Identification of new set of genotypes of tritordeum for cultivation

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Objectives
The CerealMed research project (Enhancing diversity in Mediterranean cereal farming systems 2020-2023) includes 11 research partners around the Mediterranean basin (Egypt, Greek, Italy, Lebanon, Morocco, Turkey and Spain). The main scope of Cerealmed is to develop a biodiversity based agriculture system to secure the production of staple foods in the scenario of future climate changes. In this context, one of the specific objectives if the development of new genotypes of tritordeum, the amphiploid derived from the cross between the wild barley Hordeum chilense Roem. et Schultz. and durum wheat.

Methods
- Starting material: 20 advanced breeding lines.
- Multi-local field trials for agronomy and quality traits (yellow index, grain protein, β-glucan content).
- Genotyping → Chromosome constitution
- Eight selected lines for further testing (3.6 m² plots).

Results & discussion
The tritordeum breeding lines were genotyped using chromosome specific molecular markers to investigate their chromosome constitution (Table 1). Seven of them carried the full chromosome complement from H. chilense while the rest carried at least one chromosome substitution involving chromosomes 2H and/or 5H. These chromosome substitutions are related to free threshing ability and they are derived from a tritordeum/common wheat crossing program performed at IAS-CSIC (Atienza et al. 2007, doi:10.1139/G07-081).

Table 1. Chromosome constitution of tritordeum lines by genotyping

<table>
<thead>
<tr>
<th>Type of chromosome substitution¹</th>
<th>None</th>
<th>(2H⁴)/2D</th>
<th>(5H⁴)/SD</th>
<th>(2H⁴)/2D+(5H⁴)/5D</th>
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<tbody>
<tr>
<td>HTC 10.16</td>
<td>HTC 28.15</td>
<td>HTC 30.13</td>
<td>HT 515</td>
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<td>HTC 48.15</td>
<td>HTS11</td>
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<td>HTC 55.17</td>
<td>HT 518</td>
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<tr>
<td>HT 520</td>
<td>HT 517</td>
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<tr>
<td>HTC 26.11</td>
<td>HTC 38.17</td>
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<td>Aucan*</td>
<td>HTC 58.16</td>
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</table>

¹Complete HT lines carry all 7 chromosomes from H. chilense. ‘Aucan’ is a registered tritordeum variety used as control. In bold, tritordeum lines selected for the second season.

After one season field trial, 8 lines were selected (Table 1, in bold) for further study in small plots (3,6 m²) in Spain and Italy (Figure 1). In Spain, the line HTS20 outperformed ‘Aucan’, the first tritordeum variety, while other lines obtained similar yields (in orange, Fig. 2 left). At Italy, HTS14, HTCS8.16 and HTS15 showed the best yield performance (Fig. 2, right). However, HTS15 showed poor performance at Córdoba which indicates the existence of important genotype × environment interaction.

Independent results at Escacena (Seville, Spain) showed the tritordeum lines yielded less than durum wheat but outperformed ‘Aucan’ in terms of yield (Figure 3).

Conclusions
The advanced breeding lines have potential to become new varieties of tritordeum. The chromosome substitutions (2H⁴, 5H⁴) still play an important role for free threshing ability in tritordeum breeding program.

Figure 1. Selected field trial plots during second season at Santeda (Spain). April 19, 2022.

Figure 2. Comparative performance of tritordeum lines in Santeda (Spain) (up) and Fiorenzuola d’Arda (Italy) (down).

Figure 3. Comparative performance of tritordeum advances lines (Green), ‘Aucan’ (HT registered) (yellow) and durum wheat (orange) at Escacena (data kindly supplied by Dr. I. Solis, Agrovegetal).

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