## CONTINUED RESEARCH ON GIN SAW TOOTH DESIGN S. Ed Hughs Carlos B. Armijo USDA, ARS, Southwestern Cotton Ginning Research Laboratory Mesilla Park, NM Chris D. Delhom USDA, ARS, Southern Regional Research Center New Orleans, LA Derek P. Whitelock USDA, ARS, Southwestern Cotton Ginning Research Laboratory Mesilla Park, NM

## <u>Abstract</u>

Toothed saws have been used to separate cotton fiber from the seed for over 200 years. There have been many saw tooth designs developed over the years. Most of these designs were developed by trial and error. A complete and scientific analysis of tooth design has never been published. It is not known whether the optimum saw tooth design has been found, particularly for modern upland varieties. Initial and on-going laboratory ginning evaluations of some modern gin saw teeth have shown differences between saw tooth designs in ginning performance, average fiber quality measurements and yarn quality. This is a preliminary report on continued research to document these differences with the future goal of optimizing the design of gin saw teeth.

The gin stand used for testing was a Continental Double Eagle (Continental Eagle Corp., Prattville, AL) that has been cut down to 46 saws. Four "different" sets of 16-inch diameter, commercially available replacement saws were obtained from suppliers other than Continental, and along with the standard Continental saw set, were used for the five test saw sets in the ginning test. All test saws, including the Continental saw, were newly manufactured and were each broken in by ginning one bale of cotton prior to testing. The noticeable difference between saw sets was that the number of teeth per saw varied from 328 to 352 (Table 1).

| Saw Number | Number of<br>Saw Teeth | Seed-Cotton<br>Ginning Rate,<br>Ibs/min | Lint Turn Out,<br>% | HVI Length<br>before Lint<br>Cleaning, in. | Fibrotester<br>Short Fiber<br>before Lint<br>Cleaning, % | Shirley Trash<br>before Lint<br>Cleaning, % |
|------------|------------------------|---|---------------------|--|--|---|
| 5 (std)    | 328                    | 79.7                                    | 33.8 b              | 1.160 b                                    | 7.2 ab   | 6.3 b                                       |
| 4 (std)    | 352                    | 82.4                                    | 34.0 b              | 1.181 a                                    | 4.7 c  | 5.8 b                                       |
| 2 (std)    | 330                    | 83.7                                    | 34.1 b              | 1.182 a                                    | 6.1 abc  | 7.8 a                                       |
| 1 (exp)    | 330                    | 84.1                                    | 36.2 a              | 1.167 b                                    | 7.9 a  | 8.7 a                                       |
| 3 (exp)    | 330                    | 81.9                                    | 34.6 h              | 1.181 a                                    | 5.3 bc   | 6.2 b                                       |

Table 1. Average Ginned Raw Fiber Data\*

\*Means followed by a different letter are significantly different at the 5% level by Duncan's new multiple-range test

Saws numbered 2, 4, and 5 in Table 1 were considered to be standard design for the gin stand and were commercially available. Saws numbered 1 and 3 in Table 1 were experimental and were not commercially available.

Testing of the five gin saws was replicated four times resulting in a total of 20 ginning lots. Each ginning lot was processed through the same seed cotton cleaning with no drying used on any of the ginning lots. The seed cotton was ginned on the 46 saw gin stand, followed by one saw-type lint cleaner, and the bale press. The gin stand was operated so as to maintain the same motor horsepower for each ginning lot throughout the test. Seed cotton and ginned lint samples were taken for quality analysis. The ginned lint lots were baled and sent to the USDA, ARS, Southern Regional Research Center, New Orleans, LA, for further fiber analysis and textile processing. Besides raw fiber tests, textile processing consisted of carding the ginned cotton lots at a rate of 100 lb/h and then ring spinning both 30/1 and 50/1 yarns for quality evaluation.

Previous tests had shown some significant differences in ginned fiber length properties between saws as did this test. Table 1 is a sampling of some of the raw fiber property differences measured. Earlier tests had shown significant differences in ginning rate between test saws and no significant difference in turn out. However, this test showed a

significant difference in turn out and no difference in overall ginning rate between test saws (Table 1). Part of the difference in results is probably explained by some of the earlier saw designs that were slower ginning and were not included in this test. Three of the five saws tested were new to this test series.

There were very few significant differences between saw treatments for the 30/1 ring yarn, but there were several significant differences for the 50/1 ring spun yarn. Table 2 shows some of the more important 50/1 ring spun yarn differences with ends down being one of the more important to the spinner. Ends down translates into lost spinning efficiency and lower production. It is interesting to note that saw #1 had the highest lint turnout (positive effect) and also had the highest ends down rate (negative effect). In general, all the yarn properties shown in Table 2 were worse for saw #1. This illustrates that what may be good economically for the cotton producer may not be economically good for the cotton spinner. Table 2 also shows significant differences in yarn quality as affected by saw treatment. This further indication that gin saw tooth design significantly affects spinning efficiency at the textile mill is an important reason to optimize gin saw tooth design. Optimization of tooth design not only means good ginned fiber turn out and quality for the producer but also means cotton fiber that will spin efficiently and produce quality yarn. Research is currently continuing to further understand how gin saw tooth design affects ginned fiber quality and textile processing quality factors.

| Saw Number | Thin Places, #/kyd | Thick Places, #/kyd | Neps, #/kyd | Ends Down, #/kyd |
|------------|--------------------|---------------------|-------------|------------------|
| 5 (std)    | 261 a              | 1316 bc             | 1220 bc     | 54.2 ab          |
| 4 (std)    | 166 b              | 1098 d              | 934 d       | 19.8 c           |
| 2 (std)    | 303 a              | 1410 ab             | 1352 ab     | 44.8 bc          |
| 1 (exp)    | 289 a              | 1510 a              | 1504 a      | 77.3 a           |
| 3 (exp)    | 223 ab             | 1260 c              | 1134 c      | 34.1 bc          |

Table 2. Average Uster 50/1 Ring Spun Yarn Data\*

\*Means followed by a different letter are significantly different at the 5% level by Duncan's new multiple-range test

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