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Effect of Delinting and of Genetical Factors on the Germination of Cotton Seeds at Low Temperatures[1]

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ABSTRACT

Acid delinting improved and accelerated the germination of cotton seeds at low temperatures in tests conducted both in an incubator (at 12 C and 14 C) and in the field. All the cultivars of *Gossypium hirsutum* L. and *G. barbadense* L., tested in these experiments, exhibited this effect, even though seeds of the latter species were covered only by a negligible amount of fuzz. This indicates that acid delinting increases the permeability of the seedcoat.

Water was absorbed by the fuzz during the first hours after planting, but later acid-delinted seeds showed a higher rate of water absorption. The inheritance of the ability of cotton seeds to germinate at low temperatures is probably polygenic and primarily additive, with prominent maternal effects which are associated with characteristics of the seedcoat and the fuzz.

Additional index words: **Gossypium, Fuzz, Seedcoat.**

THE ability of cotton seeds to germinate at a low temperature may enable earlier sowing in temperate regions. Differences in this trait among cotton varieties were reported by Ludwig (1932) and by Marani and Dag (1962b). Its inheritance was investigated by Marani and Dag (1962a), who found that the performance of F_1 hybrids was either intermediate or showed partial to almost complete dominance. There were significant differences between reciprocal F_1 crosses, which could have been related to seedcoat or fuzz characteristics.

Christidis (1936) reported that acid delinting improved the percentage of germination in field tests. He found that germination of the acid-delinted seeds was earlier than that of non-delinted ones, when the available moisture was limited during the germination period. MacDonald et al. (1947) also found that acid delinting caused a better and earlier germination of cotton seeds. They reported that the advantage for acid delinting was greater when meteorological conditions were bad, but even with ideal weather this advantage was still significant.

The purpose of this study was to determine the actual effects of the seedcoat and the fuzz on cotton-seed germination at low temperatures, and to investigate the inheritance of this trait further.

MATERIALS AND METHODS

Experiment A. Seeds of cultivar 'Acala 1517C' (*Gossypium hirsutum* L.) were germinated in an incubator at 12 C. Non-delinted seeds were compared to acid-delinted seeds (previously treated with concentrated sulfuric acid for 25 sec and immediately washed with tap water). In each treatment there were six replicates of 50 seeds. Germination was observed at 13 and 20 days after the onset of the experiment.

Experiment B. Four cultivars were included: 'Acala 1517C' (A); 'Coker 100A' (C); 'Giza 7' (G); and 'Pima 32' (P). The first two cultivars are of *G. hirsutum* L. and the other two are of *G. barbadense* L. F_2 progenies (having F_2 embryo and F_1 seedcoat) of the crosses A $\times$ P, P $\times$ A, A $\times$ G, and G $\times$ A were also included in this experiment. All the seeds were obtained by selfing parental varieties of F_1 plants that were grown in the same field during the preceding summer. Three replicates of 50 seeds of each cultivar were germinated at 12 C, and three replicates at 14 C. Germination was observed at 8, 12, 18, 23, 31, 38, and 53 days after the beginning of the experiment. Any seed, whose rootlet emerged and whose cotyledons at least partially emerged from the seedcoat, was considered as having germinated. Four replicates of 50 seeds of each cultivar or cross were germinated at 25 C under standard conditions (USDA Manual, 1952) and served as a check. All results of Experiment B were reported as a percentage of this check.

Experiment C. The effect of delinting on the rate of water absorption by cotton seeds was observed at 12 and 25 C. The following seed treatments were compared: *(1)* non-delinted; *(2)* acid-delinted; *(3)* mechanically-delinted; *(4)* mechanically- and acid-delinted. The first two treatments were applied to the four cultivars mentioned above, the latter two treatments to 'Acala 1517C' only. There were four replicates of 10 seeds, each in a randomized-block design. The seeds were weighed before the experiment and at 1, 2½, 4, 9, 24, 30, and 48 hours after the start of the experiment.

Experiment D. Non-delinted and acid-delinted seeds were planted in the field on the following dates: February 2, March 11, April 1, and April 19. There were six replicates in a randomized-block split-plot design, with planting dates assigned to the main plots. Fifty seeds were planted in each plot on the first planting date, 40 on each of the other dates. Emergence of seedlings was observed regularly.

RESULTS

In Experiment A (at 12 C), non-delinted seeds germinated 14.8% and 17.8% after 13 and 20 days, respectively, whereas germination percentages of acid-delinted seeds were 51.6% and 59.0%, respectively. The effect of delinting was highly significant (0.01 level) in each case.

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In Experiment B, delinting improved germination at 12 C and at 14 C (Fig. 1). This effect was highly significant in all cases. As germination was enhanced also in *G. barbadense* cultivars, which have naked seeds (no fuzz), it may be concluded that the acid used for delinting affected the seedcoat, probably making it more permeable to water.

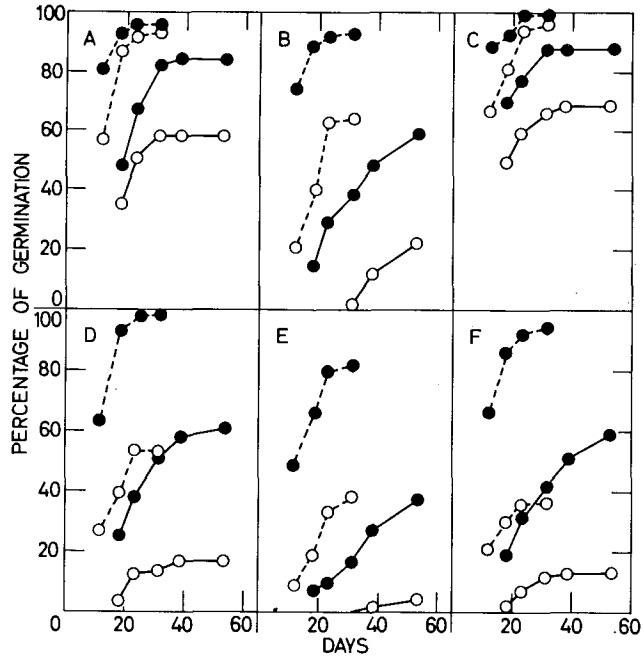

Fig. 1. Percentage of germination of cotton seeds at 12 C and at 14 C, in Experiment B. A = Giza 7; B = Coker 100A; C = Pima 32; D = Giza 7 × Acala 1517C F_2; E = Acala 1517C; F = Pima 32 × Acala 1517C F_2. (12 C ———; 14 C - - - -; non-delinted, ○; acid-delinted, ●).

The germination of *G. barbadense* cultivars was higher and earlier than that of *G. hirsutum* cultivars. 'Pima 32' germinated better than 'Giza 7,' and 'Coker 100A' better than 'Acala 1517C.' There were no significant differences between F_2 progenies of reciprocal crosses. The means of these reciprocals are given in Fig. 1. The performance of the F_2 progenies was roughly intermediate between that of parental varieties. In one case (Giza 7 × Acala 1517C, acid-delinted at 14 C) the F_2 performance was slightly better than that of its best parent.

Results of Experiment C are presented in Fig. 2. The rate of water absorption by the seeds in all the treatments was higher at 25 C than at 12 C. Acid delinting increased the rate of water absorption at both temperaures also in seeds of cultivars Giza 7 and 'Pima 32,' which are covered with a negligible amount of fuzz. Non-delinted seeds of Acala 1517C absorbed more water than delinted seeds during the first 15 hours of germination at 12 C. The same effect was observed for longer periods in Coker 100A at 12 C, and in both cultivars at 25 C. This may be explained by assuming that the fuzz itself absorbed relatively large amounts of water at the beginning of germination; this effect probably exceeding that of the increase in seedcoat permeability caused by the acid treatment. The effect of acid delinting on seeds of Acala 1517C which had been previously delinted mechanically was similar to its effect on seeds of *G. barbadense* cultivars.

Results of Experiment D are presented in Table 1. The final emergence of the acid-delinted seeds was significantly higher than that of the non-delinted ones in all planting dates.

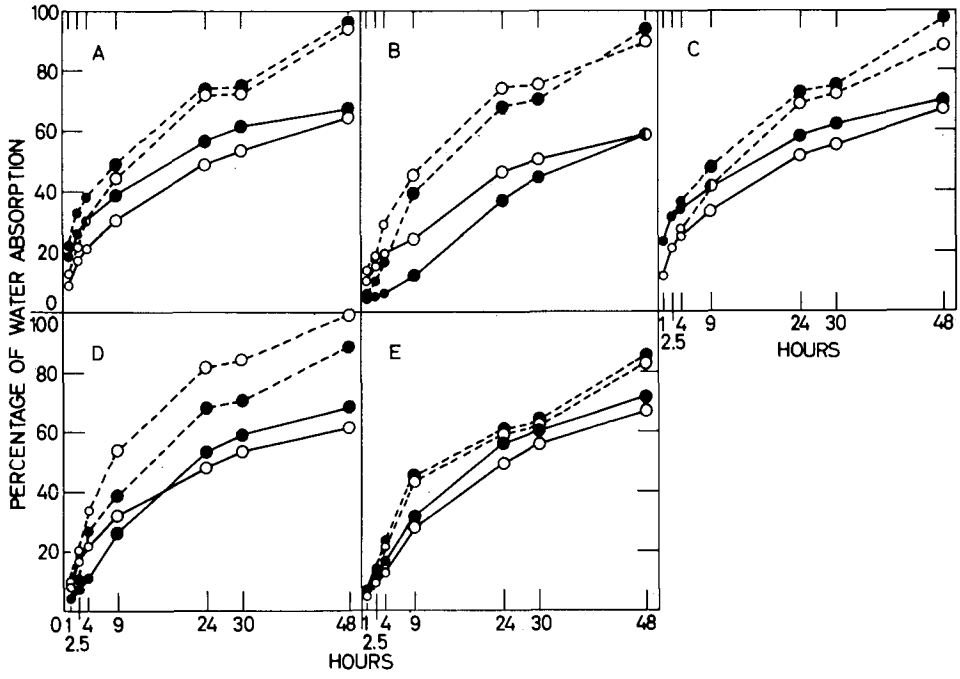

Fig. 2. Rate of water absorption of cotton seeds at 12 C and at 25 C, in Experiment C. A = Giza 7; B = Coker 100A; C = Pima 32; D = Acala 1517C with no mechanical delinting; E = Acala 1517C with previous mechanical delinting. 12 C ———; 25 C - - - -; non-delinted, ○; acid delinted, ●).

Table 1. Final percentage of emergence in Experiment D.

	Planting date			
	2/2	3/11	4/1	4/19
	% emergence			
Non-delinted	19	37	53	43
Delinted	27	84	82	59
Soil temperature*	degrees C			
800 hours	10.1	16.0	19.0	21.1
1400 hours	16.6	24.2	27.9	30.5

* Soil temperature was measured at a depth of 5 cm and averaged for 15 days after each planting date.

DISCUSSION

At low temperatures, acid-delinted seeds had a higher rate of germination than non-delinted seeds. This may be explained by the effect of the fuzz in retarding or impeding the germination. However, similar effects were also observed on seeds of *G. barbadense* cultivars which have practically no fuzz, and on seeds of *G. hirsutum* cultivars which had previously been mechanically delinted. This observation indicates that the acid used in delinting probably increases the permeability of the seedcoat.

The acid-delinted seeds emerged better than the non-delinted ones under field conditions (in Experiment D) at a wide range of soil temperatures. This is in agreement with similar findings reported by MacDonald et al. (1947). It may, therefore, be concluded that there is a beneficial effect of acid delinting on the emergence of cotton seeds at low temperatures, as well as under favorable temperature conditions.

The results of Experiment C show that the fuzz may absorb considerable amounts of water during the initial period after planting. It may, therefore, compete with the embryo for water under conditions of limited moisture. This could account for the better germination of delinted seeds under field conditions.

The intermediate germination of the F_2 progeny of crosses at low temperatures indicates polygenic inheritance with a predominance of additive effects for this trait. This is in agreement with similar findings of Marani and Dag (1962a). No differences were found between reciprocal F_2 progenies, whereas, Marani and Dag (1962a) reported significant differences between reciprocal F_1 progenies. This proves that the differences between reciprocals were not due to cytoplasmatic effects, but to maternal tissue effects, which are probably related to the characteristics of the seedcoat and the fuzz.

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