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Submissions of Saw Gin Speed on the Quality of Cotton

S. ASLAM*, N. SOOMRO[++]

Department of Textile Engineering, Mehran University of Engineering and Technology, Jamshoro, Sindh, Pakistan.

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Abstract: Rough ginning is often caused by dense seed rolls. These dense seed rolls come from feeding cotton to the gins beyond the capacity which occur damage to cotton at gins has incorrectly been credited to the speed of the gin saws, rather than to the rate of feeding. These observations made by authors during visit to the ginning industry of Pakistan.

Keywords: Cotton ginning; Quality gin management.

1. INTRODUCTION

The cotton-ginning business is highly competitive, and ginners are always inclined to follow fast ginning practices for quantity ginning to earn a lot. On the other hand the spinners in general demand quality instead of quantity ginning; therefore quality of the Pakistan cotton has continued to average lower than it should. If the best ginning methods and practices are not used, therefore, it is worthwhile to have an understanding of the speed factors in ginning and their effect on cotton quality International Cotton Advisory Committee, (2001).

There is much misunderstanding of the term "fast ginning" Many ginners, including some closely connected with the ginning industry, believe fast ginning means high speed of the saw Anthony, (2001)..

As a matter of fact, the number of bales ginned per hour is not in proportion to saw speed. The rapidity with which the lint is separated from the seed depends in far greater degree upon the rate at which the seed cotton is fed into the gin stand. To gin faster, a ginner allows the seed cotton to be fed into the roll box faster. This causes the seed cotton in the roll box to become more compact, so that each saw tooth removes more fibers than when the roll is not so dense. Thus, even with the seed board wide open, fast ginning results from the use of a tight seed roll caused by heavy feeding, whereas slow ginning results from the use of a loose seed roll caused by slow feeding.

Purpose of study.

Because the ginning time per bale, per fixed number of gin saws, has an important effect on the quality of the ginned lint, and because of misunderstanding as to what influences the rate of ginning, the authors made an extensive series of tests to determine the effect of varying seed-roll density and saw speed on certain quality elements of ginned lint and on mechanical elements of gin-stand operation.

This study uncovered facts on the relative influence of seed-roll density and gin-saw speed on the quality of ginned lint, and on the ginning capacity, power requirement, and energy consumption during ginning.

2. MATERIALS AND METHODS

In conducting the experiments, following seed cottons were especially selected to represent pure varieties of Pakistan upland BT cotton, MNH 93 (Punjab), and Chadni-95 (Sindh) of the 2014 crops. Before exercise in the ginning tests, laboratory tests of samples from the both cottons were conducted with respect to the important physical properties.

These seed cottons were ginned at air-blast types of 90-saw gins having 12-inch diameter saws of 282 teeth for the experiments at Sindh Seed Corporation ginning plant in Tandojam.

Generally the air-blast gins are used in ginning industry of Pakistan (Soomro**,** 2011) most of gins are operating at speeds 100 revolutions per minute above rather recommended speed. By feeding the cotton to the gin stands at different rates, it is possible to produce both loose and tight seed rolls at each gin-saw speed.

A loose seed roll generally has a hollow center, whereas a tight seed roll is solid. During rotation, loose seed rolls are whiter in color because they contain a greater proportion of fibrous material per pound of seed

[++]Corresponding Author: Noorullah Soomro email: noorullah.soomro@faculty.muet.edu.pk
*Department Chemical Engineering, University of Karachi, Pakistan

than the tight seed rolls (Technical Bulletin, 2014). Indentation in the loose seed roll by the hand is easy; and the cotton and seed, by this action, can easily be retarded or disturbed. Tight seed rolls can hardly be disturbed by the hand during rotation, and generally their higher speed and centrifugal action causes individual seeds to be freed from the roll at the top and dance there. Tight seed rolls rotate with greater circumference and at a higher speed than loose rolls, surpassing them in speed sometimes by more than 35 percent. In a 90-saw gin operating on dry cotton, a loose seed roll contains a mixture of approximately 30 kg of seed cotton and cottonseed, whereas a tight roll contains 40 kg or more.

Dense seed rolls are produced not only by excessive feeding of cotton to gin stands, but even with slow feeding to gin stands whose vital parts are in poor mechanical condition. If the saws have been neglected and are dull or badly worn, they will not be efficient in removing the lint from the seed. The result will be denser seed rolls and "napping", or poor preparation of the lint. Similarly, inadequate doffing of the lint from the saws because of badly worn or improperly adjusted brushes in brush gins, or because of a run- down air-blast system in air-blast gins, will produce tighter seed rolls at a given rate of feed than with efficient doffing mechanisms. A seed board too nearly closed will prevent easy discharge of the seed from the roll box which in turn will hinder loose seed-roll performance. Feeders are sometimes operated at such a high speed that the lowest feed setting provides too much cotton for loose seed-roll ginning.

For laboratory purposes of cotton-ginning research, the speed of the gin saws can be regulated during each test by use of a variable-speed of the saws regardless of the density of the seed roll, by increasing the speed of the transmission enough to overcome the retarding effect of increasing the roll density.

Three gin-saw speeds were used in the tests—low, medium, and high. The recommended medium speed for each gin is always 600 revolutions per minute except in the case of the high-speed design of air-blast gin for which 700 revolutions per minute is recommended and used. The low speed in each case is 100 revolutions per minute less and the high speed 100 revolutions per minute greater, than the medium speed.

Because a satisfactory mechanical roll-density indicator has not yet been developed, uniform density of the seed roll was obtained by the operator observing the height and "feel" of the roll and adjusting the rate of feed of the cotton into the gin stand. This method assured a uniform density across the entire width of the gin rather than at one point only. Loose and tight seed rolls are shown in cross section in **(Fig. 1)**.

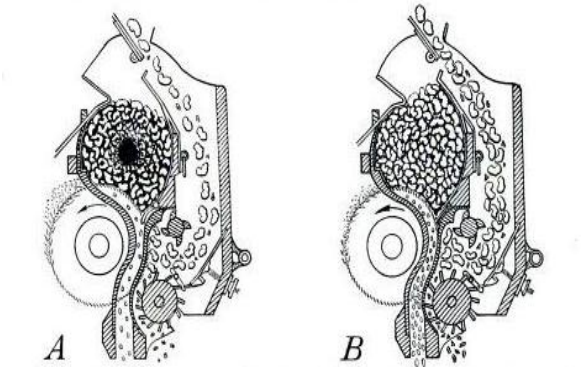


Fig.1. Cross sections of seed roll.
(*A*) Loose seed roll (*B*) Tight seed roll.
The loose roll has a hollow center, where as the tight roll is sold.

In a 90-saw gin operating on dry cotton, a loose seed roll contains a mixture of approximately 30 kg of seed cotton and whereas a tight roll contains 40 kg or more.

In the saw-speed studies for which results are hereinafter reported, each lot of seed cotton was divided into portions of which one was ginned at low saw speed with loose seed roll, another at medium speed with loose seed roll, another at high speed with loose seed roll, another at low speed with tight seed roll, another at medium speed with tight seed roll, and another at high speed with tight seed roll.

During each test, after the desired conditions had been obtained and maintained for a short time, representative samples of ginned lint weighing approximately 1 kg were taken at the condenser for fiber analysis and classification. (Laboratory analyses and classification studies made on a series of samples taken from each of several hundred tests confirm the representative nature and reliability of this method of sampling.) Additional samples taken at the condenser at the same time were placed in air-tight tin containers for use in determining the moisture content of the ginned lint. Repeated moisture tests have revealed a high degree of accuracy for this procedure of sampling.

3. RESULTS OF TESTS AND OBSERVATIONS

Quality of Lint.

(Tables 1 and 2) explain the results for certain quality elements of ginned lint as influenced by varying the seed-roll density and the gin-saw speed.

Ginning Time and Lint Turn-Out.

Gin-saw speed and seed-roll density affect not only the quality of the ginned lint but also the ginning time and the lint turn-out. The data on these factors from tests with two air-blast gins and two cottons were averaged, and are shown in table 2. The weighted average staple

length of these cottons was about 1 inch and the moisture content 9.6 percent.

Table1. Average staple length of cotton lint ginned at different saw speeds and seed-roll densities. Cotton 1/8 inches and longer.

Moisture-content of seed cottons (%) And lot nos.	Gin-saw speed (rpm)	Staple length for indicated of gin			
		Air-blast gin1 (MNH-93)		Air-blast gin2 (Chandni-95)	
		Loose Seed roll	Tight Seed roll	Loose Seed roll	Tight Seed roll
		Inches	Inches	Inches	Inches
12.0 + Lot 1, 2,3.	Low	1-5/32+	1-5/32	1-5/32 +	1-5/32
	{Medium	1-5/32+	1-5/32	1-5/32 +	1-5/32
	High	1-5/32+	1-5/32 -	1-5/32 +	1-5/32 -
Below 12.0 – Lot 1, 2, 3.	Low	1-5/32+	1-5/32	1-5/32 +	1-5/32
	{Medium	1-5/32+	1-5/32	1-5/32 +	1-5/32
	High	1-5/32+	1-5/32 -	1-5/32 +	1-5/32 -

The time required to gin 50 kg of seed cotton tended, on the average, to increase when the saw speed was reduced 100 revolutions per minute below the manufacturer's recommended speed and to decrease when the saw speed was increased 100 revolutions per minute above the recommended speed. The slightly increased capacity obtained with increased saw speed is due to the greater number of saw teeth coming in contact with the seed roll in a given time, thus removing a somewhat greater number of fibers. The gin capacity is not increased, however, in proportion to the number of saw teeth contacting the seed roll. That is, while increasing the saw speed from 400 to 500 revolutions per minute increased the number of teeth engaging the seed roll per minute by 25 percent, the increase in amount of lint obtained per minute was only about 6 percent.

Table2. Average ginning time and average lint turnout per 50 kg of seed cotton having an average moisture content of 9.6 percent ginned with 90 saw gin stands operated at different saw speeds and with different seed-roll densities.

Lot nos.	Gin-saw speed	Ginning Time		Amount of Lint	
		Air-blast gin1 (MNH-93)		Air-blast gin2 (Chandni-95)	
		Loose Seed roll	Tight Seed roll	Loose Seed roll	Tight Seed roll
		Minutes	Minutes	KGS	KGS
Lot 1, 2, 3.	Low	5.1	3.6	15.0	14.9
	{Medium	4.9	3.4	16.4	16.2
	High	4.8	3.3	16.5	16.3

By timing the rotation of the seed roll in several makes of gin stands it was found that the rotate speed of the seed roll varied not with the saw speed but with the roll density. Tests with a 90-saw gin fitted with free-turning circular ends on the roll box and a special tubular spiked core connected to these ends disclosed, with gin-saw speeds ranging from 300 to 800 revolutions per minute, a constant loose-seed-roll speed of 84 revolutions per minute and a constant tight-seed-roll speed of 116 revolutions per minute.

The difference in time required to gin 50 kg of seed cotton was much less between the lowest and the highest saw speed than that between the loose and the tight seed-roll ginning at any saw speed used in the tests. For the loose seed roll, the reduction in ginning time between the low and the high saw speed was only 0.3 minute, or 6 percent. For the medium saw speed, the difference in ginning time between loose and tight seed rolls amounted to 1.5 minutes, or 30 percent, in favor of the tight roll.

Power Requirements and Energy Consumption.

In the studies here reported, only a limited amount of data on the power phase of ginning was collected because necessary instruments were not obtained until the studies had reached an advanced stage. However, the available data show some rather interesting relationships.

The power requirement of a 90 saw gin equipped with 12-inch saws, and for the energy consumption of the gin stand in ginning 800 kg of seed cotton, varying the gin-saw speed from 100 revolutions per minute below to 100 revolutions per minute above the manufacturer's recommended speed showed a slight tendency to increase the power required by the gin stand, whereas varying the seed-roll density from loose to tight increased the power requirement by about 50 percent. So large a difference in the necessary capacity of the motors or engines required to drive the gins is a material advantage of loose seed-roll over tight seed-roll ginning.

4. CONCLUSIONS

Study have been made to determine the relative influence of gin saw speed and seed-roll density on the quality of ginned lint and on the ginning capacity, power requirement, and energy consumption during ginning, and to show the losses in monetary value of the lint that may be associated with tight seed-roll ginning. Air blast gins were used and operated at or near the manufacturer's recommended speed, and at speeds 100 revolutions per minute above and 100 revolutions per minute below this speed. By feeding the cotton to the gin stands at different rates, it was possible to produce both loose and tight seed rolls at each gin-saw speed. The especially selected to represent pure varieties of

Pakistan upland BT cottons were, MNH 93 (Punjab), and Chadni-95 (Sindh) of the 2014 crops.

The results and conclusions from this series of studies may be summarized as follows:

There were only small effects on the lint quality and the ginning capacity caused by variations of gin-saw speed 100 revolutions per minute above or below the manufacturer's recommended speed. Lowering the speed 100 revolutions per minute improved the quality slightly, but raising the gin-saw speed 100 revolutions per minute did not change the quality appreciably.

Changes in seed-roll density, caused by changes in the rate of feeding seed cotton to the gin stand, are much more important than changes in gin-saw speed in affecting the quality of the ginned lint and the mechanical operation of the gin stand. Loose-roll ginning gives the better quality cotton.

No real effect of gin-saw speed on staple length was found. As the seed-roll density was changed, the staple-length differences between loose-and tight-roll samples showed slight tendencies for the loose-roll samples to be classed longer. Laboratory determinations of the upper quartile length and of the variability of fiber length showed little relation of these elements to the gin-saw speed or the seed-roll density.

Ginning capacity and lint turn-out for the group of seed cottons giving 1-inch staple length and having 9.6 percent moisture content were generally slightly less with the low saw speed and often were greater with the high speed. Ginning capacity for an outfit of four 90-saw gins was increased 3 bales per day by increasing the gin-saw speed 200 revolutions per minute. Power requirement, though showing some tendency to increase with gin-saw speed, was not materially affected by changing the gin saw speed 100 revolutions per minute above or below the manufacturer's recommended speed. The power requirement was increased 50 percent, however, by varying the seed-roll density loose to tight.

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