Moving Wheat to the Cutting edge of Innovation
IWGSC and BreedWheat

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Coordinating Global Research for Wheat
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An international partnership for Wheat Improvement Research

- A framework to identify synergies and facilitate collaborations for wheat improvement at the international level
- Created in 2011 following endorsement by G20 Agriculture Ministries to improve food security

Why Wheat?

- The world’s most important food crop
- Provides 20% of all calories and 20% of all protein in developing and developed countries

but

- Wheat production has not always met demand in previous years
- Demand will increase by 60% in 2050/2010, while yields are stagnating and resources are declining
- Investment in wheat R&D is disproportionally low given the important of the crop
Wheat Initiative Vision and Mission

- **Vision:**
  a vibrant global wheat research community sharing resources, capabilities, data and ideas to improve wheat land productivity, quality and sustainable production

- **Mission:**
  develop a global Strategic Research Agenda and support its implementation through coordinated actions, knowledge and resource sharing and efficient investment

All countries and companies welcome!

16 countries, 9 private companies, 2 CGIAR Centres
Facilitating delivery by leveraging synergies and collaborations

**Expert Working Groups**

**Established**
- Wheat Information System
- Genetics and Genomics of Durum Wheat
- Wheat Breeding Methods and Strategies
- Wheat Phenotyping to Support Wheat Improvement
- Wheat Plant and Crop Modelling

**Newly approved**
- Control of wheat pathogens and pests
- Adaptation of wheat to abiotic stress
- Genetic resources
- Nutrient use efficiency
- Quality and safety

**Under development**
- Agronomy
Facilitating access to wheat scientific data

Wheat Information System

Bioinformatics experts from 7 countries & CIMMYT working together to develop the WheatIS

Supporting the completion of the reference wheat genome sequence

- Creation of an IWGSC-ICC taskforce
- Additional funds raised in several member countries and companies through joint efforts
Jean-Yves FOUCALUT
Président

International Wheat Genome Sequencing Consortium

2005 - 2015

IWGSC 2005

KANSAS WHEAT
K-STATE

2 sponsors
3 institutes

5 members
3 countries
**Goal**
- Lay a foundation to accelerate wheat improvement
- Increase profitability throughout the industry

**Vision**
- High quality annotated genome sequence, comparable to rice genome sequence
- Physical map-based, integrated and ordered sequence

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**The bread wheat genome is......a challenge**

- **Allohexaploid**
- **Large: 17 Gb**
- **80-90% of TEs and repeats**
- **> 50% of non recombinogenic regions**
Roadmap to the Wheat Genome Sequence

Physical mapping of individual chromosomes

Survey sequencing of individual chromosomes

Short term
Gene catalog
Virtual order
Markers

MTP sequencing

Long term

A reference sequence anchored to the genetic and phenotypic maps
Progress towards completion of Bread Wheat Projects

*Flags represent countries where work is underway with funding, as of March 2015.

IWGSC Reference*

16 chromosomes completed and 5 almost finished

1 chromosome completed, 13 underway, funding sought for 7

Still needed: €11.5 million to complete the entire project

Funding Sources

Funding provided so far for IWGSC projects to generate physical maps, survey sequences and BAC-based reference sequences for bread wheat.

Total: €50 million
Breeding for economically and environmentally sustainable wheat varieties: An integrated approach from genomics to selection

Jacques Le Gouis (INRA)
Emmanuelle Lagendijk (INRA)
BreedWheat Project Structure

WP1: Sequencing and marker development for high throughput genotyping and candidate genes isolation (E. Paux, INRA)

Sequencing (1B, WGS, trait-associated contigs)

Marker development (Genes, intergenic regions, ISBPs)

Genotyping Mapping (WP1, 2, 3, 4)

WP2: Genetics and ecophysiology of wheat adaptation to biotic and abiotic stress in the frame of sustainable agricultural systems and climate change

WP3: Characterization and exploitation of natural genetic variability

WP4: Design, implementation and evaluation of novel breeding strategies

WP5: Bioinformatic tools for data integration and dissemination

WP6: Dissemination, technology transfer & training

WP7: Management

WP8: Farmers

WP9: Breeders

WP10: Scientists

WP11: Consumers

The BreedWheat TaBW420K SNP array
WP2: Genetics and ecophysiology of wheat adaptation to biotic and abiotic stress (S. Lafarge, Biogemma)

**Our Targets:**
- Nitrogen Use Efficiency
- Grain protein composition
- Water use efficiency
- Heat stress
- Diseases resistance

**Our Tools:**
- Modelling/Innovative phenotyping
- Candidate genes identification
- Field Trials
- GWAS

**Our Results:**
- Candidate genes identification in NUE and heat stress tolerance
- Phenotyping: 3 years – 25 trials
- GWAS with 92k SNPs from WP1
- Modelling of plant canopy architecture and derived variables (green fraction)

WP3: Characterization and exploitation of natural genetic variability (A. Murigneux, Limagrain)

**Characterization** of 5’000 wheat lines from INRA collection

**Identification** of new sources for abiotic stress tolerance

- Introduction into French germplasm

- Creation of nine advanced-backcross populations using drought/heat tolerant lines
- BC1S5 available for field phenotyping in years 7-8
WP4: Design, implementation and evaluation of novel breeding strategies (G. Charmet, INRA)

Integrated statistical tools for molecular breeding
Development of real size breeding programs
Evaluation of new ideotypes in sustainable systems
Economic impact of new breeding models
Sociologic approach of genotyping data production

WP5: Bioinformatics (N. Rivière, BioGemma)

BW information system
Specific development
Data integration

First data integrated
- 471,000 SNP (WP1)
- 100,000 field datapoints (WP2)
- 5,000 genetic resources passport data (WP3)
WP6- Dissemination, and Technology transfer
(G. Berthe, Céréales Vallée)

Public web site: http://www.breedwheat.fr/

Posters and brochures (English & French)

Newsletters

Articles

Training

Conferences

International Wheat Innovation Conference

Interaction with other projects/ initiatives
Raising the profile of wheat and working together to add value for all

Funders
Research providers
Research programmes
Delivery of research outcomes