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Ginning Quality Cottonseed

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GINNING QUALITY COTTONSEED

Harold Watson 1/

High quality cottonseed is an essential factor in the modern cotton production programs of today. Advanced cultural practices presently used in cotton farming accentuates the need for top quality seed which will germinate rapidly, emerge from the soil and produce uniform stands, thus lessening the possibilities of replanting.

One of the major factors contributing to the overall quality of cottonseed is the degree to which the seed has become mechanically damaged during processing. Mechanical damage, which occurs during the harvesting, ginning and delinting processes, results in cracking, breaking or nicking of the seed coat, which may lessen the seed's ability to germinate and produce a normal, healthy seedling. Mechanical damage may also cause increased deterioration of the cottonseed during periods of storage.

During the past two years, studies have been conducted by the Stoneville Ginning Laboratory, in cooperation with the Mississippi State University Seed Technology Laboratory, aimed at evaluating the extent and causes of mechanical damage to cottonseed during the ginning process. This research was also designed to study the effect of mechanical damage upon other quality factors of the cottonseed. While concerned primarily with the ginning aspects of the mechanical damage, results of these experiments also yeilded information on two other sources of seed damage -- field weathering and mechanical harvesters.

Mechanical processing does not account for all cottonseed damage.

From the time that the cotton boll begins to open, until harvest, weathering conditions in the field may cause a limited amount of seed coat damage. Prolonged periods of dampness, followed by dry atmospheric conditions, may cause swelling and shrinking of the seed, resulting in the cracking of the seed coat. This damage is characterized by small hairline cracks and splits along the radicle end of the seed. These cracks, as well as other types of damage, are readily observable once the seed have been acid delinted. The degree of

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field damage will vary depending upon weather conditions and length of exposure. Analysis from samples of hand-picked cotton collected during the 1963 ginning season indicated that field weathering accounted for less than one percent damage to the seed.

Mechanical harvesters constitute the first source of mechanical damage to cottonseed. Results of 1963 field studies, involving seven high-capacity gin plants and 210 bales of cotton, showed that damage resulting from spindle type harvesters ranged from less than one percent to slightly above 20 percent, and average 4.2 percent. 2/ The doffing and elevating systems on these machines are the most probable cause for this damage.

The degree to which seed are damaged during the ginning process depends upon numerous elements, wuch as number and type driers and seed cotton cleaners, pneumatic conveyor design, conveying velocities, and gin stand type. Damage occurring in the conveying, drying and seed cotton cleaning systems is generally minor as compared to gin stand damage. Recent field surveys involving 7 Mississippi gins indicated that mechanical damage to cottonseed would be increased by less than one percent as a result of processing through these systems. Gin stands in these same plants created increases of 4.7 percent in damaged seed.

The total mechanical damage occurring from harvesting through ginning was 9.7 percent, based on the seasonal average of the 1963 studies. On a percentage of total basis, mechanical harvesting accounted for 43 percent of the total damage, gin conveyors, driers and cleaners accounted for 8 percent, and gin stands the remaining 49 percent.

Within a given ginning operation, two major factors tend to affect the degree of seed damage occurring during processing, these being processing rate and seed moisture.

Increases in processing rates create accompanying increases in mechanical damage, as shown by laboratory tests conducted during the 1964 ginning season. These tests were conducted in 3 series, using 5 bales each of early, mid and late season machine-picked cotton. Processing equipment employed included two tower driers, 2 cylinder cleaners, bur machine, extractor-feeder, and a large-diameter saw, high-capacity gin stand. Date from these studies indicate that ginning rate drastically affects the degree to which seed are mechanically damaged. Increased seed damage resulting from corresponding increases in processing rate may be attributed entirely to the gin stand (figure 1).

2/ Watson, Harold, and James D. Helmer, "Cotton Seed Quality as Affected by the Ginning Process-A Progress Report." U.S.D.A. Agricultural Research Service, Bulletin No. ARS 42-107.

Harvesting accounted for an average of 5.9 percent damage. Gin conveyors, driers and cleaners caused another 3.0 percent damage, bringing the total damage before ginning to 8.9 percent. Processing rate had no apparent effect upon the amount of damage incurred in the conveying, drying and cleaning systems.

Gin stand action accounted for 12.8 percent damage at a processing rate of 10 pounds of lint per saw per hour. As the processing rate was increased to 28 pounds of lint per saw per hour, gin damaged seed increased to 23.7 percent. Thus, total mechanical damage varied from 18.7 to 32.6 percent at processing rates of 10 and 28 pounds of lint per saw per hour, respectively. Increased seed roll density at the higher ginning rates is the most probable cause for increases in gin stand damage. Decreased freedom of seed movement at the higher roll densities results in a more positive action by the saw teeth upon the seed coats which, in turn, causes increased nicking and abrasion by the saw teeth.

During the fiber and seed separation process which occurs in the gin stand, cottonseed remain in the seed roll chamber for approximately 30 seconds. While in the seed roll chamber of the average high-capacity gin stand, cottonseed are exposed to approximately 40,000 saw teeth traveling at speeds ranging up to 3,000 feet per minute. Each saw tooth represents a potential source of seed coat damage, even under ideal operating conditions. With this potential source of damage existing within the gin stand, plant operators must necessarily exercise care to apply operating procedures which will result in minimum saw damage to the seed. The use of processing rates which will provide a uniform, low-density seed roll is the major means available to the operator for decreasing processing damage during ginning.

Cottonseed moisture content at the time of ginning also affects mechanical damage occurring during processing. Results obtained from studies conducted during 1963 indicate a general trend toward increased seed damage by the gin stand, with increases in seed moisture content. This trend indicates that for moisture contents ranging from 6 to 16 percent, mechanical damage will increase about 1 percent for each 2 percent increase in seed moisture content. At higher moisture contents, seed coats tend to become soft and pliable, thus making them more susceptible to nicking and abrasive actions of the gin saws.

Cotton gin drying systems can do very little toward lowering the

moisture content of cottonseed during processing. Due to the residual nature of moisture present in cottonseed, its removal requires considerably longer exposure periods than those feasible in gin drying systems. 3/

What effect does mechanical damage have on the ability of cottonseed to germinate and produce normal seedling? Germination analysis of acid delinted seed from the 1964 ginning rate studies indicated that germination percentages would be lowered an average of 3.5 percent as a result of processing. Average germination percentages for these seed before gin processing was 91.8 percent. After passing through the seed cotton conveying, drying, and cleaning systems, germination was lowered to 90.4 percent. Damage occurring in the gin stand resulted in lowering the germination to 88.3 percent. The ratio of mechanical damage increase resulting from gin processing, to decrease in germination was 6 to 1, based on an average ginning rate of 19.5 pounds of lint per saw per hour. This means that for each 6 percent increase in mechanical damage, the corresponding decrease in germination was 1 percent.

Mechanical damage also tends to increase the amount of abnormal seedlings as indicated by germination tests. Analysis of samples collected during the 1964 ginning rate study indicated an average increase of 1.9 percent in abnormal seedlings resulting from damage incurred during the ginning process. Before gin processing began, an average of 1.0 percent of the germinated seedlings were abnormal. This percentage increased to 1.6 after processing through the seed cotton conveying, drying and cleaning systems. Gin stand action resulted in increasing the percent of abnormal seedlings to 2.9 percent.

Thus, from the time the cotton boll begins to open until the final delinting operation, cottonseed is subjected to various forms of damage, both from natural and mechanical causes. Cotton gins account for much of the mechanical damage inflicted upon the cottonseed. Gin damage to seed may be reduced significantly by following these precautionary measures:

(1) Maintain reasonable ginning rates which will provide a soft, low-density seed roll. This is of special importance when seed moisture contents are in excess of 10 percent.

(2) Keep conveying velocities to a minimum in seed cotton and cottonseed pneumatic conveying systems.

(3) Use large radius elbows in pneumatic conveying systems.

(4) Keep gin machinery in proper repair and adjustment. This is

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3/ Shaw, C. Scott and Gerald N. Franks, "Cottonseed Drying and Storage at Cotton Gins." U.S.D.A. ARS Technical Bulletin No. 1262. May, 1962.

especially important in some seed cotton cleaners in order to allow sufficient clearance for seed to pass between cleaning cylinders and gridrods or screens.

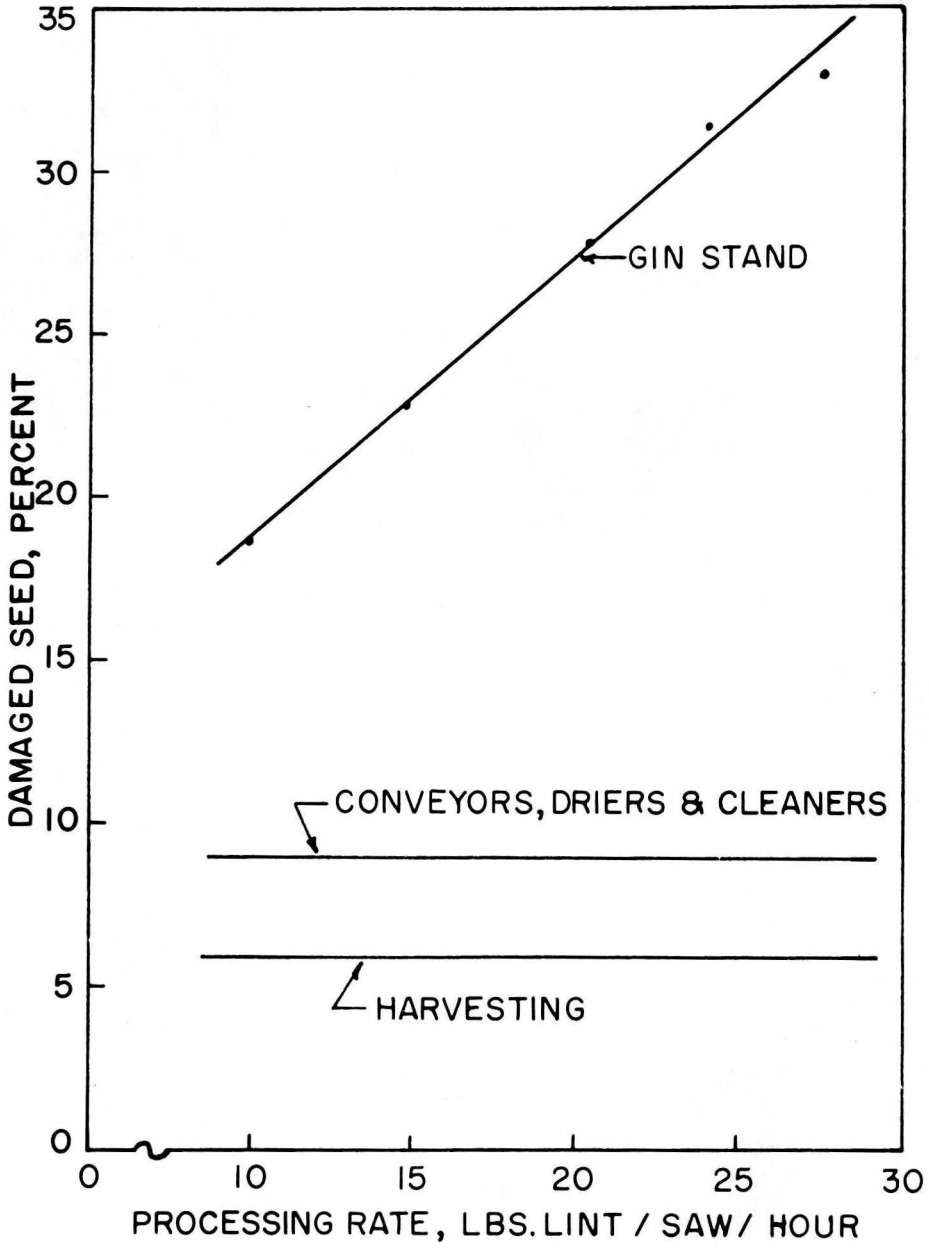

Figure 1.--The effect of processing rate on mechanical damage of cotton-seed, 1964.