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Delinting Cottonseed with the Dilute Sulfuric Acid Method

E. R. Cabrera

A. H. Boyd

DELINTING COTTONSEED WITH THE DILUTE SULFURIC ACID METHOD

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The dilute acid process for delinting cottonseeds, developed by Cotton Incorporated, has been employed by numerous plants throughout the cotton belt. Seed quality problems thought to be associated with heat and/or acid damage have periodically occurred.

In the dilute acid delinting process, gin-run cottonseeds are wetted with a 10-15% solution of sulfuric acid by weight. The excess solution is removed by a centrifuge and the seeds transferred to a rotating drum where they are dried and delinted.

The objectives of this study were (1) to evaluate the effects of delinting temperatures on germination of cottonseeds, and (2) to determine optimum delinting temperatures.

A seed delinting unit was constructed similar to the one described by Jones (1). A top loading clothes washer was utilized as a centrifuge to remove excess sulfuric acid solution. An electric clothes drier was used as the drying unit. The drier was slightly modified by adding a more accurate thermocouple to control temperature. Angle iron baffles were attached to the inner surface of the rotating drum to provide more friction.

In one study, gin-run seeds of "Stoneville 825" (ST-825) were delinted using 12% and 15% sulfuric acid concentrations and five different chamber-air temperatures. Drying times for each temperature are shown in Table 1. The seeds were then cleaned with a fractionating aspirator and placed in open storage (no temperature or humidity control) for six months. Sub-samples were removed and tested for germination each month beginning two months after delinting.

In a second study, two high quality seedlots and one low quality seedlot were wetted with 12% acid solution and delinted at 55°C, 60°C and 65°C. These temperatures were determined at the exhaust of the drying drum. The drying time for each temperature is shown in Table 2.

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[1]Assistant Agronomist, Seed Technology Laboratory, and Professor of Agronomy, respectively, Mississippi State University, Miss. State, MS.

Table 1. Drying time for concentration and chamber-air temperature treatments.

Temperature (C)	Drying Time (min.)	
	12% Solution	15% Solution
50	45	45
60	40	40
70	35	35
80	25	22
85	20	18

Table 2. Drying time for each temperature treatment.

Temperature (C)	Drying Time (min.)
55	35
60	35
65	25

All delinted samples were neutralized with sodium bicarbonate, and cleaned with a fractionating aspirator. Laboratory evaluations using standard germination and tetrazolium tests were performed immediately after delinting.

Temperature Effect

Chamber-air temperatures of 60°C and 70°C did not adversely affect seed germination (Table 3). Temperatures higher than 70°C had a detrimental effect on germination, even though shorter periods of time were required to achieve adequate delinting. Germination percentage of seeds delinted at 50°C was lower than seed delinted at 60°C and 70°C. The seeds delinted at 50°C were never delinted to the desired level and flowability was restricted. For this reason, the aspirator did not adequately remove immature seeds.

Sulfuric Acid Concentration Effect

No significant difference was observed between standard germination of cottonseeds delinted by 12% and 15% sulfuric acid solution immediately after delinting (Figure 1). However, seeds delinted with the 15% acid solution showed a greater decrease of germination during the six-month storage period. At delinting temperatures which resulted in acceptable germination levels, there was no difference in time necessary for adequate delinting.

Seed temperature increased from about 30°C to near exhaust-air temperature in about 15 minutes and stabilized at exhaust temperatures for the remaining period, which was 10 to 20 minutes, depending on delinting temperature (Figures 2-4).

Effects of Exhaust-air Temperature

The germination results of the three lots delinted at three different exhaust-air temperatures as determined by the standard germination and tetrazolium tests are given in Tables 4 and 5. The germination of those samples delinted at 55°C and 60°C was essentially the same. However, when the exhaust-air temperature was raised to 65°C, the germination was lowered significantly (Figure 5).

The detrimental effect of the highest exhaust-air temperature on the quality of the delinted seeds can be best described by the tetrazolium test results. The low vigor section of these samples was always increased. The initial quality of the seeds to be delinted is an important factor. Even though the germination of all lots was lowered at about the same rate, the low quality seedlot suffered a greater decrease in vigor potential (Figure 6).

Table 3. Effect of chamber-air drying temperature on the germination of dilute acid delinted cottonseeds.

Months in Open Storage	Temperature (C) 50	60	70	80	85
	----------%----------				
2	77.6 ab	84.5 a	82.0 a	64.6 b	47.6 c
3	75.9 a	82.8 a	79.8 a	54.1 b	47.7 c
4	79.3 a	78.1 a	80.4 a	54.2 b	41.5 b
5	64.6 b	78.5 a	79.3 a	55.6 b	37.6 c
6	77.4 a	68.3 a	74.8 a	42.8 b	32.2 c

Means in the same row not sharing a common letter differ significantly at the 5% level as determined by DMRT.

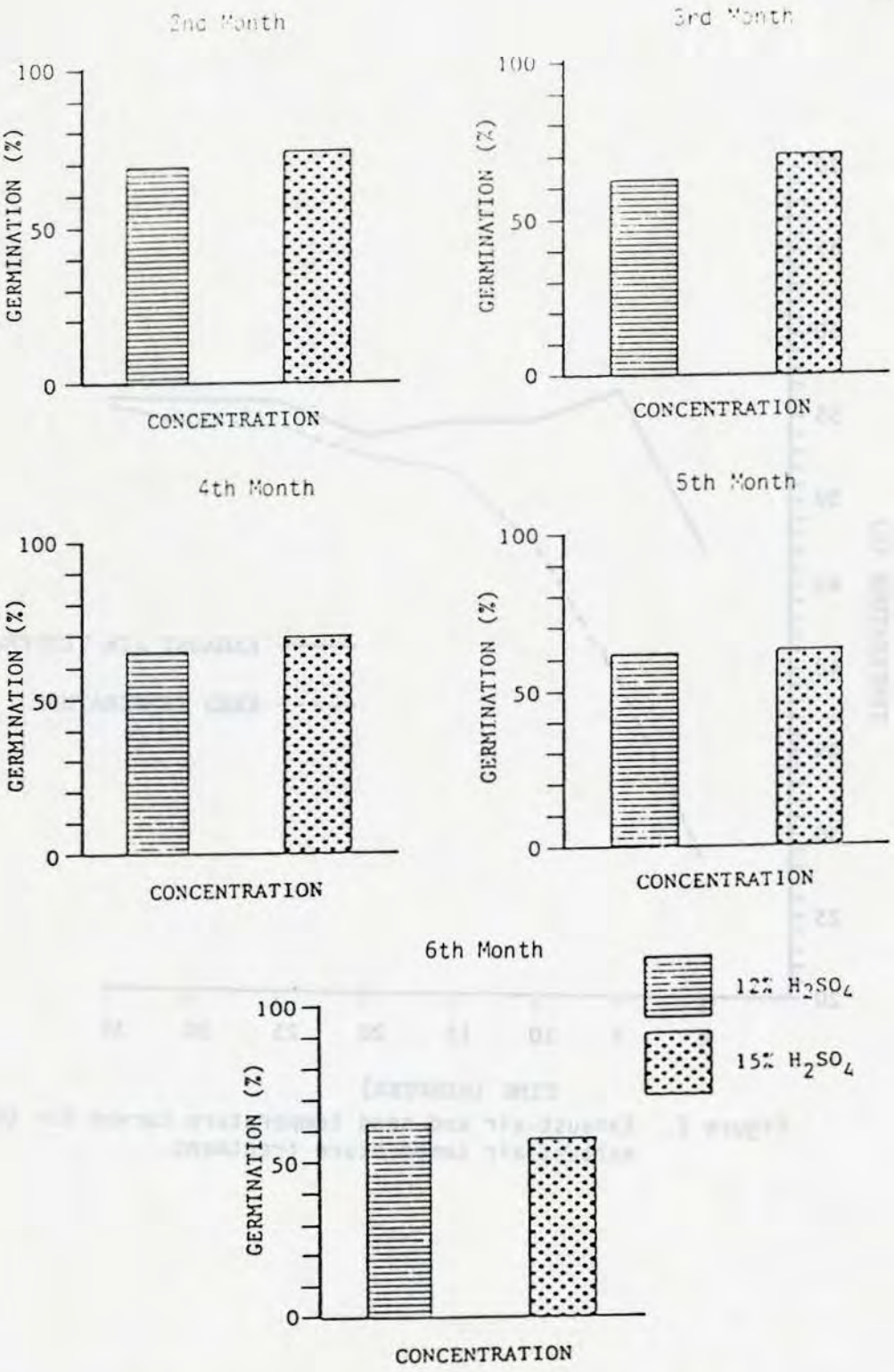

Figure 1. Monthly germination of cottonseed following delinting with 12% and 15% sulfuric acid solutions.

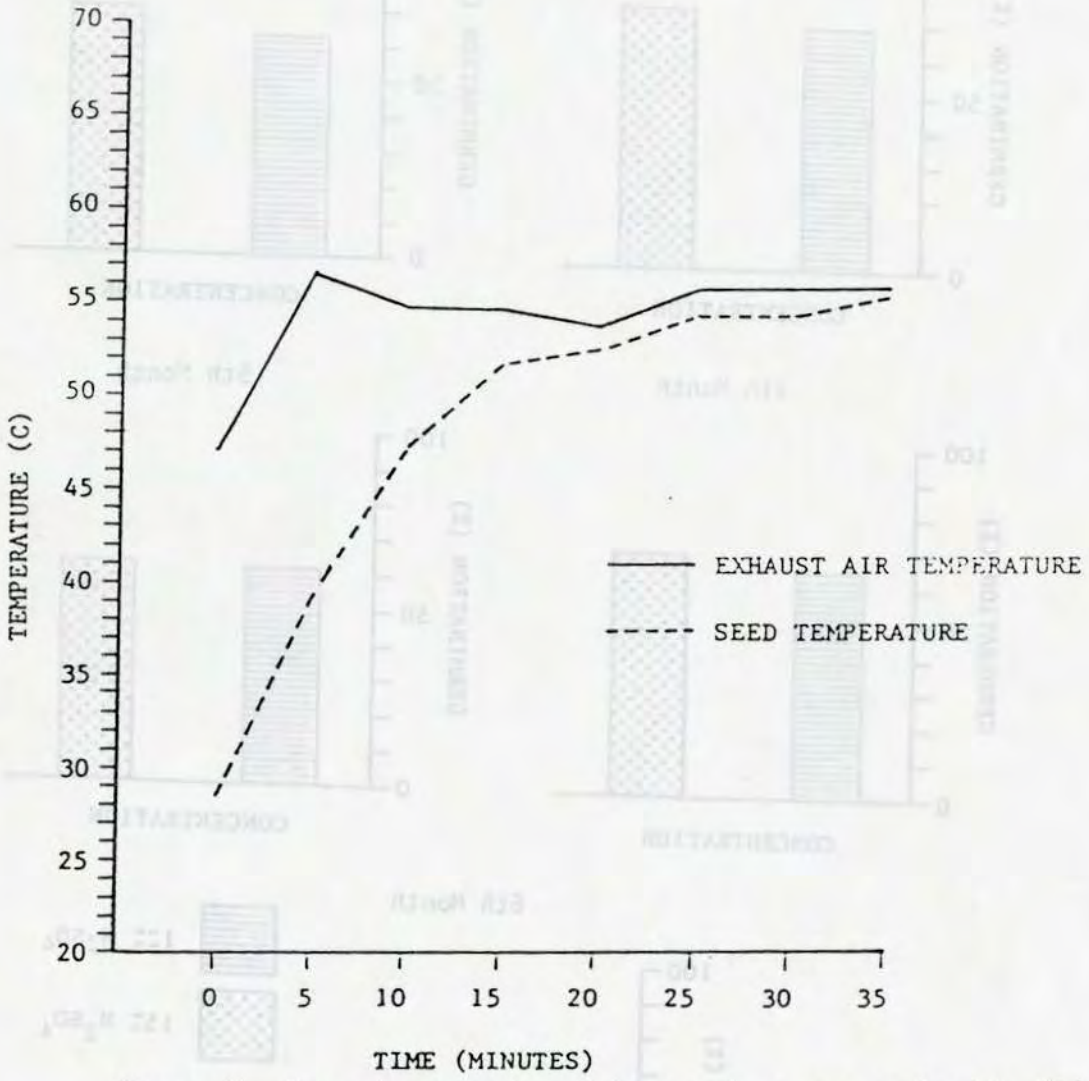

Figure 2. Exhaust-air and seed temperature curves for the 55C exhaust-air temperature treatment.

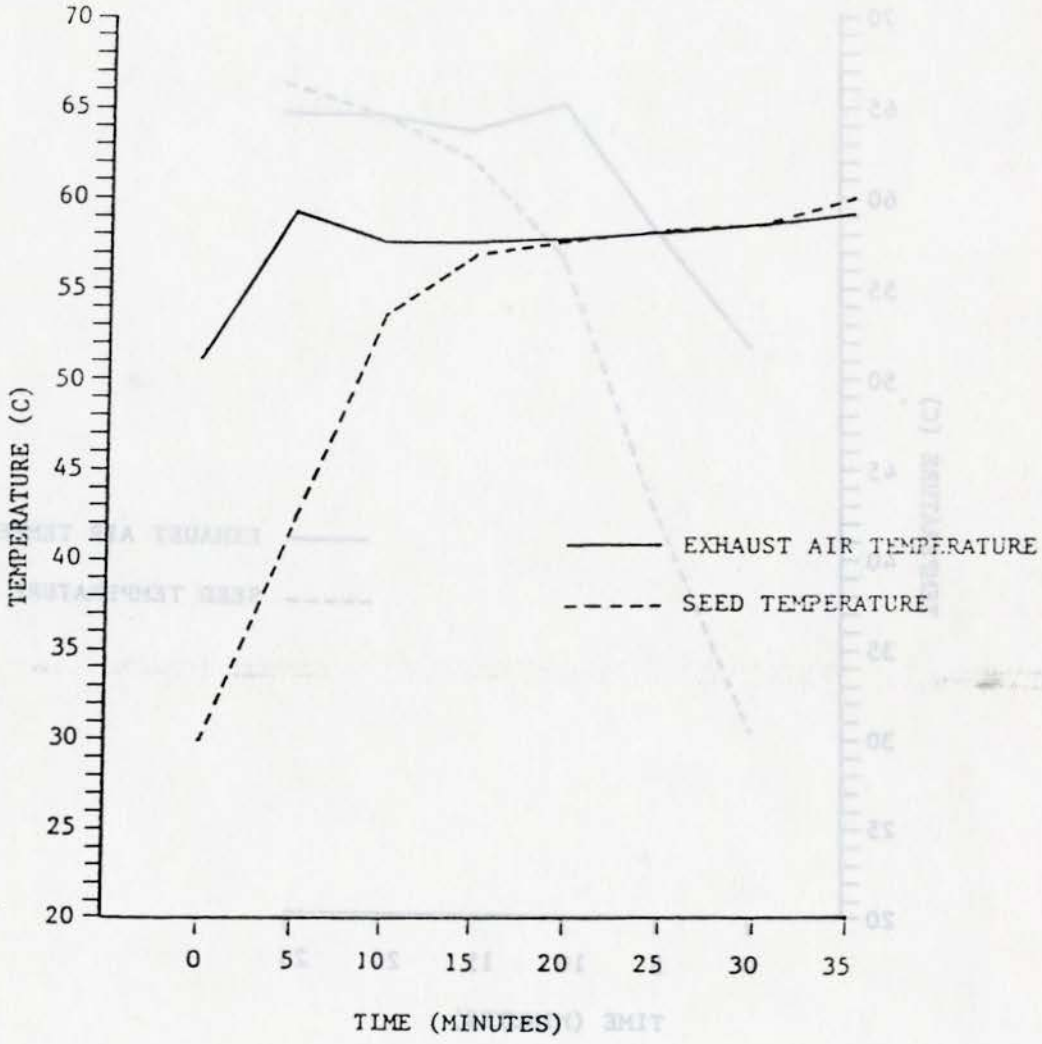

Figure 3. Exhaust-air and seed temperature curves for the 60C exhaust-air temperature treatment.

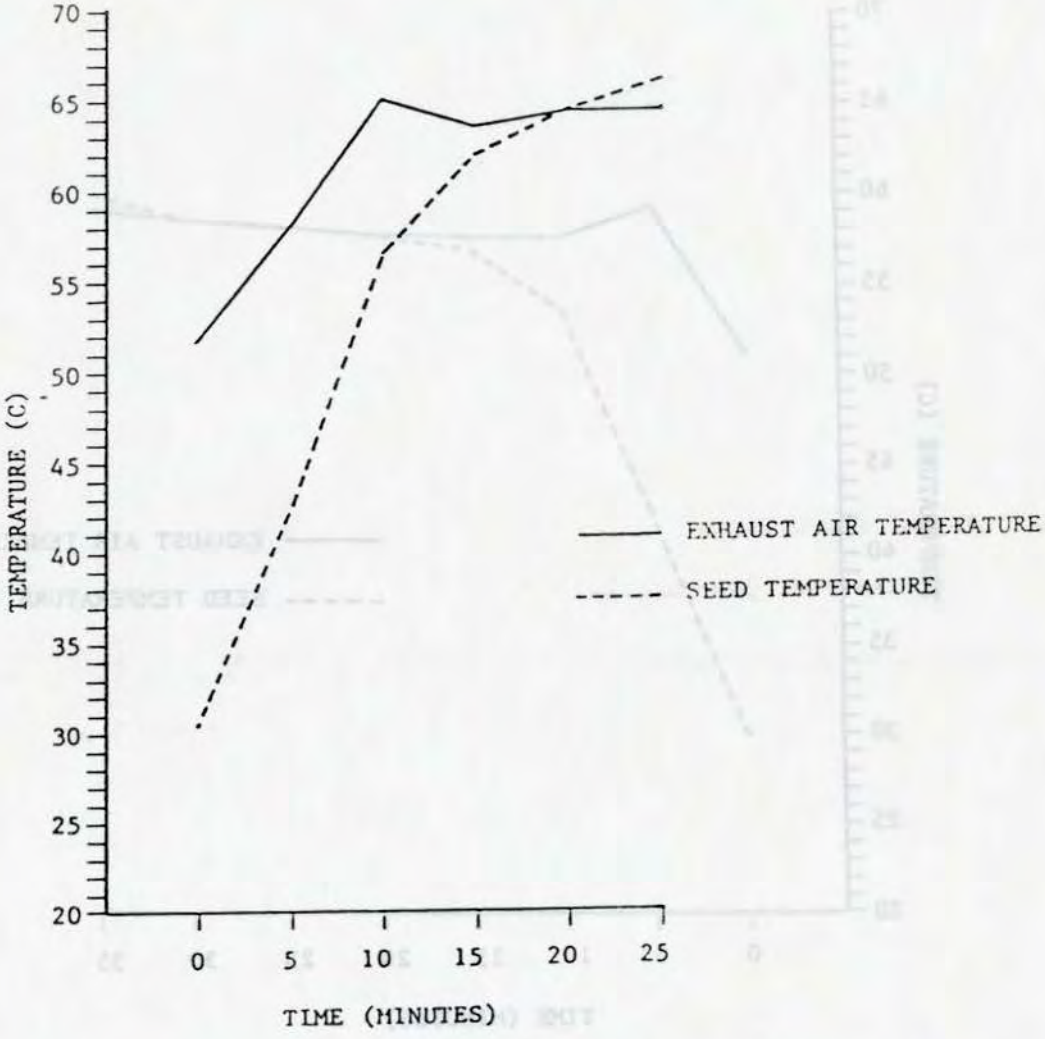

Figure 4. Exhaust-air and seed temperature curves for the 65C exhaust-air temperature treatment.

Table 4. Germination of cottonseeds delinted at three different exhaust-air temperatures as determined by the standard germination test.

Temperature (C)	Germination %
55	83.7 a
60	83.3 a
65	78.8 b

Means not sharing a common letter differ significantly at the 5% level as determined by DMRT.

Table 5. Germination of cottonseeds delinted at three different exhaust-air temperatures as determined by the tetrazolium test.

Temperature (C)	Germination %
55	84.8 a
60	83.9 a
65	77.3 b

Means not sharing a common letter differ significantly at the 1% level as determined by DMRT.

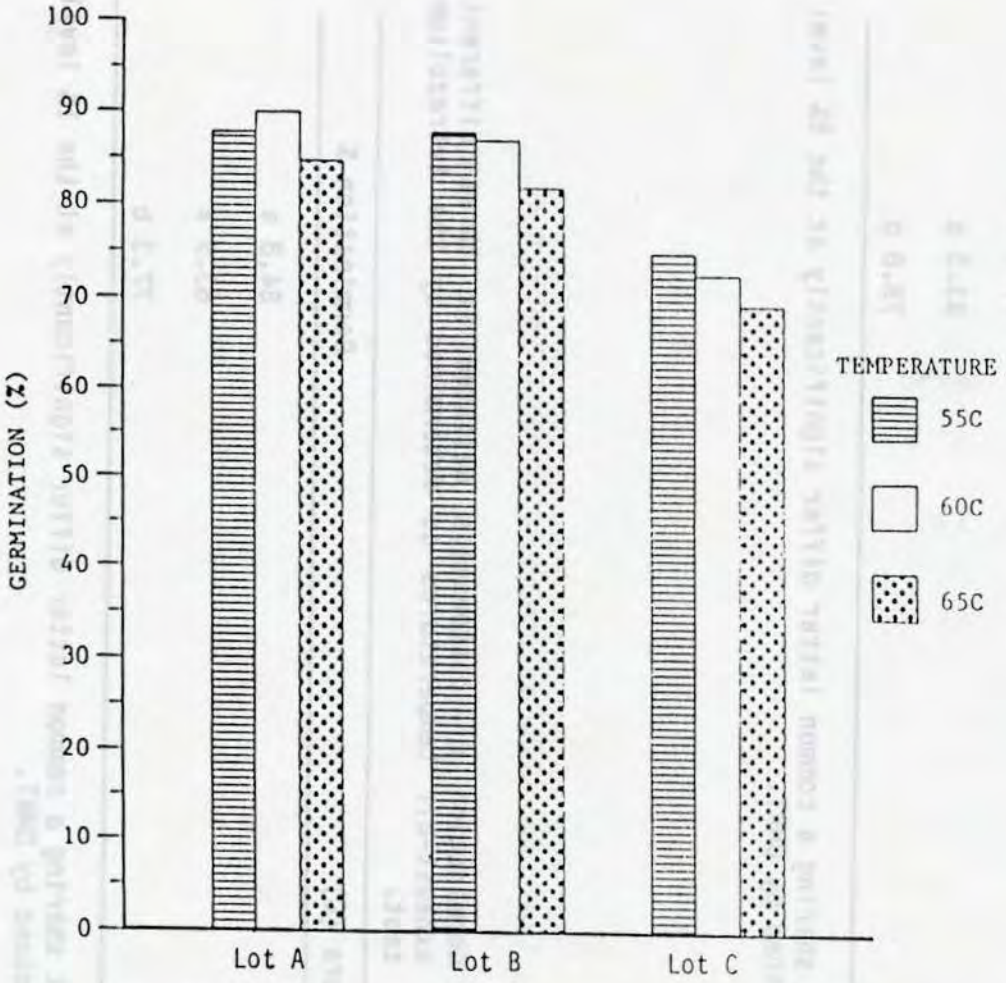

Figure 5. Germination of three cotton seed lots delinted at three different temperatures, determined by the standard germination test.

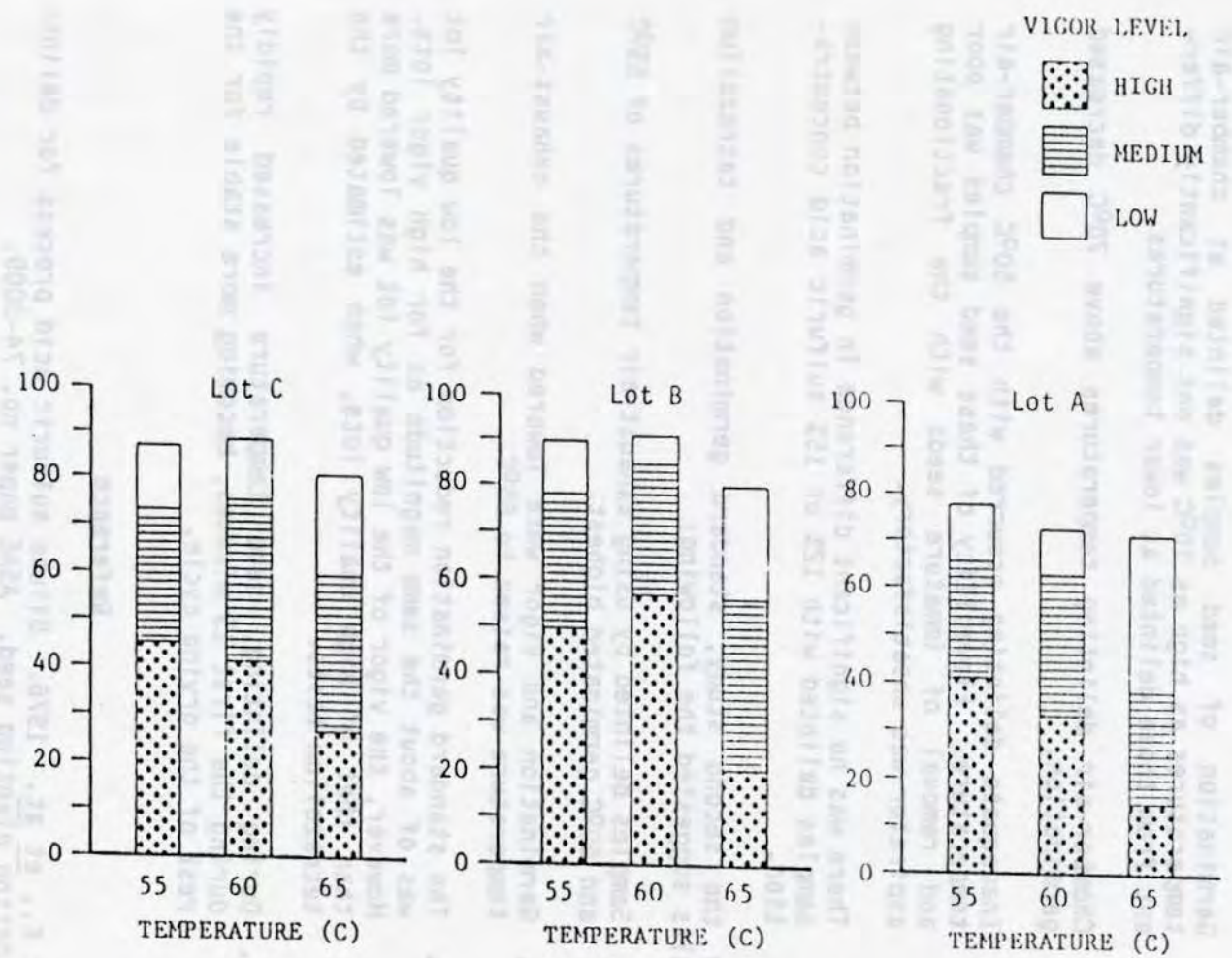

Figure 6. Germination and vigor level of three cottonseed lots delinted at three temperatures, as estimated by the tetrazolium test.

Results of the standard germination test in the first study indicated the following:

1. Germination of seed samples delinted at chamber-air temperatures as high as 70°C was not significantly different from those delinted at lower temperatures.

2. Chamber-air delinting temperatures above 70°C decreased germination.

3. Inadequate delinting occurred with the 50°C chamber-air temperature. Flowability of these seed samples was poor and removal of immature seeds with the fractionating aspirator was unsatisfactory.

4. There was no significant difference in germination between samples delinted with 12% or 15% sulfuric acid concentration.

In the second study, standard germination and tetrazolium tests results suggested the following:

1. Samples delinted by using exhaust-air temperatures of 55°C and 60°C germinated highest.

2. Germination and vigor were lowered when the exhaust-air temperature was raised to 65°C.

3. The standard germination reduction for the low quality lot was of about the same magnitude as for high vigor lots. However, the vigor of the low quality lot was lowered more than that of high quality lots, when estimated by the tetrazolium tests.

4. During delinting, seed temperature increased rapidly during the first 15 minutes, becoming more stable for the rest of the drying cycle.

Reference

Jones, J. K., et at. 1976. Dilute sulfuric acid process for delinting cotton planting seed. ASAE paper no. 74-3009.