Optimal conditions for lettuce seed germination tests

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Prescribed germination methods for lettuce

- **Substrate**
  - TP; BP

- **Temperature**
  - 20°C

- **Duration**
  - First count: 4 days
  - Final count: 7 days

- **Method for breaking dormancy**
  - Pre-chilling
Lettuce seedlings

- Normal seedling with no necrosis
- Normal seedling with small necrosis on cotyledons
- Abnormal seedling with necrosis of the cotyledons
- Abnormal seedling with necrosis of the cotyledons
Origin of this defect

- Conditions of seed maturation
- Harvest conditions
- Storage conditions
- Conditions of germination tests

Objective of the study

The objective of the study was to try to improve germination test conditions in laboratory in order to achieve the germination potential of lettuce seed lots, comparable with real plant development conditions in greenhouse.
Laboratory methods tested – 1\textsuperscript{st} step

- **one** lettuce seed lot
- **81** germination methods tested

<table>
<thead>
<tr>
<th>Solution added to paper substrate</th>
<th>Duration at 10°C</th>
<th>Type of lighting</th>
<th>Numbers of hours of light</th>
<th>Number of seeds / box</th>
</tr>
</thead>
<tbody>
<tr>
<td>( \text{H}_2\text{O} )</td>
<td>0 day</td>
<td>Mixed light White / Red</td>
<td>8 hours</td>
<td>100 / box</td>
</tr>
<tr>
<td>( \text{KNO}_3 )</td>
<td>3 days</td>
<td>White light</td>
<td>9 hours</td>
<td>50 / box</td>
</tr>
<tr>
<td>( \text{GA}_3 )</td>
<td>5 days</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>( \text{GA}_3 + \text{KNO}_3 )</td>
<td>7 days</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

- Conditions with \( \text{GA}_3 \) and \( \text{GA}_3+\text{KNO}_3 \) were not kept for the 2\textsuperscript{nd} step
Laboratory methods tested – 2\textsuperscript{nd} step

- 6 germination methods tested

<table>
<thead>
<tr>
<th>N° method</th>
<th>Solution added on paper substrate</th>
<th>Duration at 10°C</th>
<th>Type of lighting</th>
<th>Light duration</th>
<th>Number of seeds per box</th>
</tr>
</thead>
<tbody>
<tr>
<td>29</td>
<td>KNO$_3$</td>
<td>5 days</td>
<td>White light</td>
<td>9 hours</td>
<td>4 x 100</td>
</tr>
<tr>
<td>33</td>
<td>Water</td>
<td>3 days</td>
<td>White light</td>
<td>8 hours</td>
<td>4 x 100</td>
</tr>
<tr>
<td>38</td>
<td>KNO$_3$</td>
<td>3 days</td>
<td>White light</td>
<td>8 hours</td>
<td>8 x 50</td>
</tr>
<tr>
<td>39</td>
<td>KNO$_3$</td>
<td>3 days</td>
<td>Mixed light</td>
<td>8 hours</td>
<td>8 x 50</td>
</tr>
<tr>
<td>42</td>
<td>Water</td>
<td>3 days</td>
<td>White light</td>
<td>9 hours</td>
<td>8 x 50</td>
</tr>
<tr>
<td>50</td>
<td>Water</td>
<td>0 day</td>
<td>White light</td>
<td>8 hours</td>
<td>4 x 100</td>
</tr>
</tbody>
</table>

- 15 lots of lettuce seeds from different types
Conditions of plant development in greenhouse

- Seed planting in mini plugs
- Temperature and light
  - 8 days - 20°C day / 15°C night
  - 5 days - 15°C day / 15°C night
  - 15 days - 20°C day / 20°C night
  - Natural light during 12 days then supply in artificial light
- Counts
  - 7, 21 and 28 days
  - Determination of normal, abnormal and non germinated seeds
Germination results for the 15 samples on the 6 laboratory methods and in greenhouse

- After these results, elimination of method 42 (lowest results) and 4 samples (highly heterogeneous results)
Germination results for the 11 samples on the final 5 laboratory methods and in greenhouse

- 2 groups of methods
  - Method 29 (KNO$_3$, 5 days at 10°C, white light)
  - Methods 33, 38, 39 and 50
    - Method 33 (3 days at 10°C, white light) and method 50 (no pre-chilling, white light). These methods do not use KNO$_3$
    - Method 38 (3 days at 10°C, white light) and method 39 (3 days at 10°C, mixed light). These methods use KNO$_3$
- Methods with KNO$_3$ cause retarded primary roots

<table>
<thead>
<tr>
<th>Methods</th>
<th>% Normal seedlings</th>
<th>Groups*</th>
</tr>
</thead>
<tbody>
<tr>
<td>29</td>
<td>90,34</td>
<td>A</td>
</tr>
<tr>
<td>33</td>
<td>89,09</td>
<td>B</td>
</tr>
<tr>
<td>39</td>
<td>89,00</td>
<td>B</td>
</tr>
<tr>
<td>38</td>
<td>88,66</td>
<td>B</td>
</tr>
<tr>
<td>50</td>
<td>87,73</td>
<td>B</td>
</tr>
</tbody>
</table>

* Groups according to test of Newman Keuls at the level of 5%
Effect of KNO₃ concentration on germination results

- Decreasing the concentration of KNO₃ slightly reduces the % of abnormal seedlings (root defects) but the difference is not significant.
- Using low concentrations of KNO₃ allows easier seedling evaluation.
Conclusions

- Some germination conditions lead to better germination results
  - Pre-chilling treatment
  - KNO₃ solution
- Results obtained with the best laboratory conditions are very close to those obtained in greenhouse
- However KNO₃ concentration has an adverse incidence on root elongation; reducing the concentration could make the seedling evaluation easier
- It is not yet possible to use KNO₃ for lettuce within ISTA rules, so perhaps a validation study could be suggested to add it to the lettuce germination method
Acknowledgments

- The Briand company
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  - Laurent Barbarin
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  - Isabelle Tranchant
  - Marie Chevreul