

How to Interpret Cotton Seed Cool and Warm Germination Tests for Planting Decisions¹

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Introduction

With the increase in cost of cotton production, primarily concerning seed acquisition and lower price for cotton lint, producers are looking for high-quality cotton seed to obtain good stand for maximum return on investment. As of this writing, we rely on warm and cool germination tests for cotton seed quality. These two tests serve entirely different purposes, which are discussed in this publication. These germination tests provide seed quality information in terms of germination potential, but they are not the best predictor of field performance such as actual emergence potential. Currently, there is a Cotton Belt-wide effort, led by Drs. Guy Collins and Keith Edmisten at North Carolina State University in collaboration with other cotton Extension specialists, to adapt these tests to better represent actual field performance. Cotton seed germination potential for modern upland cotton varieties differs significantly, with most varieties having a higher germ potential under optimal conditions but differing in cold tolerance. The information gained from these tests and correct interpretation can be beneficial in informed decision-making, particularly when a decision is needed to plant cotton early.

This publication discusses warm and cool germination tests for cotton seed quality and ways to interpret these results. A warm germination test is a good predictor of seed germination when cotton is grown under favorable conditions. Cool germination test results only provide an indication of the performance of a given seed lot when planted under unfavorable conditions. This publication is intended for growers, crop advisors, and Extension agents.

Warm Germination Test

Specialized equipment is needed to conduct an accurate and repeatable warm germination test. It is advised to ship seeds from the desired seed lot to a nearby laboratory. However, the damp paper towel method can be used to conduct a cotton germination test at home. The seeds need to be placed in dampened paper towels and left in a plastic bag that is left slightly open. The seeds are kept in a place with a temperature range of 65 to 75 degrees Fahrenheit

(°F). After 7–10 days, the percentage of sprouted seeds is measured.

The laboratory method for warm germination tests consists of cotton seed germination under alternating temperatures of 86°F for 8 hours followed by 68°F for 16 hours during a period of 12 days. After 12 days, the total number of germinated seeds is counted and expressed as a percentage of the total seeds tested. This percentage excludes malformed and abnormal seedlings based on the test protocols. The warm germination test is a predictor of cotton seed germination potential under normal planting conditions. For example, a seed lot with a 90% warm germination test means that 90% of the seeds will germinate and not necessarily emerge if planted under favorable cotton planting conditions. Note that emergence is dependent on several external environmental factors, such as soil type that can cause crusting, pathogens, and excessive or insufficient moisture. Because emergence of seedlings is dependent on these environmental factors, it cannot be accurately predicted by the warm germination test.

How Repeatable Is the Warm Germination Test?

The warm germination test is usually highly repeatable (Edmisten and Collins 2025). The test can start as soon as the seeds are placed in the correct testing environment. Tests for different samples from the same seed lot should be performed reasonably close to each other with a small margin of error. Due to its high repeatability, the warm germination seed test is the only test that is needed for the legal sale of seeds. Note that the results of the seed samples from the same seed lot could show different germination percentage results due to some minor variations in handling, substrata type, moisture content, and test length across different laboratories. As of this writing, there is interest in understanding the potential reasons for different warm germination test results when the same seed lot is tested at different laboratories.

Cool Germination Test

The cool germination test is different from the warm germination test because it is conducted at a constant temperature of 64.4°F for seven days. A seed is considered germinated when it has sprouted and the radicle length has reached 4 centimeters (cm). If the seed germinates but the radicle does not achieve a length of 4 cm, it is not counted as a germinated seed. Cool germination test results are reported as a percentage of sprouted seeds with a radicle length of at least 4 cm.

How Repeatable Is the Cool Germination Test?

The cool germination test is not as repeatable as the warm germination test. Currently, there is no legal standard for the cool germination test. The cool germination test is less repeatable due to the cool temperature used for the test and the required radicle length of 4 cm. A germination variation of 20% to 30% can be seen with a cool germination test when seeds from the same seed lot undergo either simultaneous tests or consecutive tests.

Interpreting Cool Germination Test Data

A 40% cool germination test does not mean that the seeds planted from the same seed lot in a cool planting season will show 40% germination or emergence. This means that this seed lot with a 40% cool germination test emerges less than a seed lot with a 60% cool germination test if planted in less-than-ideal conditions. To use cool germination test data to our advantage, we should consider planting the seed from the lot with a higher cool germination test if we must plant in cooler or less-than-ideal cotton planting conditions. Planting cotton in less-than-ideal conditions is not preferred, but if it is necessary, take precautions. These include planting at a shallower depth and using a higher seed rate. Consider hill-dropping seed if soil crusting is an issue.

Germination Tests in Relation to Normal Cotton Planting Conditions

The cotton planting season is usually characterized by the onset of warmer daytime temperatures. However, it is important to be careful about low overnight temperatures, which can reduce cotton seed emergence. The higher temperature range for optimal cotton planting conditions is between 80°F and 85°F. The ideal lower range (i.e., overnight lows) is above 60°F to ensure that plants accumulate the needed heat units, DD60s. For cotton seed to germinate after planting, it generally requires a minimum of 50 to 60 heat units accumulated as 6 to 10 heat units per day for the following 5 to 7 days after planting.

When planting cotton in ideal conditions, the warm germination test serves as the best predictor of seed emergence in the field. Under ideal conditions, the cool germination test provides very little to no information on the seed germination or actual emergence in the field.

Planting cotton in ideal conditions is critical for crop establishment, but that is not always possible. When it is necessary to plant in less-than-ideal conditions, the cool germination test can be helpful. Remember that the cool germination test percentage is not a predictor for the percent emergence in the field; instead, it should be used to select the appropriate seed lot for unfavorable conditions.

Selecting Laboratories for a Cotton Seed Quality Test

Before selecting a laboratory for seed quality analysis, consider the following.

- Seed sample size for submission is different for different laboratories.
- Shipping charge would vary depending on the distance and seed sample size.
- Turnaround time for each laboratory should be considered before submitting the samples.

List of Public Laboratories for Cotton Seed Cool and Warm Germination Tests

- **North Carolina Department of Agriculture and Consumer Services Seed Laboratory:** 1060 Mail Service Center, Raleigh, NC 27699.
- **Iowa State University Seed Laboratory:** 109 Seed Science Center, 2115 Osborn Drive, Iowa State University, Ames, IA 50011.
- **Texas Department of Agriculture — Seed Laboratory:** PO Box 629, Giddings, TX 78942.
- **Arkansas State Plant Board Seed Laboratory:** 1 Natural Resources Drive, Ste. B, Little Rock, AR 72205.
- **Louisiana Department of Agriculture & Forestry Seed Testing Laboratory:** 5825 Florida Boulevard, Ste. 3004, Baton Rouge, LA 70806.
- **New Mexico Department of Agriculture State Seed Laboratory:** PO Box 30005, MSC 3-LD, 3190 S. Espina Street, Las Cruces, NM 88003.
- **Oklahoma Dept. of Agriculture, Food and Forestry, Laboratory Services Division:** 2800 N Lincoln Boulevard, Oklahoma City, OK 73105.

Reference

Edmisten, K., and G. Collins. 2023. "Chapter 6: Cotton Seed Quality and Planting Decisions." In *2025 Cotton*

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