

Correlation between vigour tests and field emergence in cotton

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ABSTRACT Considering that cotton hybrids are grown in a wide range of agro-ecological conditions, both rainfed and irrigated, it is important that the hybrid seeds should not only meet the minimum standards of germination, but exhibit high planting value (vigour) to ensure a successful field emergence and stand establishment. This can be achieved by providing high vigour seeds. Vigour assessment studies conducted in 21 commercial seed lots of hybrids and varieties of cotton showed significant differences in the lots for different physical, physiological and performance based vigour tests. The speed of germination, 100-seed weight and electrical conductance of seed leachates were found to be very good indicators of the planting value of seed lots. The germination in sand medium and brick-gravel test showed a positive correlation with field emergence in six months stored seeds.

Key words: Vigour test, field emergence, brick-gravel test, correlation, cotton

Cotton a major fibre crop of global importance with high commercial value, is important for livelihood of the Indian farming community and the sustainable economy of India. The success of cotton industry depends heavily on the timely production, adequate supply of vigorous and genetically pure seeds of the desirable hybrids to the farmers. These high value seeds are expected to perform better, resulting in good field emergence and crop plant establishment.

Among the various vigour tests, its correlation with the seed performance in the field is the most important one [1, 2]. Thus, the accurate vigour assessment of high value cotton seed is one of the components of evaluation of seed quality in cotton. Considering this, the present study was conducted with the objective to standardize a protocol for determining the true planting value of cotton seed based on vigour estimation. The investigation was carried out at the experimental fields and the laboratories of Division of Seed Science and Technology, Indian Agricultural Research Institute, New Delhi.

MATERIAL AND METHODS

Twenty one seed lots of cotton were used for assessing vigour parameters. The seed lots, comprising of different cotton hybrids and open pollinated varieties were collected from different sources. The seed vigour parameters studied were: 100-seed weight, germination (first and final count), accelerated ageing test (100% RH, 41°C for 96 hr), electrical conductivity from seed leachates, brick-gravel test, seed density, emergence in sand medium under controlled condition, field emergence under optimum growing condition and germination from six months stored seeds.

RESULTS

Physical tests

i. 100-seed weight: The test weight of the seed lots ranged from 5.24-11.35 g. Most of the hybrids recorded higher test weights (ranging from 8-11 g) as compared to open pollinated varieties (5.24-6.72 g). There was a significant positive

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correlation between the test weights and field emergence of the seed lots, as well in field emergence from six months stored seeds (Table 1).

ii. Seed density: The seed density, recorded by following weight/volume of the toluene displaced, registered significant differences (ranged from 0.75-1.46) among the different cotton seed lots.

Germination performances

i. First and final count: The first count of germination of 21 seed lots ranged from 46.70-94.00%. In general, hybrids recorded a faster germination rate than the open pollinated varieties. All the lots which recorded 70% or seed higher germination on first count, showed about 80-97% germination on the day of final count.

The first count and final count of seed germination recorded strong significant correlation with immediate field emergence as well between germination and field emergence from six months stored seeds (Table 1).

ii. Germination in sand medium: Both BP and sand media are recommended for conducting the seed germination test of cotton [3]. An evaluation of seed germination on sand medium showed that this simple and inexpensive test for seed germination can also be useful to assess the seed vigour (their germinability in field) of seed lots (based on seed germination on 12 days from seed planting at 25°C). The seed germination among different seed lots in sand medium showed significant variations (ranging from 44-88%). Seed germination on sand medium also showed a significant positive correlation ($r = 0.863$) with field emergence from six months stored seeds (Table 1).

Stress tests

i. Brick-gravel test: The germination recorded for different seed lots were significantly lower under this condition than those either to between paper or sand medium. It ranged from 26.67-82.67%, recorded significant differences among the seed

lots. The brick-gravel test showed a strong positive correlation with field emergence ($r = 0.838^{**}$) in six months stored seeds.

ii. Accelerated ageing test: The seed germination after accelerated ageing varied significantly from 30-45.3% in hybrids; and from 25-36% in open pollinated varieties. The correlation between seed germination and field emergence (%) were non-significant (Table 1). However, seed germination from six months stored seeds recorded significant positive correlation (0.744^{**}) with the accelerated ageing test.

Electrical conductance from seed leachates (EC)

The electrical conductance (EC) values ($\mu\text{S}/\text{cm}/\text{g}$) calculated on the basis of per gram seed showed significant differences among the seed lots, it ranged from 21.15-75.07 in the hybrids; and from 72.68-97.44 in the open pollinated varieties. A very high but negative significant correlation was recorded between the electrical conductance and field emergence ($r = -0.742^{**}$) of the cotton seed lots (Table 1). The electrical conductivity also had a very strong negative correlation with the field emergence ($r = -0.916^{**}$) in six months ambient stored seeds.

Field emergence

The field emergence ranged from 86-56% in hybrids, whereas it ranged from 62-42% in OP varieties. Field emergence also in six months stored seeds ranged from 80-56% in hybrids and 46-33% in OP varieties.

Relative efficacy of vigour tests

From the above data, it was inferred that to predict the true planting value of cotton seed lots (field emergence %), under optimum field conditions, the following vigour tests may be adopted *i.e.* standard germination test ($r = 0.861^{**}$), emergence in sand ($r = 0.834^{**}$) first count of the standard germination test ($r = 0.821^{**}$), electrical conductance ($r = -0.742^{**}$), 100-seed weight ($r = 0.738^{**}$), brick-gravel test ($r = 0.692^{**}$) and accelerated ageing test ($r = 0.561^{**}$) see also table 1.

Table 1. Correlation coefficients among different vigour tests in cotton seeds

S.No.	1	2	3	4	5	6	7	8	9	10	11
1. Final count germination	1	0.861**	0.952**	0.798**	-0.786**	0.952**	0.780**	0.730**	0.942**	0.962**	0.629**
2. Field emergence		1	0.821**	0.738**	-0.742**	0.834**	0.692**	0.561**	0.886**	0.882**	0.495*
3. First count of germination			1	0.734**	-0.706**	0.921**	0.710**	0.830**	0.888**	0.972**	0.633**
4. 100-seed weight				1	-0.948**	0.679**	0.893**	0.516*	0.919**	0.769**	0.706**
5. Electrical conductance					1	-0.698**	-0.804**	-0.518*	-0.916**	-0.739**	-0.642**
6. Emergence in sand media						1	0.635**	0.753**	0.863**	0.915**	0.504
7. Germination in brick-gravel test							1	0.425**	0.838**	0.748**	0.809**
8. Germination from accelerated aging								1	0.674**	0.744**	0.432
9. Field emergence in six months stored seeds									1	0.926**	0.665**
10. Germination in six months stored seeds										1	0.601**
11. Seed density											1

**Significant at 1%; *Significant at 5

DISCUSSION

Wanjura [4] reported, that establishing a stand of cotton that consists of an adequate number of vigorous seedlings, is important. The germination test is widely accepted and used as the quality indicator of a seed lot. In order to overcome the inconveniences, the estimation of seed vigour is important. In the present study, both the test weight and density of the seeds were found to be good measure of the planting value of cotton seeds as this recorded significant positive correlation with field emergence. Hoffman *et al* [5] observed that the field emergence and lint yield in cotton was higher from the seed lots with higher density than those of low density classes. The hundred seed weight showed a positive correlation both with the field emergence, as well as performance from six months stored seeds (Table 1).

It was observed that most of the seed lots which recorded a higher percentage of germination on first count, resulted in better field emergence and hence it gave a highly positive significant correlation with field emergence ($r = 0.821$) and performance in six months stored seeds ($r = 0.942$) table 1. The final count also gave a very highly significant but positive correlation both with field emergence ($r = 0.861$) and performance in six months stored seeds ($r = 0.886$) table 1. Several workers [6, 7] observed that germination itself is a good indicator of planting value of seed lot. Hence indicating the actual germination percent on the seed lot tag may be one way of indicating the vigour status of the seed lot. Accelerated ageing test proposed by Delouche and Baskin [8] has been the most reported vigour test for a large number of species with suitable modification wherever required. In the present study, though the correlation on accelerated ageing was

not significant, a significant positive correlation was observed between accelerated ageing and germination in six months stored seeds.

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