Generating new wheat germplasm with enhanced drought/heat tolerance using AB genomes

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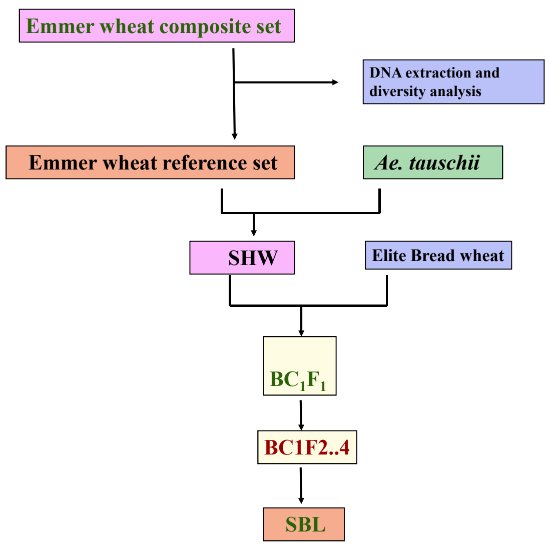

Fig.1. Development of Synthetic hybrid lines by using emmer wheat, *Triticum turgidum* L. subsp. *dicoccon* (Schrank) Thell.

Fig. 2. Measurement of morpho-physiological traits on the emmer wheat collection (leaf area, biomass)

Fig. 3. Variation in spike and seed morphology. Above, from left to right: Iranian, Serbian, Ethiopian (2 spikes), Moroccan and Tunisian, and Italian and Spanish forms Below: spike and seed of two Indian emmers

Synthetic hexaploid wheat to enhance the genetic diversity in wheat

Abiotic stresses such as drought, temperature, salinity, and nutrient imbalances reduce wheat (*Triticum* sp. L.) yield in many environments. To address this challenge we propose combining the use of new sources of novel genetic diversity and molecular markers to create new wheat germplasm as a potential source of drought and heat tolerance.

Synthetic hexaploid wheat, derived by crossing emmer wheat (*Triticum turgidum* L. subsp. *dicoccon* (Schrank) Thell. with *Aegilops tauschii* (donor of D genome of hexaploid wheat), provides new genetic variability for adaptation to drought, high temperature, salinity, water logging and soil micronutrient imbalances of bread wheat

Use of cultivated emmer and durum to develop new synthetic hexaploid wheat

Synthetic backcross lines generated using emmer based Synthetic Hybrid Wheat (SHW) showed higher yield under drought-prone conditions in Mexico, Pakistan and Eastern India compared to SBL generated using durum based SHW (Trethowan and Mujeeb-Kazi, 2008).

In this project (Fig.1) a large range of cultivated emmer wheats from different origins are being used as the female parents in the development of new SHW.

Describing diversity in cultivated emmer

A collection of 300 well-documented emmer wheat accessions originated from 35 countries, covering the area of distribution of the species, has been established. Morphological (plant, leaf and spike characteristics) and physiological traits (e.g., chlorophyll content, leaf temperature, specific leaf dry weight) were measured in greenhouse conditions at CIMMYT Mexico (Fig. 2). A large variation was observed for these traits, associated to geographical origin (Fig. 3). Accessions from India are very early, had high biomass and leaf area and long and fertile spikes. Accessions from Ethiopia are short-statured and showed a wide variation of forms. Genetic diversity is being analyzed using SSRs and DArT markers, allowing the establishment of a core set of around 100 genetically diverse and agronomically valuable accessions.

Development of emmer based synthetic hexaploid wheats

Around 100 genetically diverse emmer wheat accessions, with good agronomical performance will be crossed to three *Ae. tauschii* accessions already identified as having high crossability with AB genome, to produce new emmer based SHW (Fig. 4). Genetic diversity among these newly created SHW will be analysed and a core set of emmer based SHW will be established. These SHW will be crossed to elite varieties from CIMMYT, India and Pakistan to generate SBL that will be evaluated for drought and heat stress tolerance and made available to be used in wheat breeding. Double haploids will accelerate the production of SBL. The most diverse SHW (either emmer or durum based), and those already identified as drought or heat tolerant will be inter-crossed to combine their diversity.

This project will allow a better knowledge of the genetic diversity within *Triticum turgidum* L. subsp. *dicoccon* (Schrank) Thell and the development of a core-collection of cultivated emmer wheat, facilitating further evaluation and utilization by breeders. It will also permit to generate new bread wheat germplasm with enhanced genetic diversity and drought and heat tolerance.

Fig. 4. Spikes from emmer wheat ,*Ae. Tauschii* and emmer based SHW

References

Trethowan R.M., Mujeeb-Kazi A. (2008) Novel germplasm resources for improving environmental stress tolerance of hexaploid wheat Crop Science 48: 1255-1265.