Seed Viability Testing

Doing What Seed Companies Do

Introduction

How long can seeds be stored and still be expected to grow? What percentage of seeds can be expected to sprout when planted? These are critical economic questions for gardeners and the agricultural industry.

Concepts

- Tetrazolium test
- Viability
- Germination

Background

There have been stories of wheat seeds or other edible plants germinating after lying dormant in Egyptian pyramids or Native American tombs for thousands of years. Most of these reports have not been confirmed and there is evidence in many cases that rodents in more recent times actually carried the seeds into the tombs or caves. There have, although, been a few actual replicated cases with seeds as old as 1,200 years that have proven to be viable. What is the normal viability of common seeds?

Seeds remain viable (retain their capacity to germinate) for periods that vary greatly, depending upon the species and the conditions of storage. Some seeds such as willow, cottonwood, tea, and orchid are viable for only a few days or weeks regardless of how they are stored. However, the viability of most seeds is extended much longer. Most seeds are able to germinate after months or years when stored at low temperatures and dry conditions.

This laboratory activity studies two important concepts—viability and germination. A seed is considered *viable* if the plant embryo is still alive and, therefore, is capable of germination. Germination of a seed depends on the interplay of a number of factors and a viable seed may not germinate. Whether a seed germinates or not is dependent upon a complex set of variables involving dormancy, after-ripening, temperature hardening, water, oxygen, enzyme activity, anaerobic conditions, light conditions, and others.

The test used in this laboratory (Tetrazolium Test) is a standard laboratory test used by seed testing companies. The test is often called the quick germination test. The test utilizes the chemical tetrazolium chloride. Upon penetrating *living* cells, the tetrazolium chloride is reduced by dehydrogenase enzymes present in living tissue to formazin, which is a reddish, water-insoluble compound. Dead tissues do not stain, remaining their original color because of the lack of respiration and formazin production. The key to the test is to understand seed anatomy so that the seed embryo (the living part of the seed) is examined for the tetrazolium color change.

Materials

Tetrazolium solution, 1%, 20 mL
Corn seeds, soaked for 24 hours, 40
Beaker
Forceps
Hot plate
Marker
Paper towel
Petri dish, 3
Razor blade or sharp scalpel

Safety Precautions

Seeds are routinely treated with mold-inhibiting chemicals to help preserve them. Be sure to wash hands and work surfaces thoroughly upon completion of laboratory work. Handle razor blades with care when cutting the seeds. Wear chemical splash goggles, chemical-resistant gloves, and a chemical-resistant apron. Please review current Material Safety Data Sheets for additional safety, handling, and disposal information.

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Preparation

Make a 1% tetrazolium solution by mixing one part of triphenyl tetrazolium chloride with 99 parts of distilled water. Keep the solution in a dark bottle or in the dark until use. Soak corn seeds in water for 24 hours before use in the laboratory.

Procedure

1. Place 20 soaked corn seeds in a beaker of water and boil them for 5 minutes. Allow seeds to cool and label them as boiled seeds.
2. Perform a tetrazolium test for viability on ten pre-soaked *non-boiled* seeds and on ten soaked, *boiled* seeds as follows:

   a. Use a razor blade or sharp scalpel to cut each kernel lengthwise down the middle of the seed as shown in Figure 1.

   b. Discard one half of each seed and place the other half in a Petri dish (top or bottom), cut surface down. Place the boiled seeds in one labeled Petri dish and the unboiled in another.

   c. Cover the seed halves with 10 mL of tetrazolium test solution.

   d. After 25 minutes use gloves and forceps to remove each half seed and examine the embryo part of the seed for possible color change. Record the number of seeds (boiled vs. unboiled) that show a color change (and therefore are viable seeds).
3. Perform a germination test on ten soaked, non-boiled seeds and ten soaked, boiled seeds as follows:

   a. Place the seeds between wet paper towels inside a sealed Petri dish. Use separate labeled dishes for the boiled and non-boiled seeds.

   b. Let the dishes stand for three days.

   c. After three days determine which seeds have started to germinate (sprouting any amount) and record the results.
4. Pool data from the entire class and answer these questions:

   a. Calculate the percent viability and germination for boiled and non-boiled seeds.

   b. Explain the difference between both factors for the two different seed treatments.

   c. Explain the difference in the germination rate and viability tests for the non-boiled seeds.

   d. Is it possible to tell if seeds are alive just by looking at them?

   e. How might you use the corn seed data if you were going to plant corn?

Disposal

Please consult your current *Flinn Scientific Catalog/Reference Manual* for general guidelines and specific procedures, and review all federal, state and local regulations that may apply, before proceeding. Tetrazolium solution as well as the corn seeds treated with tetrazolium solution should be disposed of according to Flinnn Suggested Disposal Method #8.

Connecting to the National Standards

This laboratory activity relates to the following National Science Education Standards (1996):

Unifying Concepts and Processes: Grades K–12
Evidence, models, and explanation
Constancy, change, and measurement
Content Standards: Grades 5–8
Content Standard C: Life Science, structure and function in living systems
Content Standard E: Science and Technology
Content Standard F: Science in Personal and Social Perspectives, science and technology in society

Content Standards: Grades 9–12

Content Standard C: Life Science, the cell, matter, energy, and organization in living systems
Content Standard E: Science and Technology
Content Standard F: Science in Personal and Social Perspectives, science and technology in local, national, and global challenges

Tips

- Store tetrazolum solution in a dark bottle at 5 °C. If kept appropriately, tetrazolium should last several months.
- Results will vary but typically would resemble the following:

	Viability Test		Germination Test	
	Boiled	**Non-boiled**	**Boiled**	**Non-boiled**
Seeds Tested	120	120	120	120
Seeds Active	0	109	0	98
% Active	0	90.9%	0	81.7%

Materials for *Seed Viability* are available from Flinn Scientific, Inc.

Catalog No.	Description
T0027	Triphenyl Tetrazolium Chloride
AB1427	Corn Seed–Yellow Dent

Consult your *Flinn Scientific Catalog/Reference Manual* for current prices.