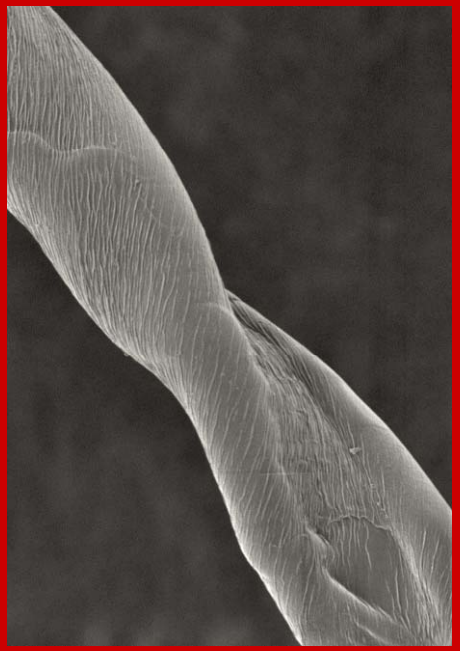
TEXAS TECH UNIVERSITY™



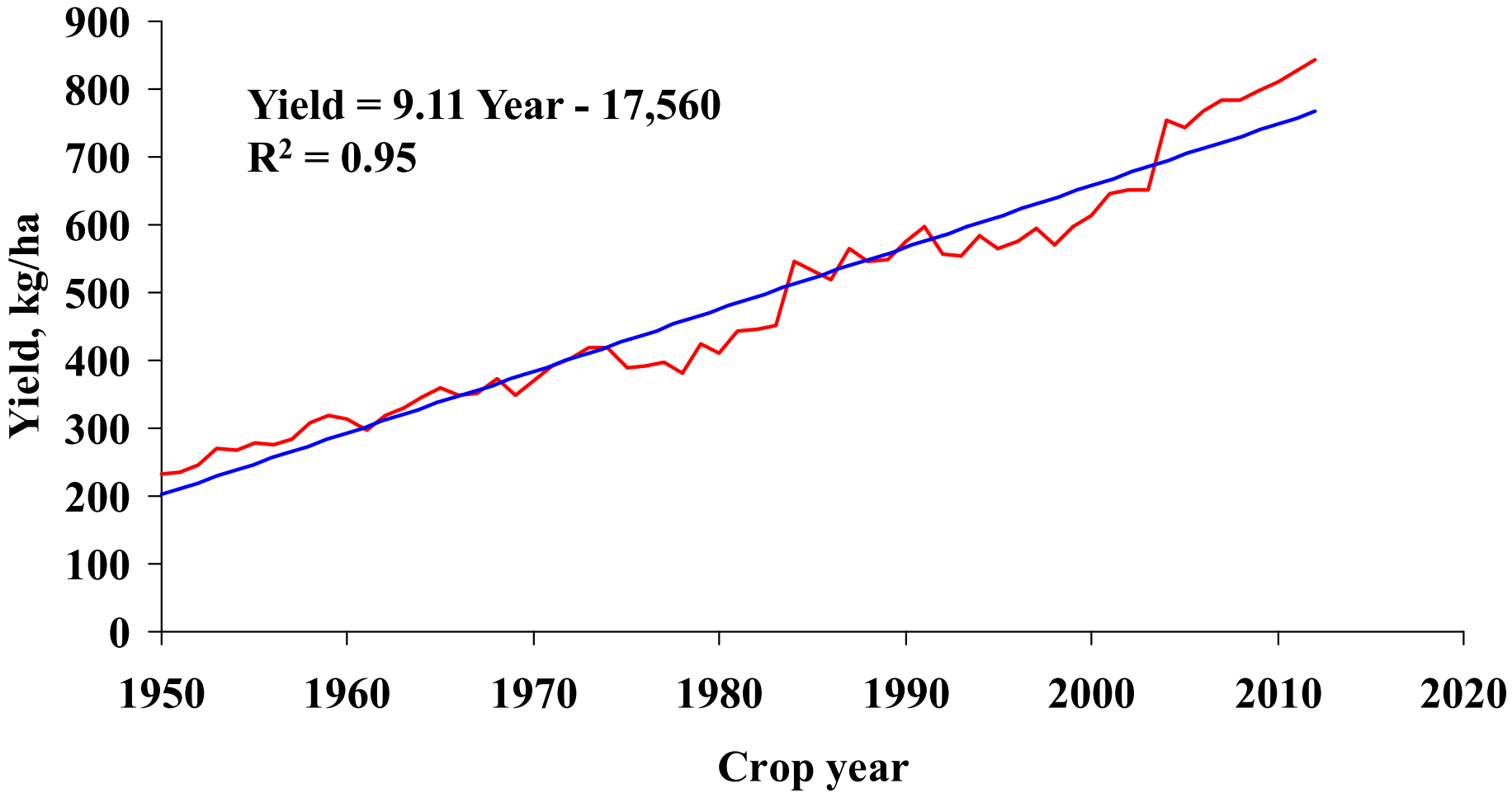
Importance of Cotton Fiber Quality

Eric F. Hequet

Plant and Soil Science Department
Fiber and Biopolymer Research Institute
Texas Tech University

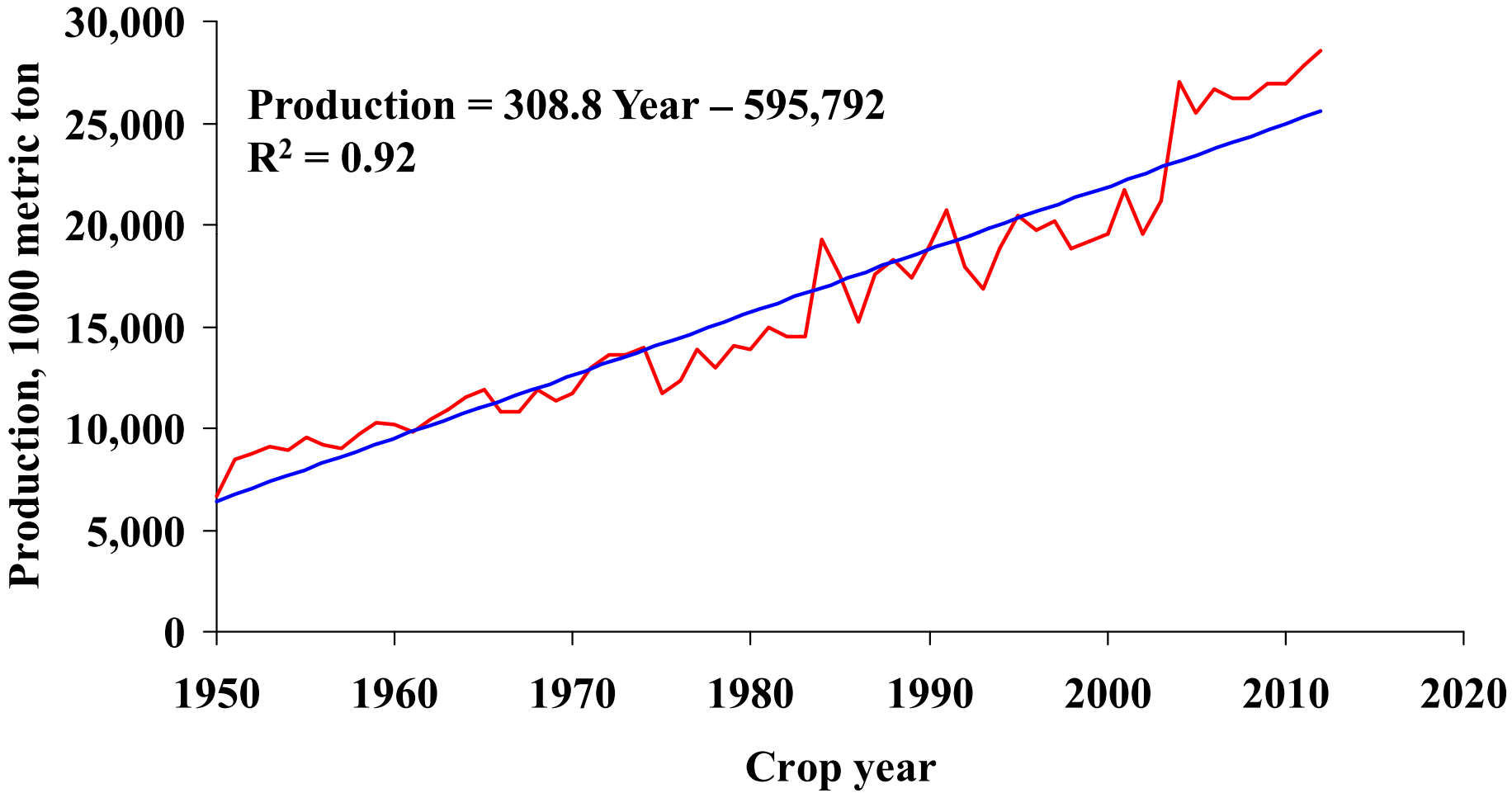
World statistics

Yield evolution (average world)



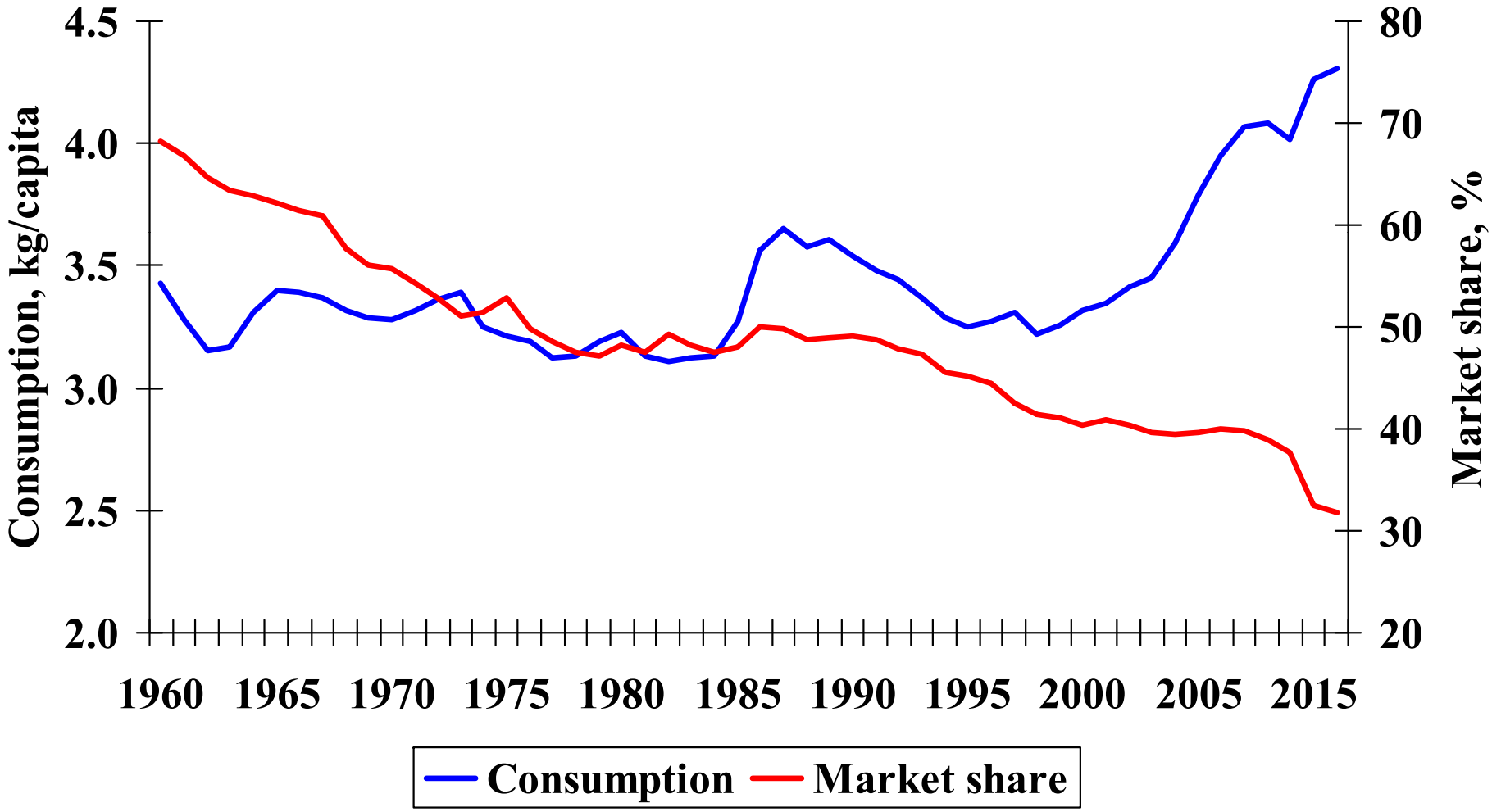
Source: ICAC

Production evolution (world)



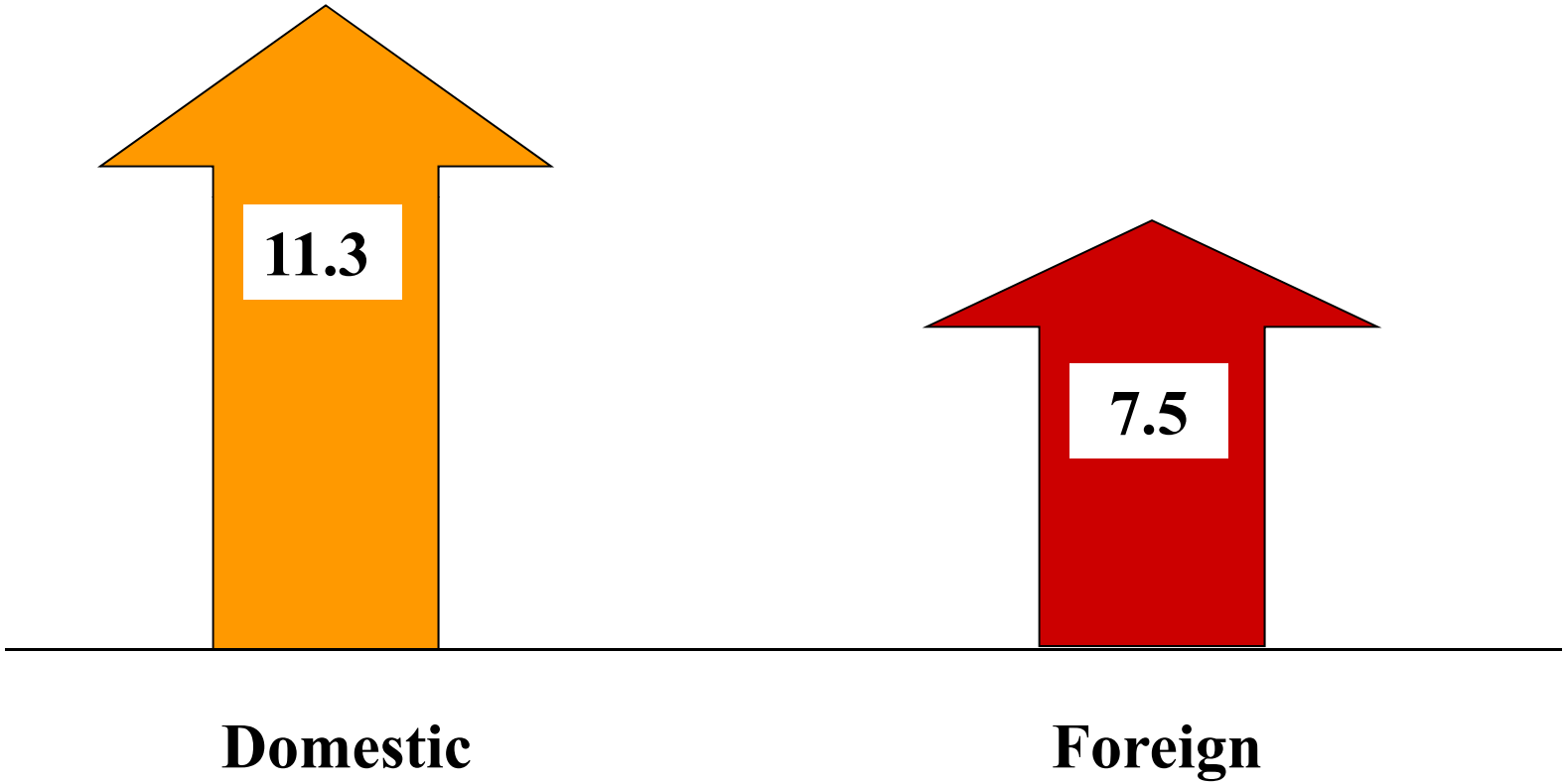
Source: ICAC

Cotton: Consumption per capita and market share

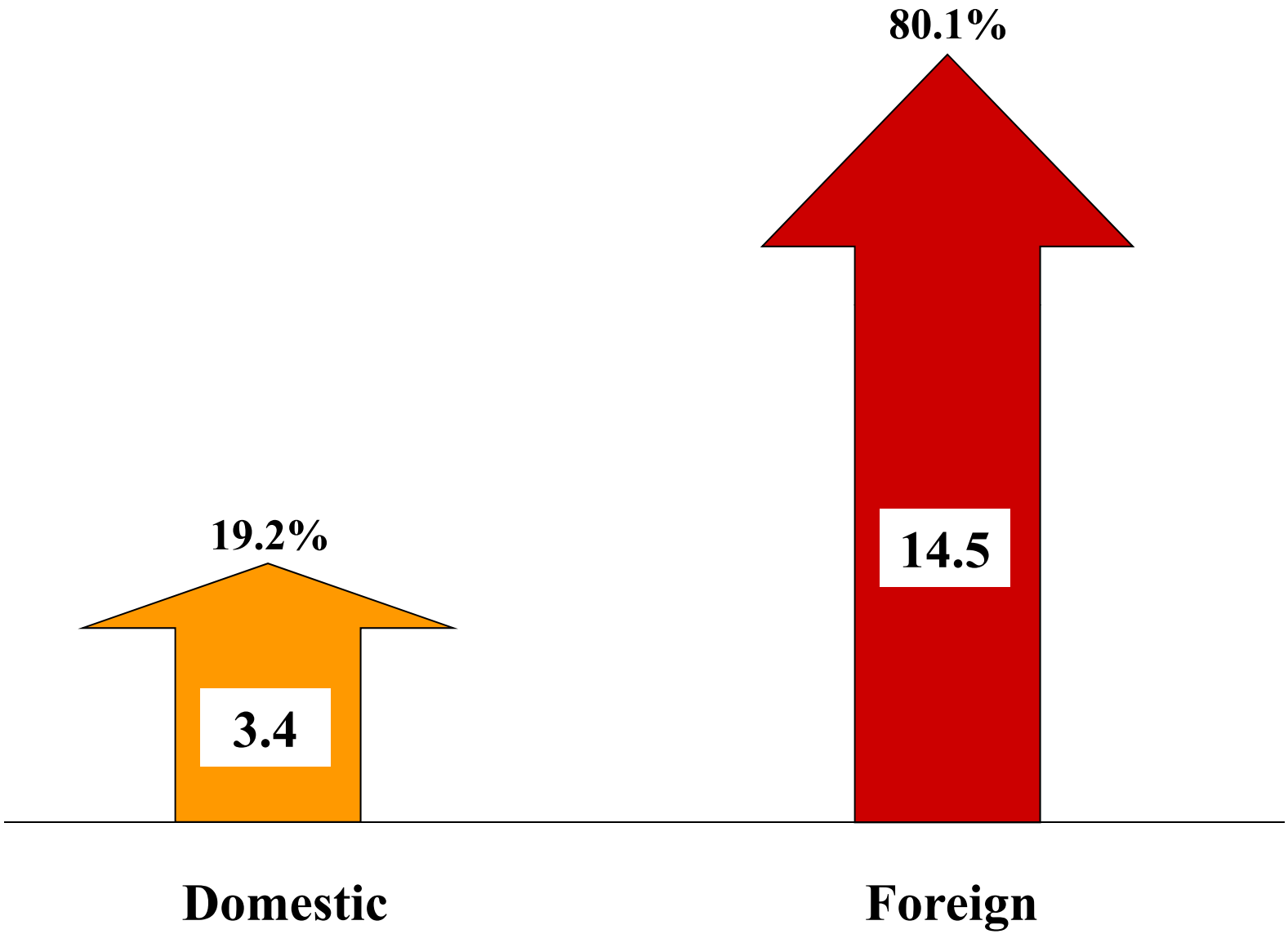


Source: ICAC

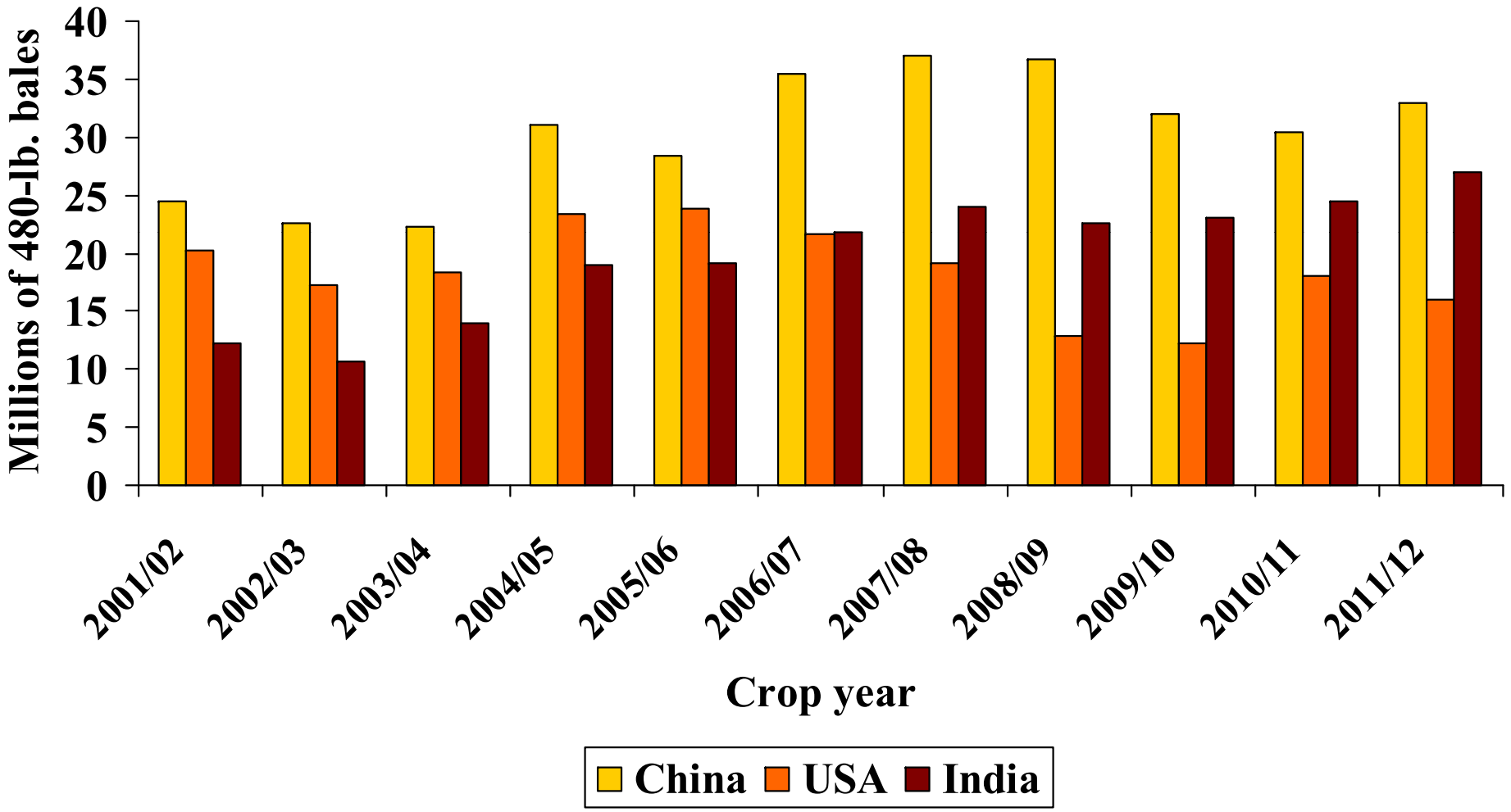
1997 Cotton Sales (millions)



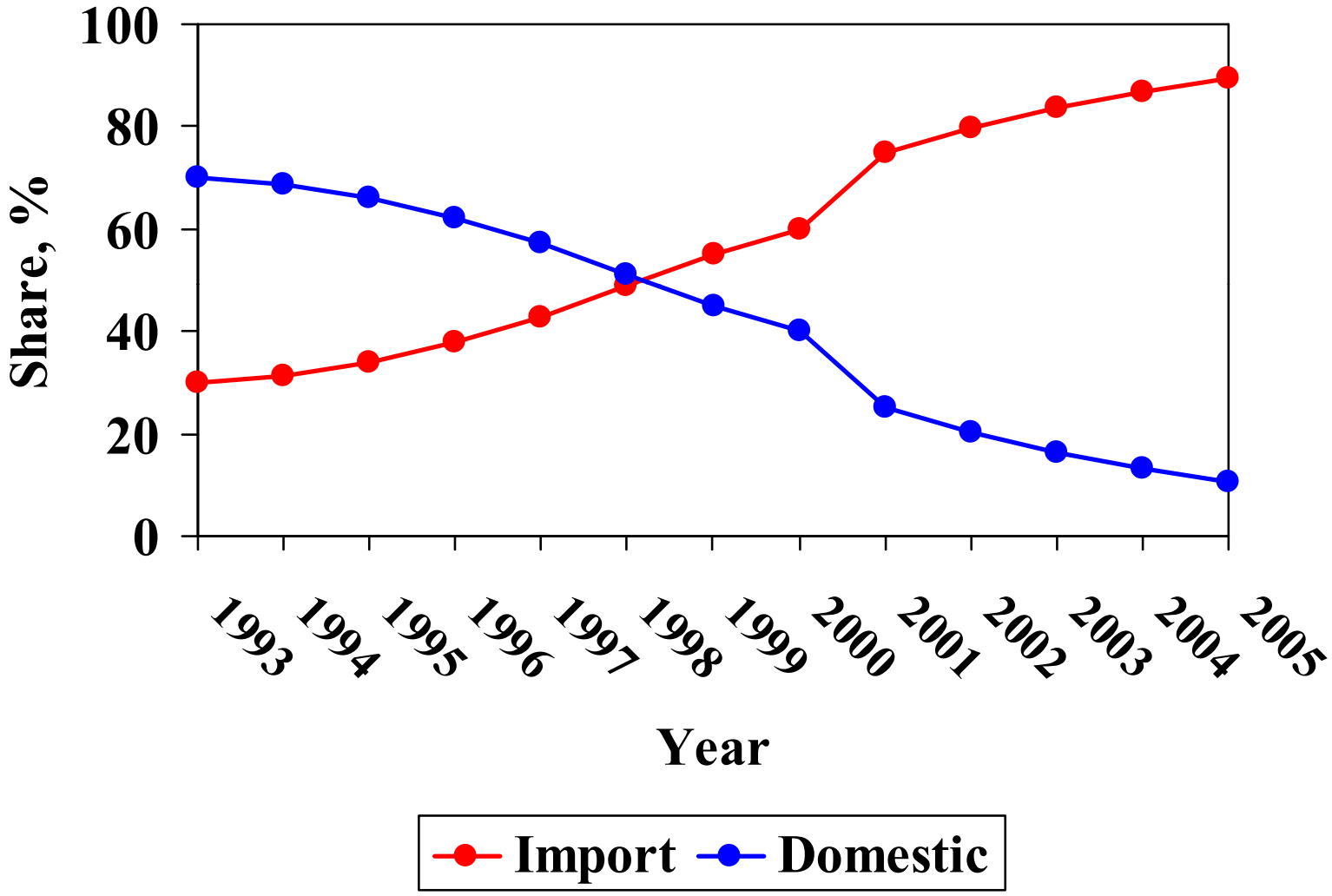
2010/11 Est. Cotton Sales (millions)



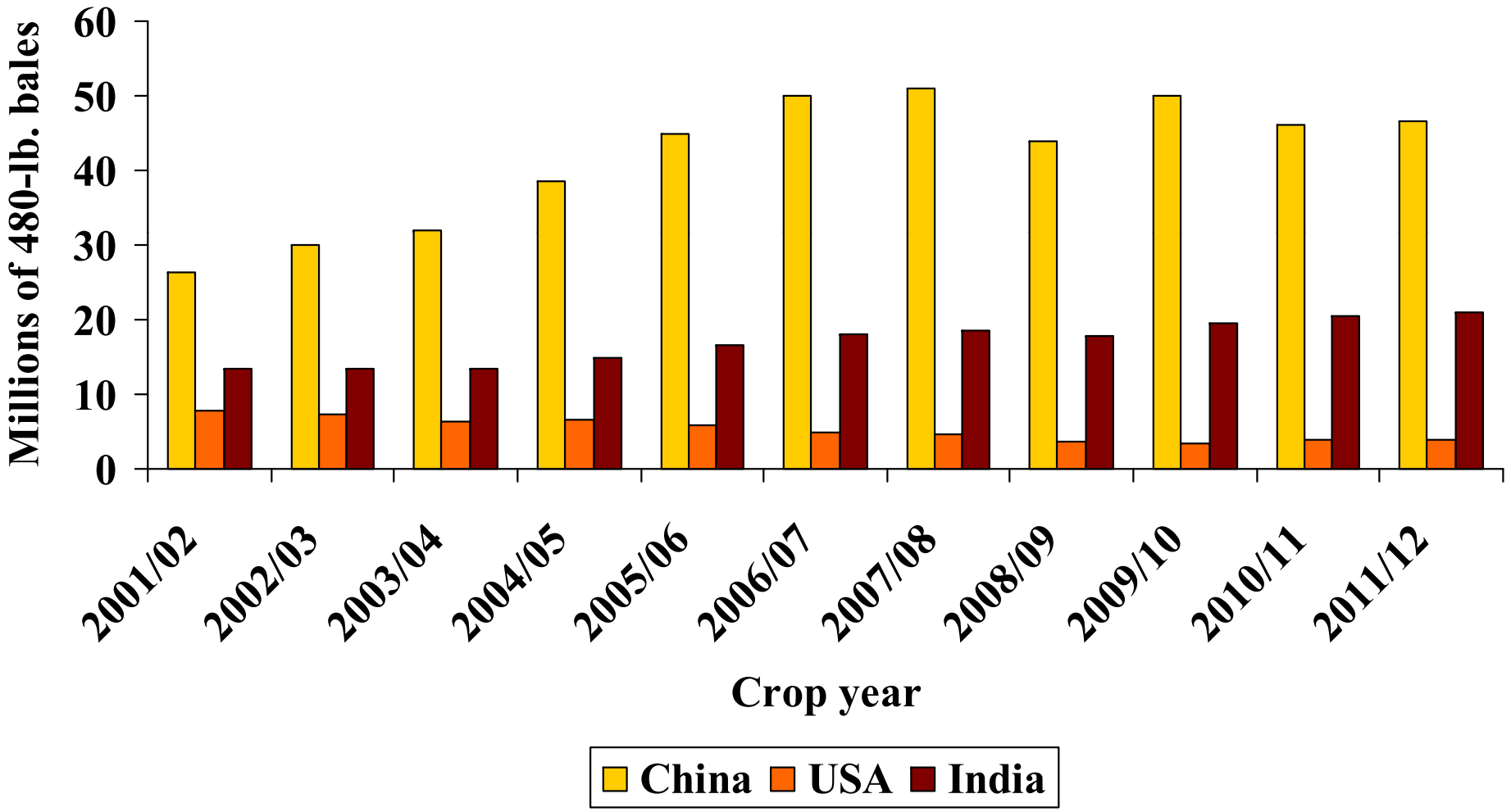
Cotton production



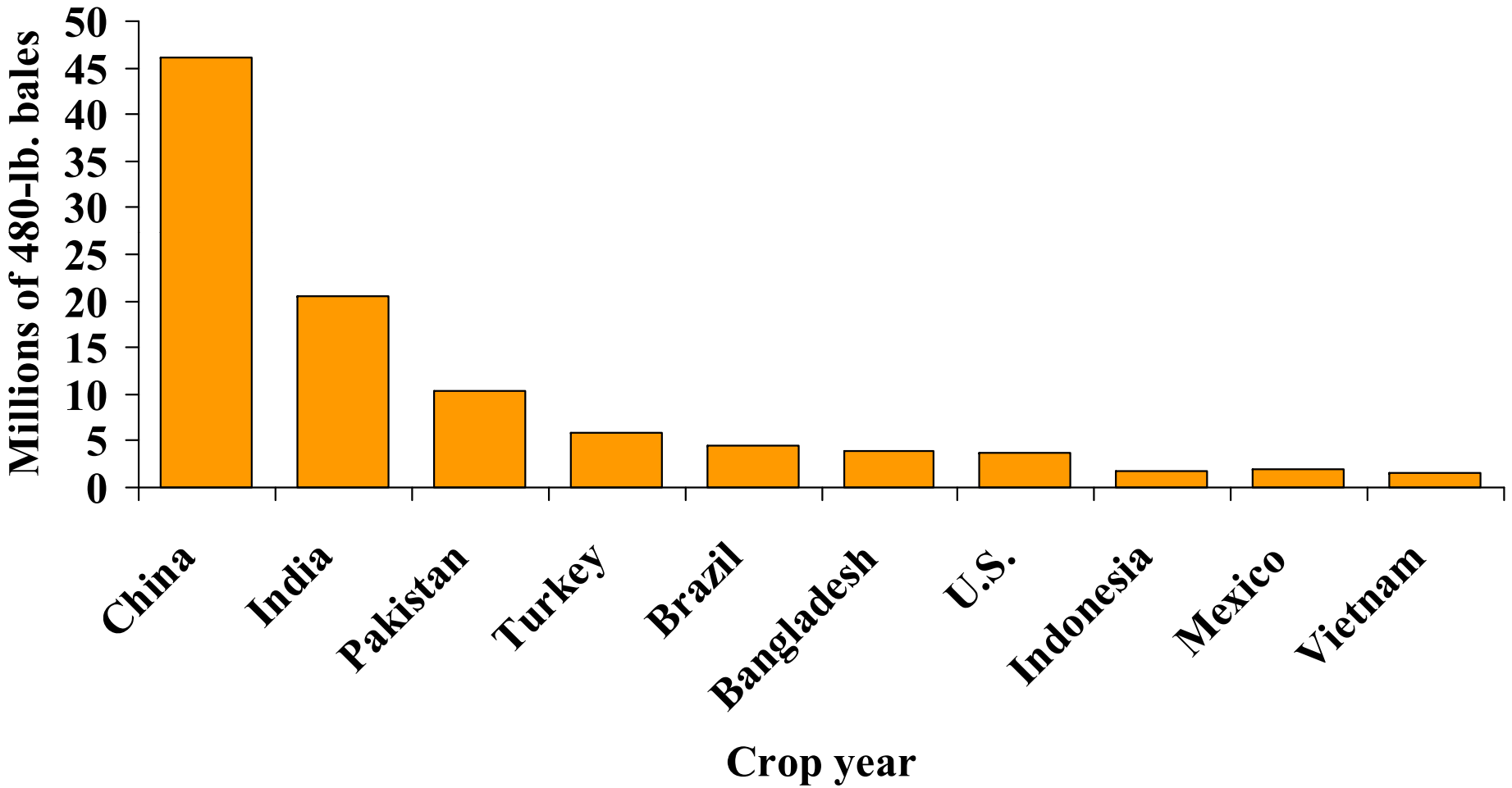
Share of U.S. Apparel Sales by Manufacturing Source



Cotton consumption

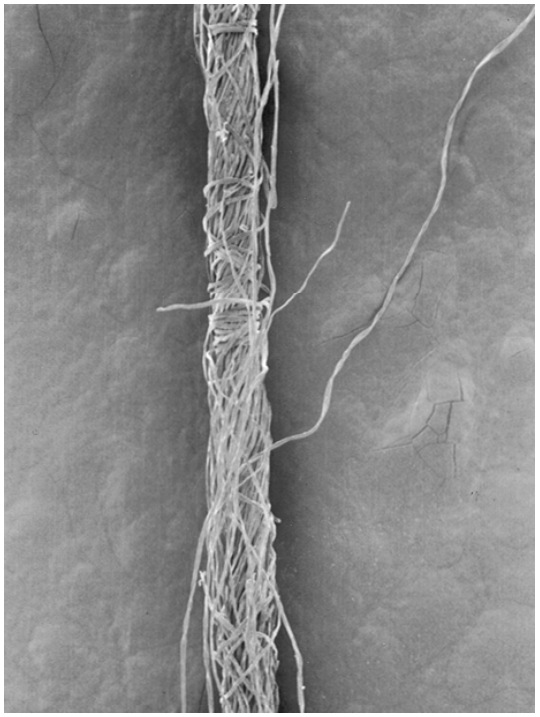


World cotton consumption 2010/11



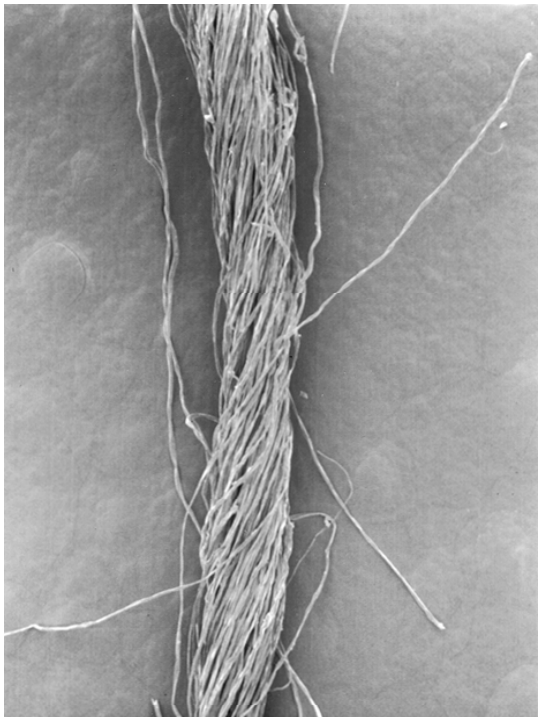
Rotor and ring spun yarns

Rotor spun yarn



Rank	Rotor
1	Strength
2	Fineness
3	Length
4	Cleanliness

Ring spun yarn



Rank	Ring
1	Length
2	Strength
3	Fineness
4	

Installed Spinning Capacities (short staple)

		1984	1994	2004	2007	2009
Rotor	US	300,000	1,008,000	569,000	364,000	293,000
	China	100,000	550,000	1,160,000	2,037,000	2,198,000
Ring	US	14,330,000	6,261,000	1,602,000	1,043,000	708,000
	China	22,000,000	41,585,000	67,000,000	99,000,000	110,000,000

Source ITMF

2009 Installed Spinning Capacities

	Spindles Short staple	Spindles Long staple	OE Rotors
Africa	2.3%	1.7%	2.1%
America, North	2.4%	6.2%	5.9%
America, South	4.1%	4.8%	6.4%
Asia & Oceania	85.3%	45.6%	53.1%
Europe, East	1.7%	8.8%	21.4%
Europe, West	1.5%	27.9%	3.4%
Europe, Turkey	2.8%	5.1%	7.7%
World	232,175,862	14,656,900	7,782,779

Source ITMF

Cumulative Shipments 2001-2010

	Spindles Short staple	Spindles Long staple	OE Rotors
Africa	1.0%	2.6%	0.9%
America, North	0.5%	1.9%	5.3%
America, South	0.7%	3.9%	4.9%
Asia & Oceania	93.6%	63.5%	74.0%
Europe, East	0.1%	4.0%	2.0%
Europe, West	0.6%	9.1%	2.6%
Europe, Turkey	3.3%	15.0%	10.4%
World	88,707,286	2,013,362	3,478,902

Source ITMF

2009 Installed Weaving Capacities*

	Shuttle-less	Shuttle
Africa	1.1%	4.1%
America, North	4.4%	3.3%
America, South	5.6%	4.9%
Asia & Oceania	72.3%	85.3%
Europe, East	10.0%	0.7%
Europe, West	3.1%	0.4%
Europe, Others	3.5%	1.3%
World	1,138,526	1,507,394

* Looms primarily for weaving yarns spun on the cotton system

Source ITMF

Weaving Machinery Cumulative Shipments 2001-2010

	Shuttle-less	Shuttle
Africa	1.0%	1.6%
America, North	0.8%	0.0%
America, South	1.2%	0.1%
Asia & Oceania	88.9%	97.8%
Europe, East	0.6%	0.1%
Europe, West	4.2%	0.2%
Europe, Others	3.2%	0.2%
World	626,723	77,035

Source ITMF

Background

Increased reliance on the export market will require U.S. cotton to compete in terms of both price and quality with foreign crops.

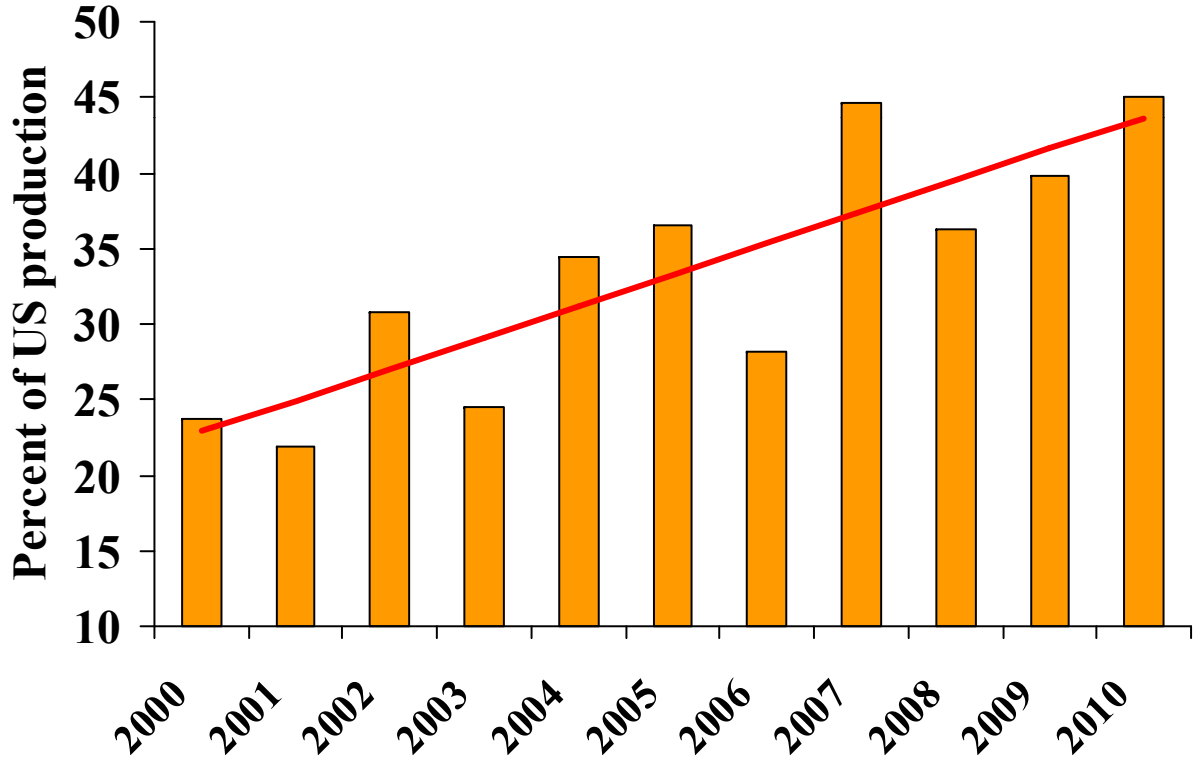
Base level

	U.S.A.	International
Staple	34	35
Tenacity	26	28
Micronaire	3.5-4.9	3.8-4.6
UI%	80-82	82-83
Color	41	31
Leaf	4	3

Situation in Texas

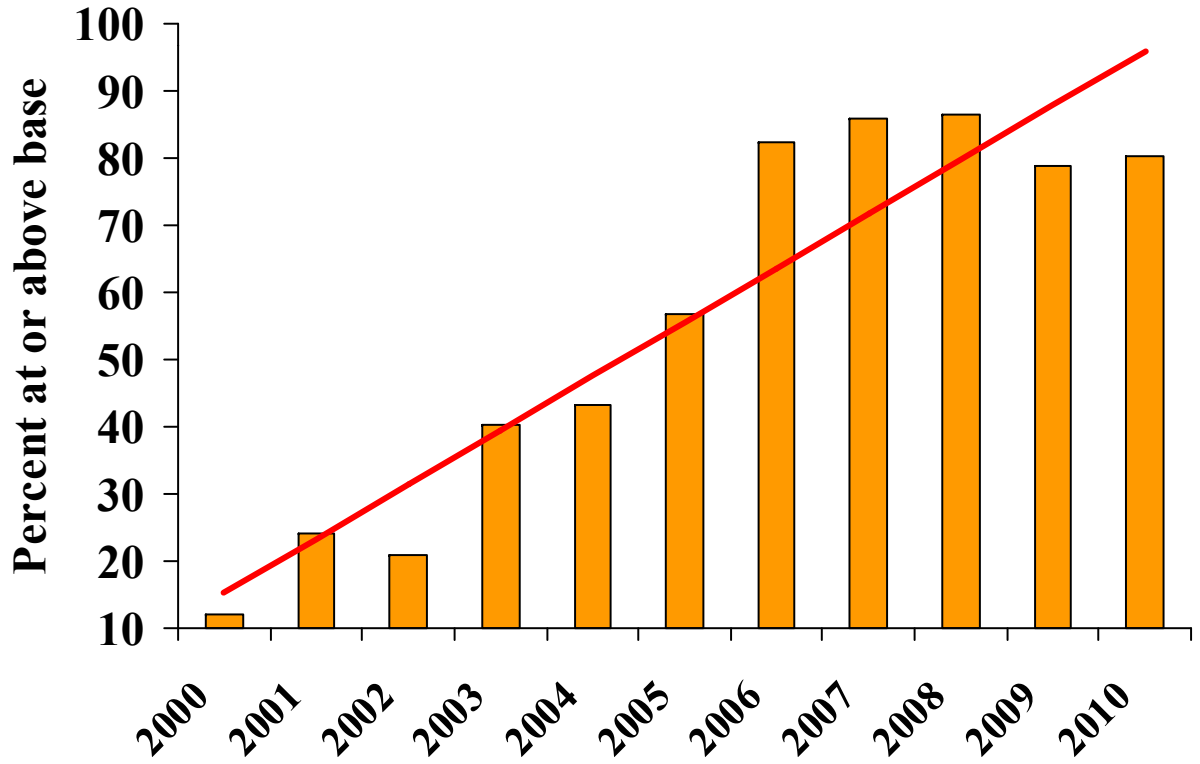
Texas in % of US production

Texas is the largest cotton producer in the nation.



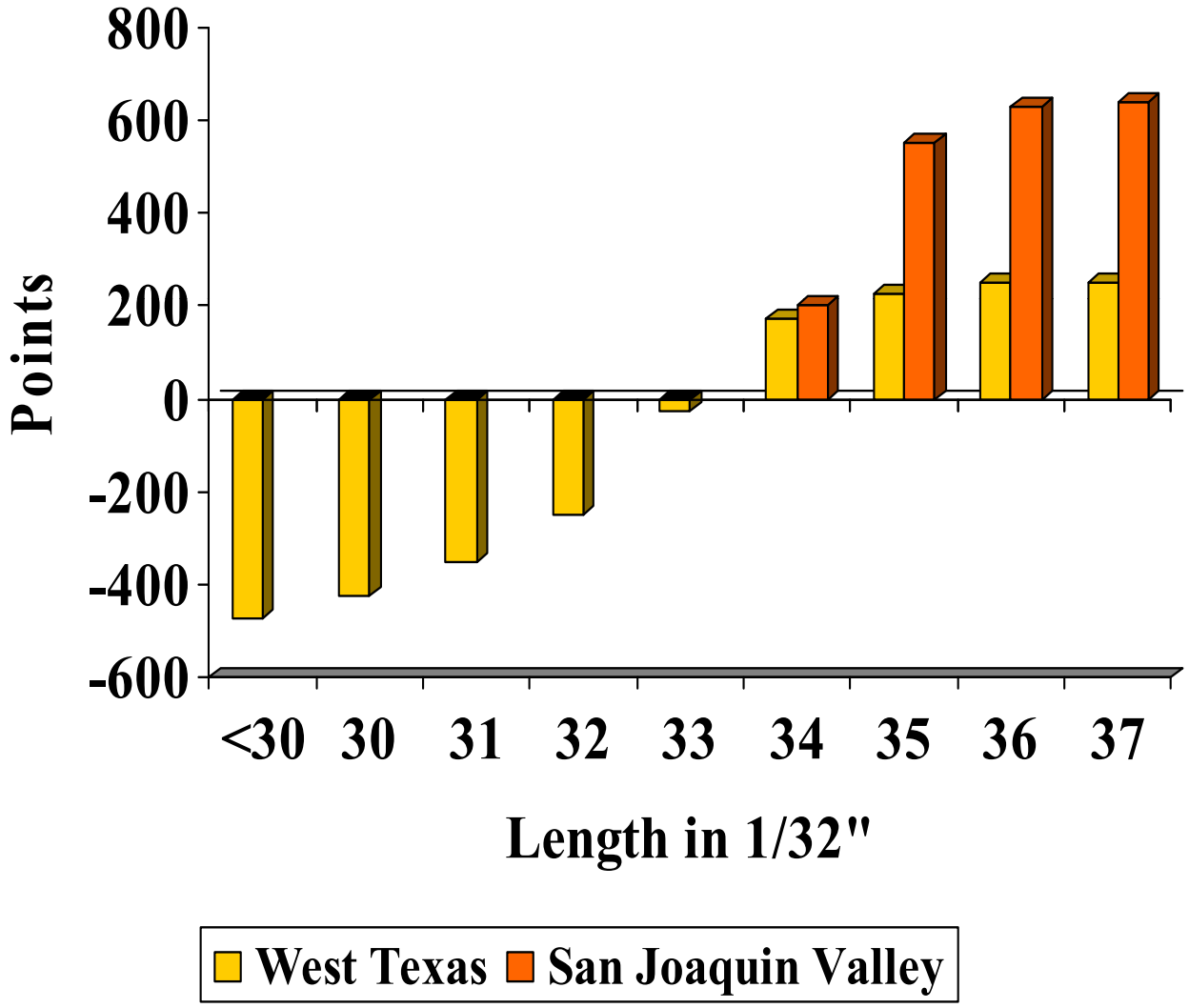
Texas: % at or above base (35 staple)

For the entire state of Texas, the percentages of the production at or above the international base for length (staple 35) are:



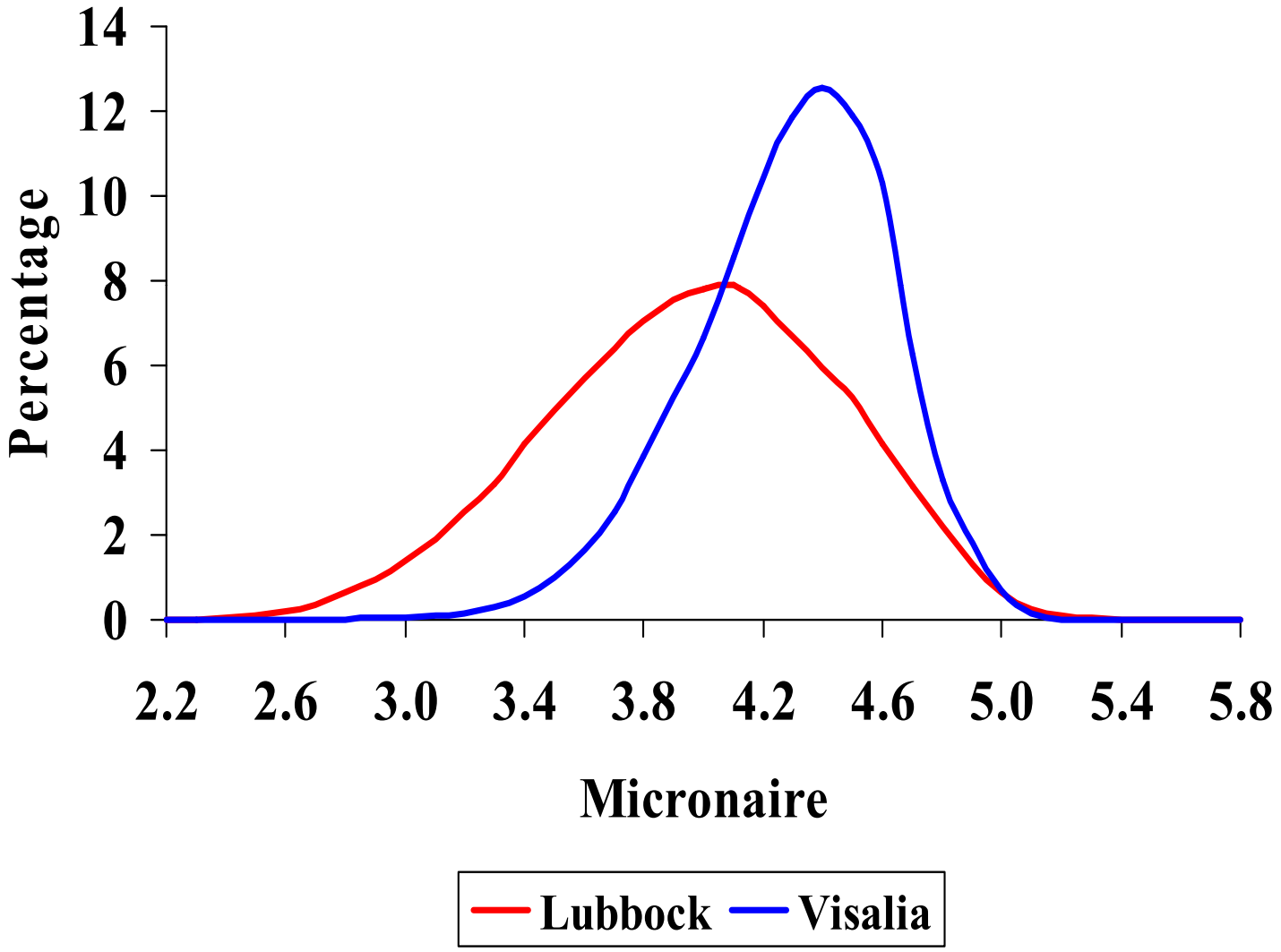
Premiums & discounts for cotton

41 - Leaf 1-2 (July 29, 2011)



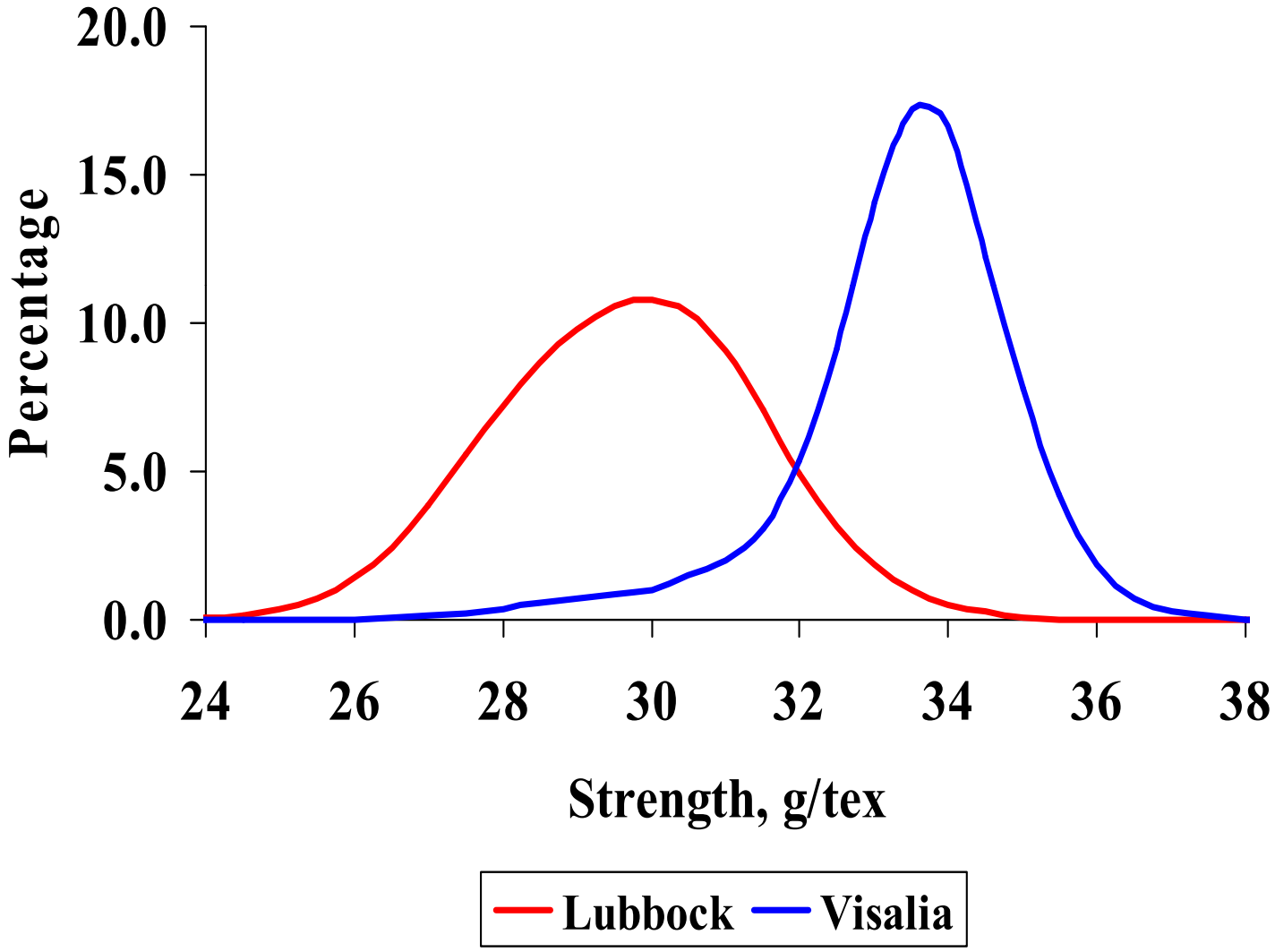
Micronaire distribution (2007-08)

Staple length = 35 or higher

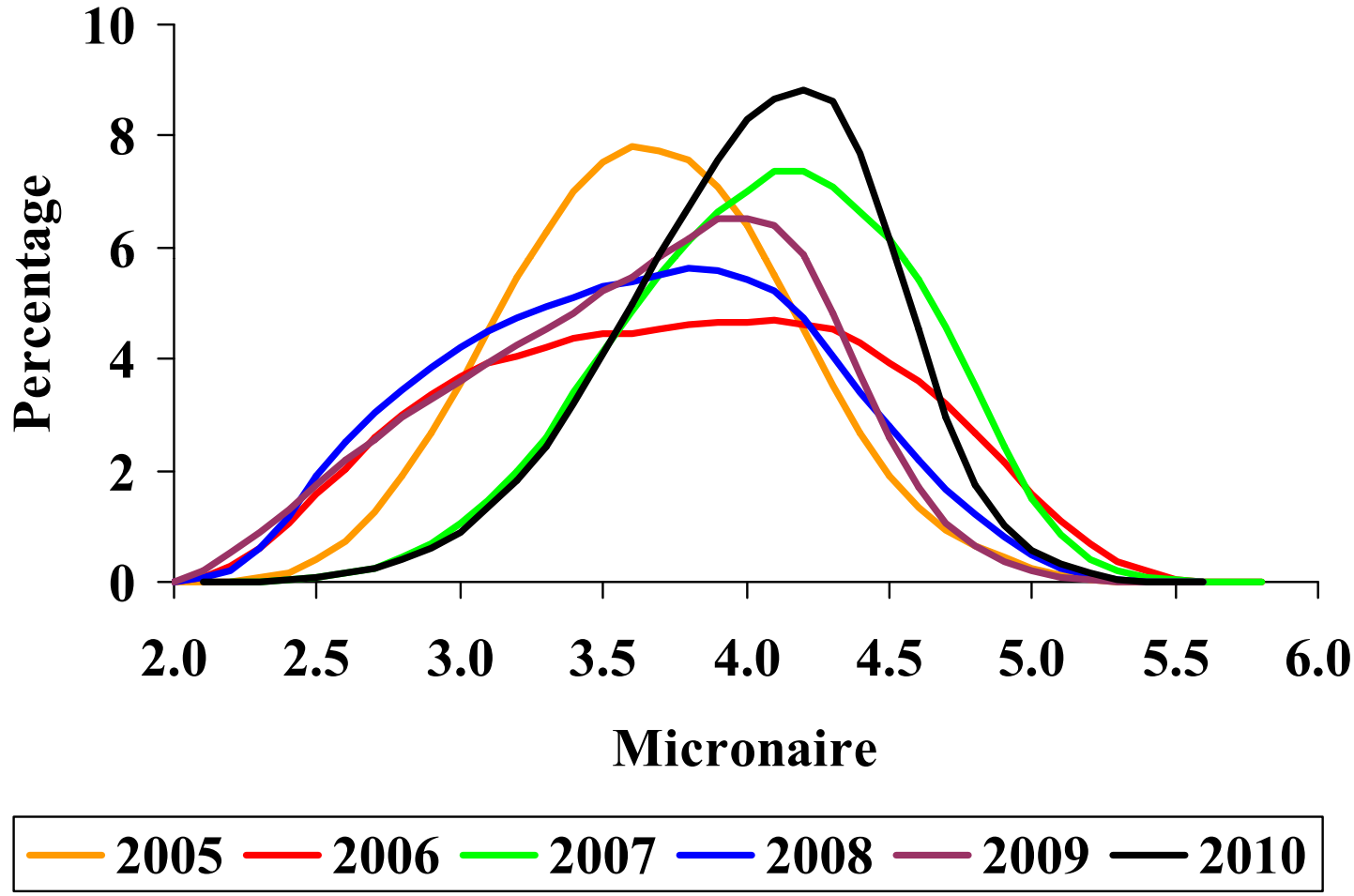


Strength distribution (2007-08)

Staple length = 35 or higher



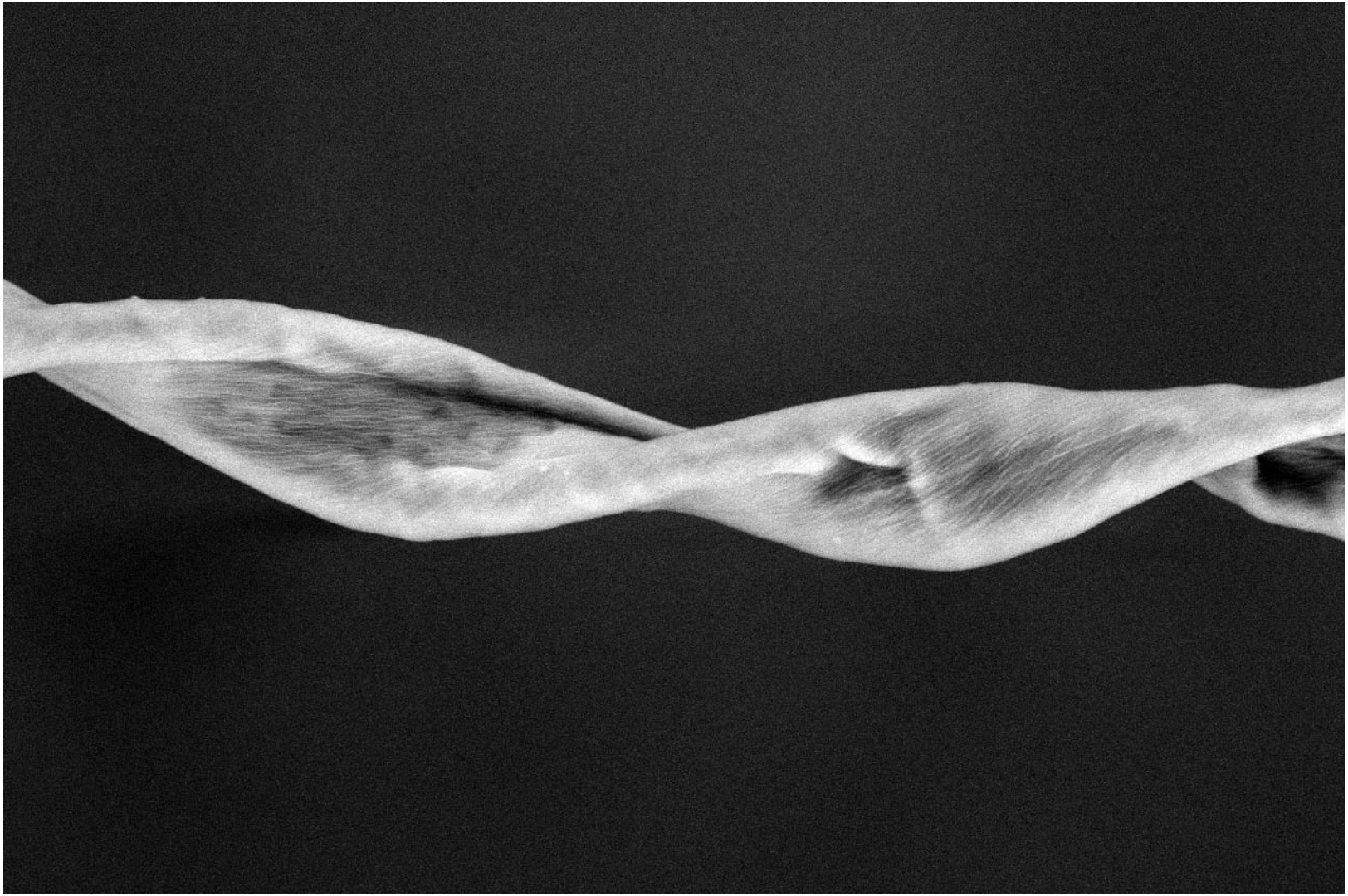
Micronaire Lubbock Classing Office



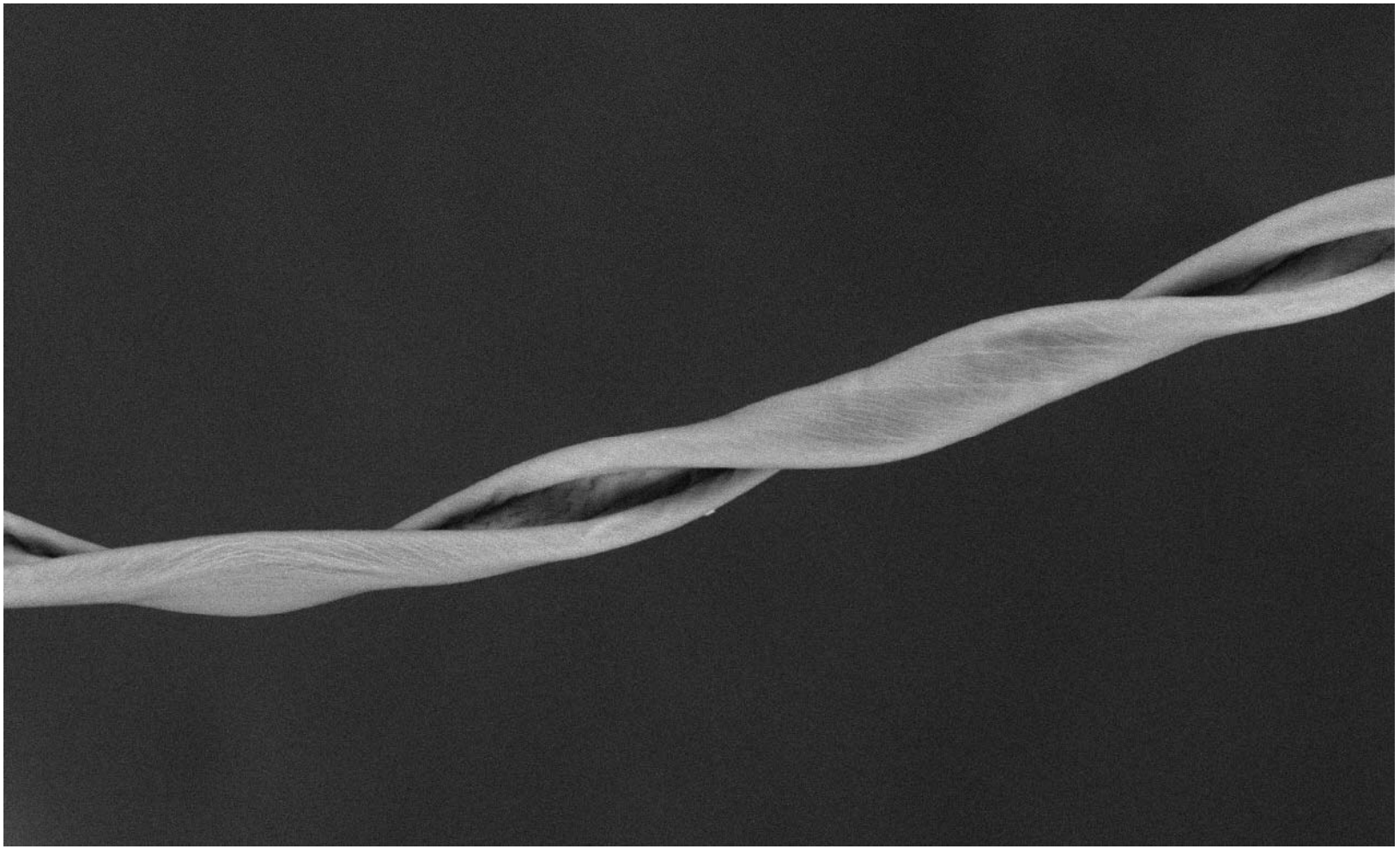
Fineness and Maturity complex:

Why is it important?

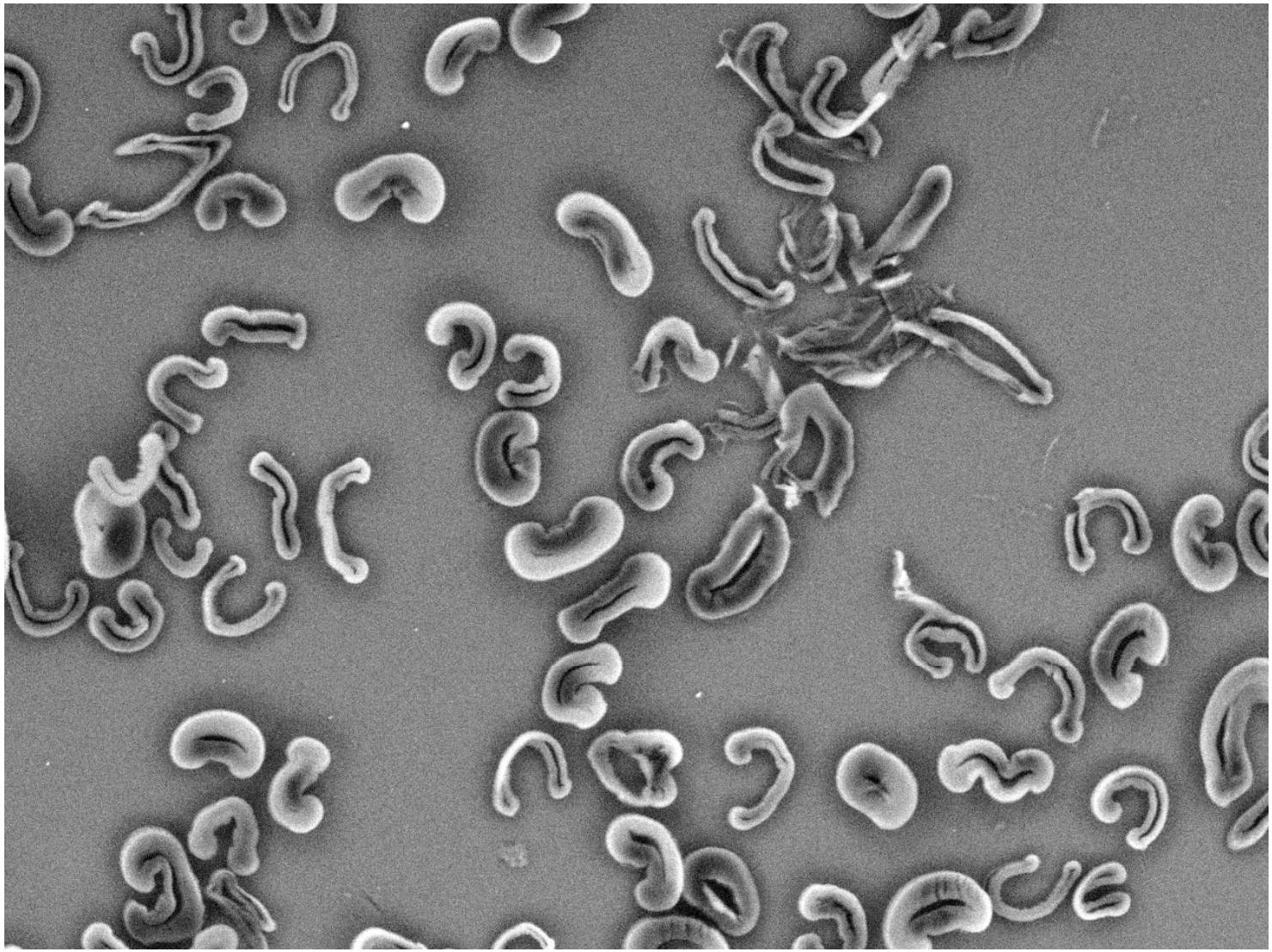
Mature cotton fibers



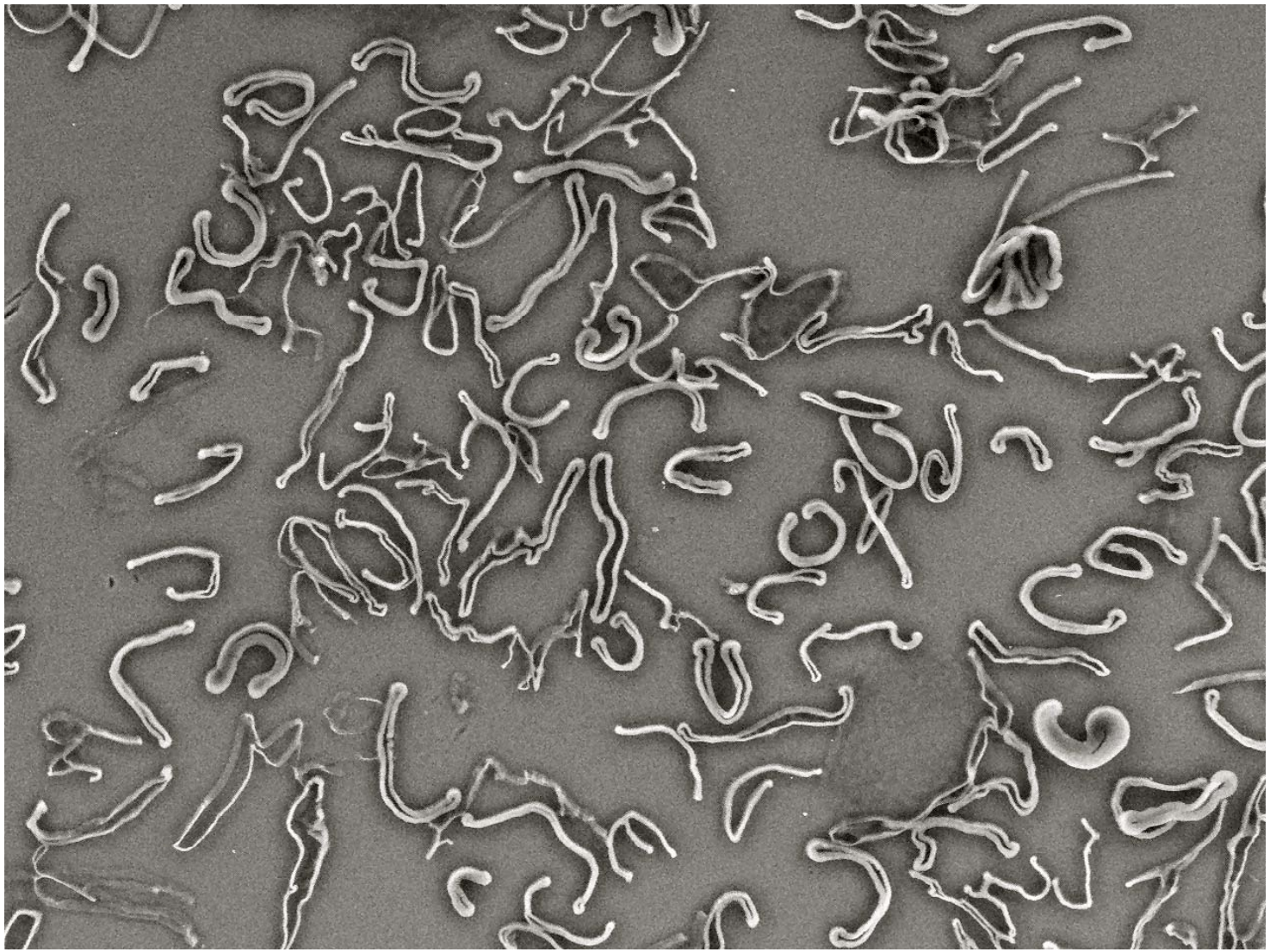
Immature cotton fibers



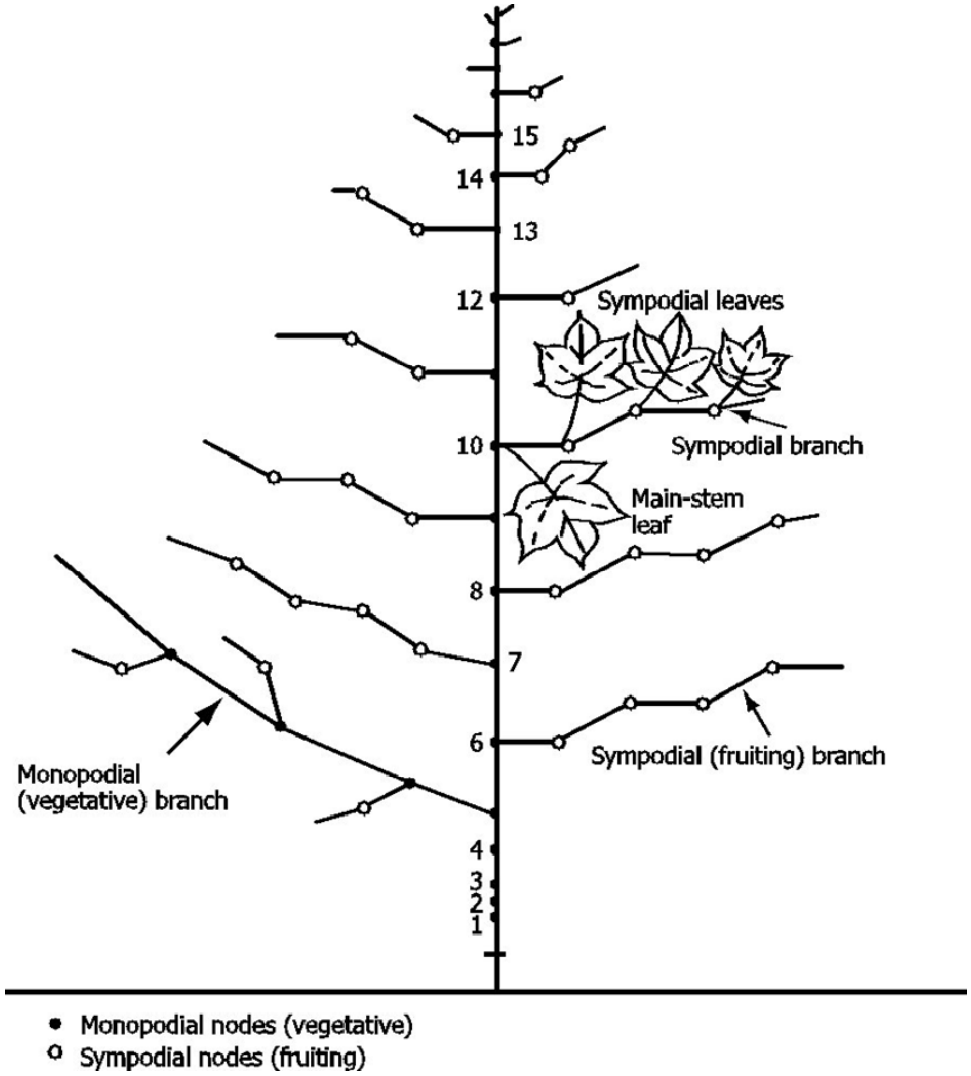
Typical cotton fiber cross-sections



Immature cotton fiber cross-sections

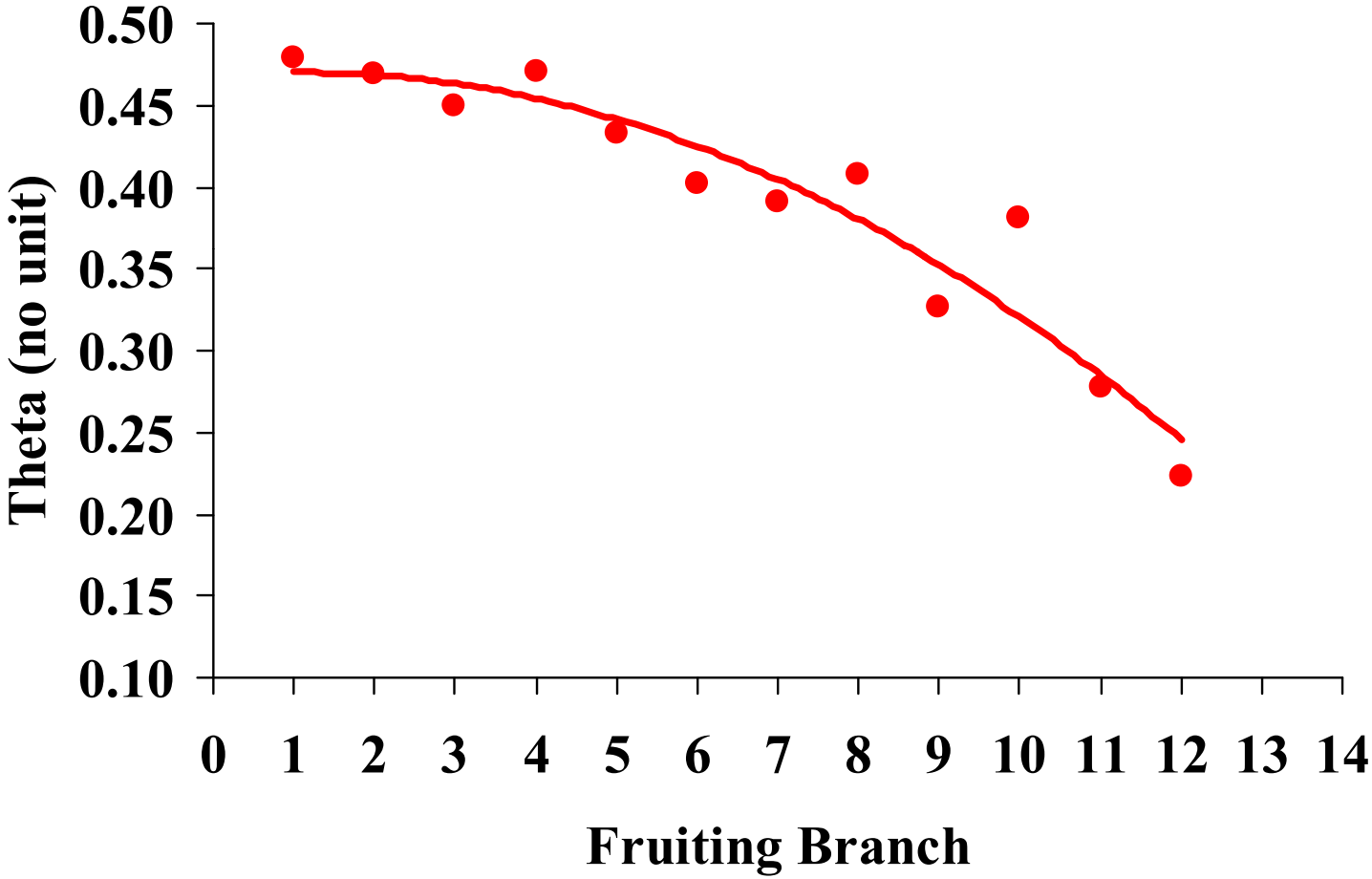


Plant Growth

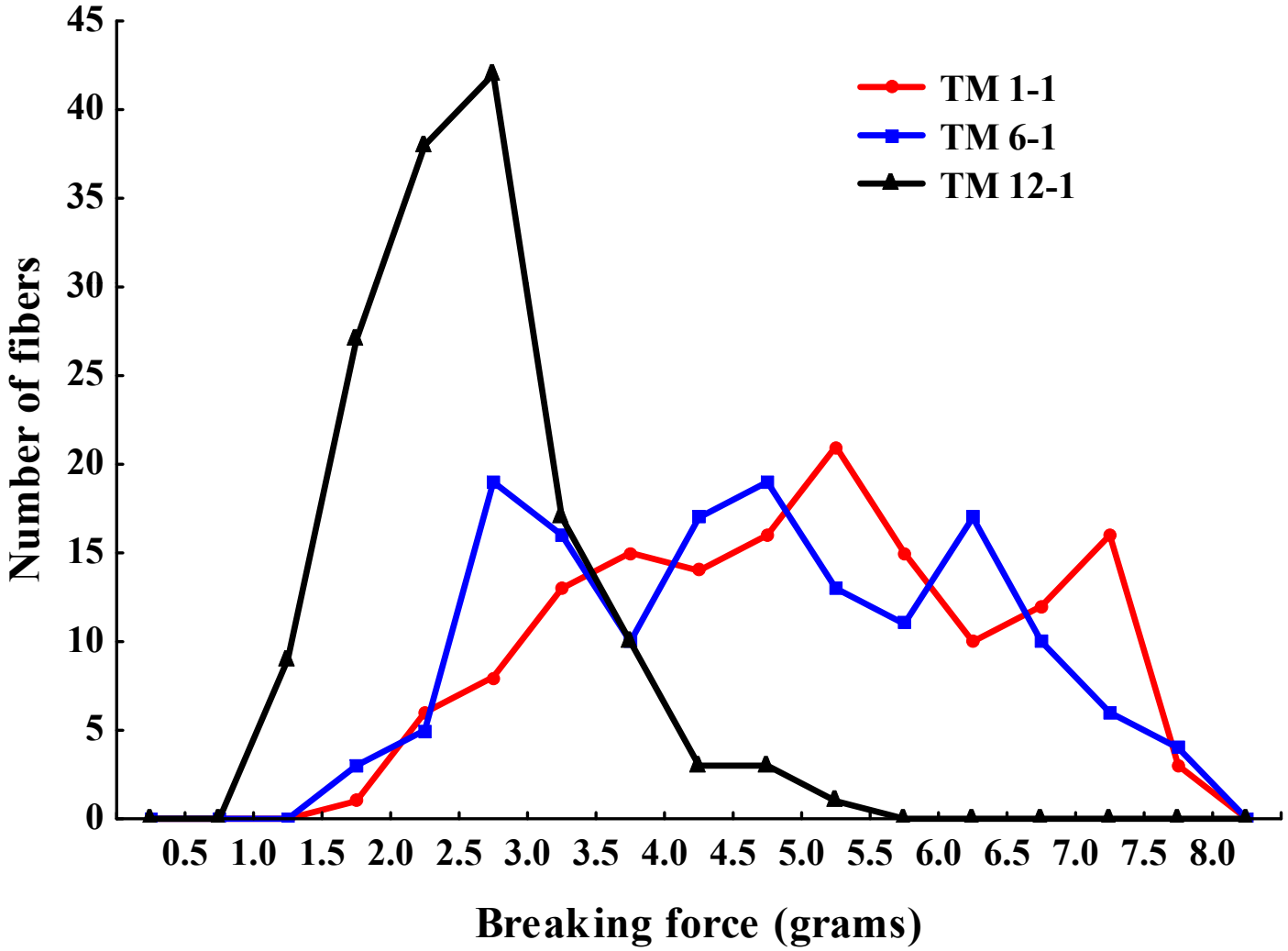


Source: Cotton fiber development and processing. An illustrated overview ISBN 9704182-0-5 (Figure 12, D. Oosterhuis)

Variation of θ along the plant



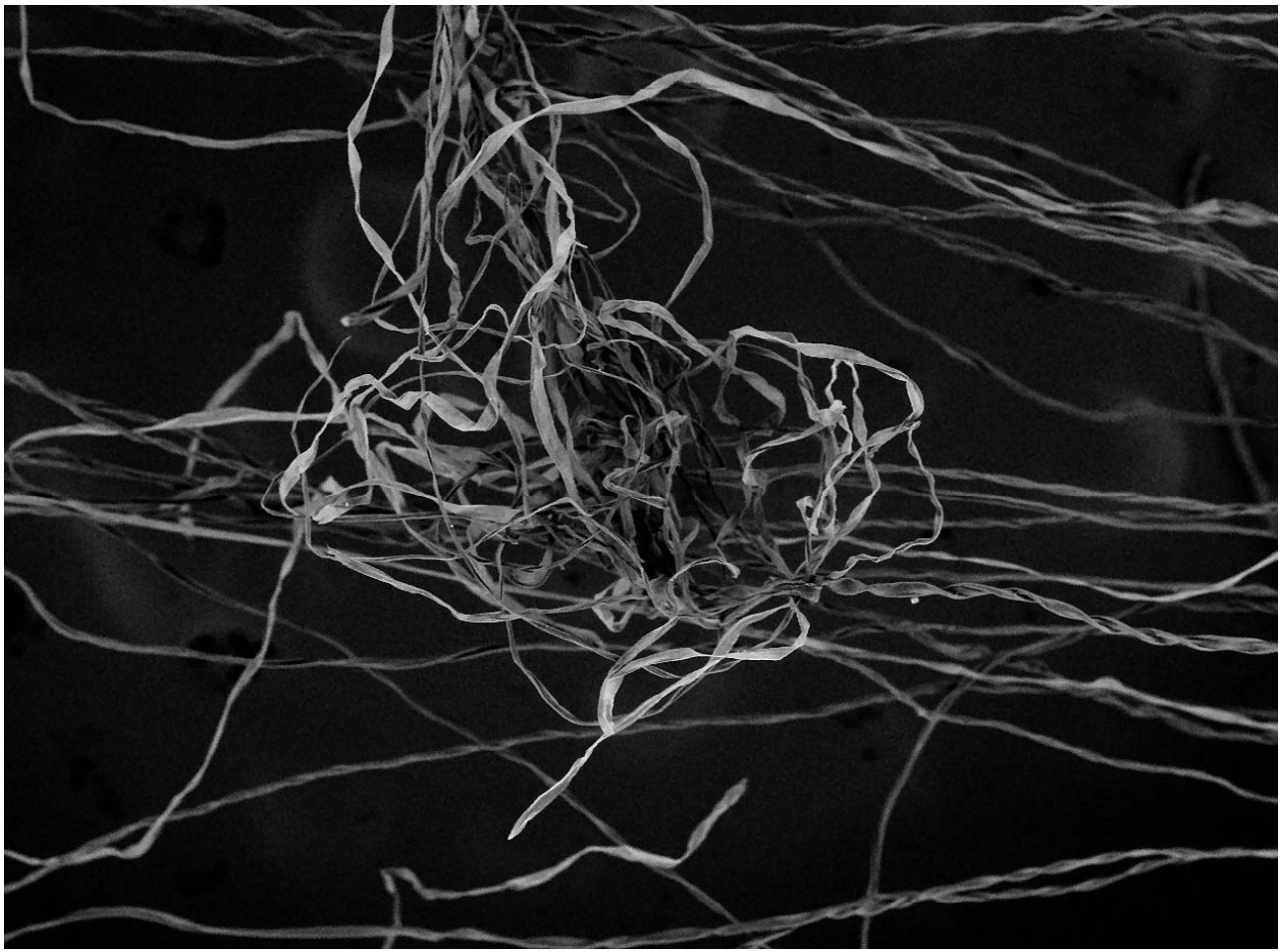
Distribution of individual fibers breaking forces (fruiting position #1)



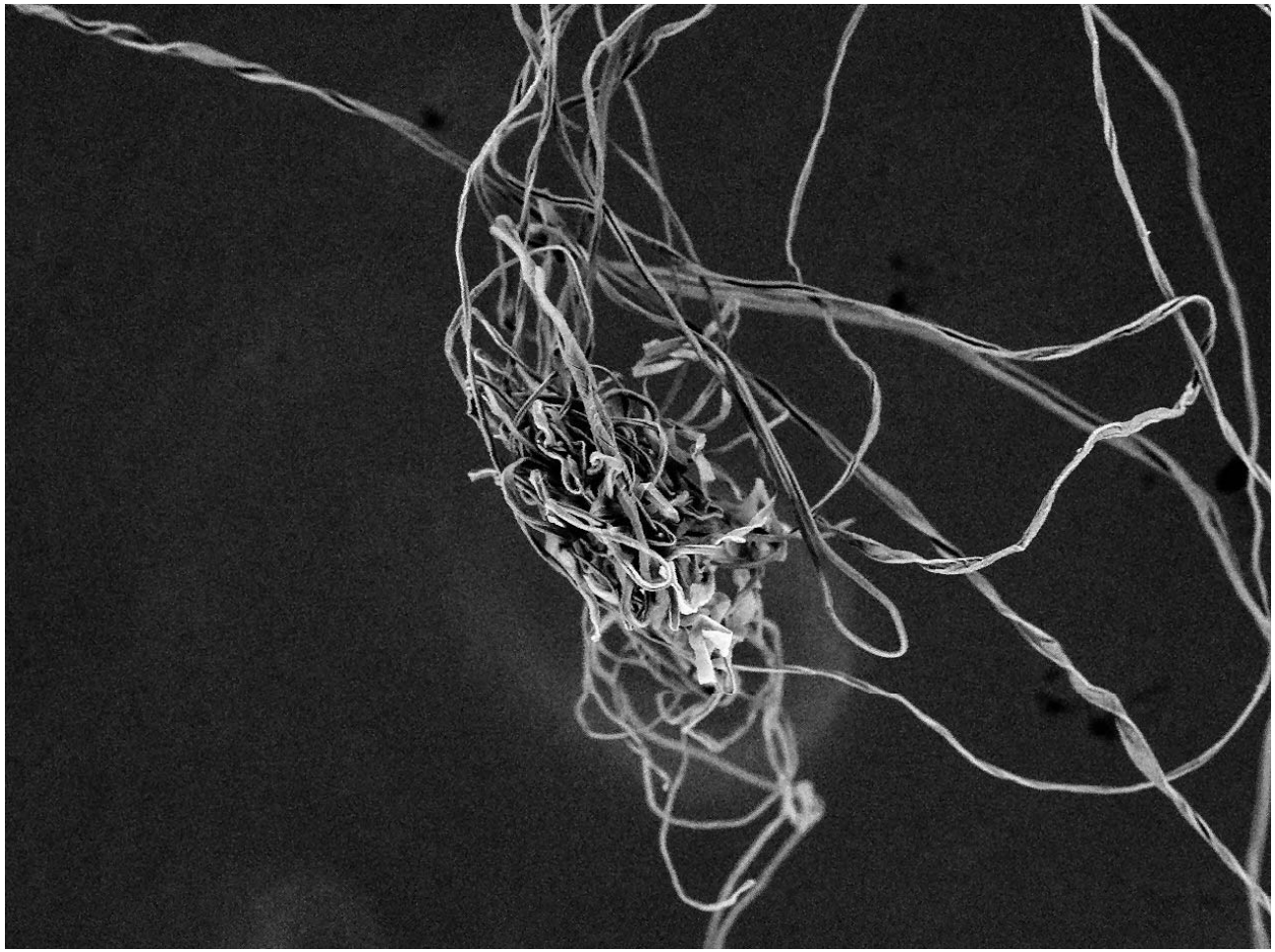
What is a fiber nep?

A small knot of entangled fibers that usually will not straighten to a parallel position during carding or drafting

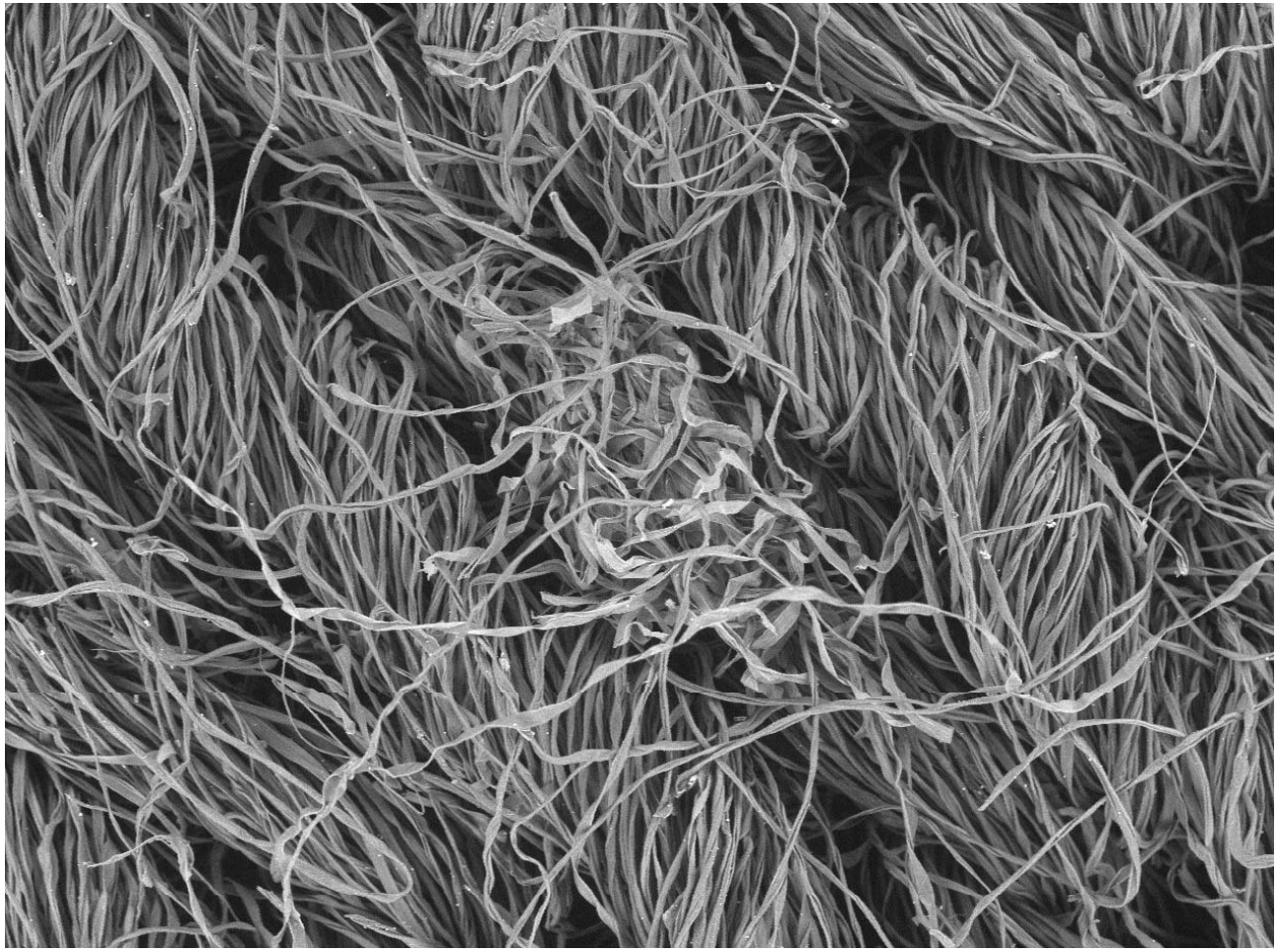
Fiber nep



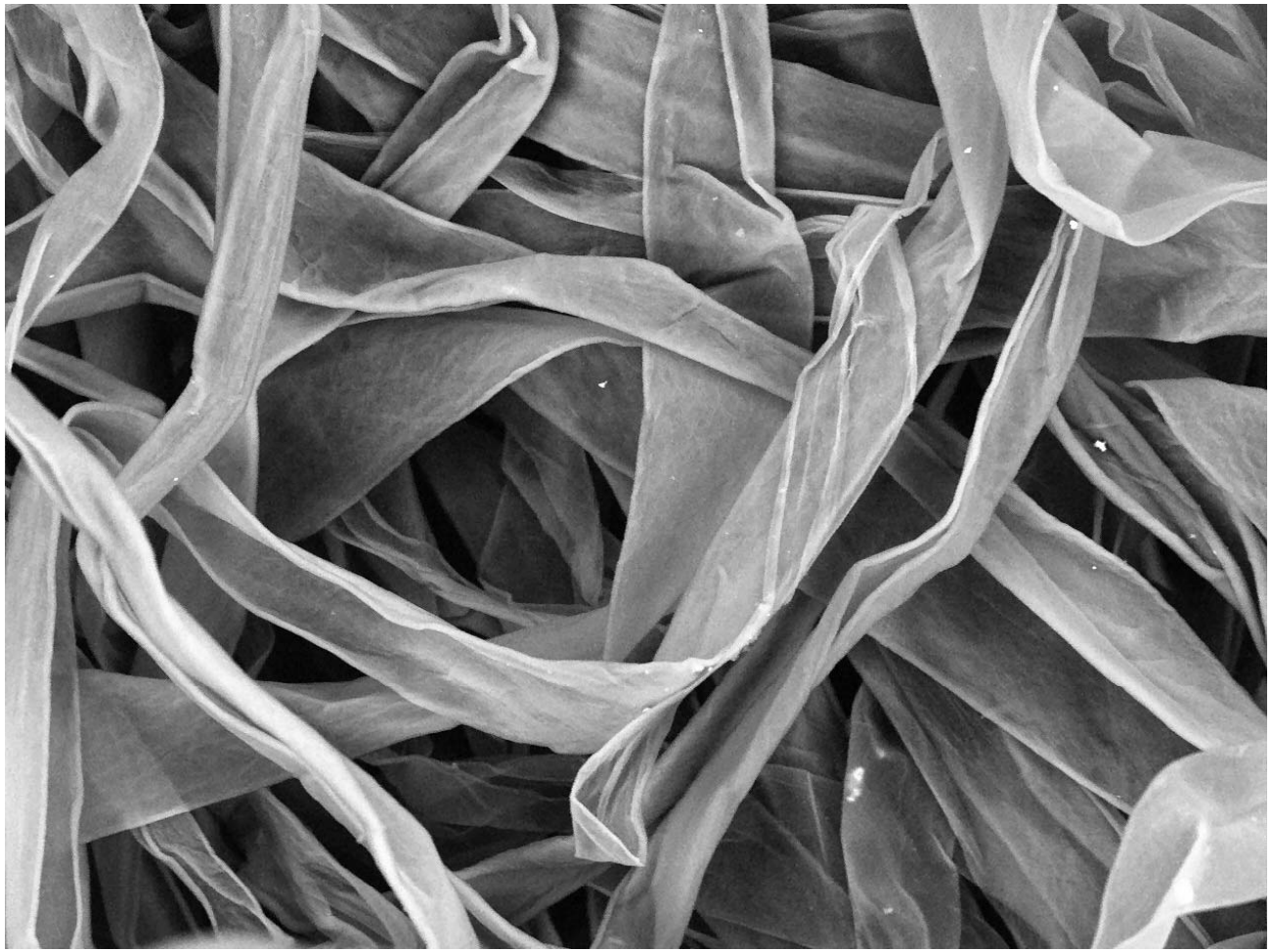
Fiber nep



White speck



White speck

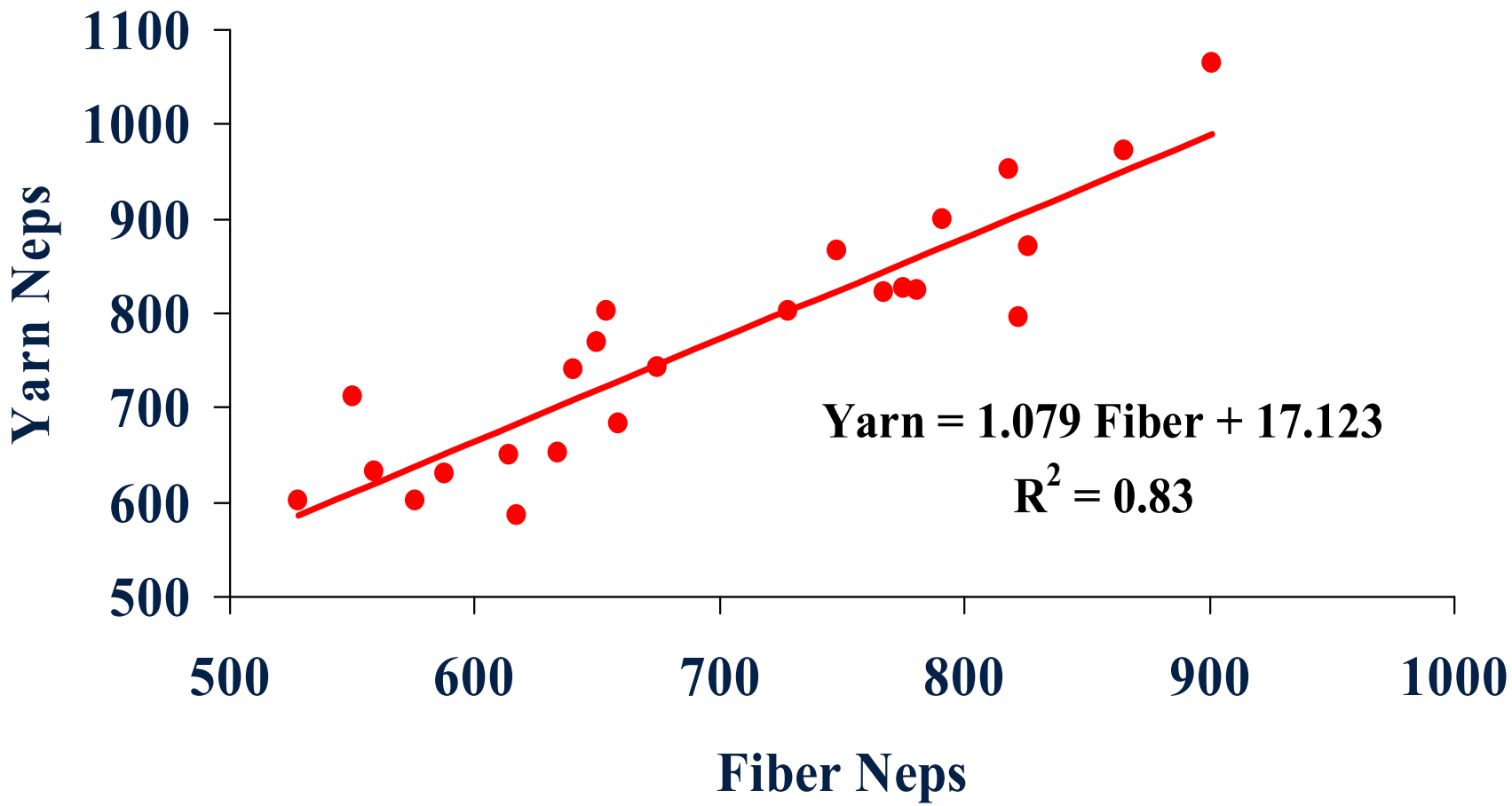


Why is it important?

Fiber neps result in yarn neps.

Yarn neps result in fabric defects.

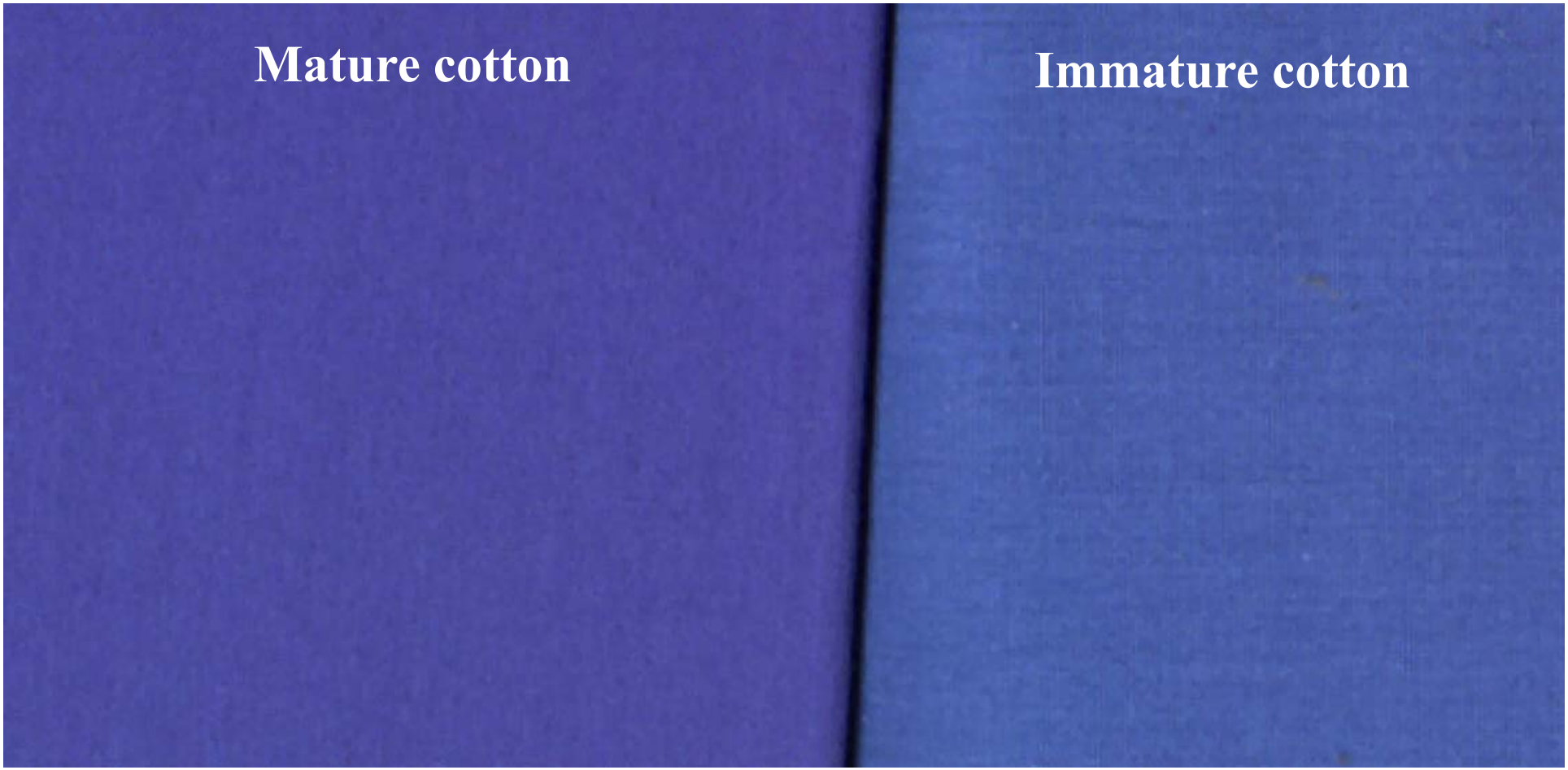
Yarn neps RS 40Ne vs. Fiber neps



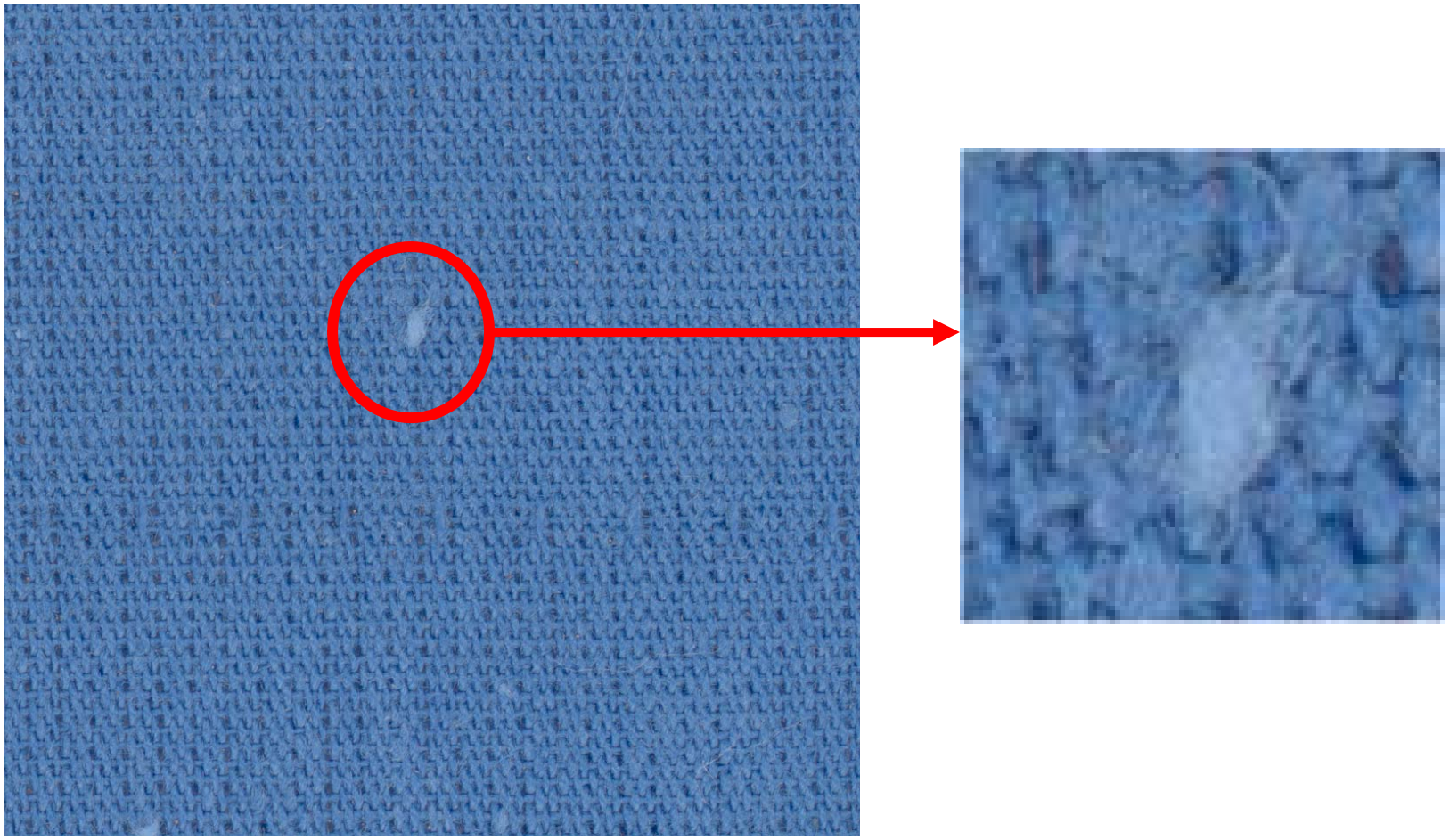
Maturity – Effect on dye uptake

100% cotton fabric

(same variety, same field)

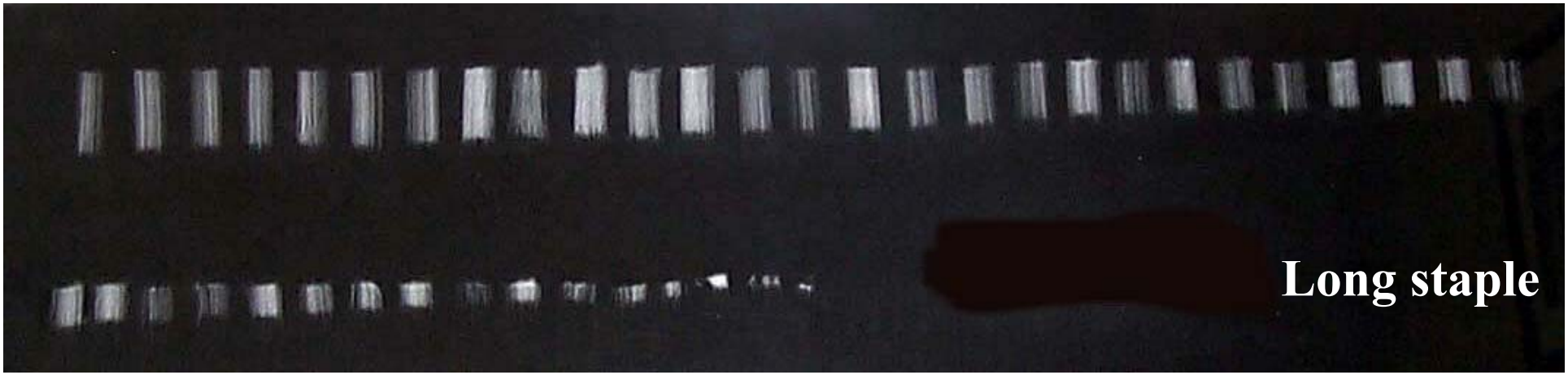


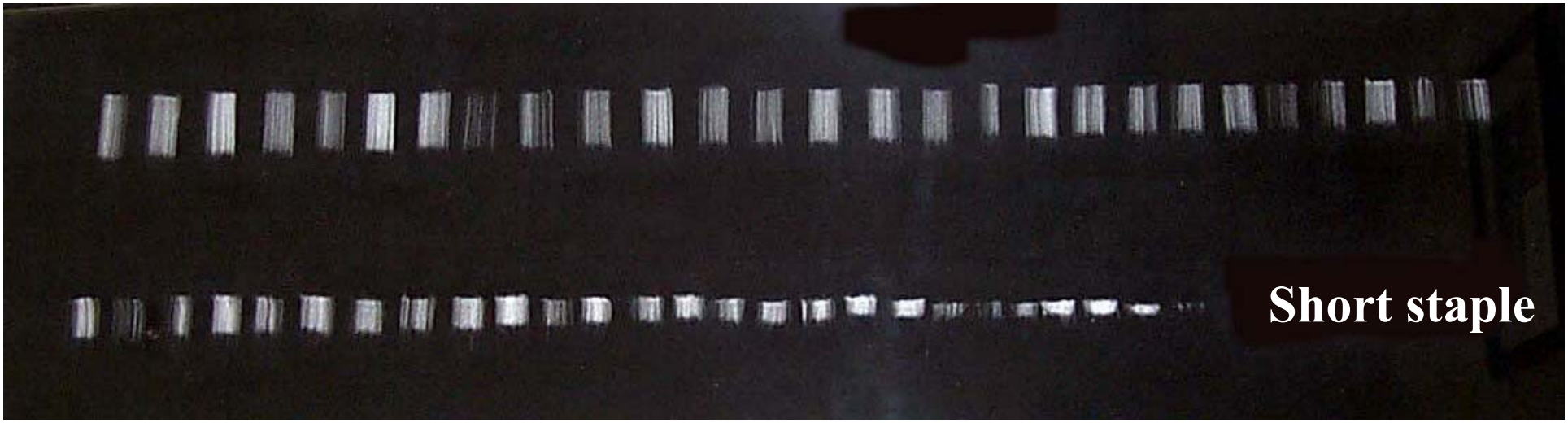
Shiny nep on fabric



Fiber length and uniformity

Sutter-Webb



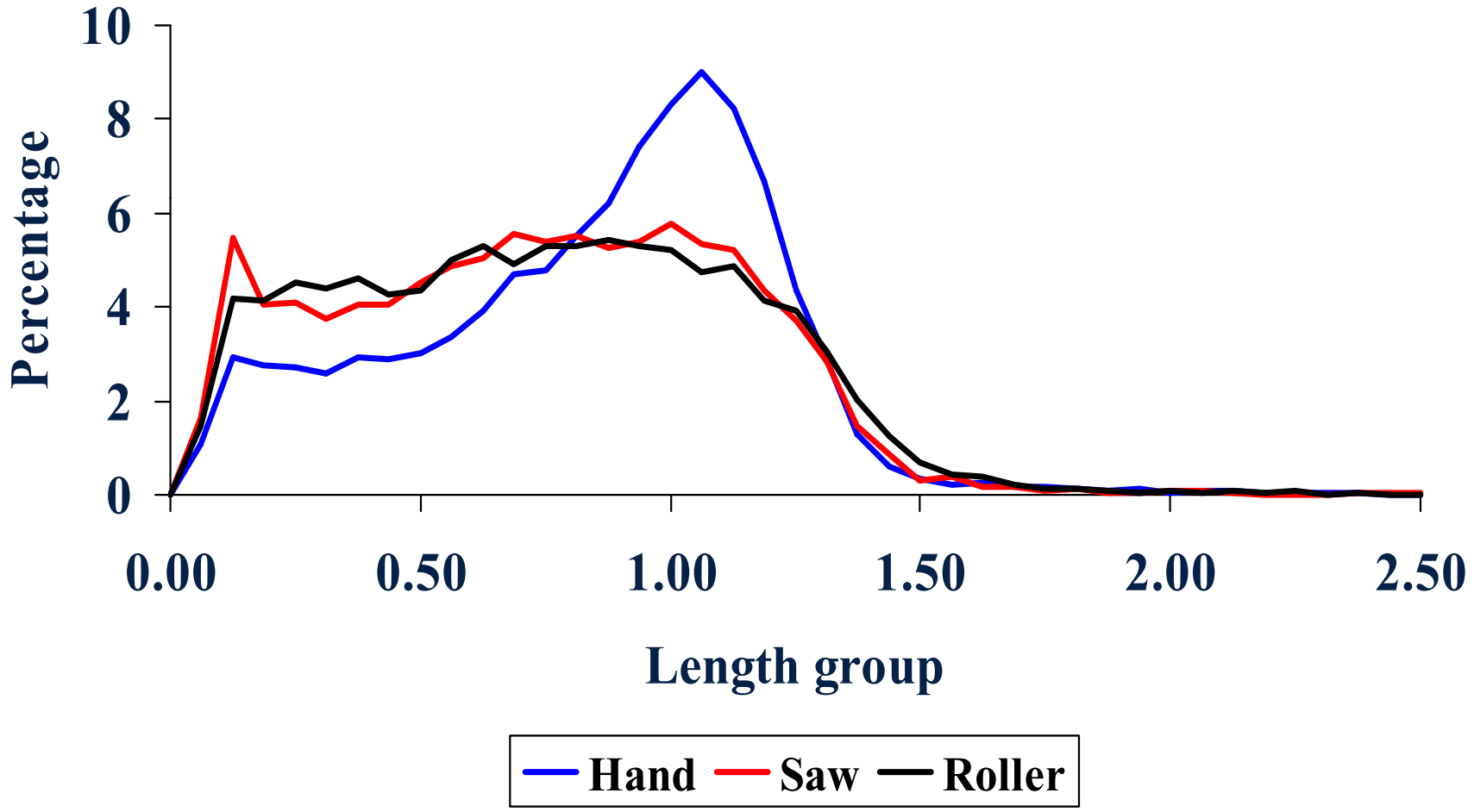


What is the Short Fiber Content?

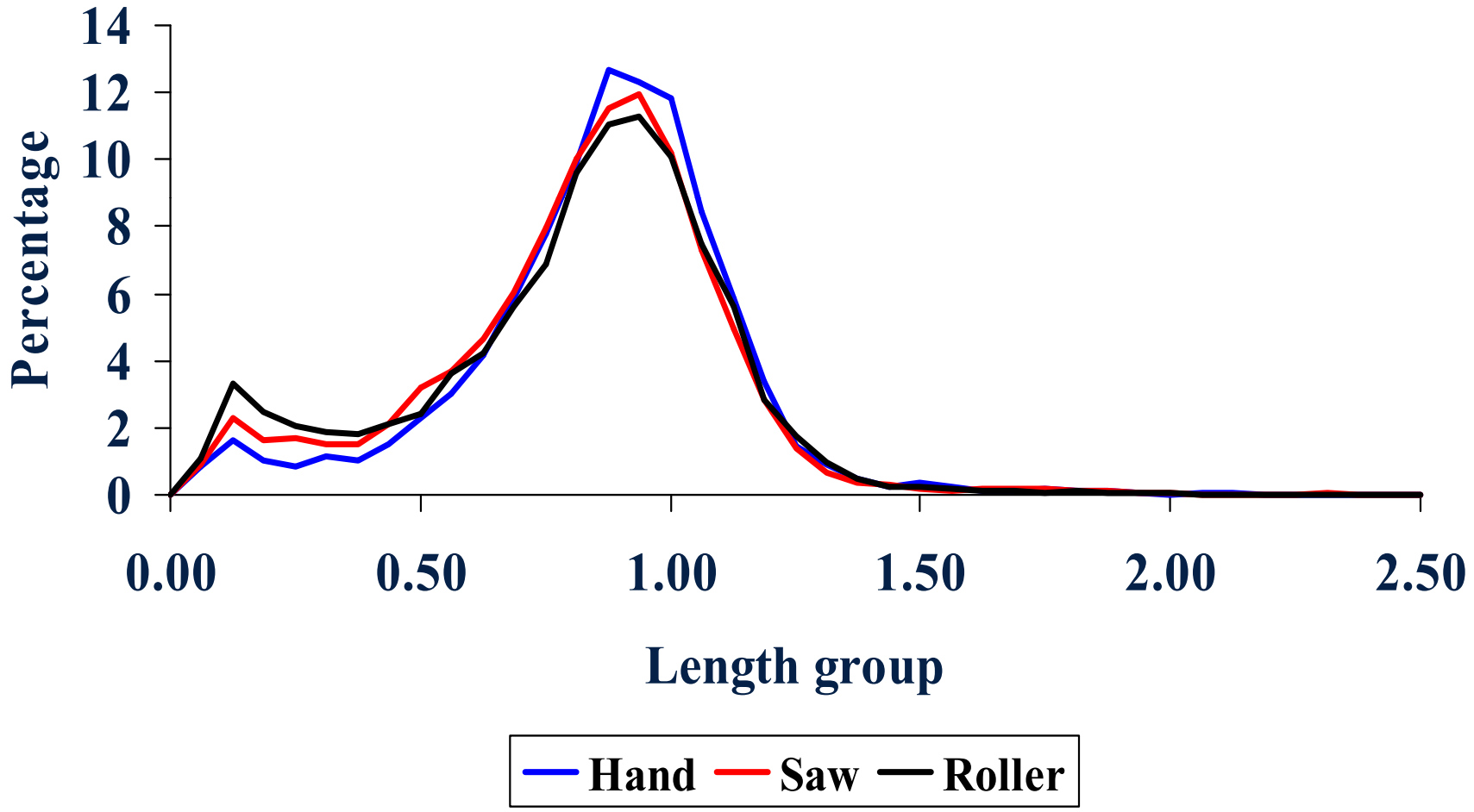
Percentage, by weight, of fibers ½ inch in length or shorter.

Percentage, by number, of fibers ½ inch in length or shorter.

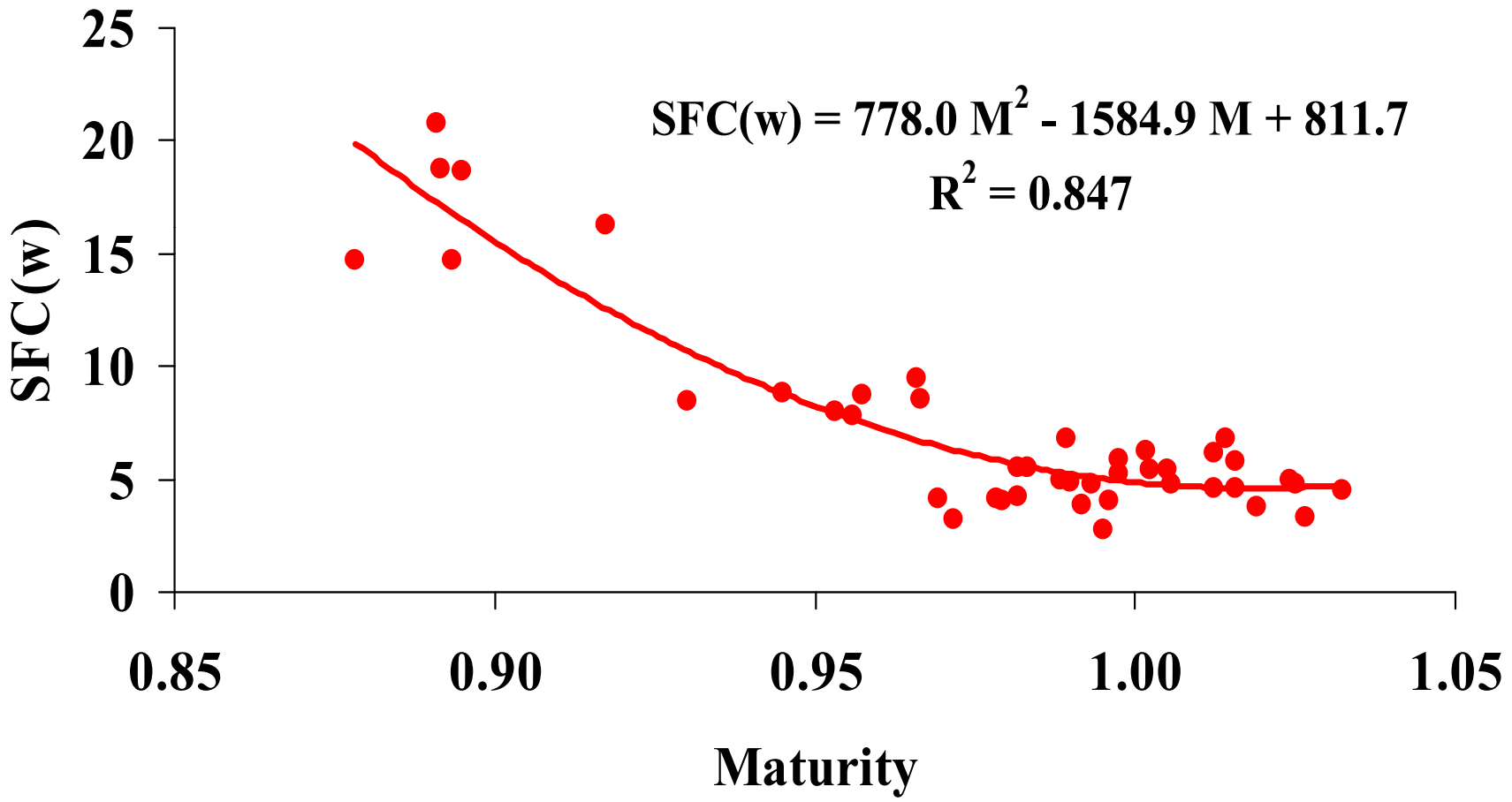
Sample 461: Length distribution by number (L(n) hand = 0.81; MR = 0.82)



Sample 465: Length distribution by number (L(n) hand = 0.83; MR = 0.90)



Short Fiber content (w) vs. Maturity



Why is it important?

- **Higher SFC% results in higher loss at the carding machine.**
- **Higher SFC% results in more yarn defects and productivity loss.**
- **More yarn defects result in more fabric defects.**

Conclusions

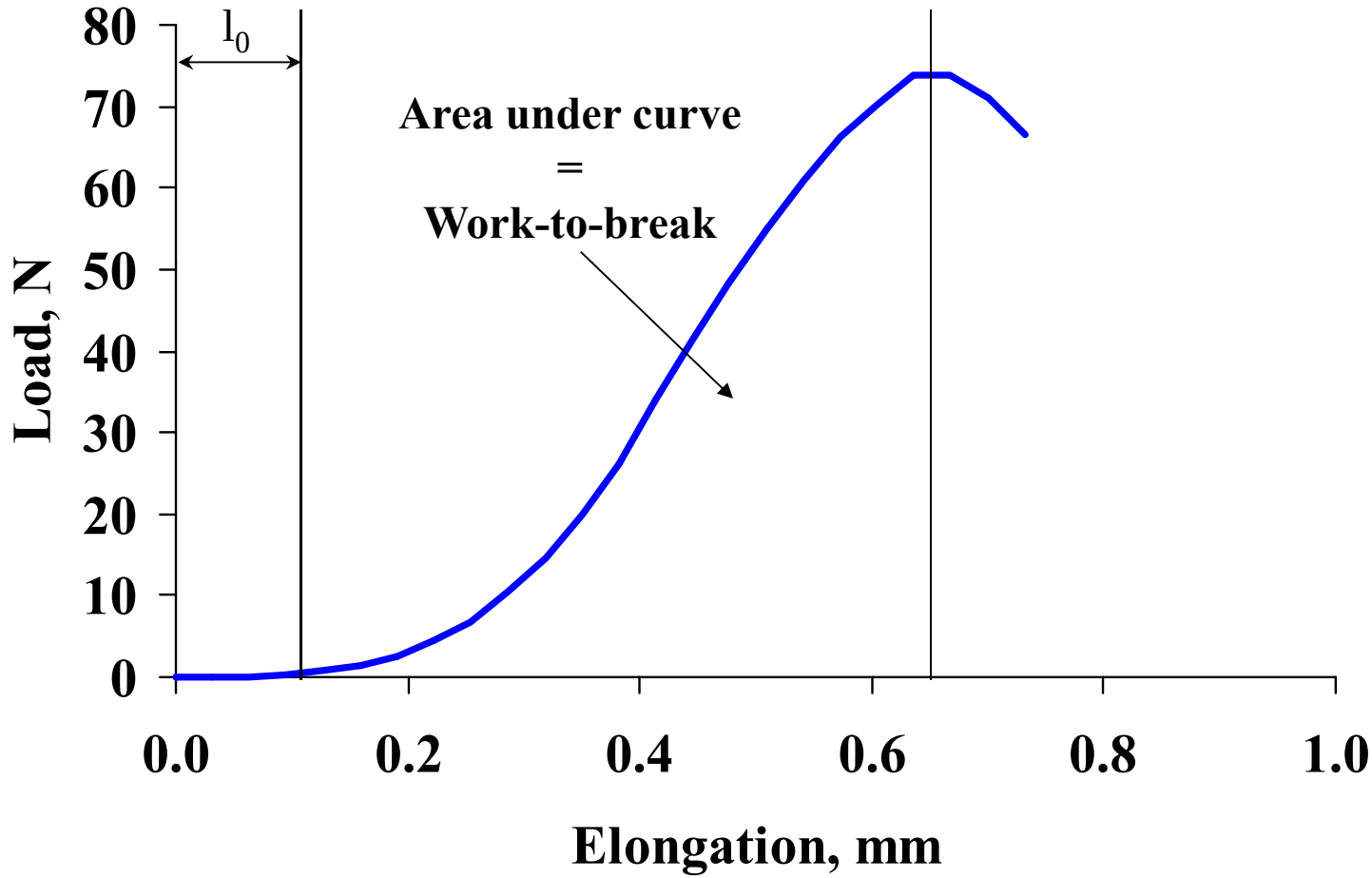
- **Length distribution is of the utmost importance for good spinning performances.**

- **Length distribution is related to individual fiber strength, therefore to fineness and maturity.**

Fiber Strength

Fiber Elongation

Typical Load – Elongation curve

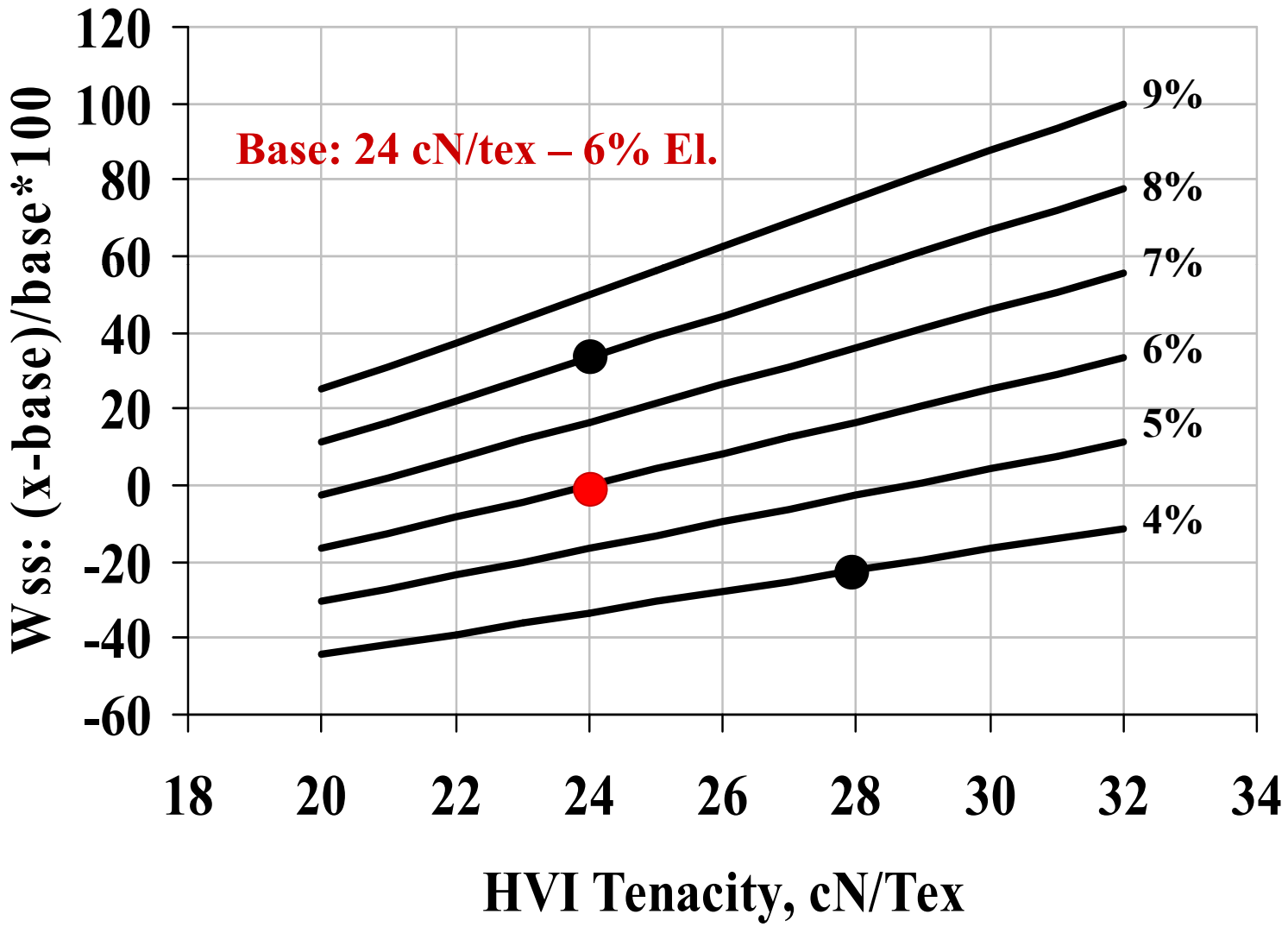


Fiber Elongation

- **Due to the lack of calibration standards, High Volume Instruments (HVI) do not provide consistently accurate fiber elongation data.**

- **The contribution of fiber bundle elongation in the work of rupture of fiber bundles is critically important to processing performance.**

Estimated HVI work of rupture W_{SS} vs. HVI Tenacity for selected elongations



Conclusion

- **With the current marketing system the variety with a higher strength and a lower elongation would receive a premium while its performances in spinning and weaving (all other parameters being equal) would be lower.**