Rule Change Proposal No. 13

Purpose

To replace the tolerance Table in section 5.5 Germination tolerances with Table G3 p. 646 of S. R. Miles, 1963. Handbook of Tolerances and of Measures of Precision for Seed Testing. Add cross reference (Table 2a) in section 4.4 Number of seeds for germination.

Present Rule

5.5 Germination tolerances

The following tolerances are applicable to the percentages of germination and also to the sum of the germination plus the hard seed when 400 or more seeds are tested:

Mean	Tolerance	Mean	Tolerance
96 or more	5	70 or over but less than 80	8
90 or over but less than 96	6	60 or over but less than 70	9
80 or over but less than 90	7	Less than 60	10

When only 200 seeds of mixtures are tested, 2% shall be added to the above germination tolerances.

4.4 Number of seeds for germination. At least 400 seeds shall be tested for germination except that in mixtures 200 seeds of those kinds present to the extent of 15 percent or less may be used. In this case an additional 2 percent is to be added to the regular germination tolerances. These seeds shall be tested in replicate tests of 100 or less to avoid crowding on the substratum.

Proposed Rule

5.5 Germination tolerances

c. Tolerances between germination tests. Table 2a lists the maximum acceptable difference (i.e., tolerance) between two germination tests on the same seed lot. The values are to be used to compare germination percentages (or the sum of germination and hard seed) determined from 400-seed tests. The tolerances are applicable for comparison of tests of the same seed lot, whether from the same or different submitted samples of that lot, and whether performed in one laboratory or different laboratories. Table 2a adapted from S. R. Miles, 1963 Handbook of Tolerances and of Measures of Precision for Seed Testing. p. 646 Table G3 Columns A, B, and C.

4.4 Number of seeds for germination. At least 400 seeds shall be tested for germination except that in mixtures 200 seeds of those kinds present to the extent of 15 percent or less may be used. In this case an additional 2 percent is to be added to the regular germination tolerances (Table 2a). These seeds shall be tested in replicate tests of 100 or less to avoid crowding on the substratum.

Table 2a. Maximum tolerance values for 400-seed germination tests of the same or different submitted samples tested in the same or different laboratories

Average percent Germination		Tolerance
A	B	C
99	2	2
97 to 98	3 to 4	3
94 to 96	5 to 7	4
91 to 93	8 to 10	5
87 to 90	11 to 14	6
82 to 86	15 to 19	7
76 to 81	20 to 25	8
70 to 75	26 to 31	9
60 to 69	32 to 41	10
51 to 59	42 to 50	11

When only 200 seeds of mixtures are tested, 2% shall be added to the above germination tolerances.

d. Procedure for determining whether two test results are within tolerance

Calculate the average of the two germination results to the nearest whole number. Calculate the difference between the two germination results. Locate the average in Table 2a (column A or B) and the acceptable difference (tolerance) for that average (column C). When the difference between the two germination test results is equal to or less than the tolerance values, the difference is due to only random-sampling variation.

Example 1

The germination for a 400-seed test of wheat is 87%. The germination of a sub-sample of the same seed lot submitted to another laboratory was reported to be 76%. Are these two results within tolerance?

Average germination % = $\frac{87 + 76}{2}$ = 81.5 (rounded to nearest whole number = 82%

Difference between the two germination results = 87 - 76 = 11%
In Table 2a, for 82% average germination, the tolerance is 7.

Since the difference between the two tests results (11%) is greater than 7%, the difference is significant and not due to random-sampling variation. Differences among results might be due to sampling method, test conditions, seedling evaluation, or reporting error.

Example 2

A 200-seed germination test of orchardgrass from a forage mixture resulted in 79% germination. The label on the mixture indicated a germination of 87%. Are these two results within tolerance?

Average germination % = $\frac{79 + 87}{2}$ = 83%

Difference between the two germination results = 87 - 79 = 8%

In Table 2a, for 83% average germination, the tolerance is 7%. Since the tests being compared are 200-seed tests, 2% is added to the tolerance, for a total of 9%. Since the difference between the two test results (8%) is less than 9%, it can be assumed to be due to random sample variation, thus the two test results are within tolerance.

Harmonization Statement

This proposal will be a step closer to ISTA germination tolerance tables as they are using the same proposed table (2a) which is adapted from S. R. Miles, 1963 Handbook of Tolerances and of Measures of Precision for Seed Testing, Table G3 Columns A, B, and C. p. 646. It appears in the ISTA Rules as Table 5.3 in the tolerance section. The FSA is using the current germination tolerance table in page 58 of the AOSA Rules.

Supporting Evidence

The current germination tolerance table in page 58 first appeared in the Rules for Seed Testing published by the USDA in 1927. The only difference is that the germination tolerance value for above 95% was not included in 1927 version.

It is worthy to note that the 1927 table is prefaced by the following statement: "A larger and more arbitrary tolerance [in reference to the purity tolerance] must be allowed in the results of germination tests. Until more reliable information is available, the following tolerances should be allowed between a given germination and the result of the germination test:"

A more reliable information regarding germination tolerance was published in 1963 by Professor S. R. Miles, a statistician from Purdue University, Lafayette, Indiana, USA in his book " Handbook of Tolerances and of Measures of Precision for Seed Testing. p. 641-653. The proposed table adapted from Miles, 1963 book, page 646 Table G3 Columns A, B, and C.

The international Seed Testing Association (ISTA) adapted Miles' Table (G3), which we are proposing above as Table 2a, earlier. It appears as Table 5.3 in ISTA Rules in the tolerance section.

Although the tolerance values included in the proposed Table 2a differ slightly than those in the current AOSA tolerance table in page 58 of the Rules, the proposed Table (i.e., 2a) was established on reliable statistical bases searched and documented by Dr. Miles. The current tolerance table in page 58 was intended to be temporary until more reliable information is available as stated in the 1927 Rules. Now such information is available in the proposed Table, 2a.

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Date Submitted: October 15, 2003 Revised January 13, 2004