Fiber Quality: How Is Cotton Graded? Why Is Quality Important?

Why do fiber properties matter? Fiber characteristics affect textile manufacturing processes and both intermediate and end products. Therefore, mills have preferences for specific characteristics. Raw cotton represents a major portion of the cost of textile production, thus the fiber "property" buyers most scrutinize is price. For producers, the goal is to earn a premium price for above-average fiber quality or, at a minimum, avoid discounts.

The two significant phases of fiber development are elongation and fill. Elongation begins the day of flowering and continues for about 20 days. Fill begins 15 to 20 days after flowering and continues until the boll is mature, at about 45 days.

Growers preserve fiber strength by harvesting cotton in a timely manner. Weathering on open cotton can result in a significant decline in fiber strength.

What do the quality numbers mean?

The U.S. Department of Agriculture (USDA) classes 12 million to 18 million bales annually in 10 offices across the Cotton Belt. The goal is to provide a consistent, quantifiable description of every bale of cotton grown in the United States.

In the gin press where each bale is formed and wrapped, small portions (about 4 ounces) of lint are cut from opposite sides of each bale. The bale, with its collective sample, is assigned a permanent bale identification number, and the sample is shipped to a USDA Classing Office. The bale then is conditioned to a standard humidity and subjected to analysis using precision equipment referred to as high-volume instrumentation (HVI). Elements for analysis are color grade, staple, micronaire, strength, uniformity, leaf grade and trash. Human classers also inspect for extraneous matter and other unwanted conditions.

Color grade

Color grade is a measurement of reflectance, or brightness, and yellowness of fiber. It is reported as a three-digit number, such as 41-4, which is the current base grade. The lower the number, the better; for example, a 31-3 is superior to the base grade of 41-4. Elevated numbers (e.g., 42 or 52) indicate a dullness of color and typically result from late-season weathering. Reduced color diminishes the dyeing properties of fibers and negatively affects spinning efficiencies.

Staple

Staple refers to fiber length and is the average length of the longest 50 percent of the fibers in a sample (referred to as the upper half mean length). It is reported in 32nds or hundredths of an inch. The current base grade for staple is 34 (34/32nds) or 1.06 inches. Longer fiber improves yarn strength, consistency, fineness and spinning efficiency. Genetics significantly influence fiber length, but moisture, temperature and nutrient deficiencies also can affect staple.

Micronaire

Referred to as mic, micronaire is a determination of fiber fineness and sample density in a cross section and often reflects fiber maturity. The mic range includes premium, base and discount levels. Mic is determined greatly by genetics but also is affected by environmental factors. Hot, dry conditions often reduce fruit set, which concentrates production in a limited number of bolls and results in elevated mic. In areas of the Cotton Belt with a short growing season, premature crop termination often results in low mic. Cotton is discounted for low mic if it grades below 34 and for high mic if it grades above 50. A mic grade between 37 and 42 earns a premium. Everything else is base grade.

Strength

Strength is measured as the force required to break a certain volume of fibers and reported in g/tex. Fiber strength significantly affects yarn strength and spinning efficiency. Genetics, crop management and environment affect strength. Weathering of open cotton can result in a significant decline in fiber strength. Base grade for strength is 27 to 28.9 g/tex.

Length Uniformity Index

Length uniformity index (LUI) is a ratio of the overall average fiber length and the upper half mean length. If all fibers are identical in length (which is never the case), the LUI is 100. Uniformity ranges from the upper 70s to mid-80s, and the base is 81 to 81.9. LUI indirectly measures short fibers (less than 0.5 inch). Short fibers create inefficiencies and inconsistencies in yarn spinning.

Leaf grade, trash and extraneous matter

Leaf grade and trash indicate the level of nonlint particles in a sample and are determined by a digitized examination of the surface area of a sample. Leaf, bark and small particles called "pepper trash" are difficult to remove from lint and create significant challenges at the gin and mill. Variety, defoliation, harvest conditions and ginning all affect leaf and trash in cotton.

Extraneous matter and conditioning are evaluated by the human eye and include penalties for bark, seed coat fragments, grass, oil, spindle twist and "prep" (roughness of finish).

Fiber develops from flower to harvest

Cotton lint production is a biological process subject to physiological, environmental and genetic effects that create variation in the product. Germplasm quality/cottonseed varieties, environment and management are sources of variation in fibers.

For information on choosing varieties known for high yield and excellent fiber quality and managing them for optimum return on investment, please contact a PhytoGen cotton development specialist (CDS). Contact information for any PhytoGen CDS can be found at **PhytoGen.com**.

PhytoGen® COTTONSEED

References:
The Cotton Incorporated website (http://www.cottoninc.com/fiber/quality/) is an excellent source of overall fiber quality information as well as specific reports for quality of current and recent crops.
Smith, C. W., and J. T. Cothren. 1999. *Cotton: origin, history, technology, and production*. John Wiley & Sons, New York, NY.

L53-076-005 (06/15) BR DAAGPHYG4060

Dow AgroSciences