi’ on the first place (see below its description) and straw was harvested after that [2, 14].

L. Dekaprevich in 1954 proposed to split Makha into species: 1) Gvatsa Makha (*T. tubalicum* Dekapr.) – characterized by lax and fragile spikes and 2) Chelta Makha (*T. imereticum* Dekapr.) – characterized by stiffer and less fragile spike [3]. However, this proposal was not accepted.

There are 14 varieties of *T. macha* identified by Georgian wheat researchers: *T. macha* var. *colchicum* Dekapr. & Menabde; *T. macha* var. *georgicum* Menabde; *T. macha* var. *ibericum* Dekapr. & Menabde; *T. macha* var. *letshchumicum* Dekapr. & Menabde; *T. macha* var. *megrelicum* Menabde; *T. macha* var. *scharaschidzei* Menabde; *T. macha* var. *ericzjanae* Menabde; *T. macha* var. *rubiginosum* Menabde; *T. macha* var. *subcolchicum* Dekapr. & Menabde; *T. macha* var. *submegrelicum* Dekapr. & Menabde; *T. macha* var. *subletshchumicum* Dekapr. & Menabde; *T. macha* var. *palaeoimereticum* Dekapr. & Menabde; *T. macha* var. *palaeocolchicum* Dekapr. & Menabde; *T. macha* var. *planocompressum* Menabde

Dough mixed from Makha flour was stuck easily to walls of a bread-baking oven (*tonée* in Georgian, or *tondir* in other languages of the region), so the bread would not fall off and burn. Makha’s bread was considered as of high quality among the local population. It was white, tasty and flavorful, not to mention its ability to remain soft for several days. It was honor to treat guests to ‘makha’ bread at feasts.

***Triticum palaeocolchicum* Menabde**

T. palaeocolchicum (Colchis emmer) is a hulled tetraploid (AABB) wheat, endemic to Georgia. It is very similar to wild forms of tetraploid wheat due to its morphological characteristics. Its spikes contain up to 40 fertile spikelets. Leaves are broad. The stems are strong and tall (up to 120 cm). It’s important agricultural characteristics include resistance to fungal diseases. Grains of Colchis emmer are distinguished by high protein content, and

high lysine content in protein. Colchis emmer was widely spread as mixture of the Makha landrace in West Georgia. The local population did not differentiate it from Makha wheat and grain of both species were milled altogether



Fig. 3. *Triticum palaeocolchicum* Menabde (*Colchis emmer*)

Taxonomic identification of Colchis emmer seems to remain a stumbling stone and deserves a special consideration. It was first described as *T. dicoccum* var. *chvamlicum* Supat. [15], and shortly afterwards determined as *T. dicoccum* grex (subsp.) *georgicum* Dekapr. and Menabde [16]. Later, V. Menabde considered Colchis emmer under the name of *T. palaeocolchicum* [17], while Dekaprevich applied *T. georgicum* Dekapr [18]. Dorofeev first considered *T. dicoccum* subsp. *georgicum* Dekapr. & Menabde as the scientific name for Colchis emmer [19]. However later Dorofeev et al. identified Colchis emmer as *T. karamishevii* Nevski [20]. The confusion with Colchis emmer continues in the present days. Van Slageren considers Colchis emmer as *T. turgidum* subsp. *palaeocolchicum* (Menabde) A. Love & D. Love [21], while MacKey as *T. turgidum* ssp. *georgicum* (Dekapr. & Menabde) MacKey [22]. The authors of the present paper proposed to conserve the name *T. palaeocolchicum*.

Colchis emmer is represented by 3 varieties in Georgia: *T. palaeocolchicum* var. *chvamlicum* (Supat.) Menabde; *T. palaeocolchicum* var. *rubidium* Menabde and *T. x palaeocolchicum* var. *nigrescens* Menabde.

Zanduri

The following two species represent the Zanduri landrace. It consists of three species: *T. monococ-*

cum var. *hornemanii* (Gvatsa [narrow] zanduri), *T. timopheevii* (Chelta [wide] zanduri) and *T. zhukovskiyi* (Zanduri). Gvatsa zanduri (*T. monococcum* var. *hornemannii*) is not endemic to Georgia, as it was widely spread in other regions as well and it is not considered in the present paper. However, chelta zanduri and hexaploid zanduri are found only in Georgia. Zanduri landrace was widely distributed in Lechkhumi and Racha in 1930-ies, when they were described by the wheat scientists.

Triticum timopheevii (Zhuk.) Zhuk.

T. timopheevii (Zhuk.) Zhuk (Timopheevi wheat) is called Chelta Zanduri by the population of Georgia. It is a tetraploid (AAGG) late-maturing hulled spring wheat with leaf blades that are pubescent on both sides. Spikes are very compact, rather short, somewhat pyramidal in shape with soft, thin, rather short awns. Spikelets usually contain two kernels. Kernels are medium long, slender and hard or flinty. *T. timopheevii* is known as drought and frost resistant plant. Chelta zanduri owing to its special immunity to fungal diseases deserved particular attention of wheat breeders. It was used as a source cytoplasmic male sterility in wheat breeding. It is known by adaptation to all kinds of soils (even to limestone). Among its negative features hulled grains and difficulty in threshing should be mentioned.

Zhukovski found a two-kernel wheat on the way to village Mokhisi of the Gori district, in the neighborhood of village Asarma in 1922. He described it as a new variation of wild emmer *Triticum dicoccoides* var. *timopheevii* Zhuk. [11]. Later E. Stoletova in 1923 came across with a field of this plant



Fig. 4. *Triticum timopheevii* (Zhuk.) Zhuk (*Timopheevi wheat, Chelta Zanduri*)

in Lechkhumi, West Georgia. She recorded that the local population called it Chelta Zanduri [23]. In 1928, P. Zhukovski promoted this variation to the rank of species *T. timopheevii* (Zhuk.) Zhuk. and ascribed it to domesticated wheats [2, 24].

Bread baked from ‘cheltazanduri’ (*T. timopheevii*) flour was rather widespread in West Georgia but it was not as tasty and flavorful as that of Makha or Dika. In some cases, Zanduri landrace was used to produce poultry feed. *Triticum timopheevii* is represented by three varieties: *T. timopheevii* var. *typicum* Zhuk., *T. timopheevii* var. *viticulosum* Zhuk. and *T. timopheevii* var. *nigrum* Eritzjan

Triticum zhukovskyi Menabde et Eritzjan

T. zhukovskyi Menabde et Eritzjan (Zanduri) is a hexaploid (AAGGAA), late-maturing hulled spring wheat, a member of the Zanduri landrace. It was found in a Zanduri population in 1959 by V. Menabde and A. Eritzjan. They proposed that it should have originated through allopolyploidization of diploid gvatsa zanduri (*T. monococcum*) and tetraploid chelta zanduri (*T. timopheevii*).



Fig. 5. *Triticum zhukovskyi* Menabde et Eritzjan (Zanduri)

Farmers did not differentiate it from Chelta zanduri and the hexaploid plants did not have a special name. However, (results of karyological studies have shown) the authors found hexaploid plants (42 chromosomes), which were distinguishable from Chelta Zanduri through the ploidy level – *T. timopheevii* (28 chromosomes) and named it as *Triticum zhukovskyi* Menabde & Eritzjan – in honor of the outstanding researcher of *Triticum* and other cereals [25].

It is a very late maturing wheat. However, it is characterized by wide adaptation, frost and drought resistance. Bread baking quality is similar to that of Chelta zanduri.

Interestingly, the local population developed special tools to harvest hulled wheats Makha and Zanduri. First the wheat spikes were harvested by Shnakvi (Fig 6), a special tool consisting of two sticks tied together and gathered in baskets. After wheat stems were cut with sickles and bundled. The bundles were used to cover the roofs of houses and barns.

Georgian historians such as T. Kaukhchishvili and T. Mikeladze found evidence of wheat cultivation in ancient Georgia in the works of Ancient Greek historians Herodotus and Xenophon, respectively [26, 27]. Iv. Javakhishvili suggested in 1930 that the names of the ancient Georgian wheats: Dika, Zanduri, Makha and others were first mentioned in Georgian written sources as early as the V century AD [28]. Records about wheat production in Georgia are available in the works of Sul Khan-Saba Orbeliani (1658-1725; “Sitkvis Kona”, Georgian Vocabulary), Vakhushti Batonishvili (1696–1757; “Description of Kingdom of Georgia, its habits and canons”), as well as in the travel notes of naturalists of XVIII-XIX centuries such as Johann Anton von Guldenstädt [29], Johann Gottlieb Georgi [4, 30].

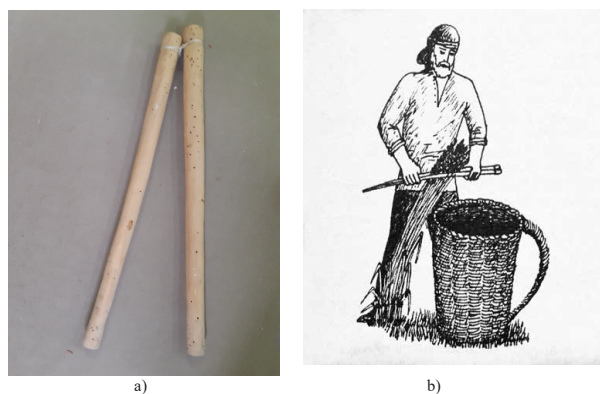


Fig. 6. a) Shnakvi, a special tool to harvest wheat heads in Georgia and b) A wheat farmer is harvesting wheat spikes using shnakvi [4]

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