COOL GERMINATION TEST ON COTTON -- VARIABILITY BETWEEN SEED-TESTING LABORATORIES

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Abstract

The Cool Germination Test is the most widely used measure of seed/seedling vigor to evaluate cotton (*Gossypium hirsutum* L.) planting-seed quality. Unfortunately, significant variation exists between laboratories that perform this test. A Southern Region V AOSA/SCST cool germination referee project was conducted in 1996 to explore variances that exist between seed-testing laboratories. Two samples (A and B) of cottonseed from commercial lots with varying vigor were sent to twenty-seven commercial, state, and independent seed-testing laboratories. Each participating laboratory was instructed to follow the suggested Cool Germination Test procedures for cotton in the AOSA Seed Vigor Testing Handbook. Data from twenty-one laboratories that responded indicated that significant variation existed. Sample A had average results ranging from 24% to 92% cool germination, with an average of 81%; sample B had average results ranging from 17% to 81% cool germination, with an average of 64%. Only nine responding laboratories were within acceptable germination tolerances on both samples. It appears that the most critical elements of this method are: 1) maintenance of constant 18ºC (64.4°F) ± 0.5ºC in testing portion of germination chamber for duration of test, and 2) type and moisture content of germination substrata. Before further consideration is given to labeling Cool Germination Test results in cotton, major improvements in standardization and uniformity of testing must occur. Another referee project that will focus on specific variables causing large variations is currently in progress.

Introduction

The Cool Germination Test ("Texas Cool Test") is the most widely used measure of seed/seedling vigor to evaluate cotton (*Gossypium hirsutum* L.) planting-seed quality (Drummond and Savoy, 1996; Kerby et al., 1989; Metzer, 1987). The purpose of this test is to determine if seed lots are suitable for planting in cool soils. A high cool germination percentage identifies seed lots that may be planted under a wider range of field conditions than seed lots with a lower cool germination percentage. Results from this test are used by growers as a tool for scheduling plantings, determining seeding rates, and determining seed vigor of carry-over seed. The possibility of labeling cool germination results has been suggested. Unfortunately there is significant variation, with undocumented causes, between laboratories that perform this test. Factors contributing to variability could not be identified in a comparison between water-curtain and dry-box germination chambers (Osburn and McGhee, 1988). In pursuance of uniformity of testing, this referee was conducted to evaluate and explore variances between laboratories that perform the Cool Germination Test on cotton.

Materials and Methods

Two representative samples of cotton seed from commercial lots with varying vigor were sub-divided and sent to twenty-seven commercial, state, and independent seed-testing laboratories. Initial Standard and Cool Germination Tests were performed at Delta and Pine Land Company's Quality Assurance Laboratory in Scott, MS. These results indicated that Sample A had an 87% cool germination and a seed-vigor index of 178 (91 + 87), indicating excellent planting-seed quality. Sample B had a 64% cool germination and a seed-vigor index of 138 (74 + 64), indicating fair planting-seed quality. The seed-vigor index is the sum of the four-day standard ("warm") germination percentage and the cool germination percentage (Metzer, 1987).

A copy of the Cool Germination Test Procedures for cotton, suggested in AOSA Seed Vigor Testing Handbook, was sent to each laboratory, along with directions that each participant was requested to follow. The tests were conducted on four replications of 50 seed, which were planted on moistened germination towels (two on bottom, two on top) then rolled. Rolled towels were placed upright in a less-than-airtight container to prevent towels from drying too rapidly, to maintain high humidity, and to provide proper aeration to germinating seeds. These containers were placed in germination equipment capable of maintaining 18°C (64.4°F). The duration of the test was seven days. At this time, one count of normal seedlings that had a combined hypocotyl and root length of (1.5 in) or longer was made. The root-hypocotyl measurement was made from the point of cotyledon attachment to the tip of the radicle. Individual replication data was requested and data were analyzed using the Tattersfield Method (1979) to statistically identify deviant results ($\alpha = 0.01$). In addition, acceptable germination tolerances (AOSA, 1993) were determined about averages calculated with normal data.

Results and Discussion

Twenty-one laboratories responded, consisting of fourteen regulatory and seven commercial and independent seed-testing laboratories. Average results for samples A and B are shown in Table 1. Five laboratories were significantly deviant from others with Sample A; four laboratories were significantly deviant from others with Sample B. Data from deviant laboratories were not included in calculation of overall sample averages. Even among laboratories that were not statistically deviant from one another, considerable

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variation existed. Excluding deviant data, Sample A had average results ranging from 60% to 92%, with an average of 81%. Sample B had average results ranging from 39% to 81%, with an average of 64%.

Acceptable germination tolerance was ± 7% with sample A and ± 9% with sample B (AOSA, 1993). Considering these tolerances, only about one-half of seed-testing laboratories were within the acceptable tolerance range, and only nine out of twenty-one were within tolerance on both samples A and B (Table 1). This level of variability is commercially unacceptable and could lead to confusion when seed samples are collected by regulatory personnel, farmers, dealers, distributors, state extension personnel, and other clientele, and sent to one or more laboratories and results are compared. Also, the suggestion of labeling cool germination percentages on finished seed lots causes serious concern due to these large variances that exist.

It appears that the most critical elements of this test are 1) maintenance of constant 18ºC (64.4°F) ± 0.5ºC in testing portion of germination chamber for duration of test, and 2) type and moisture content of germination substrata. Other possible variables are type of germination equipment used, type of container, humidity control, aeration of seeds, initial temperature of moistened germination substrata, seed analyst variability, and normal sample variability. All variables should be explored in detail to determine causes of large variances, which will ultimately lead to solutions and/or recommendations.

Conclusion

Significant variation still exists between seed-testing laboratories that perform the Cool Germination Test on cotton. Before further consideration is given to labeling Cool Germination Test results in commercial cotton seed lots, major improvements must be made in standardization and uniformity of testing. Another referee project is currently in progress, which will focus on specific variables that may be causing wide variations in test results between laboratories. This information should provide a basis for understanding causes of variability and could lead to beneficial modifications to Cool Germination Test suggested procedures for cotton (AOSA, 1983).

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Table 1. Average Cool Germination Test results from twenty-one seed-testing laboratories that participated in cool germination referee project.

Sample A			Sample B		
Lab. Number	Germination %		Lab. Number	Germination %	
12	92		12	81	
10	89		10	78	
22	88	wt	23	74	
7	88	wt	21	72	wt
26	87	wt	7	72	wt
20	87	wt	17	72	wt
21	86	wt	22	71	wt
23	84	wt	15	69	wt
1	84	wt	25	66	wt
17	82	wt	1	65	wt
5	80	wt	24	64	wt
25	79	wt	20	61	wt
15	77	wt	26	59	wt
2	73		5	50	
4	64		2	46	
27	60		27	45	
9	51*		4	39	
24	51*		6	34*	
13	50*		13	26*	
6	49*		9	23*	
11	24*		11	17*	
Average†	81		Average†	64	
Tolerance‡	± 7		Tolerance‡	± 9	

*Significantly (I = 0.01) deviant from other results (Tattersfield, 1979).
†Deviant data were omitted in calculation of overall sample averages.
‡Acceptable germination tolerance (AOSA, 1993).
wt = Within acceptable germination tolerance.