Seed Viability: Procedures Used by Professional Seed Analysts

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INTRODUCTION

The establishment of plugs or trays with 100% stand establishment saves bench space, increases the profit/area ratio of the plants, and saves labor costs for refilling skips. I hope this talk can provide information on the determination of accurate germination testing, vigor testing, and a mathematical expression of seed vigor.

GERMINATION TESTING

Reproducibility using standard methods and conditions is the first consideration of seed germination and vigor assessment. Accurate records are a must. A germination cabinet is the best way to control temperature, light, and moisture of the germinating seed. Samples are run as four replicates of 50 for the most part, although corn is usually done as 2×100 and members of the Cucurbitaceae as 4×25.

Methodology for testing must be standardized and in Canada is dictated by the methods and procedures, as determined by Agriculture Canada. Interpretation of the results is also standardized with optimum methods for germination of individual crops. Replicates must be within the tolerance tables provided, for the results to be considered valid. Germination can be done using blue blotters, silica sand, or rolled towels. All media must be tested for phytotoxicity. Some seed require light, but seedlings must have all essential structures to be considered normal. The AOSA determines the State rules for the U.S.A. State laboratories, and ISTA is an international association of government laboratories. All are working towards a standardized system for testing and common acceptance worldwide. Both ISTA and the AOSA have established methods to test flower and tree seeds, while Canada has methodology only for herbs, vegetables, and field crops.

A pair of cotyledons or coleoptile, stem, and proper root development are necessary to have a normal seedling. Abnormal seedlings, with disease, split hypocotyls, necrosis, etc. are noted but never included in the germination count. The number of dead seeds are also noted. Methodology determines when interim and final count are made.

FACTORS AFFECTING SEED VIGOR

1) Vigor and health of the parent plant.
2) Maturity of the seed during harvest. Immature seed have generally less vigor and loose their vigor sooner.
3) Environmental conditions during seed development and harvest, especially temperature and humidity.

4) Conditions under which seed are stored. Cool, dry conditions decrease respiration and premature aging.

VIGOR TESTING OF SEED

Accelerated Aging. As cool dry conditions preserve the viability of seeds, moist warm conditions act in an opposite manner. Accelerated aging is accomplished by holding a seed sample for a specified time at a specified humidity and then testing for germination and rate of germination. Sample size is usually based on weight not numbers. Monitoring of the aging process requires a thermohydrograph and checking the moisture content of the seed after aging using a moisture tester. A control of untreated seed is required for comparison purposes. Comparison of the germination rate of both samples should give a good indication of the vigor and long-term viability of the original sample.

Stress Test. Corn seed are routinely chilled at 4 to 5C, after moistening, for 7 to 10 days prior to germination at standard temperature and conditions. Again a comparison of chilled and unchilled samples indicates the vigor of the original sample.

Conductivity Test. Brassica seed soaked in 1% sodium hypochlorite (Javex/ Clorox) will release sinapine within 10 min. Leakage from the seed is directly proportional to the integrity of the seed cell wall. Sinapine has a yellowish color under alkaline conditions (> pH 10), so the addition of potassium hydroxide clearly enumerates the percent of abnormal and dead seeds present. An alternate method would be to soak the seed for 4 to 5 h in tap water and add a drop of 2.5% triple phosphate.

Tetrazolium Test. Replicates of pure seed are imbibed and stained with 0.1% or 1% tetrazolium chloride. Seed may require excision before or after treatment with tetrazolium, but always requires some botanical knowledge of how the embryo is located in the seed. The degree of tetrazolium absorption determines the number of viable and nonviable seed in the sample and the percent of normal/ abnormal or dead seed. This method is highly subjective and misinterpretation often occurs.

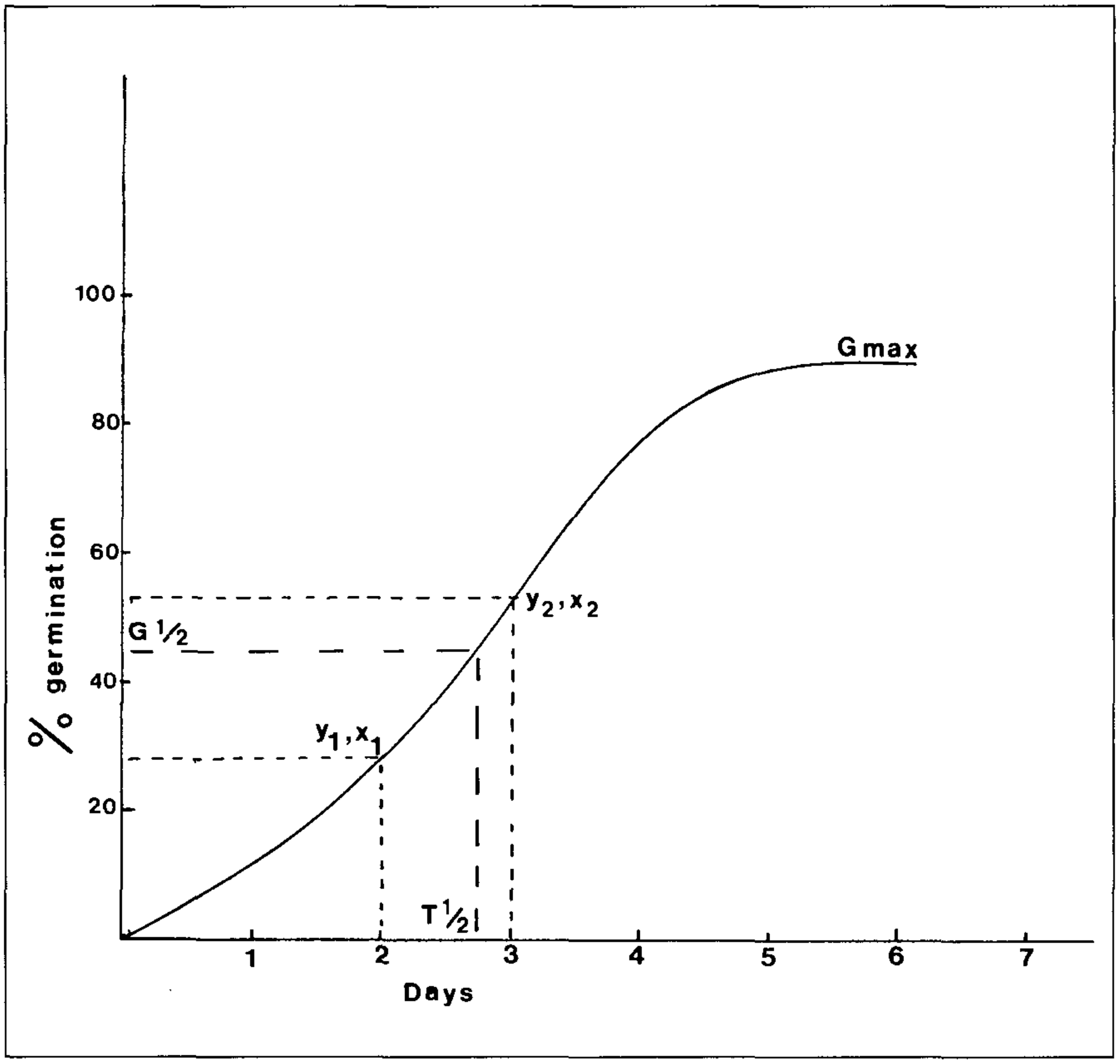
VIGOR DETERMINATION

The simplest way to calculate the vigor of a sample would be to measure the daily emergence of the radicle under the prescribed conditions and time for the species being tested. Plot the percent germination for each day until there is no more improvement in germination. This is the final germination or G_{max}. If the final germination is 90%, then the time to half maximum germination (G 1/2) would be 45%. Drop a perpendicular from 1/2-max germination to get T 1/2 the time to half final germination, measured in days. This is an inverse relationship as the lower the value or time, the faster germination occurs.

Should greater accuracy be required the following formula, developed by Terry McIntee at Stokes Seeds, can be used. G_{max} is the final germination and T 1/2 the time to half final germination. The values x1, y1 are the day and percent germination just before G 1/2, while x2, y2 are the day and percent germination just after G 1/2.

$$T\,1/2 = \frac{\frac{Gmax}{2} - \left(y_1 - \left(\frac{y_2 - y_1}{x_2 - x_1}\right) x_1\right.}{\left(\frac{y_2 - y_1}{x_2 - x_1}\right)}$$

The rate of germination (R 1/2) at T 1/2 is equal to the above denominator y2 - y1/x2 - x1.



This is the slope of the line or percent (%) germination/day.

Calculation of the half time to half maximum germination is an excellent way to judge the vigor of your seeds. Knowing the percent germination does not always give a true measure of the viability of the sample. The advantage in synchronicity and stand establishment are well worth the time required to calculate the true vigor of your seeds.

ADDITIONAL READING

Anchor Paper. 480 Broadway, P.O. Box 65648, St. Paul MN. 55165-0648

AOSA. Seed Vigor Testing Handbook.# 217.

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