Exploiting the INRA bread wheat collection to sample accessions used in French BREEDWHEAT project

Audrey DIDIER, Marion DELOCHE, Lionel BARDY and François BALFOURIER

INRA, Genetic, Diversity and Ecophysiology of Cereals (GDEC)
Clermont-Ferrand - FRANCE

Eucarpia Genetic Resources section meeting: Pre-breeding – fishing in the gene pool
June 11-13, 2013 (Alnarp, Sweden)
What is BREEDWHEAT project?

Breeding for economically and environmentally sustainable wheat varieties: integrating approach for genomics to selection

Develop tools
- sequence-based tool box for the wheat genome,
- exploit and develop new capabilities for phenotyping

Outcomes
- to understand the genetic and ecophysiological basis of key traits (abiotic and biotic stress tolerance, yield components and quality),
- to use genetic resources to increase allelic variability in the elite gene pool,
- to develop and deploy new breeding methods
WP1: Sequencing and marker development for high throughput genotyping and candidate genes isolation

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 and induced genetic variability

WP4: design, implementation and evaluation of novel breeding strategies

WP5: Bioinformatic tools for data integration and dissemination

WP6: Outreach

WP7: Management

Farmers  Breeders  Consumers  Scientists

Eucarpia Genetic Resources section meeting: Pre-breeding – fishing in the gene pool - June 11-13, 2013
Exploiting the INRA bread wheat collection to introduce new diversity into the French elite germplasm
Objectives

➢ To selected a bread wheat sample of 4600 accessions

➢ To analyze genetic diversity within the sample in order to define two sub-samples for further associations

Panel 1: abiotic stress
Panel 2: biotic stress
Eucarpia Genetic Resources section meeting: Pre-breeding – fishing in the gene pool - June 11-13, 2013
Available data on whole INRA bread wheat collection

- **Passport data**
  - Geographical origin (country, region, state…)
  - Status (landraces, breeding lines, cultivars, elite lines)
  - Registration period
  - Habit (Winter, Spring or Alternative type)
  - Pedigrees

- **Molecular data**
  - 42 SSR on 4000 accessions
Temporal wheat genepool structure

- Landraces
  - 1840-1930
  - 1930-1945
  - 1945-1960
  - 1960-1970
  - 1970-1980
  - 1980-1990
  - 1990-2000

1st bottleneck related to first breeding programs

- Cultivars selected before the 60’s

2nd bottleneck due to “green revolution” process

- Cultivars selected after the 60’s

(Roussel et al, TAG, 2004,2005)
Worlwide wheat genepool structure

6 geographical groups
North-West Europe
South-East Europe + North America
Mediterranean
Middle East and Central Asia
South America + Africa
Eastern Asia

NJ tree on Cavalli-Sforza and Edwards distance
(Balfourier et al, TAG 2007)

Eucarpia Genetic Resources section meeting: Pre-breeding – fishing in the gene pool - June 11-13, 2013
Sampling Constraints

- Optimal worldwide diversity mainly based on available passport data
- Balanced sample size between countries, regions, registration periods, ... in order to reflect genetic structure
- Availability of seeds samples
Eucarpia Genetic Resources section meeting: Pre-breeding – fishing in the gene pool - June 11-13, 2013
Breedwheat sample

Eucarpia Genetic Resources section meeting: Pre-breeding – fishing in the gene pool - June 11-13, 2013
2329 accessions

North-West Europe
1431
South-East Europe
633
Mediterranean
265

32 countries

Eucarpia Genetic Resources section meeting: Pre-breeding – fishing in the gene pool - June 11-13, 2013
Russian Federation

150 acc. (121 Western + 29 Asian)
28 different regions represented
550 accessions
29 different American states + 5 Canadian provinces

Eucarpia Genetic Resources section meeting: Pre-breeding – fishing in the gene pool - June 11-13, 2013
Eucarpia Genetic Resources section meeting: Pre-breeding – fishing in the gene pool - June 11-13, 2013

319 accessions
14 countries
214 accessions

22 countries

Eucarpia Genetic Resources section meeting: Pre-breeding – fishing in the gene pool - June 11-13, 2013
Eucarpia Genetic Resources section meeting: Pre-breeding – fishing in the gene pool - June 11-13, 2013
Eucarpia Genetic Resources section meeting: Pre-breeding – fishing in the gene pool - June 11-13, 2013
Breedwheat sample

Growth type

- Spring: 37%
- Intermediate: 3%
- Winter: 57%
- Unknown: 10%

Pedigrees

- Available pedigree: 90%
- Unknown: 10%

Status

- Landrace: 763
- Registered: 3360
- Unknown: 477
- Registered: 73%

Eucarpia Genetic Resources section meeting: Pre-breeding – fishing in the gene pool - June 11-13, 2013
Breedwheat sample
763 landraces

Europe: 272 in 27 different countries

Asia: 353 in 33 different countries and 20 Chinese provinces
Breedwheat sample Registration period

Eucarpia Genetic Resources section meeting: Pre-breeding – fishing in the gene pool - June 11-13, 2013
Conclusions

The composition of this balanced sample (in terms of geographical origins, registration period, status) should permit to answer both to:

- **Breedwheat aims:**
  - A worldwide diversity analysis of bread wheat species
  - Two adapted panels for further associations analyses

- **Diverse populations genetic analyses using deliverable molecular data**
  - Multiple comparison of genetic diversity evolution (between countries, between region within country, between registration periods, between breeders, …)
  - Ecogeographical structure of diversity at different scale
Thanks for your attention!

Eucarpia Genetic Resources section meeting: Pre-breeding – fishing in the gene pool - June 11-13, 2013
# Breedwheat sample / registration period

<table>
<thead>
<tr>
<th>Region</th>
<th>unknown</th>
<th>landrace</th>
<th>&lt;1930</th>
<th>30'</th>
<th>40'</th>
<th>50'</th>
<th>60'</th>
<th>70'</th>
<th>80'</th>
<th>90'</th>
<th>total</th>
</tr>
</thead>
<tbody>
<tr>
<td>France</td>
<td>41</td>
<td>105</td>
<td>48</td>
<td>52</td>
<td>49</td>
<td>52</td>
<td>85</td>
<td>80</td>
<td>80</td>
<td>88</td>
<td>680</td>
</tr>
<tr>
<td>Europe without France</td>
<td>113</td>
<td>137</td>
<td>108</td>
<td>63</td>
<td>56</td>
<td>126</td>
<td>166</td>
<td>262</td>
<td>277</td>
<td>220</td>
<td>1528</td>
</tr>
<tr>
<td>Russia</td>
<td>12</td>
<td>30</td>
<td>13</td>
<td>6</td>
<td>4</td>
<td>13</td>
<td>10</td>
<td>22</td>
<td>20</td>
<td>20</td>
<td>150</td>
</tr>
<tr>
<td>USA</td>
<td></td>
<td></td>
<td>9</td>
<td>46</td>
<td>18</td>
<td>20</td>
<td>27</td>
<td>48</td>
<td>103</td>
<td>64</td>
<td>65</td>
</tr>
<tr>
<td>CAN</td>
<td>2</td>
<td>2</td>
<td>24</td>
<td>6</td>
<td>7</td>
<td>10</td>
<td>11</td>
<td>22</td>
<td>38</td>
<td>28</td>
<td>150</td>
</tr>
<tr>
<td>South America</td>
<td>31</td>
<td>40</td>
<td>7</td>
<td>19</td>
<td>11</td>
<td>37</td>
<td>57</td>
<td>56</td>
<td>50</td>
<td>11</td>
<td>319</td>
</tr>
<tr>
<td>CHN</td>
<td>103</td>
<td>107</td>
<td>0</td>
<td>1</td>
<td>3</td>
<td>28</td>
<td>73</td>
<td>50</td>
<td>23</td>
<td>12</td>
<td>400</td>
</tr>
<tr>
<td>Asia without China</td>
<td>126</td>
<td>246</td>
<td>13</td>
<td>36</td>
<td>28</td>
<td>15</td>
<td>38</td>
<td>33</td>
<td>25</td>
<td>19</td>
<td>579</td>
</tr>
<tr>
<td>Australia</td>
<td>8</td>
<td>0</td>
<td>26</td>
<td>5</td>
<td>8</td>
<td>6</td>
<td>13</td>
<td>15</td>
<td>51</td>
<td>18</td>
<td>150</td>
</tr>
<tr>
<td>New Zealand</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Africa</td>
<td>41</td>
<td>87</td>
<td>5</td>
<td>6</td>
<td>10</td>
<td>6</td>
<td>38</td>
<td>12</td>
<td>7</td>
<td>2</td>
<td>214</td>
</tr>
<tr>
<td>Total</td>
<td>477</td>
<td>763</td>
<td>293</td>
<td>214</td>
<td>199</td>
<td>322</td>
<td>539</td>
<td>659</td>
<td>644</td>
<td>490</td>
<td>4600</td>
</tr>
</tbody>
</table>