LABORATORY TESTS DESIGNED TO IMPROVE COTTON PLANTING SEED QUALITY

Robert G. McDaniel

Abstract

A number of representative seed lots of both upland and Pima cotton cultivars and experimental strains have been evaluated utilizing two instruments which measure relative seed coat strength. Seed coat strength was found to have a strong genetic component of determination, with relatively minor influence of environment and year of production being observed. Greater seed coat strengths should contribute to the relative resistance to seed damage and cracking during picking, ginning and conditioning operations. It may be possible to incorporate this trait into cotton cultivars by mass selection techniques.

Introduction and Results

Numerous studies have shown that the proportion of cracked and damaged cotton seed in a seed lot can be a major cause of poor field emergence and stand establishment. It is not unusual to find commercial lots of planting seed which contain 30% or greater cracked seed. Sometimes this damage cannot be readily detected by visual inspection, because some seed coat cracks are quite fine; and additionally, because the seed may be evaluated before delinting where the presence of fiber makes inspection of the seed coat surface difficult. It was also evident that some genetic strains of cotton were more likely to show seed cracking damage than others; and that the picking, ginning and conditioning operations could contribute to such damage.

We felt that the best approach to assessing such damage was to sample cotton planting seed lots, in many cases using fuzzy seed prior to delinting, and to apply physical stress to the seed in an effort to determine the actual response of individual seeds to imposed force. A number of seed sources, representing both upland and Pima varieties, obtained from cooperating Arizona private (corporate) and USDA breeders, and also seed of several cotton strains provided by the Acala Cotton Board of California have been evaluated.

We utilized two designs of force gauge to simulate the actual forces which might be expected to damage cottonseed. A hand operated Dillon force gauge, calibrated in Newtons (units of force), as well as an automatically actuated VanKel, Inc. pharmaceutical tablet hardness testing instrument were used. Our previous studies had shown a good relationship between the cell ultrastructure making up the cotton seed coat, and the resistance of the seed to force applied at a right angle to the long axis of the seed. Since moisture status of the seed was also determined to be an important factor in the relative strength exhibited by cottonseed, all our tests were run using low moisture seed, which provided us with the most consistent gauge readings.

The genetic background of the seed source being tested proved to be the major determinant in the relative resistance of that seed to cracking damage. Seed sources with greater resistance to applied force showed superior seed coat strength. Significant differences in seed coat strength were seen when populations of seed produced at various Arizona and California locations were tested. Also some effects of year of production were noted across these locations. These differences were usually less marked than responses due to genetic source of the seed tested.

Figure 1. illustrates a representative nomogram which presents the distribution of seed coat strength readings observed when a random sample of individual seeds drawn from a single seed lot were evaluated. When no unexpected factors are operating (for example, presence of a high percentage of unfilled seed which have relatively weak seed coats) a normal distribution of seed coat strengths is observed. The mean of this distribution, with an appropriate error term, affords a good estimation of the expected seed coat strength of this cultivar or genetic strain of cotton. Of course, the larger the sample of seed it is possible to test, the better the estimate of average expected seed coat strength. We have obtained very good estimates using several hundred seed samples drawn with appropriate sampling techniques from individual seed lots.

Based upon these initial studies, it may be possible to select for increased seed coat strength using mass screening techniques to identify individual seed which show superior seed coat strength. These seed, although cracked during testing, could be resealed with a polymeric coating, planted, and seed increased. A small scale effort to evaluate this approach is presently underway.

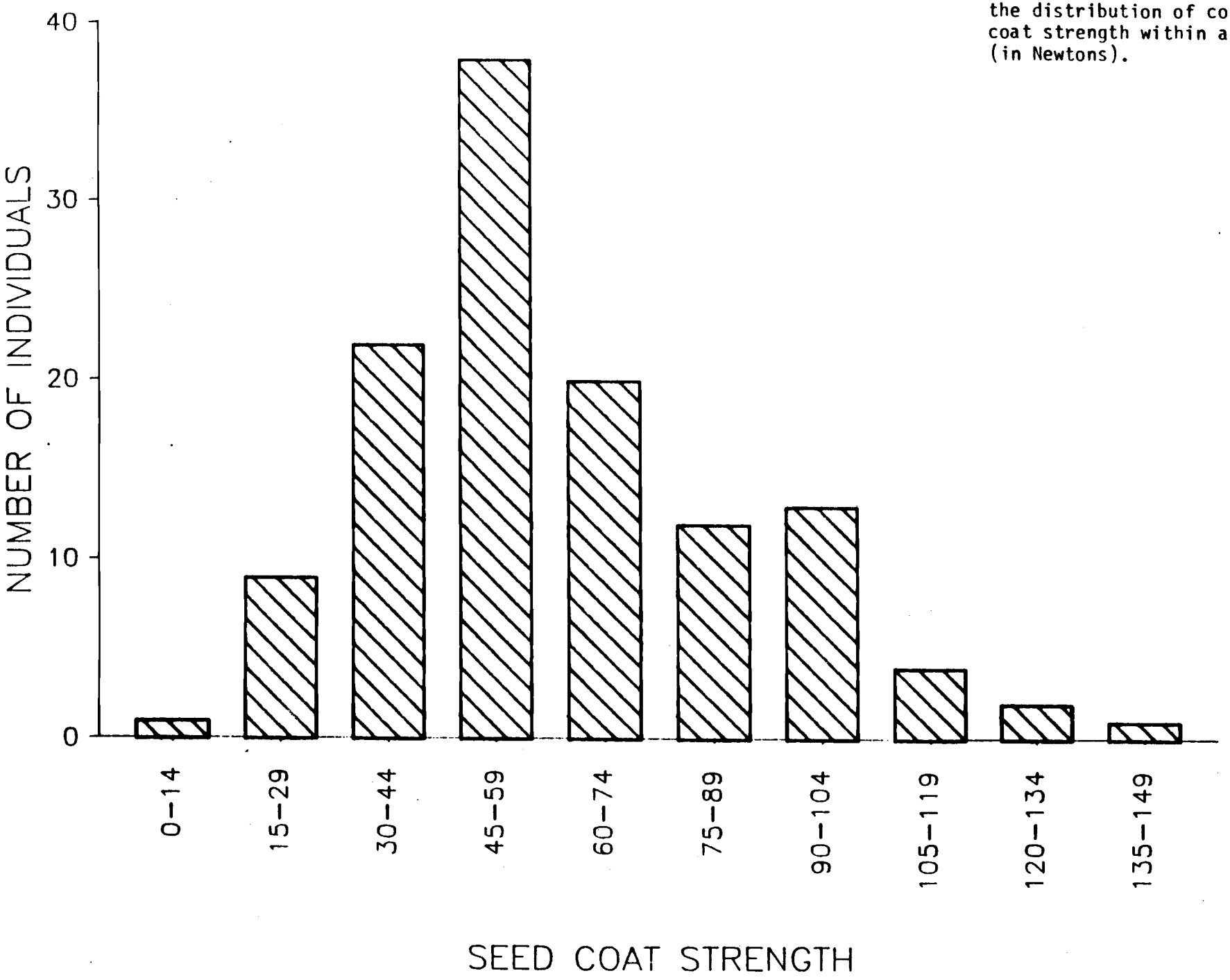

Figure 1. Nomogram illustrating the distribution of cottonseed coat strength within a seed lot (in Newtons).