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Deep Dive into Fiber Quality Series – Fiber Length (Staple)

Cotton fiber length has been evaluated for at least 150 years. Staple is a term used describe fiber length, and since cotton is a natural fiber, there is considerable variation. It has been reported in 32nds of an inch for many decades. When considered in totality, a distribution of fiber length exists within a field, ranging from very short to very long.

- If seed is not set, fiber can't be produced. Each cotton fiber arises from a single epidermal cell on the seed coat, and is composed mostly of cellulose.
- After the ovule is fertilized the primordial fiber tubular structures elongate much like a balloon expands as it is inflated.
- This elongation phase continues for about 20 days or so.
- Fiber length is determined primarily by genetics (about 82%) but can be negatively impacted by environment (about 18%). There is considerable variation among varieties with respect to genetic potential for fiber length.
- Management practices which promote good plant-water relations coupled with varieties with genetic potential for long staple maximize fiber length.
- Under dryland conditions, rainfall and moderate temperatures during the boll setting period helps considerably to allow varieties to achieve genetic potential for long fibers.
- Conversely, high moisture stress and high temperatures throughout the boll setting period do not allow a variety's fibers to reach the genetic potential, and thus short staple can occur.
- Cotton varieties grown under irrigated conditions can normally reach their genetic potential given moderate temperatures and adequate water.
- Low-capacity irrigation coupled with extreme evapotranspiration (ET) rates during boll setting will reduce fiber length, although not likely to the level experienced by dryland under the same environmental conditions.

- Potassium fertility stress (deficiency) can also prevent the fiber from reaching its genetic potential.
- A 3-year replicated date-of-harvest commercially harvested experiment was conducted at Lubbock about 20 years ago, with harvests ranging from October through January. Results indicated that extended weathering reduced staple by about 1/32nd of an inch. This was likely due to microbial degradation and photodegradation of the fibers.
- As fibers become more brittle after extended field exposure, they can be broken during the ginning process, which then results in considerably more short fiber (those less than 0.5 inch).
- Fibers which lack maturity (i.e. low micronaire) are also more likely to be broken during ginning operations. This can reduce the length and increase short fiber content.

Fiber Length Importance to Mills

- Longer staple cottons produce finer yarns and allow for more expensive end-products.
- Longer staple cottons produce stronger yarns by allowing fibers to twist around each other more times.
- Longer staple cottons enable higher spinning speeds by reducing necessary twist and increasing yarn strength, evenness, hairiness, and the overall efficiency of the process.
- Fabrics derived from longer staple cottons impacts include improved appearance, strength, and pilling.
- **USDA-Agricultural Marketing Service Classing Procedures for Fiber Length**
- Fiber Length is measured by high volume instrument (HVI) machines and is defined by AMS as "the average length of the longer half of the fibers." This can be restated as "upper half mean length."
- When performing the HVI length measurement, a sample is measured by passing a "beard" of parallel fibers through an optical sensing point.
- The beard is formed when fibers from a sample are automatically grasped by a clamp, then combed and brushed into parallel orientation.
- Fiber length is measured in 100ths inch, and then converted to staple in 32nds inch using the corresponding fiber length conversion relationships in the table below.
- For an excellent explanation of the US classing system, click on the Cotton Incorporated link below: https://www.cottoninc.com/wp-content/uploads/2017/02/Classification-of-Cotton.pdf
- For a companion document from USDA-AMS that discusses classing data, click on the link below: https://www.ams.usda.gov/sites/default/files/media/Cotton%20DB%20Understanding%20the%20Data.pdf

Upland Length Conversion Chart			
Length (32nds)	Length (Inches)	Length (32nds)	Length (Inches)
24	0.79 and shorter	36	1.11-1.13
26	0.80-0.85	37	1.14-1.17
28	0.86-0.89	38	1.18-1.20
29	0.90-0.92	39	1.21-1.23
30	0.93-0.95	40	1.24-1.26
31	0.96-0.98	41	1.27-1.29
32	0.99-1.01	42	1.30-1.32
33	1.02-1.04	43	1.33-1.35
34	1.05-1.07	44 and longer	1.36 and longer
35	1.08-1.10		

Impact of Staple on Loan Value

Staple should be a major consideration during the variety selection process. Growers should strive to identify varieties that can fit into their management and that are stable with respect to both yield and fiber quality across various environments. Fiber length is a significant factor that should be carefully considered. 2019 Commodity Credit Corporation (CCC) Loan values range from discounts for short staple to premiums for long staple. This relationship varies with and is tied to color grade. Examples of premiums and discounts (in points per pound) for varying staples and color grades with leaf grade 1 or 2 are below:

Color grade	31	32	33	34	35	36	37	38+
21	-285	-215	-40	125	290	410	465	475
22	-520	-295	-140	50	145	270	295	300
31	-395	-245	-80	75	230	370	420	430
32	-570	-380	-235	-65	15	80	90	95
41	-555	-345	-190	30	85	195	215	225
42	-690	-555	-450	-245	-170	-95	-85	-85