# The conservation of precise genetic stocks in Europe

**Background**

The polyploid nature of *Triticum aestivum*, *T. turgidum* and other *Triticum* species has opened opportunities to develop basic resources for genetic analysis which are so crucial to advancement of research and genetic improvement of the crop. Indeed it has been extensively exploited to develop sets of lines through genomic manipulation to give a range of different types of stocks including intervarietal and interspecific translocations, chromosome and chromosome arm additions and deletions, chromosome and alien substitution – addition lines, mono- and polysomic series, point and other mutations, and synthetics involving species within the Triticeae. While this process has been more extensively developed in wheat, some types of genetic stocks have also been developed in barley and oat. These stocks have been essential to the development and understanding of the genetics of a polyploid species like wheat and have had significant impacts on wheat science and applied breeding worldwide for many decades. These genetic stocks will continue to be important for resistance breeding for abiotic and biotic traits associated with climate change. A survey for the preparation of the Global Wheat Conservation Strategy indicated that clients of wheat germplasm collections cited the conservation of wheat genetic stocks as a high priority. The issue also arose independently in the Global Barley Conservation Strategy and coordination in this area was also initiated.

These genetic stocks are the result of years of cytogenetic investigation. Proper recording and verification of the genetic descriptions and characterizations of these stocks can be problematic. Many of these stocks are prone to chromosomal instability and so require special conditions for the proper regeneration of genetically sound germplasm, including cytogenetic observation on individual regenerated plants. It is widely acknowledged that such specialist skills are becoming scarce as training in this area is no longer provided as part of the general undergraduate level training and the skills now reside in an alarmingly few centres in older staff where there is often inadequate succession management. These valuable wheat genetic stocks are often conserved under less than optimal conditions, often to-this-day in the laboratories, or the successor laboratories, of the original developer cytogeneticists. **Many of these stocks are thus in danger!**

Many stocks remain in private collections, their existence hidden, and their value to science and breeding obscured. Finally, due to the intimate relationship between the scientist and the wheat genetic stock germplasm they develop, full and proper recognition of intellectual oversight and ownership of this germplasm is particularly critical.

These genetic stocks can be classified in three categories:

- Conventional material including mapping populations (DH or RIL), isogenic lines for key genes, mutant population (TILLING populations) and mutant isogenics. The regeneration of this type of material needs selfing under bags and is thus time- and labour-consuming and results in an only very limited amount of seeds available for distribution.

- Material with alien chromatin including synthetics, amphiploids, alien additions, substitutions and translocations as well as alloplasmic lines. Precautions have to be taken during the regeneration of this not always very fertile material and self-pollination has to be carried out. In some cases, chromosome verification or counts are necessary.
- Aneuploids, including deletion lines, monosomics, ditelocentrics, double ditelocentrics, isochromosomes, trisomics, tetrasomics, nulli-tetrasomics, single chromosome substitution lines, recombinant chromosome substitution lines and intra-varietal translocation lines. The regeneration of this type of material necessitates very often cytogenetic observations and can only be carried out by specialized laboratories.

From an informal survey carried out for the Wheat Conservation Strategy of the Global Crop Diversity Trust, collections of precise genetic stocks were identified in eight European countries but significant repositories in other European countries have not responded yet.

The ECPGR Wheat Working Group decided during its meeting in Foça, Turkey in 2008 to prepare a report on the inventory of stocks in the public domain which are freely available and future options.

This inventory was carried out and replies were received from France, Germany, Israel, Netherlands, Romania, Switzerland and United Kingdom.

The precise genetic stocks conserved by the different countries are listed in Annexes I and II, according to whether they are maintained and available, as indicated by the responding institutes:

- Annex I: material secured by the respective holding institutes;
- Annex II: not secured material (unique material only).

Sometimes the same material is conserved in different institutes.

Several countries included in the inventory for the Wheat Conservation Strategy (http://www.croptrust.org/documents/cropstrategies/Wheat%20Strategy.pdf) are not yet included in this inventory (Bulgaria, Hungary, Italy, Kazakhstan and Russia) and this inventory has to be completed.

The importance of the material of Annex II has to be evaluated to determine what material has to be secured, and responsibilities have to be assigned for the maintenance of these stocks and ensuring their availability.

# Annex I. Precise genetic stocks secured and available for distribution

- **France**
  Pierre Sourdille, INRA UMR 1095, Genetics, Diversity and Ecophysiology of Cereals, Domaine de Crouël, 234 avenue du Brézet, 63100 Clermont-Ferrand (pierre.sourdille@clermont.inra.fr)

  RIL population, 1 set (Chinese Spring/Renan)

- **Germany**
  Andreas Börner, Institut für Pflanzengenetik und Kulturpflanzenforschung (IPK), Corrensstrasse 3, 6466 Gatersleben (boerner@ipk-gatersleben.de)

  2 sets of Single chromosome substitution lines, i.e. Chinese Spring/Synthetics and Cappelle Desprez/Bezostaya

  84 Wheat (Chinese Spring)/*Aegilops tauschii* introgression lines

  Long term storage of this material at -15°C is assured.

- **The Netherlands**
  Noor Bas, Centre for Genetic Resources, the Netherlands (CGN) Wageningen University and Research Centre, P.O. Box 16, 6700AA Wageningen (noortje.bas@wur.nl)

  22 accessions Synthetic amphiploids from crosses between *T. turgidum* subsp. *Dicoccoides* (female) and *Ae.squarrosa* (male)

- **Romania**
  Aurel Giura, Research Institute for Cereals and Industrial Crops, Fundulea (agiura@incda-fundulea.ro)

  - Monosomics: 2 sets in cv. Favorit and Bezostaia 1A. (Few seeds in both stocks).
  - Substitution lines: 1set Favorit / F.26-70. Not all lines verified for correctness of substitution.
  - Recombinant substitution lines (SCRL): 80 lines for chromosome 7B (Favorit / F26-70 7B)
  - Synthetic hexaploids: 28 (Winter wheat Romanian durum wheats / *Aegilops tauschii* of diverse geographic origins).
  - Alien additions: 2 lines Ad.503- Favorit / *Ae. triaristata*; Ad.533- Favorit / *Ae. triuncialis*.
  - Alien substitution: 1 line G.615- Favorit / *Ae. variabilis*.
  - Alien translocations: 2 lines G.613-Fundulea 132 / *Ae. comosa* and Fundulea 132 / *Ae. caudata*.
  - Mapping populations:
    - 80 DH-lines: Fundulea 132 / G.603 (grain weight / grain size)
    - 151 DH-lines: Fundulea DH-132 a selection for intergeneric crossability Martonvasari 9

- **Switzerland**
  Beate Schierscher, Agroscope Changins-Wädenswil ACW, Nyon (beate.schierscher-viret@acw.admin.ch)

  RIL populations, 2 sets (Arina/Forno, Forno/Oberkulmer).
  DH populations, 1 set (Toronit/211.12014)
  Two male sterile mutants of Probus (genetic, cytoplasmic)

- **United Kingdom**
  Steve Reader, John Innes Centre, Norwich Research Park, Colney, Norwich NR4 7UH (steve.reader@bbsrc.ac.uk)

  A summary of the material listed in the online database is given below. Detailed data are available from JIC's Web site (http://www.jic.ac.uk/GERMPLAS/prec_ce/).

  - Intervarietal Substitutions
    Bersée / Champlein Substitutions
    Bersée / Desprez 80
    Bersée / Koga II Substitutions
    Langdon / Chinese Spring Substitutions

  - Alien introductions
    *Aegilops bicornis*
      Holdfast / Aegilops bicornis Additions
      Holdfast / Aegilops bicornis Substitutions
    *Aegilops comosa*
      Avalon / Aegilops comosa Translocations
      Chinese Spring / Aegilops comosa Amphiploid
      Chinese Spring / Aegilops comosa Additions
      Chinese Spring / Aegilops comosa Substitutions
      Chinese Spring / Aegilops comosa Translocations
      Hobbit 'sib' / Aegilops comosa Additions
      Hobbit 'sib' / Aegilops comosa Substitutions
      Hobbit 'sib' / Aegilops comosa Translocations
      Mercia / Aegilops comosa Translocations
      Widgeon / Aegilops comosa Substitutions
    *Aegilops crassa 4x*
      ? / Aegilops crassa Translocations
    *Aegilops longissima*
      Chinese Spring / Aegilops longissima Amphiploid
      Chinese Spring / Aegilops longissima Additions
      Chinese Spring / Aegilops longissima Substitutions
    *Aegilops mutica*
      Chinese Spring / Aegilops mutica Amphiploid
      Chinese Spring / Aegilops mutica Additions
    *Aegilops sharonensis*
      Brigand / Aegilops sharonensis Additions
      Brigand / Aegilops sharonensis Substitutions
      Chinese Spring / Aegilops sharonensis Amphiploid
      Chinese Spring / Aegilops sharonensis Additions
      Chinese Spring / Aegilops sharonensis Substitutions
      Selkirk / Aegilops sharonensis Additions
    *Aegilops sharonensis* + *Secale cereale*
      Chinese Spring Double Alien Additions

*Aegilops speltoides*
- Wembley / Aegilops speltoides Translocations

*Aegilops triuncialis*
- Chinese Spring / Aegilops triuncialis Additions

*Aegilops umbellulata*
- Chinese Spring / Aegilops umbellulata Amphiploid
- Chinese Spring / Aegilops umbellulata Additions
- Chinese Spring / Aegilops umbellulata Substitutions

*Aegilops umbellulata + Ae sharonensis*
- Chinese Spring Double Alien Substitutions

*Aegilops uniaristata*
- Chinese Spring / Aegilops uniaristata Additions
- Chinese Spring / Aegilops uniaristata Substitutions
- Chinese Spring / Aegilops uniaristata Translocation

*Aegilops variabilis*
- Chinese Spring / Aegilops variabilis Additions
- Chinese Spring / Aegilops variabilis Substitutions

*Aegilops ventricosa*
- Moisson / Aegilops ventricosa Additions

*Dasypyrum villosum (Haynaldia villosa)*
- Chinese Spring / Dasypyrum villosum Additions
- Chinese Spring / Dasypyrum villosum Translocations
- Creso / Dasypyrum villosum Additions

*Hordeum chilense*
- Chinese Spring / Hordeum chilense Amphiploid
- Chinese Spring / Hordeum chilense Additions
- Chinese Spring / Hordeum chilense Substitutions
- Chinese Spring / Hordeum chilense Translocations
- Hobbit 'sib' / Hordeum chilense Substitutions
- Moulin / Hordeum chilense Substitutions

*Hordeum vulgare*
- Chinese Spring / Hordeum vulgare Additions
- Chinese Spring / Hordeum vulgare Substitutions

*Secale cereale*
- Chinese Spring / Secale cereale Amphiploids
- Chinese Spring / Secale cereale Additions
- Chinese Spring / Secale cereale Substitutions
- Chinese Spring / Secale cereale Translocations
- Holdfast / Aegilops bicornis Additions
- Holdfast / Secale cereale Amphiploid
- Holdfast / Secale cereale Additions
- Holdfast / Secale cereale Substitutions

*Secale montanum*
- Chinese Spring / Secale montanum Amphiploid
- Chinese Spring / Secale montanum Additions
- Chinese Spring / Secale montanum Substitutions

*Thinopyrum bessarabicum*
- Chinese Spring / Thinopyrum bessarabicum Amphiploid
- Chinese Spring / Thinopyrum bessarabicum Additions
- Chinese Spring / Thinopyrum bessarabicum Substitutions
- Chinese Spring / Thinopyrum bessarabicum Translocations

*Thinopyrum elongatum*
Chinese Spring / Thinopyrum elongatum Amphiploid
Chinese Spring / Thinopyrum elongatum Additions
*Thinopyrum intermedium*
? / Thinopyrum intermedium Additions
Courtot / Thinopyrum intermedium Substitutions
Novi Sad 60 / Thinopyrum intermedium Additions
Panoniya / Thinopyrum intermedium Additions
Vilmorin 27 / Thinopyrum intemedium Substitutions
Vilmorin 27 / Thinopyrum intermedium Amphiploid
Vilmorin 27 / Thinopyrum intermedium Additions
*Triticum urartu*
Chinese Spring / Triticum urartu Additons
Chinese Spring / Triticum urartu Substitution

- Aneuploid stocks
Cappelle
Cappelli
Chinese Spring
Holdfast
Maris Nimrod
Norstar
Wembley

## Annex II. Not secured precise genetic stocks

- **France**
  Pierre Sourdille
  INRA UMR 1095, Genetics, Diversity and Ecophysiology of Cereals, Domaine de Crouël, 234 avenue du Brézet, 63100 Clermont-Ferrand (pierre.sourdille@clermont.inra.fr)

  DH lines, Chinese spring x Courtot Size 230; Euréka x Renan Size 153; SSD, MP98 x Courtot Size 603

  Monosomics: Courtot size 20

  Single chromosome substitution lines:
  - Parental background: Courtot Size 6. Substituted chromosomes: Groups 1 and 6. Donor parents: Azteca, Cappelle, Magdalena, Magnif 27, Prinqual, Vilmorin 23.
  - Parental background: Courtot Size 2. Substituted chromosomes: 5B. Donor parents: Fukuokomugi, Norin 29.

  Mutant population (gamma irradiation). Parental background: *Triticum aestivum* cv. Renan. Size: 4400 M2 lines, 2000 M4 lines.

  Mutant population (EMS) Parental background: *Triticum monococcum* landrace Pays de Sault. Size: 2000 M2 lines

- **Israel**
  Hanan Sela, Institute for Cereal Crops Improvement (ICCI), Tel Aviv University, PO Box 39040, Tel Aviv 69978 (hans@tauex.tau.ac.il)

  The precise genetic stocks are maintained in the Department of Plant Sciences, the Weizmann Institute of Science, Rehovot collection. The owner is Prof. M. Feldman (moshe.feldman@weizmann.ac.il). Distribution of the material is limited to few samples.

  The whole monosomic series of Mara, some nullisomic lines (that are viable), Trisomic lines (of the durum cv. LD222), Ditelosomic lines (Bethlehem - only for A and B genomes), Double ditelosomic lines (Langdon durum), Double ditelosomic rye

  Intervarietal disomic substitution lines in CS (Chinese Spring) (for cvs. Hope, Timstein, Thatcher, Red Egyptian, Cheyyen and Atlas66) and in Wichita (for Cheyyen)

  Disomic addition lines in CS (of *Ae. umbellulata, Ae. variabilis, Ae. searsii, Ae. longissima, Ae. ventricosa*) and ditelosomic addition lines (of *Ae. variabilis and Ae. searsii*)

  Disomic substitution lines in CS (of *T. timopheevii, Ae. speltoides, Ae. longissima, Ae. umbellulata, Ae. comosa, Ae. variabilis and Ae. searsii*)