Seeds – germination

Introduction

A germination test is a simple way to determine if the seeds you are planting are viable after storing them for a season or if you are unsure of the germination rate. A germination test may also help farmers, extension agents, and students troubleshoot germination issues and understand that when seeds fail to germinate regularly in the field and garden, it might be due to factors other than the quality of the seeds. Additionally, it can be used to compare the viability of different varieties and make purchase decisions or to adjust for a lower rate when needing to produce a specific number of plantlets. Treating or cleaning seeds may also improve germination and prevent plant diseases.

Learning Objectives

- Extension agents will learn practically what seed viability is and how to determine the germination rate.
- Extension agents will learn how to treat and clean seeds for planting.

Learning Outcomes

At the conclusion of this training, female extension agents will be able to:
- Perform a germination test
- Calculate number or seeds to plant for transplants
- Determine how much seed is needed for successful planting
- Treat seeds to ensure they are clean from bacterial and fungal plant diseases

Materials

- small plastic containers (cup size)
- bleach
- 500ml empty water bottles with cap
- clean water
- small strainers
- tissue paper or roll of absorbent paper
- plastic bags
- permanent marker and pencil
- tweezers
- different types of seeds (different brands, possibly some seed with unknown germination rate, local seed to be compared with certified seed)
- flipchart or blackboard
- chalk or marker

Lecture Notes and Lesson Plan

Introduce the topic of the day. Ask the class to describe germination and viability. This might require some explanation and examples.

Viability can be assessed simply and easily. A germination test can help rule out germination failure as a cause of missing plants in our gardens. Furthermore, it can help us determine if a batch of...
seeds is worth planting when the viability is extremely low, and how to compensate for a lower germination rate when preparing trays and seedlings for transplant.

For the germination test:
Every student should have the chance to distribute the seed on the wet paper, label the bag with their name plus the date and the indication of the seed used. In about a week, each participant should calculate the viability of their sample.

1. Randomly select 20-30 seeds from the lot to be tested. Record the exact number.
2. Spread the seed evenly on a wet paper towel
3. Roll up the towel or cover it with another layer of wet absorbent paper
4. Seal it in a polyethylene bag with some holes in it. Make sure the paper is uniformly wet but there is no excess water in the bag
5. Label each bag with type and number of seed and date. Put the bag in a warm, undisturbed place (22 °C).
6. Check periodically staring after 3 days to make sure the paper is wet and there is no mold. Remove any moldy seeds. When you do not observe any more germination, calculate the percentage of germination using the equation below. Record your results including the time and temperature of germination. Note: Different seeds have different germination rates and optimal germination temperatures.
7. Calculate the % germination

\[
\text{Number of seeds that have germinated} \times 100 = \% \text{ germination}
\]

\[
\text{Total number of seed}
\]

In practical terms, if the viability of our seed is 85%, and we need 100 seedlings, we will have to 118 seeds in total (100 divided by .85).

Practice different examples with different viability and different numbers of seedlings requested, so that the women can familiarize with the calculation process.

Seed Germination Times at Optimum Temperatures*

<table>
<thead>
<tr>
<th>Crop</th>
<th>Soil temperature (C)</th>
<th>Optimum</th>
<th>Days</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Range</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Beans</td>
<td>15.5-29.5</td>
<td>26.5</td>
<td>7</td>
</tr>
<tr>
<td>Sugar Beets</td>
<td>10-29.5</td>
<td>29.5</td>
<td>5</td>
</tr>
<tr>
<td>Cabbage</td>
<td>7.2-35</td>
<td>29.5</td>
<td>4</td>
</tr>
<tr>
<td>Corn</td>
<td>15.5-35</td>
<td>35</td>
<td>3</td>
</tr>
<tr>
<td>Cucumber</td>
<td>24-35</td>
<td>35</td>
<td>3</td>
</tr>
<tr>
<td>Eggplant</td>
<td>4.5-29.5</td>
<td>29.5</td>
<td>5</td>
</tr>
<tr>
<td>Lettuce</td>
<td>4.5-26.5</td>
<td>24</td>
<td>2</td>
</tr>
<tr>
<td>Peppers</td>
<td>18.3—35</td>
<td>29.5</td>
<td>8</td>
</tr>
<tr>
<td>Radishes</td>
<td>7.2-32</td>
<td>29.5</td>
<td>3</td>
</tr>
<tr>
<td>Squash</td>
<td>21-35</td>
<td>35</td>
<td>9</td>
</tr>
<tr>
<td>Tomatoes</td>
<td>15.5-29.5</td>
<td>29.5</td>
<td>5</td>
</tr>
</tbody>
</table>


Follow-up

Seeds should be monitored periodically every few days. Depending on the time of the year and on the type of seed, it might take up to ten days or more for a final count. If the temperature can be controlled and optimal germination temperature can be provided (small incubator), the experiment will be over sooner.

Since seed is valuable, the ones used for the test can be carefully rescued and transplanted in trays or containers and nurtured to grow for further transplant to final destination.
Facts about germination:
- **Germination** is the resumption of active embryo growth after a dormant period. The seed must be viable (the embryo must be alive and capable of germination).
- Low seed germination (vigor) is a function of the age and storage conditions of the planted seed as well as the health and maturity of the plant from which the seed was harvested.
- Internal conditions of the seed must be favorable for germination, that is, any physical, chemical, or physiological barriers to germination must have disappeared or must have been removed.
- The seed must be subjected to appropriate environmental conditions, including water (moisture), proper temperature, oxygen, and for some species, light.
- Vegetable seeds have different germination rates and optimal temperatures.
- Lima bean, parsley, watermelon, and okra are examples of vegetable crops that germinate relatively slowly (10-21 days) at typical spring soil temperatures.

Treating and cleaning seeds

We can treat seeds we produce to make sure they are clean from fungal spores and bacteria and prevent certain diseases. Generally this is not required with commercial seeds, which have a guarantee and are often treated with fungicides.

Seed treatments can be done using either chemicals or heat. *(A separate module will provide instructions for seed disinfection and cleaning for the purpose of seed storage.)*

**Chemical seed treatment** can be achieved by using sodium hypochlorite treatment. Sodium hypochlorite is a powerful disinfectant. It efficiently eliminates bacteria and fungi on seed surfaces, but it is less effective at killing diseases that reside inside seeds. It is also used to sanitize water.

Commercial bleach is a sodium hypochlorite solution (usually 5-6%). For the purpose of seed cleaning, we generally dilute commercial bleach with clean water using a 1 part bleach: 3 parts water ratio.

*Have the participants practice with preparing the bleach dilution and cleaning the seed.*

1. Use a plastic bottle. Use one cup of bleach and three cups of water, cap the bottle and mix by inversion. You can add a drop of vegetable oil or liquid soap to help the solution adhere to the seed coat (optional). This solution needs to be prepared fresh prior to use each time. It cannot be stored, since a chlorinated solution is unstable to light and heat.
2. Pour the solution into a cup containing the seed to be treated. Allow the seed to soak 5-10 minutes, swirling them periodically.
3. Strain the seed and rinse with abundant clean water for several times, until the smell of bleach is very faint or gone altogether.
4. Finally, spread the seed on a clean surface and let them dry completely, before storing them.

*Remind the class* that a fresh solution of 10% commercial bleach in water (1:10) can be used to disinfect utensils, tools, shoes and boots, wooden stick, surfaces, recycled pots, vessels and seed trays, pots and stakes, greenhouse nettings and plastic tunnel covers by direct immersion or by generous spraying. It can be used for foot baths before entering greenhouses or poultry houses. Potassium permanganate is a better alternative for the latter examples, since it is more durable and requires less
maintenance. Chlorine tend to evaporate and to be inactivated easily by dirt and exposure to sunlight.

**Assessment questions**

1. **T or F** - A germination test can help determine how many seeds to plant for a planned number of seedlings. (A = T)
2. List 3 environmental conditions that must be favorable for germination of seeds (A = temperature, water, oxygen)
3. What common chemical solution can be used to treat and disinfect seeds before planting? (A = commercial bleach with 5-6% sodium hypochlorite solution)

**Glossary**

**Germination**: beginning of growth of a plant from its seed.

**Seed viability**: the ability of the seed to germinate and grow. It cannot be checked by visual inspection. Viability is measured by germination tests performed by the seed company and reported on the label as a percentage (%).

**Resources/Web sites**

University of Maryland’s Home and Garden Information Center

Troubleshooting poor germination:

Guide to planting seeds (pdf):

Vegetable seed germination and transplants (pdf) – a simple, clear handout:

Seed treatment document from Louisiana State University

Seed treatment information from Cornell University
http://vegetablemdonline.ppath.cornell.edu/NewsArticles/HotWaterSeedTreatment.html

Parts of this factsheet are adapted from University of Maryland Extension, Home and Garden Information Center - http://extension.umd.edu/hgic

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