



A Tetraploid Core Collection (TCC) from the Global Durum Genomic Resource assessed for resilience traits including root system architecture, stem anatomy and developmental traits

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Background

The **Tetraploid Core Collection (TCC)** consists of **432** accessions capturing more than 95% of the GDP and TGC biodiversity, as shown with the Illumina iSelect 90K array. **Tetraploid Wheat Global Collection (TGC)**, referred to as **GTC** in Maccaferri *et al.* 2019, Nature Genetics) is a germplasm collection consisting of **1,856** accessions developed as part of the durum wheat genome sequencing project, mainly focused on tetraploid genetic resources including **wild** and **domesticated emmer**, durum wheat **landraces** and tetraploid **subspecies**. The TGC (=GTC) collection was developed using a Reverse approach, starting from the analysis of botanical/origin data from the Gene Bank (accessions passports). TGC (=GTC) was designed to cover most of the **variation** found in tetraploid wheats.

Materials & Methods

- The **iSelect 90K SNP array** anchored to the Svevo genome sequence allowed us to study population structure and perform haplotype and GWAS analysis. Passport and genotypic data of the Global Durum Resource are available in GrainGenes (https://wheat.pw.usda.gov/GG3/global_durum_genomic_resources).
- The population genetic structure of TGC and GDP has been analysed by means of **ADMIXTURE**, **sNMF**, **PCA** and phylogenetic tree (NJ)
- Based on population structure results, a **Tetraploid Core Collection (TCC)** has been defined by **sampling pure representatives** of each population and subpopulations.
- GDP, TGC and TCC are being characterized in multi-environmental fields in various ways to dissect the QTLome for resistance to **yellow rust**, **leaf rust**, **soil-borne cereal mosaic virus (SBCMV)**, **root growth angle (RGA)** and **ear fertility** traits.

Results, Discussion and Conclusions

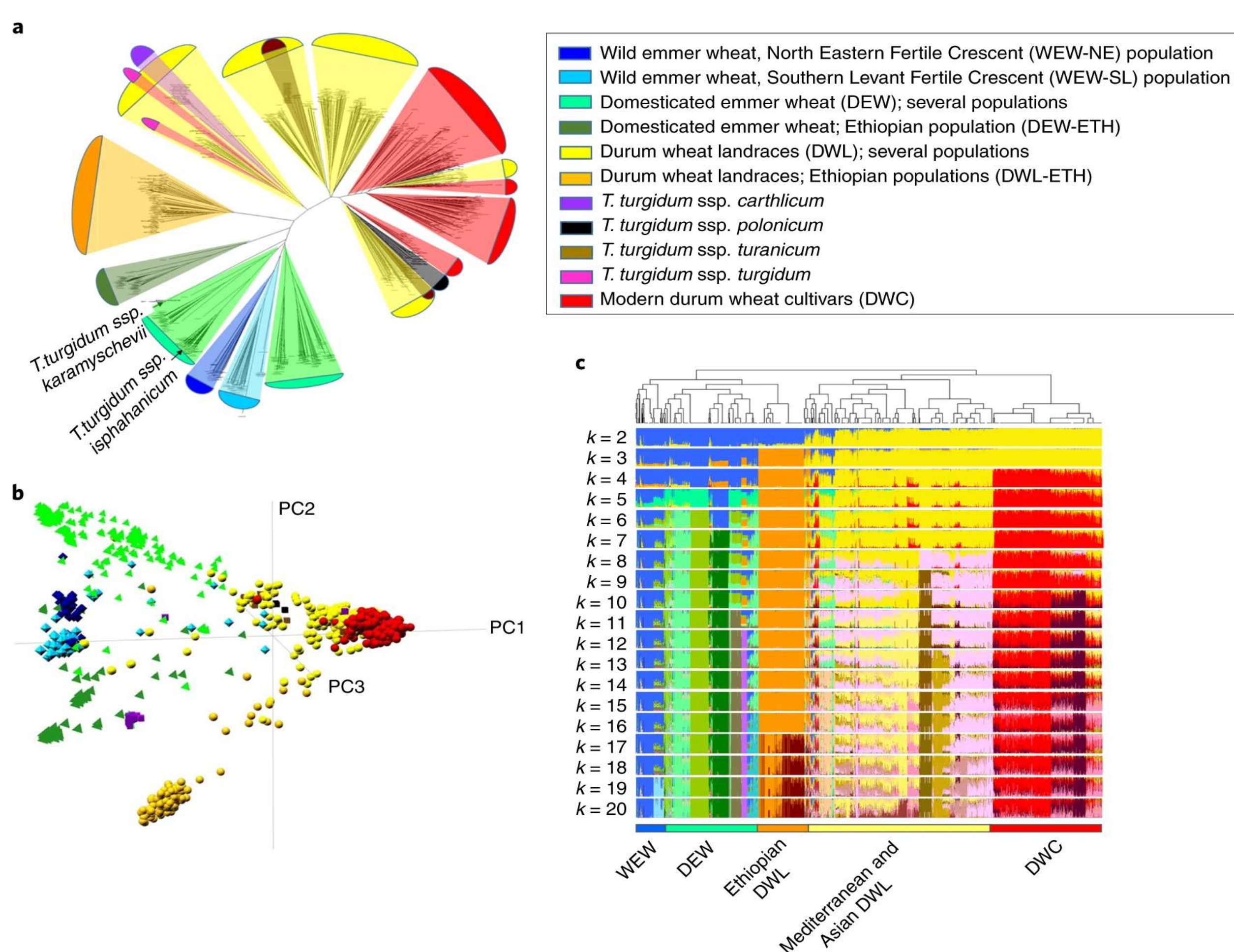


Figure 1. Tetraploid germplasm Collection (TGC) structure and phylogenetic relationships (Maccaferri *et al.* 2019)

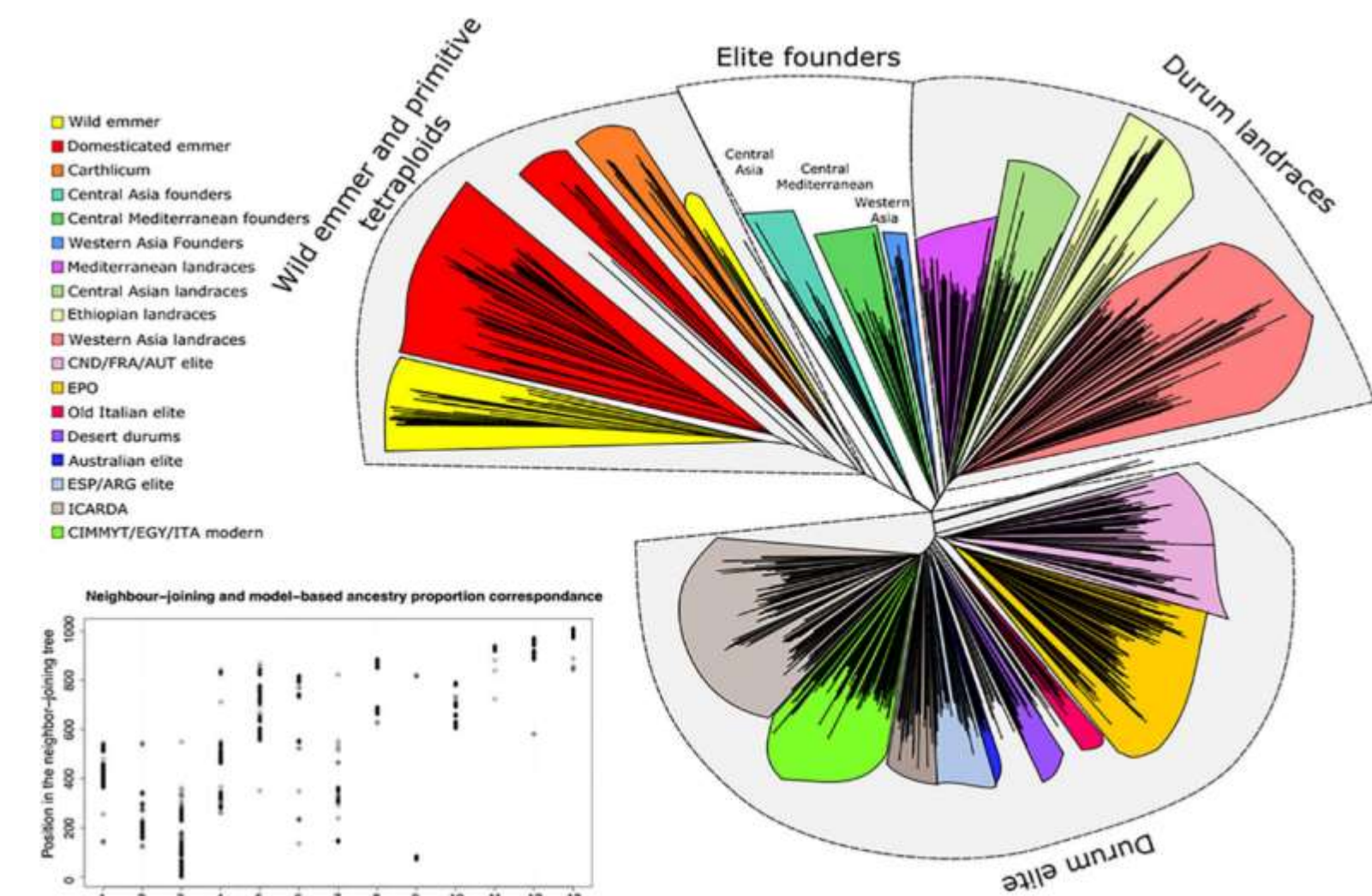


Figure 2. Global Durum Panel (GDP) structure and phylogenetic relationships (Mazzucotelli *et al.* 2020)

- The combined analysis of these resources allows us to define a Tetraploid Core Collection **organized on three priority levels** (gold, silver, and bronze).

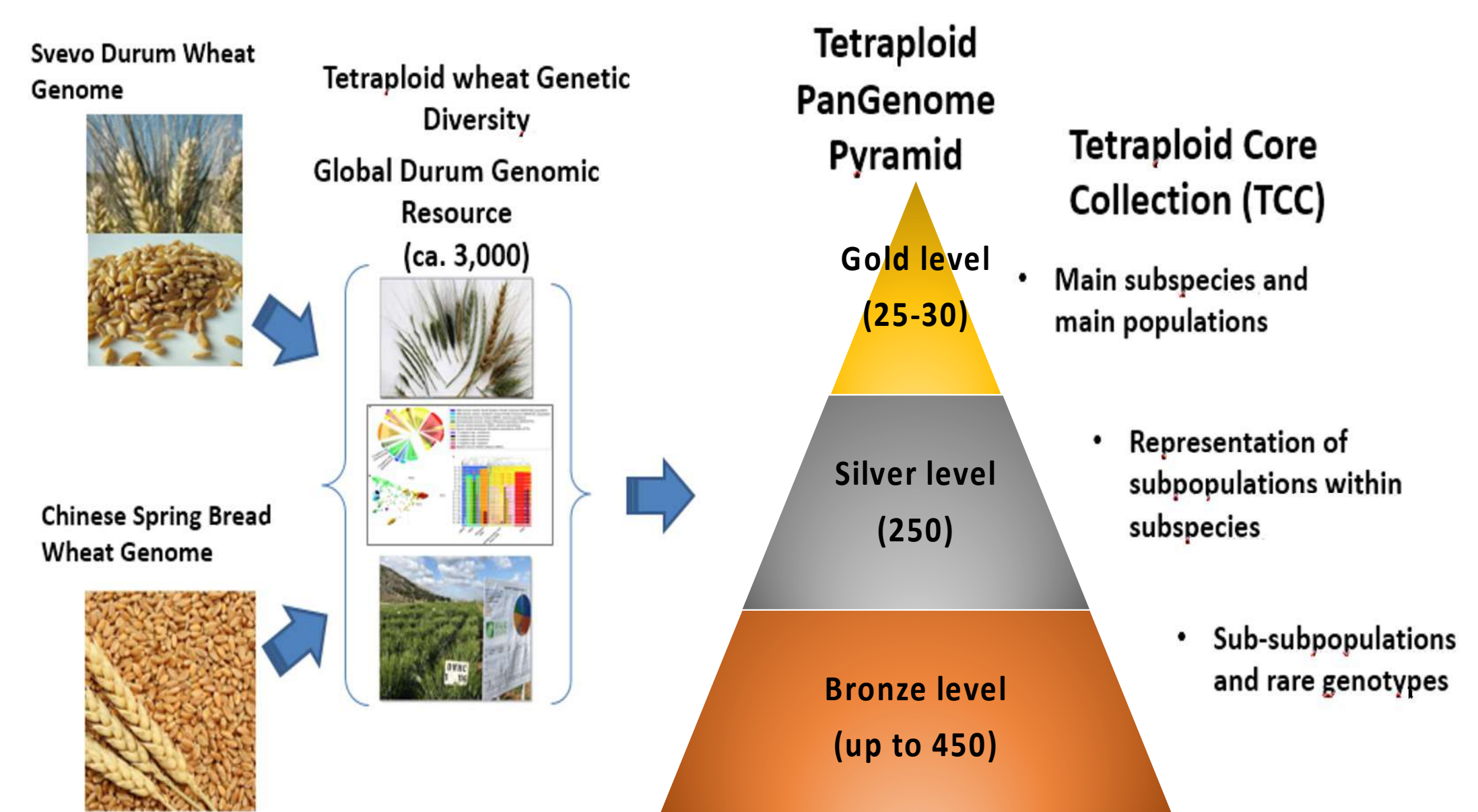
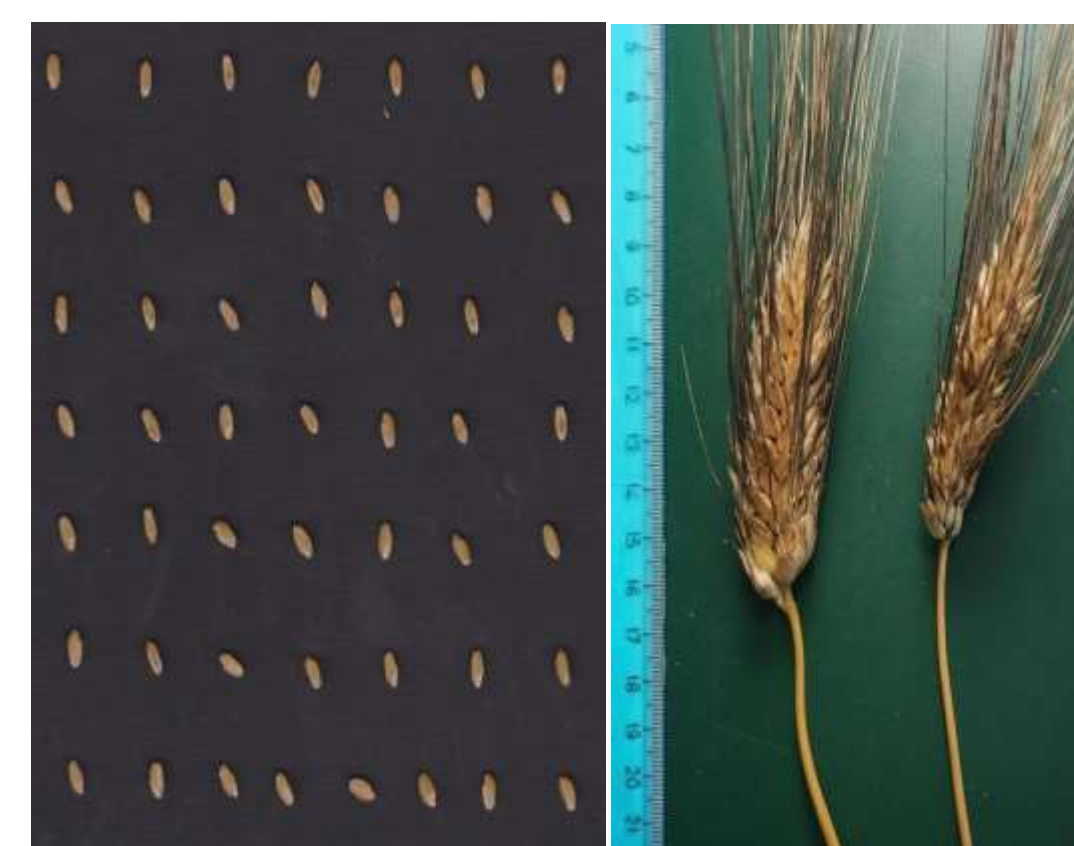


Figure 3. Tetraploid Core Collection and Tetraploid Pangenome pyramid diagram.



- We characterized TCC with **traits relevant** to adaptation to different **Mediterranean** and **Eurasian environments**, such as harvest date, peduncle length, flag leaf size and area, root and nodal traits, root growth angle, spike fertility traits, and traits of kernel weight and shape in **two nurseries** grown in Cadriano at the University of Bologna experimental farm.

- We therefore performed **trait analysis distribution** within and among populations and subpopulations based on population structure analysis and performed preliminary GWAS based on 90K and exome capture data.
- In summary, the Global Durum Resource offers unprecedented opportunities to make the most of the **native diversity** of the **A and B genomes** for the identification and dissemination of **new beneficial haplotypes** in both durum and soft wheat.

References

Maccaferri *et al.* Durum wheat genome highlights past domestication signatures and future improvement targets. Nature Genetics, 51, pages 885-895 (2019); Mazzucotelli *et al.* The Global Durum Wheat Panel (GDP): An International Platform to Identify and Exchange Beneficial Alleles. Front Plant Sci. 2020 Dec 21;11:569905. doi: 10.3389/fpls.2020.569905. PMID: 33408724; PMCID: PMC7779600.