FIBER QUALITY ASPECTS OF COTTON GINNING

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The gin's customer is the grower, the one who pays in one way or another to have the cotton ginned. It is the ginner's responsibility to maximize the revenue from every module of cotton. This does not simply mean maximizing the value of a bale, or the price per pound for the fiber, or even the grade. Instead, it means maximizing the return to the grower. As ginners, you need to know how to operate the gin so as to optimize its performance for the growers and for their customers, the mills. In general, the less drying and cleaning, the better for all concerned provided, of course, that you meet the grower's objectives.

Several fiber properties are important to the mill and many are affected by how the gin is operated. These fiber properties are:

1. **Cleanness**
   - trash
   - seed-coat fragments
   - grass and bark
2. **Length**
   - Uniformity Index
   - Short-Fiber Content
3. **Smoothness**
   - Prep
4. **Color**
   - Rd and +b
5. **Maturity**
   - mic
   - dye uptake
   - yarn strength
6. **Strength**
   - fiber strength (g/tex)
   - yarn and fabric strength
7. **Contamination**
   - stickiness
   - grass and bark
   - foreign fibers

Cleanness. It is no surprise that clean cotton is worth more per pound than trashy cotton. Cleaning involves the removal of both moisture and trash, but it also means the loss of some marketable fiber. In the West, there is generally a heavy penalty for leaf grade trashier than 3, with much lower premiums for grades better than that. In most of the rainbelt, leaf grade 4 is normal, and there are only small premiums for better, but heavy discounts for worse. The general rule is that cleaning to a better leaf grade than is normal for your area, or than is required by your customer (the grower), usually results in loss of profit to the grower because the premiums for the extra cleaning do not compensate for the loss of marketable weight (gin turnout) in the form of lint-cleaner waste or motes.

Better leaf grades than normal may be due to unneeded cleaning and can be the cause of lost marketable weight, with less than maximum revenue to the owner of the cotton. When normal leaf grades are being exceeded, one or more of the second-stage lint cleaners should be bypassed — but not necessarily all of them — until you are getting the right leaf grade, with as few bales as possible above that level and almost no bales below it. Remember, the discounts for bales that are trashier than normal are heavy, and when the normal grades are not being attained, all available cleaning, and aggressive drying must be used in your attempt to meet your customer's goal.

Unneeded cleaning has other disadvantages — it reduces staple length and it causes the creation of short fiber and neps, which are especially detrimental in the spinning process. A gin's reputation among mill buyers is often related to the amount of short fiber and neps that are believed to be in that gin's cotton, causing buyers to speak of over-ginned cotton.

The over drying that often goes along with excessive cleaning also causes loss of marketable weight, water. Even the best lint-slide humidifiers seldom bring over-dried cotton back up to about 7 percent moisture, which is generally desirable and expected by the mills. Every ginner should know that "the dryer is the best cleaner in the gin" when used correctly to dry seed cotton just enough for smooth ginning and effective cleaning, but not any more.

Seed-coat fragments (SCF) result from broken seed, which can be caused by harvesters, by high-impact gin machinery or by worn gin saws and ribs. Tight seed rolls aggravate the problem. The cotton variety is a contributing factor in SCF, based on the thickness of the seed coat and strength of the fiber attachment. Lint cleaners reduce the volume of SCF present but their number tends to remain unchanged because the lint cleaners make what is not removed smaller.

In summary, do only the drying and cleaning that are in the grower's best interest and discuss this with growers; above all, know your job and how to operate your gin to accomplish the goal. Be sure that growers know the importance of harvesting the crop in the best possible condition so that cleaning stages can be bypassed.

2. Length. Three length properties are important: (1) staple length or the average length of the longer half of the fiber; (2) the percentage by weight of the fibers shorter than half an inch, referred to as short fiber content (SFC); and (3) length uniformity index (UI) or the average fiber length as a percentage of staple length. Pima sells at a premium price in part because of superior length properties that make it suitable for the manufacture of fine, strong yarns; the same is true for Acala cottons in comparison to other varieties. Staple and UI, but not SFC, are measured in the USDA Classing Office. The loan charts specify premiums and discounts for differing staple lengths but cotton buyers know when to suspect that short fiber problems when the UI is lower than it should be. Ginners must therefore know how gin operation affects length.

The staple length of modern cotton varieties is the result of years of breeding, and is not something that the ginner can produce. But the ginner must know how to protect length and avoid creating short fiber. As a general rule, do only the cleaning and drying necessary to achieve the desired leaf grade. Each lint cleaner reduces staple by up to 1/32 of an inch and this is worsened if excessive drying has weakened the fiber.

In summary, fiber length is a genetic property, know how to protect it by the way you operate the gin.

3. **Smoothness.** Rough preparation refers to the appearance of cotton and causes increased waste to be produced during textile processing. Only about 0.5 percent of the crop is currently penalized because of preparation. Processing cotton while it is wet, transporting cotton in pipes with excessive air speeds, and feeding too much air into air-fed cylinder cleaners can cause the twisting, knotting and roping that are recognized as poor preparation.

Incomplete doffing of gin or lint-cleaner saws causes recirculation and produces neps in vast quantities. Be certain that doffing brushes or air-blast doffing systems are correctly maintained. Cotton can enter the gin with preparation problems because of spindle twist from harvesting. Lint cleaning helps to remove twisted bundles of cotton but the best solution is to never create them.

In summary, preparation problems are caused by the mechanical twisting and roping of the fiber. The less mechanical processing that the fiber receives, the lower will be its nep content. Be sure that gin maintenance is on schedule.

4. Color. The color is important to mills in the dyeing of fabric. Color of cotton as harvested depends on weather, and on the presence of stains from green or other material such as soil or deteriorating seed. Storage with high moisture content (whether in a module or in a trailer) will reduce the brightness of the cotton. Color grade is assigned by the classer's visual observation with the aid of instrumentation that measures brightness, Rd, and yellowness, +b, of the sample. The least serious level of undesirable color

("light spot") can be obscured by the way lint cleaners disperse small tufts of stained fiber, in which case the value is not discounted because of poor color. But lint cleaners cannot obscure full-spotted, tinged or yellow-stained color grades. Using no lint cleaning can cause an increase in light-spotted color grades even if the leaf grade were satisfactory without any cleaning – this could cause loss of revenue to growers.

In summary, always use at least one lint cleaner unless your customer instructs you otherwise. Be sure that growers know about the color problems caused by storing cotton damp.

5. Maturity. Fiber maturity is related to the amount of cellulose deposited during boll development. It is primarily a function of variety, culture, and weather. Cellulose is the element of the fiber that is dyed in the textile process and the more cellulose present, the better dye uptake. Maturity is not affected by gin operation but there is some evidence that dye uptake is reduced in fiber that has been heated above 350°F. Modern gins are equipped with limiting devices that prevent such high temperatures.

Micronaire or mic is measured on the HVI line by blowing air through a standard volume of cotton and measuring the volume of air. When fiber is fine or thin-walled, less air passes and low micronaire is indicated. When fiber is thick or very trashy, air passes through the plug easily and high micronaire is indicated. Producing a very trashy sample is therefore the only way for gin operation to affect micronaire. Low micronaire is usually a predictor of low dye uptake and high micronaire is a sign of good dye uptake but very high micronaire causes reduced yarn strength. Cotton buyers provide premiums for the most desirable micronaire (3.8 – 4.2), with varying discounts for departures above or below the premium range.

In summary, maturity (the ability to take up dye) is important to mills but is not affected by gin operation. If fiber is very trashy, it appears more mature because the micronaire reading is high.

6. Strength. Strength is another quality resulting from breeding, and gin operation has little effect on it. Cotton can be made weak by over drying, thus worsening both the loss of staple and the creation of short fibers during ginning and cleaning. Humidification can improve strength but not staple loss. In the HVI strength-measuring system, the classing offices condition lint samples so that each has the same moisture. Fiber strength is measured in g/Tex. The loan charts provide premiums and discounts for strength.

In summary, strength cannot be improved by how a gin is operated but temporary loss of strength during the ginning and cleaning processes (because of over-drying) leads to loss of other qualities.

7. Contamination. Fiber contamination is a serous and expensive problem for the mills. This includes stickiness from insect sugars, grass and bark and synthetic fibers. Stickiness is caused by insect sugars on the fiber forming sticky deposits on the surfaces of mill machinery with which cotton comes into contact. The same deposits are often seen in gins (especially roller gins) and they can make ginning very difficult, the same way they make carding, drawing and spinning difficult for mills. Ginners can use a textile over-spray (containing a textile lubricant) to make the gin run smoother but the effect of the lubricant does not carry over into the mill. It is suspected that the benefits of an over spray disappear once it has soaked into the fiber and is no longer transferred from the fiber to the surfaces where cotton would usually stick. Decreasing moisture or humidity helps to process the cotton.

Grass and bark enters the system during the harvesting and field storage process. Once this material gets ground up, it can resemble fibers and is difficult to separate from the cotton. The keys are to keep it from getting in to the seed-cotton or remove it before ginning. Classers look for grass and bark while grading the cotton and it is discounted based on the level of material in the sample.

Foreign fibers or other contaminates can enter into the cotton during harvesting, field storage and ginning. Module covers and tie downs have been major source of fiber contamination. Once this material gets into

the gin or the mill, it is distributed through out the fibers and is difficult to remove. It is very difficult to detect until the fabric has been dyed.

In summary, the ginner cannot, as yet, solve the problem of sticky cotton – control of white flies and aphids is the real answer. When grass and bark are problems, ginners must provide good pre-cleaning of seed cotton before ginning. Ginners must be aware of the problems with contamination of cotton and instruct workers of the same.

Process Control. Computer control of the ginning process is one way to ensure that the appropriate drying and cleaning are done to the fiber. The ideal computer-controlled gin would have instruments that recognize the condition of the incoming seed cotton (foreign matter and moisture contents) and that monitor the seed cotton and fiber at several points in the gin for the purpose of continually adjusting machine settings such as the feed rate, the drying temperature and number of drying stages, the number of lint cleaners, and finally the moisture content of the fiber as it is packaged in the bale. As these process control systems are put to use in the industry, the economics of the computer-controlled ginning system for both producers and ginners will also become evident. Theoretically, custom ginning based on a customer's specifications could be done best in a system monitored and controlled by a computer.