THE ANCIENT, TRADITIONAL GEORGIAN WHEAT SPECIES AND THEIR ROLE IN WHEAT EVOLUTION

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Introduction.

Georgia is one of the most important centers of diversity of the domesticated wheat. Georgia is the only country in the world where all the genomes (AA, AABB, AAGG, AAGGAA, AABBDD) of the wheat can be found. Despite the small territory Georgia is the only country in the world where 15 species (s. str.) of wheat (*Triticum boeoticum* Boiss., *T. monococcum* L., *T. dicoccum* (Shrank) Schübl., *T. palaeocolchicum* Menabde, *T. timopheevii* (Zhuk.) Zhuk., *T. durum* Desf., *T. turgidum* L., *T. carthlicum* Nevski, *T. macha* Dekapr. & Menabde, *T. zhukovskyi* Menabde & Ericzjan, *T. turanicum* Jacubz., *T. polonicum* L., *T. spelta* L., *T. compactum* Host, *T. aestivum* L.) are present. Among them 5 species (*T. macha*, *T. palaeocolchicum*, *T. timopheevii, T. zhukovskyi* and *T. carthlicum*) are endemics to Georgia. The same diversity is found in the material obtained from the archaeological excavations.

Georgia is the only country in the world where all 7 species of hulled wheat are present (among them 4 endemic species). Georgian endemic, hulled wheat species play important role in the evolution of wheat. They represent ancient, relict taxa, showing all directions and transitional stages in wheat evolution from diploid to tetraploid and hexaploid species. In Georgia, relict tools used to collect hulled wheat spikes (with brittle rachis) have survived to present day. This is a woody tool, known as 'Shnakvi', originally created for wheat, and a stone mortar for dehusking (peeling) of ears of hulled wheat - makha, zanduri and asli.

Key words: Triticum, Hulled, endemic, diversity, conservation

Palaeoethnobotanical evidence of the Neolithic culture in Georgia.

Georgia is a country of the ancient agriculture. The Neolithic revolution probably began in the 8th millennium BC (10 000 BP) in Georgia (Dzidziguri, 2000: 109). In the end of the 7th and in the beginning of the 6th millennia BC a Neolithic culture known as the Shulaveri – Shomu Culture appeared in East Georgia (Hamon, 2008). It was diffused over what is now southeastern Georgia, mainly in Kvemo [Lower] Kartli Region and characterized by settlements in villages, circular vaulted mud-brick homes and farm buildings, tools made of obsidian, stone, bone and horn, female figurines reflecting fertility beliefs or clay vessels decorated with relief and notched ornaments and the farming of domestic animals (cattle, pigs) and cereals (Bregadze 2004, Jalabadze et al. 2010). Wheat, barley, oil-fiber crops were widely cultivated along with the vineyards and fruit gardens (Menabde, 1948, Gorgidze, 1977, Pruidze et al., 2016).

Nine species of wheat were found in the Neolithic site of Arukhlo (south-east Georgia): *Triticum boeoticum*, *T. monococcum*, *T. dicoccum*, *T. carthlicum*, *T. durum*, *T. spelta*, *T. aestivum*, *T. sphaerococcum* Percival, *T. compactum*, eight of which are domesticated species. Analyses of archeological excavations of Arukhlo (8,000 BP): shows predominance of free-threshing, hexaploid wheat species. Quantity preference of free-threshing wheat species *T. aestivum-compactum* is evident, percentage of these soft wheat is 50-75% of all wheat population.

As many as seven species of domesticated wheat dating back to 8,000 BP were identified in the archaeological excavations of Lower Kartli (south eastern Georgia) in Khramis Didi Gora: *Triticum monococcum, T. dicoccum, T. durum, T. spelta, T. aestivum, T. compactum, T. spaerococcum*, alongside with other 'founder' crops: barley (*Hordeum vulgare and H. distichum*), oat (*Avena sativa*), rye (*Secale cereale*), lentils (*Lens esculenta*), peas (*Pisum sativum*) and bitter vetch (*Vicia ervilia*) (Lisitsyna, 1984; Rusishvili, 1988; Lortkipanidze, 1991).

Comparison of the Shulaveri-Shomu complex with the Halaf and Hassuna cultures in northern Mesopotamia, and Hacilar in Anatolia provides evidence that cereals cultivated in the South Caucasus are much more diverse than in Anatolia and Mesopotamia (Hamon, 2008:87-88). Hamon (2008:90) proposed that the great variety of endemic wheat species in the South Caucasus could have favored local domestication of cereals, even if these cereals were already cultivated in the Near East.

The diversity and distribution of *Ae. tauschii* in the South Caucasus

Hexaploid wheat originated only about 8,000 years ago (Nesbitt and Samuel 1996) by hybridization of D genome donor diploid *Aegilops tauschii* Coss. with the already domesticated tetraploid AABB wheat (Kilian et al., 2011). It is widely recognized that the center of origin of *Ae. tauschii* is the South Caucasus (Hammer, 1980; Jaaska, 1980). Furthermore, Dudnikov (2012) indicates that divergence of *Ae. tauschii* into its two subspecies, *Ae. tauschii* Coss. subsp. *tauschii* and *Ae. tauschii* subsp. *strangulata* (Eig.) Tzvel. also took place in the Caucasus.

According to Matsuoka et al. (2008) the ancient, late flowering forms of both subsp. *taushii* and subsp. *strangulata* are found only in the Caucasus. Based on the analysis of Chloroplast DNA, three

linages of *Ae. tauschii* were identified: TauL1, TauL2 and TauL3. *Ae. tauschii* with all, three linages is presented only in Georgia. The ancestral lineage TauL3 is found only in Georgia. The small TauL3 is the ancestral linage and TauL1 and TauL2 diverged from it (Gogniashvili et al., 2016). According to Dudnikov (2012) subsp. *tauschii* was the first to start geographic expansion and relatively rapidly occupied a vast area from the Caucasus - eastward to central Tien Shan and Himalayas. In contrast to subsp. *tauschii,* geographic dispersal of subsp. *strangulata* was a complicated, multi-stage and slow process (Dudnikov, 2012).

Georgia as the origin place of cultivated hexaploid wheat

There are two polyploid lineages in the genus *Triticum*: a) *T. timopheevii - T. zhukovskyi* lineage with AAGGAA-genome and b) *T. turgidum – Tr. aestivum* lineage with AABBDD-genome.

The AAGGAA-genome has limited distribution and both tetraploid (*T. timopheevii*) and hexaploid (*T. zhukovskyi*) are endemics to Georgia (the South Caucasus). Together with diploid *T. monococcum* (AA) they grow in admixtures of tree species forming local landrace "Zanduri" in west Georgia. .

The *T. turgidum – Tr. aestivum* lineage (with AABBDD) has much wider distribution covering the whole West Asia. However, three species (*sensu stricto*) out of this linage were apparently domesticated in Georgia and are considered as local endemics: *T. paleocolchicum, T. carthlicum*, and *T. macha.* the latter two species, are distinguished with exceptionally high intraspecific variability. They are presented by 12 and 14 (12)[1] varieties, respectively (Mosulishvili *et al.,* 2017).

There are only two hulled domesticated tetraploid (AABB) wheat species *T. dicoccum* (emmer) and *T. palaeocolchicum* (Colchis emmer), which could have contributed AABB genomes to hulled hexaploid (AABBDD) spelts: *T. spelta* and *T. macha*. Both emmer wheats were widely distributed on the territory of Georgia in the Neolithic period (Rusishvili 1988). Colchis emmer (*T. palaeocolchicum*) was described as recently as the early 1930-ies[2]. It was spread in humid West Georgia, while common emmer (*T. dicoccum*) was mostly cultivated in the dry lands of East Georgia. Both emmers co-existed in the early Neolithic period with *Aegilops tauschii* the D-genome donor, which diverged for subsp. *strangulata* and subsp. *tauschii* in the South Caucasus.

T. macha a hulled hexaploid (AABBDD) wheat species endemic to Georgia was described by Dekaprelevich and Menabde in 1932 from prov. Lechkhumi (west Georgia). This species always grows in admixture with another endemic to Georgia hulled but tetraploid (AABB) species *T. palaeocolchicum* in Lechkhumi and in adjacent to Lechkhumi regions.

Hulled hexaploid (AABBDD) Spelt (*Triticum spelta*) was initially described from Germany by Linne (1753). Spelt was found to be common in Spain (Asturias). Later, spelt was discovered in Iran (Kuckuck and Schiemann 1957; Kuckuck 1959; Dorofeev, 1972) and other places in Asia (Dvorák et al., 1998). Spelt was discovered also in the South Caucasus (Dorofeev, 1966; 1972).

Tzvelev (1976: 167) considered that "the South Caucasian and Middle Asian *T. spelta* specimens, which had been determined as subsp. *kuckuchianum* Gökgöl described from Iran be similar to *T. macha,* the endemic species of Georgia, or *T. aestivum"*. Dorofeev (1972: 124) suggested that "the great variety of *T. spelta* forms found in the South Caucasus provides basis for considering the Transcaucasus as the homeland of the first hexaploid wheat prototype, which can be west Georgian endemic wheat 'makha' (*T. macha*)". Earlier the same author noted that the first hexaploid wheat of the *T. spelta* type penetrated to Iran and other regions of Inner Asia, as well as to Europe from the South Caucasus (Dorofeev, 1966:31 33).

If we assume that hulled hexaploid spelt wheats (*T. macha* and *T. spelta*) are alloploids originated through a cross of D-genome donor *Aegilops tauschii* subsp. *strangulata* with a hulled (AABB) tetraploid wheat such as *T. palaeocolchicum* or *T. dicoccum* and take into account that spelt wheats (as well as free-threshing hexaploid wheats) originated in ca. 8000 BP, Georgia is the only country where both conditions are met.

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[1] 14 varieties are described in the publications of L. Dekaprelevich and V. Menabde, but only 12 are conserved in genebanks at present.

[2] This taxon was first described by Supatasvili (1929) as a *T. dicoccum* var. *chvamlicum* Supat. In 1940 Menabde published the new species name *T. palaeocolchicum* Menabde; the epithet '*palaeocolchicum'* was adopted as carbonized seeds of the taxon were found at an archaeological site (Dikha-Gudzuba) of the Neolithic Period at the Colchis ("Kolkhis") area in 1940 in West Georgia.

T. carthlicum, a free-threshing (AABB) tetraploid Karthlian[3] wheat, is endemic to Georgia (erroneously named as Persian[4] wheat). This wheat has been cultivated for at least 8000 years in Georgia according to the data of the Neolithic archeological excavations (Rusishvili, 1988). Dika, as a highland crop, is well adapted to severe conditions. This variety must have formed in Georgian highlands at 1000-2000 meters above sea level, on the southern slopes of the Greater Caucasus, although its crops could be encountered both above and below this range, even at heights that severely limit agriculture – 2200-2300 meters. Karthlian wheat 'dika' (*T. carthlicum)* is the product of the Georgian people's prolonged farming culture. 'Dika' is mentioned in the 5th century historical documents. (Menabde, 1948; Dekaprelevich, 1954; Pruidze et al. 2016).

All varieties identified within *T. carthlicum*, were found only in Georgia and only one variety was found in the adjacent to Georgia, mountainous regions of Dagestan, as well as in Armenia and Turkey (on historical territories of the Kartvelian [Georgian] people). Common name of this species 'dika' is only in Georgian language, in all other languages it has no name, also pure sowings of 'dika' were registered only in Georgia, in all other countries found as impurities in sowings of bread wheat (*T. aestivum*) (Menabde, 1948; Dekaprelevich, 1954). According to Matsuoka (2011), *T. carthlicum* is strikingly similar to *T. aestivum* in morphology.

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 (Takumi and Morimoto 2015). Moreover, Kihara, *et al*. (1950) showed that the morphology of synthetic hexaploid wheat derived from crosses between subsp. *carthlicum* and *Aegilops tauschii* Coss., resembles that of common wheat and considered subsp. *carthlicum* as a candidate for the AB-genome donor of common wheat.

The formation of hexaploid wheat occurred so recently that little divergence has occurred between the D-genomes present in the hexaploid and diploid species (Feldman, 2001; sited by Shewry 2009). The South Caucasus is considered to be the center of the distribution of the D genome donor subsp. *strangulata* and hence the place of origin of *T. aestivum* to Georgia, the south Caucasus (Jaaska, 1980; Dvorak et al., 1998; Matsuoka, 2008). *Ae. tauschii* with all, three linages (TauL1, TauL2, TauL3) is presented only in Georgia. According to Takumi et al. (2009) common wheat (*T. aestivum*) was derived from single or limited accessions of *Ae. tauschii* and *Ae. tauschii* populations far from its birthplace were not involved in the formation of common wheat.

The archeological excavations of the Neolithic sites of Arukhlo and Khramis Didi Gora (southeast Georgia) confirm that the spelt (*T. spelta*) as well as bread wheat (*T. aestivum*) and dwarf wheat *(T compactum*) existed in Georgia (Arukhlo, Khramis Didi Gora) in 8000 BP (Rusishvili, 1988), earlier than in other parts of the Near East.

Georgian Endemic wheat species as a healthy food

5 species out of 15 are endemics to Georgia (4 hulled wheat species): *T. palaeocolchicum, T. macha T. timpoheevii, T. zhukovskyi* and free-trashing *T. carthlicum*). Colchic emmer - *T. palaeocolchicum* ('Kolkhik asli') are very similar to wild forms of wheat due to their morphological characteristics, Their important agricultural characteristics include resistance to fungal diseases; a fertile spikelet (34-39 spikelets per spike); broad leaves, tall strong stems (100-120 cm tall), which is important for wheat breeding. Grains of 'Kolkhik asli' are distinguished by high protein content, and high lysine content in protein. *T. macha* ('makha') bread was highly priced among the local population. It was white, tasty and flavorful, not to mention able to stay soft for several days. It was considered an honor to treat guests to 'makha' bread at feasts. 'Zanduri' land-race is considered as the most special local population. Three species are identified in the 'zanduri' population: 1.*T. monococcum* ('gvatsa [narrow] zanduri'); 2.*T. timopheevii* ('chelta [wider] zanduri') and 3.*T. zhukovskyi* ('zanduri'). 'Chelta zanduri' owing to its special immunity to fungal diseases, deserves particular attention. Bread baked from 'chelta zanduri' (*T. timopheevii*) flour is very tasty and flavorful, it remains soft for the whole week. 'Zanduri' (*T. zhukovskyi*) is known as drought and frost resistant plant. It is known by growth potential in all kinds of soils (even in limestone). Among the negative features hulled grains and difficulty in threshing should be mentioned. 'Dika' (*T. carthlicum*) is characterized by early yielding, easy threshing, resistance to flattening and grain dropping. Grains of 'dika' are also distinguished by their high protein and Lysine contents. 'Dika' as a highland crop, is well adapted to severe conditions. Its important feature is good

[3] Karthli – a province in East Georgia.

[4] Endemic to Georgia, erroneously named as Persian wheat by N. Vavilov.

bread bake ability. This species is characterized by strong immunity to diseases, frost resistance and a short vegetation period.

Endemic Georgian wheat species are healthy food, quite precious for breeders, all characterized by high resistance to fungal diseases. Local wheat varieties are rich of useful genes for wheat improvement. The local endemic species are unique as they combine wild and domesticated traits. 15 species of wheat, 188 varieties (were registered till 60-70-ies of the last century. At present the situation is radically changed, local varieties occupy very small areas and this number, especially of varieties, forms and landraces is significantly decreased. We consider that together with these processes the protection of plant genetic resources, should get more active.

Conservations of wheat diversity, *in situ* and *ex situ c*onservation

Georgian endemic species of wheat are of great importance for the study of evolution and domestication and evolution of wheat. However, this diversity of Georgian wheat is under the threat of extinction, particularly since the 1980s and 1990s. Georgian endemic species are not practically cultivated in the places of their origin, in Lechkhumi, Racha and others. Currently they are preserved in the living collections and gene banks of some institutions (National Botanical Garden of Georgia, Institute of Botany of Ilia State University, Mukhrani Experimental Station of Agricultural University of Georgia, Scientific – Research Center of Agriculture, Biological Farming Association "Elkana" and in the collection of private enthusiasts). It is necessary to carry out urgent measures in Georgia to preserve the diversity of wheat and to restore it in places of origin (especially in Lechkhumi and Racha) and undertake local wheat cultivation.

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References.

1. Bregadze , N. 2004. Georgia as an Independent Center of Origin of Agriculture (in Georgian). Tbilisi: Publishing House Samshoblo.
2. Dekaprelevich, L.L., V. Menabde, (1932) Hulled wheats of west Georgia, Proc. Appl. Bot. Genet. Plant Breed. 5 (1) 3-46.
3. Dorofeev, V. F. 1966. "Geographical localization and gene centers of hexaploid wheats in the Transcaucasia (in Russian)." *Genetika* 3: 16-33.
4. Dorofeev, V. F. 1972. "Wheats of the Transcaucasus." *Proceedings in Applied Botany, Genetics and Plant Breeding* 47: 3-206.
5. Dudnikov, A. J. 2012. "Chloroplast DNA non-coding sequences variation in Aegilops tauschii Coss.: evolutionary history of the species." *Genetic Resource and Crop Evolution* 59: 683–699.
6. Dvorak, J., M. C. Luo, Z. I. Yang, and H. B. Zhang. 1998. "The structure of the Aegilops tauschii genepool and the evolution of hexaploid wheat." *Theoretical and Applied Genetics* 97: 657–670.
7. Dzidziguri, L. 2000. "The oldest agriculture of the South Caucasus." *The Journal of the Centre for Archaeological Studies of the Georgian Academy of Sciences (in Georgian)* Supplements II: 343.
8. Feldman, M. 2001. Origin of Cultivated Wheat, In: A. P. Bonjean and W. J. Angus, Ed., The World Wheat Book: A History of Wheat Breeding, Intercept Ltd., London, 3–56.
9. Gogniashvili M., Jinjikhadze T., Maisaia I., Akhalkatsi M., Kotorashvili A., Kotaria N., Beridze T., Dudnikov A.J. (2016). Complete chloroplast genomes of Aegilops tauschii Coss. and Ae. cylindrica Host sheds light on plasmon D evolution. Current Genetics. 62(4):791-798.
10. Gorgidze, A. 1977. Phylogenesis of Georgian Endemic Wheats. Tbilisi: Metsniereba.
11. Hammer, K. 1980. "Vorarbeiten zur monographischen Darstellung von Wildpflanzensortimenten: Aegilops L." *Kulturpflanze* 28: 33–180.

12. Hamon, C. 2008. "From Neolithic to Chalcolithic in the Southern Caucasus: Economy and Macrolithic Implements from Shulaveri-Shomu sites of Kwemo-Kartli (Georgia)." *Paléorient* 34: 85-135.
13. Jaaska, V. 1980. "Electrophoretic survey of seedling esterases in wheats in relation to their phylogeny." *Theoretical and Applied Genetics* 56: 273-284.
14. Jalabadze, M., K. Esakia, N. Rusishvili, E. Kvavadze, I. Koridze, N. Shakulashvili, and M. Tsereteli. 2010. "Report on Archaeological work carried out on Gadachrili Gora in 2006- 2007 (in Georgian)." *Dziebani, Journal of the Archaeology* 19: 17- 24.
15. Kihara, H. 1944. "Discovery of the DD-analyser, one of the ancestors of Triticum vulgare (in Japanese)." *Agriculture and Horticulture* 19: 13-14.
16. Kihara, H., M. Okamoto, M. Ikegami, J. Tabushi, H. Suemoto, and Y. Yamane. 1950. "Morphology and fertility of the new synthetized hexaploid wheats. Report of Kihara Institute of Biological Research." *Seiken Jiho* 4: 127- 140.
17. Kilian, Benjamin, William Martin, and Francesco Salamini. 2010. "Genetic Diversity, Evolution and Domestication of Wheat and Barley in the Fertile Crescent." In *Evolution in Action*, edited by M. Glaubrecht, 137-166. Springer-Verlag Berlin Heidelberg.
18. Kuckuck, H. 1959. "On the findings of Triticum spelta L. in Iran and on the arising of Trititicum aestivum-types through crossings of different Spelta-types." *Wheat Information Service (electronic newsletter for wheat researchers)* 9-10: 1-2.
19. Kuckuck, H., and E. Schiemann. 1957. "Über das Vorkommen von Spelz und Emmer (Triticum spelta L. und Tr. dicoccum Scübl.) im Iran." *Zeitschrift für Pflanzenzüchtung* 38: 383-396.
20. Lisitsyna, G. N. 1984. "The Caucasus—a centre of ancient farming in Eurasia." In *Plants and ancient man: studies in palaeoethnobotany*, edited by W. van Zeist and W. A. Casperie, 285–292. Rotterdam (the Netherlands): Balkema.
21. Lortkipanidze, O. 1991. Archäologie in Georgien: von der Altsteinzeit zum Mittelalter. Weinheim : VCH, Acta Humaniora.
22. Matsuoka, Y., Takumi, S., & Kawahara, T. (2008). Flowering Time Diversification and Dispersal in Central Eurasian Wild Wheat Aegilops tauschii Coss.: Genealogical and Ecological Framework. PLoS ONE, 3(9), e3138. doi:PLoS ONE 3(9): e3138. doi:10.1371/journal.pone.0003138
23. Matsuoka, Yoshihiro. 2011. "Evolution of Polyploid Triticum Wheats under Cultivation: The Role of Domestication, Natural Hybridization and Allopolyploid Speciation in their Diversification." *Plant and Cell Physiology* 52 (2): 750–764. doi:doi:10.1093/pcp/pcr018,.
24. Menabde, V.L. (1940) Botanical-systematical Data on bread grain crops of Ancient Colchis, Bull. Georgian Branch Acad. Sci. USSR 1 (#9).
25. Menabde, V. L. 1948. Wheats of Georgia (in Russian). Institute of Botany, Academy of Sciences of Georgian SSR. Publishing House of Academy of Sciences of Georgian SSR.
26. Mosulishvili, M., D. Bedoshvili, and I. Maisaia. 2017. "A consolidated list of Triticum species and varieties of Georgia to promote repatriation of local diversity from foreign genebanks." *Annals of Agrarian Science* 15: 61-70. doi:http://dx.doi.org/10.1016/j.aasci.2017.02.006.
27. Nesbitt, M., and D. Samuel. 1996. "From staple crop to extinction? The archaeology and history of hulled wheats." In *Hulled wheats. Promoting the conservation and use of underutilized and neglected crops 4. Proceedings of the 1st International Workshop on Hulled Wheats*, 41–100. Castelvecchio Pacoli, Tuscany (Italy): International Plant Genetic Resources Institute.
28. Pandey, H. N., and M. V. Rao. 1987. "Grain improvement in Triticum durum through interspecific hybridization." *Indian Jounral of Genetics and Plant Breeding* 47: 133-135.
29. Pruidze, L., I. Maisaia, Sh. Sikharulidze, and M. Tavartkiladze. 2016. *Georgia - the Ancient Cradle of Agriculture.* Tbilisi: Color Ltd.

30. Rusishvili , N. 1988. "Fossil Wheat from the Territory of Georgia (in Georgian)." *Flora, Geobotany and Palaeobotany.*
31. Shewry P.R. 2009. Wheat. Journal of Experimental Botany. 60, 6: 1537–1553.
32. Takumi, Shigeo , Emi Nishioka, Haruhiko Morihiro, Taihachi Kawahara, and Yoshihiro Matsuoka. 2009. "Natural variation of morphological traits in wild wheat progenitor Aegilops tauschii Coss." *Breeding Science* 59: 579–588.
33. Takumi, Shigeo and Ryoko Morimoto. 2015. "Implications of an inverted duplication in the wheat KN1-type homeobox gene Wknox1 for theorigin of Persian wheat." *Genes & Genetic Systems* 90, (2): 115–120.
34. Tzvelev, N. N. 1976. Zlaki USSR (in Russian). Nauka.

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ანოტაცია. საქართველო არის კულტურული ხორბლის (*Triticum* L.) წარმოშობისა და ფორმირების ერთ – ერთი მთავარი ცენტრი და ეს ცენტრი ძალზე მდიდარია ხორბლის ენდემური სახეობებით. მიუხედავად მცირე ტერიტორიისა, საქართველო ერთადერთი ქვეყანაა მსოფლიოში, სადაც 15 სახეობის (s.str.) ხორბალი (*Triticum boeoticum, T. monococcum, T. dicoccum, T. palaeocolchicum, T. timopheevii, T. durum, T. turgidum, T. carthlicum, T. macha, T. zhukovskyi, T. turanicum, T. polonicum, T. spelta, T. compactum, T .aestivum*) არის დაფიქსირებული. ხორბლის 15 სახეობიდან 5 მათგანი არის აქართველოს ენდემი (*T. macha, T. palaeocolchicum, T .timopheevii, T. zhukovskyi, T. carthlicum*). აქედან 4 სახეობა არის კილიან მარცვლიანი ხორბალი. საქართველო მსოფლიოში ერთადერთი ქვეყანაა, სადაც კულტურული კილიან მარცვლიანი ხორბლის ყველა 7-ვე სახეობაა წარმოდგენილი (ყველა სხვა ქვეყანაში კილიანმარცვლიანი ხორბლის მხოლოდ ერთ, ორი ან მაქსიმუმ 3 სახეობა გვხვდება) .

Triticum- ის ყველა გენომი (AA, AABB, AAGG, AAGGAA, AABBDD), ისევე როგორც *Aegilops taushii*-ს ყველა, სამივე ღინიჯი (TauL1, TauL2, TauL3) გვხვდება მხოლოდ საქართველოში.

ჰექსაპლოიდური ხორბლის ორივე გენომი: AABBDD და AAGGAA (საქართველოს ენდემი) გვხვდება მხოლოდ საქართველოში. ჰექსაპლოიდური (AABBDD) ხორბალი წარმოიშვა AABB გენომის ტეტრაპლოიდის და *Ae. tauschii* subsp. *strangulate-ს* (D გენომის დონორი), შეჯვარების გზით დაახლოებით 8000 წლის წინ. *Ae. tauschii* subsp. *strangulata* ორივე ხაზით (ღინიჯით) TauL2 და TauL3 გვხვდება მხოლოდ საქართველოში. არქეოლოგიური გათხრების დროს, არუხლოს ნეოლითურ (8000 BP) დასახლებაში აღმოჩნდა ხორბლის ცხრა სახეობა, რომელთაგან რვა სახეობა არის კულტურული ხორბალი. მათ შირის შიშველმარცვლიანი (ადვილად ლეწვადი) ხორბლის (*T. aestovum T. compactum*) წილი არუხლოს (8000BP). ნამოსახლარზე შეადგენს ხორბლის მთლიანი რაოდენობის 50-75%.

ქართული ენდემური ხორბლის სახეობები არის ჯანსაღი საკვები, მდიდარი ცილებითა და მინერალებით. ყველა მათგანი ხასიათდება სოკოვანი დაავადებების მიმართ გამძლეობით (იმუნიტეტით). ბოლო პერიოდში (1970-იანი წლებიდან) საქართველოში ხორბლის სახეობებისა და სახესხვაობების (varieties) მრავალფეროვნება მნიშვნელოვნად შემცირდა. საქართველოში უნდა გააქტიურდეს მცენარეთა გენეტიკური რესურსების დაცვა და უნდა მოხდეს. ენდემური ხორბლების წარმოშობის ადგილებში, ლეჩხუმსა და რაჭაში მათი აღდგენა.

საკვანძო სიტყვები: Triticum, კილიან მარცვლიანი, ენდეემი, მრავალფეროვნება, კონსერვაცია.