Differential germination in seeds produced in apical and basal fruits of two *Thlaspi arvense* populations

Edo-Tena E; Olalla I; Torra J; Gesch RW; Royo-Esnal A
Introduction

**Thlaspi arvense:**
Rare weed in Spain
Potential oilseed crop, biofuel

**Position on the mother plant:**
Affects dormancy level of the seeds (Baskin & Basking, 1998)
Affects oil content of seeds (Matthies, 1990)
The mother plant effect is related to the growing conditions where seeds were produced.

**Objective**
To study the germination percentages and rates of seeds produced in the apical and basal fruits of the infructescences on two *T. arvense* accessions, grown in the same fields in Lleida (Spain) and in Morris (USA)
Material and Methods
Apical fruits

Morris
- Teruel Apical
- Teruel Basal
- Minnesota Apical
- Minnesota Basal

Almenar
- Teruel Apical
- Teruel Basal
- Minnesota Apical
- Minnesota Basal

Basal fruits

Photo from Dr. Clinton Shock
Germination chamber, darkness
21 days
Daily sampling of germinated seeds

Total germination (ANOVA)
Germination rates (Boltzmann, GDD)
Estimation of $T_{50}$ and $1/T_{50}$ for $T_b$. 
Boltzmann function

\[ Y = \frac{A}{1 + e^{(2 \times \ln(9) \times (T_{50} - \text{GDD})/B)}} \]

A = maximum germination
T_{50} = GDD from sowing to 50% germination
B = GDD from 10 to 90% of maximum germination
Results

Seeds produced in Morris

Seeds produced in Almenar
Germination rates over time and GDD

Seeds from Teruel accession produced in Morris

Germination over time

Germination over GDD

Thlaspi arvense - APICAL

Thlaspi arvense - BASAL

Thlaspi arvense (Teruel) - BASAL
### Boltzmann function for seeds germinated at 8ºC

<table>
<thead>
<tr>
<th>Site</th>
<th>Accession</th>
<th>Seed type</th>
<th>A</th>
<th>B</th>
<th>T&lt;sub&gt;50&lt;/sub&gt;</th>
<th>P&lt;0.01</th>
</tr>
</thead>
<tbody>
<tr>
<td>Almenar</td>
<td>Teruel</td>
<td>Apical</td>
<td>4.3 ± 0.22</td>
<td>44.3 ± 12.55</td>
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<td>21.1 ± 0.23</td>
<td>37.5 ± 2.76</td>
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<td>Teruel</td>
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Most differences were due to parameter A (total germination), where most significant differences appeared between sites.
Boltzmann function for seeds germinated at 8ºC

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No statistical differences in parameter B in any of the comparisons:
- Seed type: Apical = Basal in Almenar and in Morris
- Accession: Teruel = Minnesota in Almenar and in Morris
- Site: Almenar = Morris in apical and basal seeds
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Differences in parameter T<sub>50</sub> were not very clear, although apical seeds tend to germinate earlier than basal ones, except in the Morris produced Minnesota seeds.

In general, Almenar produced seeds need less GDD for germination.
Estimation of base temperature ($T_b$)

Seeds produced in Morris

Thlaspi arvense (Teruel)

Temperature (ºC)

$\frac{1}{T_{50}}$

$y = 0.0167637x - 0.0216441$

$R^2 = 0.974826$

$y = 0.0149513x - 0.0241647$

$R^2 = 0.96538$

Thlaspi arvense (Minnesota)

Temperature (ºC)

$\frac{1}{T_{50}}$

$y = 0.018948x - 0.0471963$

$R^2 = 0.980424$

$y = 0.0166587x - 0.0355328$

$R^2 = 0.9745$

Seeds produced in Almenar

Thlaspi arvense (Teruel)

Temperature (ºC)

$\frac{1}{T_{50}}$

$y = 0.0202413x - 0.0613791$

$R^2 = 0.822362$

$y = 0.0156489x - 0.0370415$

$R^2 = 0.78706$

Thlaspi arvense (Minnesota)

Temperature (ºC)

$\frac{1}{T_{50}}$

$y = 0.0153218x - 0.0264651$

$R^2 = 0.879277$

$y = 0.0147993x - 0.0302552$

$R^2 = 0.770057$
Conclusions

Dormancy levels clearly differ between apical and basal seeds due to maternal influence when seeds were produced in Almenar (Mediterranean climate), where seeds produced first acquired a stronger inherit dormancy.

Higher germination percentages were obtained in seeds produced at Morris, and differences between populations were also relevant, which suggests better places for seed production in order to produce seeds for cropping and that some accessions might be more amenable for cultivation.
What happened in the field?
What happened in the field?

<table>
<thead>
<tr>
<th>Season</th>
<th>Accession</th>
<th>Almenar (Lleida)</th>
<th>Morris (Minnesota)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>%CE aut-wint</td>
<td>%CE spring</td>
</tr>
<tr>
<td>2011-12</td>
<td>Teruel</td>
<td>0.7</td>
<td>4.3</td>
</tr>
<tr>
<td>2011-12</td>
<td>Minnesota</td>
<td>2.1</td>
<td>2.2</td>
</tr>
<tr>
<td>2012-13</td>
<td>Teruel</td>
<td>0.2</td>
<td>19.2</td>
</tr>
<tr>
<td>2012-13</td>
<td>Minnesota</td>
<td>17.9</td>
<td>50.9</td>
</tr>
</tbody>
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Future considerations

There certainly are better accessions or places than others for seed production in *T. arvense*, but we still have to deepen in these studies to clear up these contradictory results.

We must be very careful extrapolating lab results to the field. Field conditions have the last word.
Thank you very much!!!
Merci beaucoup!!!

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