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Upland Cotton Cultivar Trends and Plant Breeding Education Trends

Texas--U.S.--Texas A&M University

Wayne Smith
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Associate Department Head
Director, Distance Plant Breeding Pgm

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Today's Topics

- Genetic Gain from 1900 to 2002-Texas
  - Schwartz and Smith
- Genetic Gain from 1980 to 2010-U.S.
  - Kuraparthy and Bowman
- Breeding for Exceptional Fiber Quality
  - Smith et al.
- Educating the Next Generation Worldwide
  - Smith et al.

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A Century of Cotton Cultivars Grown in Varying Plant Spacings

Brian Schwartz (MS thesis research) and Wayne Smith

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- Evaluate 9 cotton (*Gossypium hirsutum L.*) cultivars released throughout the 20th century
- Evaluate changes in lint yield and fiber qualities attributable to plant breeding
  - Cultivars and year of release:

    Lone Star (1900)
    Half & Half (1910)
    Deltatype Webber (1922)
    Rowden 41B (1930)
    Deltapine 14 (1941)
    Stoneville 213 (1962)
    Deltapine 55 (1974)
    Stoneville 506 (1982)
    Deltapine 491 (2002)

Schwartz, B.M. and C.W. Smith. 2007. Genetic gain in yield potential of upland cotton under varying plant densities. Crop Sci. 48:601.

Schwartz, B.M. and C.W. Smith. 2007. Genetic gain in fiber properties of upland cotton under varying plant densities. Crop Sci. 48:1321.

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- Year: 2003 – 2004
- Location: Texas A&M Research farm near College Station
- Cultural practices: Consistent with the normal production of upland cotton at this locale, including furrow irrigation as needed
- Furrow Irrigated
- Hand Harvested

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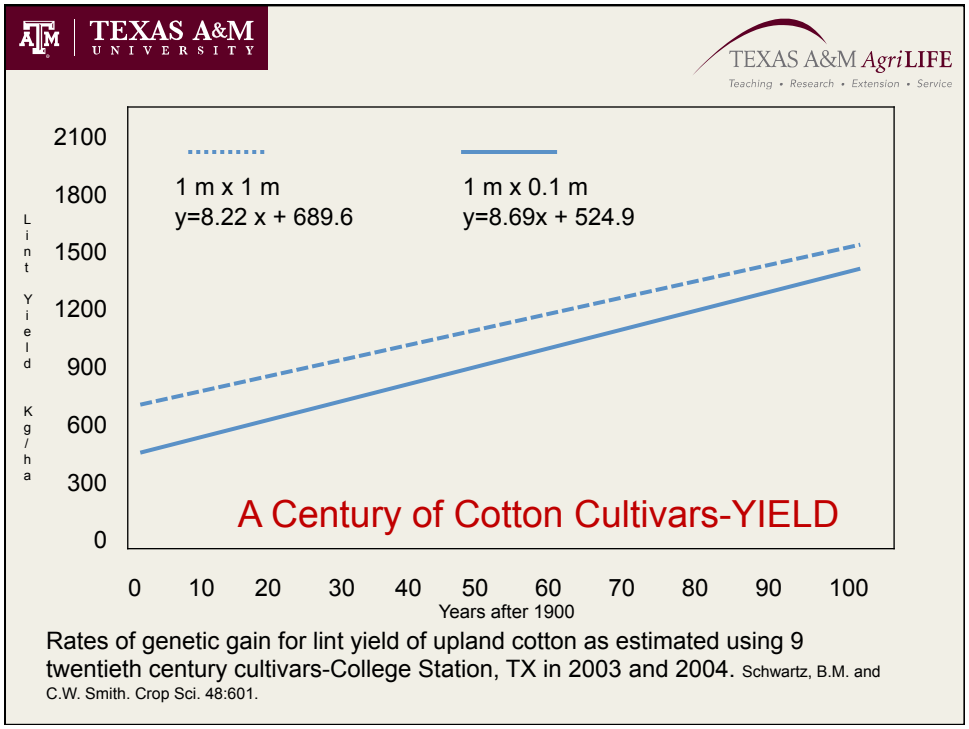
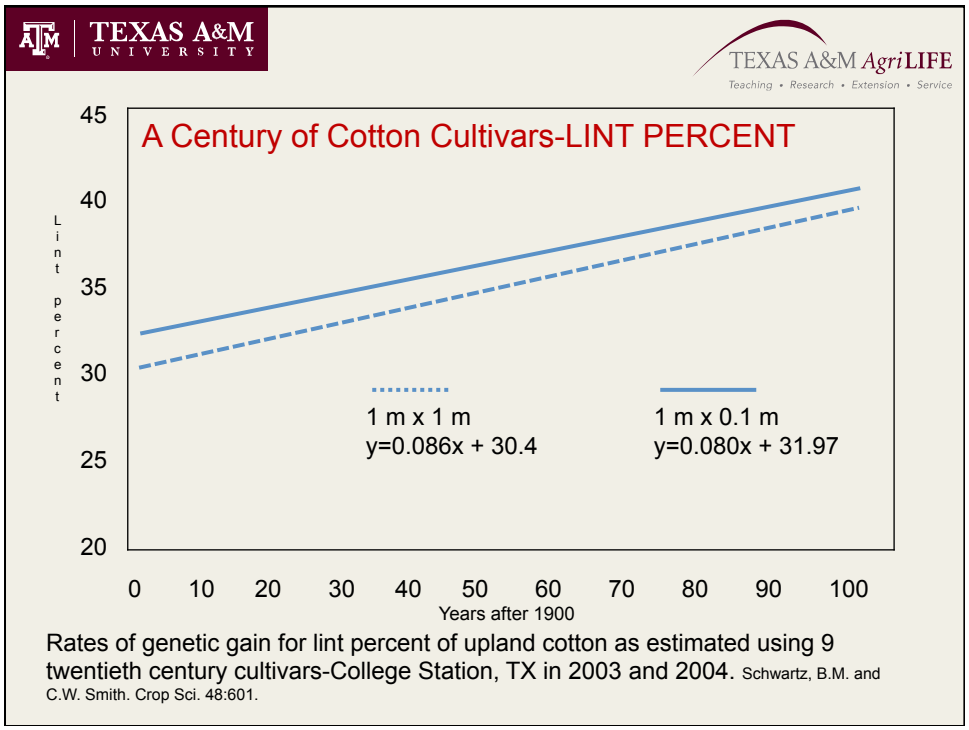
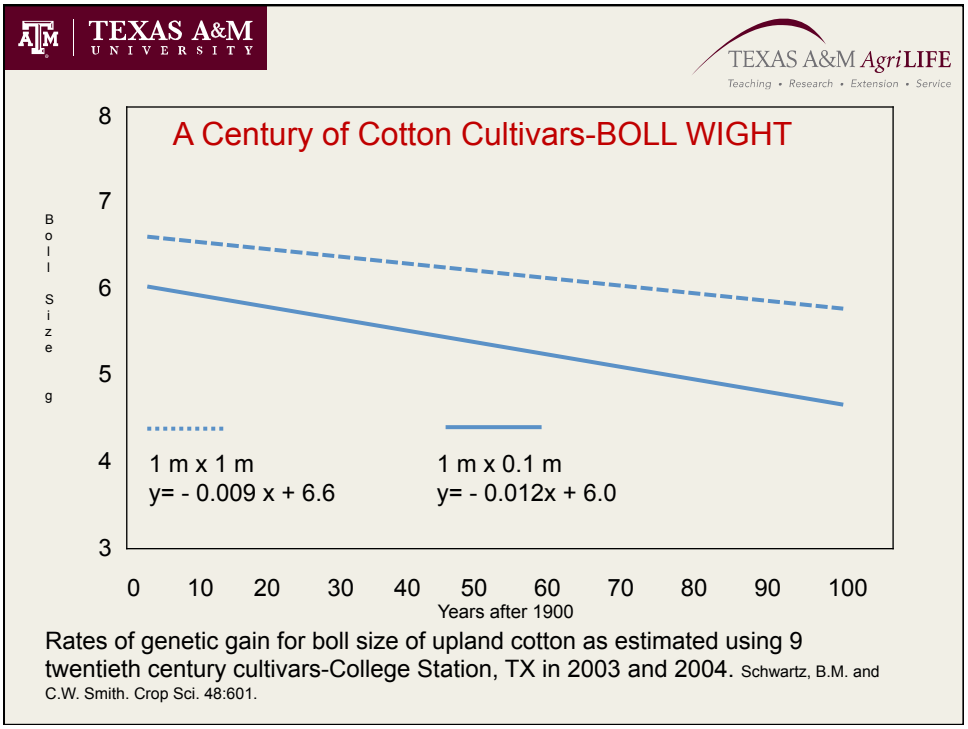
- Two plant populations evaluated
  1 m x 1 m (reduced interplant competition)
  1 m x 0.1 m (commercial population)
- Split block of a randomized complete block
- Four replications
  - Yield determination
  - Morphological traits
  - Yield components
  - HVI fiber properties



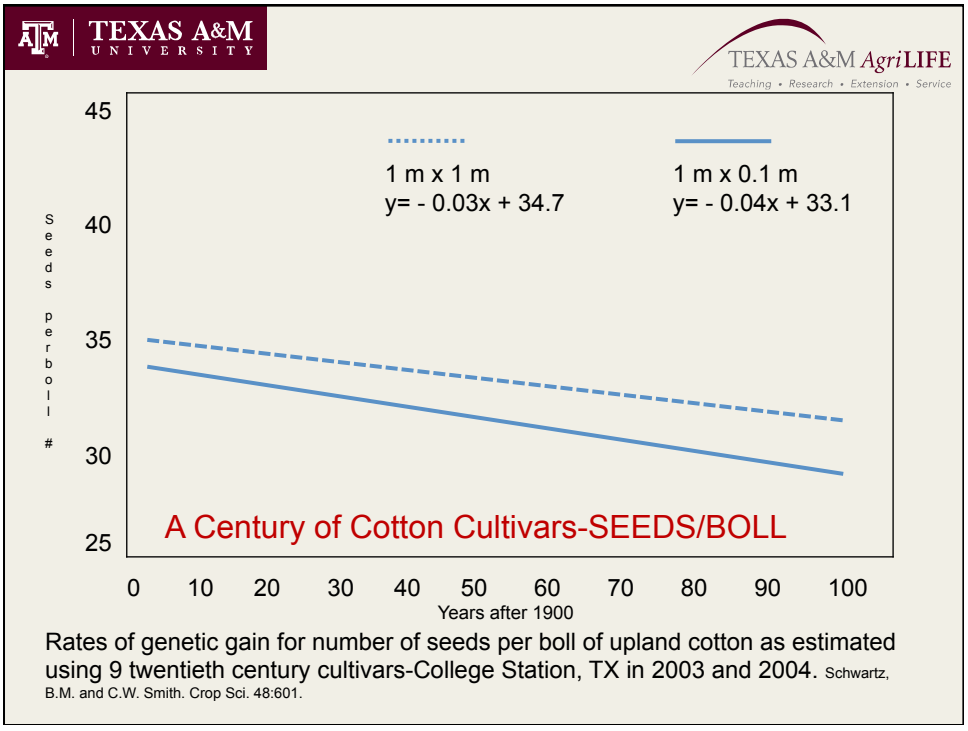
Rates of genetic gain for lint yield of upland cotton as estimated using 9 twentieth century cultivars-College Station, TX in 2003 and 2004. Schwartz, B.M. and C.W. Smith. Crop Sci. 48:601.



Rates of genetic gain for lint percent of upland cotton as estimated using 9 twentieth century cultivars-College Station, TX in 2003 and 2004. Schwartz, B.M. and C.W. Smith. Crop Sci. 48:601.



Rates of genetic gain for boll size of upland cotton as estimated using 9 twentieth century cultivars-College Station, TX in 2003 and 2004. Schwartz, B.M. and C.W. Smith. Crop Sci. 48:601.



Rates of genetic gain for number of seeds per boll of upland cotton as estimated using 9 twentieth century cultivars-College Station, TX in 2003 and 2004. Schwartz, B.M. and C.W. Smith. Crop Sci. 48:601.

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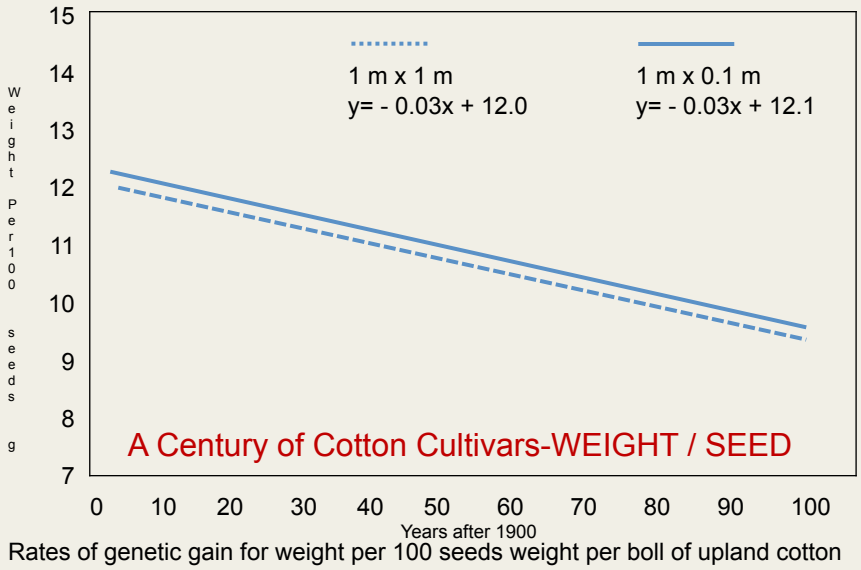

Rates of genetic gain for weight per 100 seeds weight per boll of upland cotton as estimated using 9 twentieth century cultivars-College Station, TX, 2003/04.
Schwartz, B.M. and C.W. Smith. Crop Sci. 48:601.

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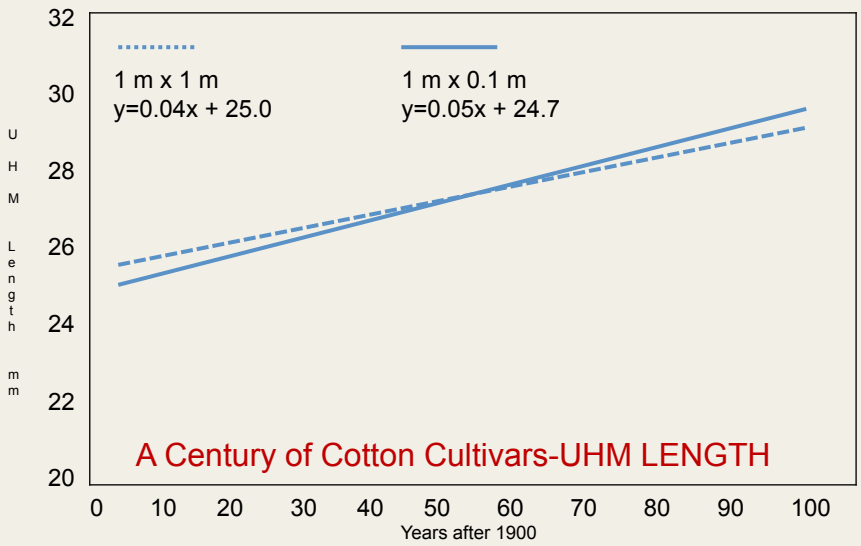

Rates of genetic gain for Upper Half Mean Length of upland cotton as estimated using 9 twentieth century cultivars-College Station, TX, 2003/04. Schwartz, B.M. and C.W. Smith. Crop Sci. 48:1321.

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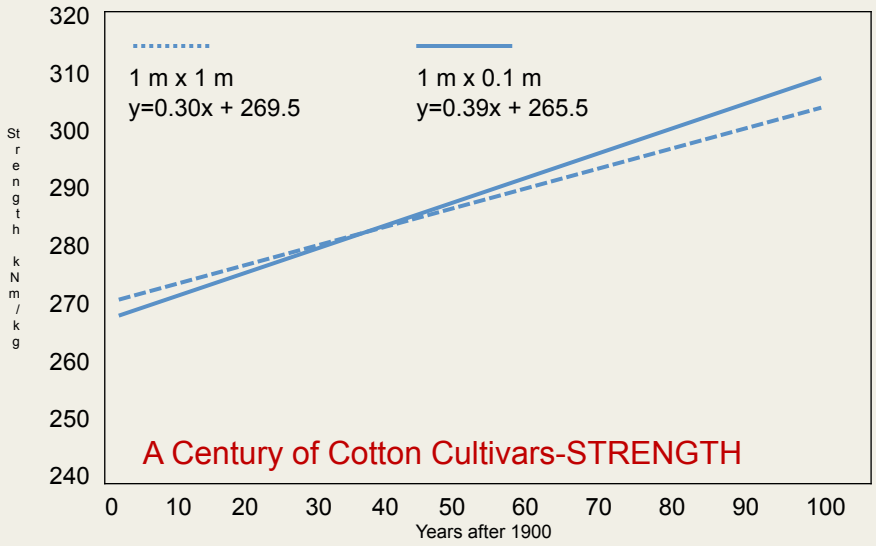

Rates of genetic gain for Fiber Bundle Strength of upland cotton as estimated using 9 twentieth century cultivars-College Station, TX, 2003/04. Schwartz, B.M. and C.W. Smith. Crop Sci. 48:1321.

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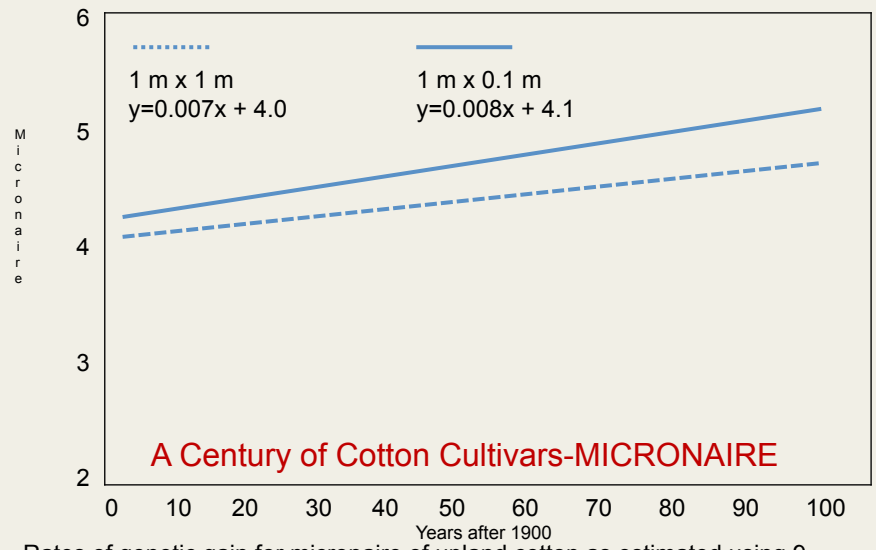
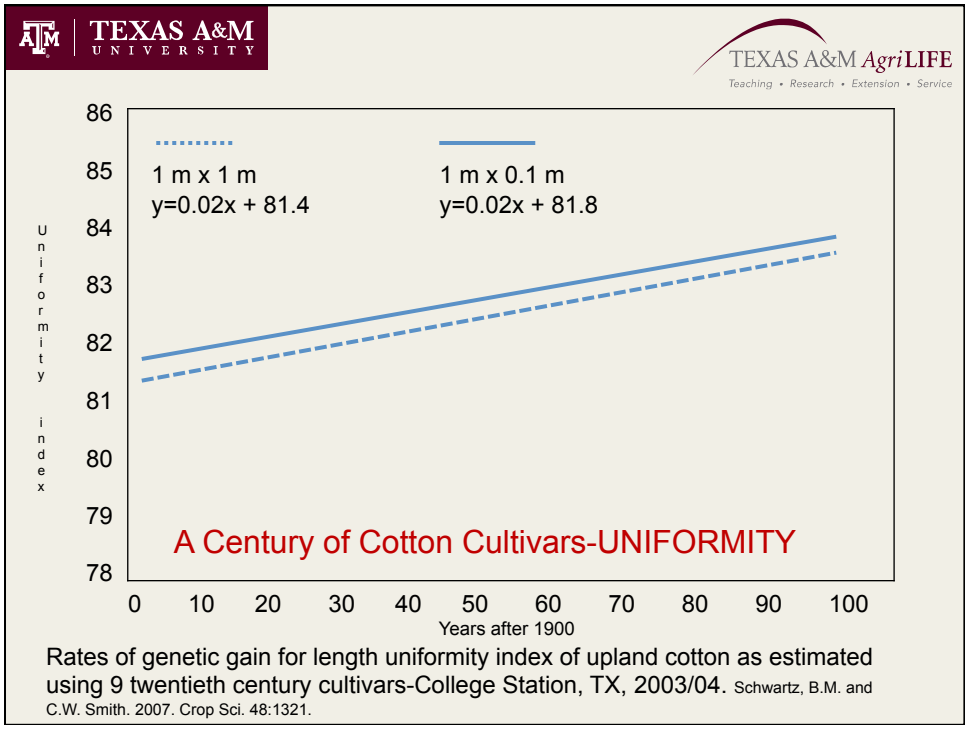
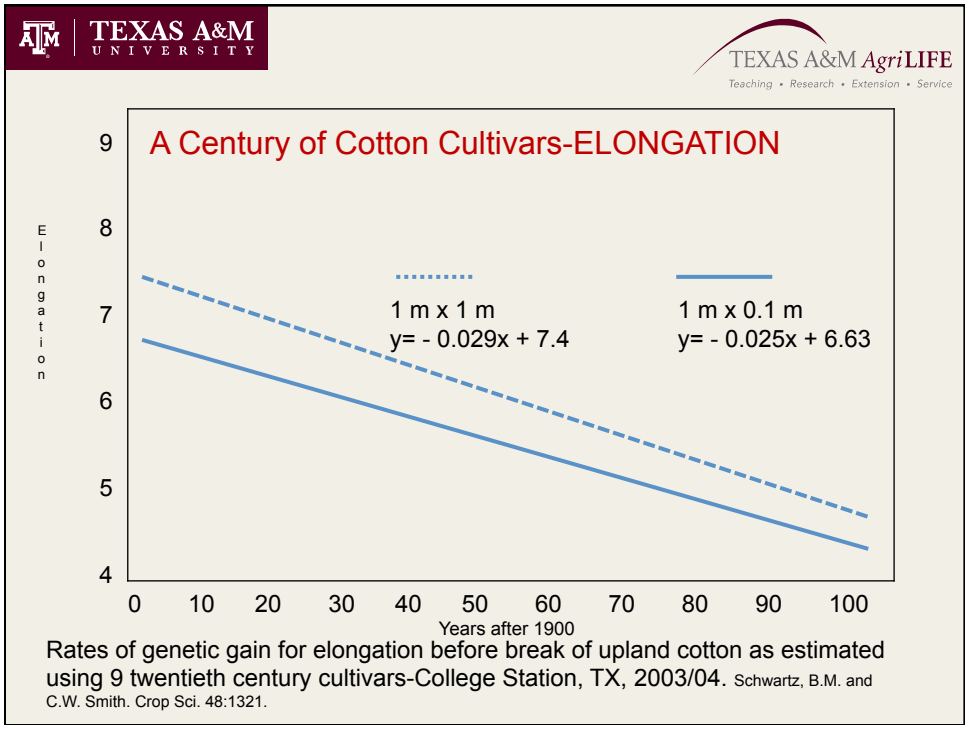


Rates of genetic gain for micronaire of upland cotton as estimated using 9 twentieth century cultivars-College Station, TX, 2003/04. Schwartz, B.M. and C.W. Smith. 2007. Crop Sci. 48:1321.



Rates of genetic gain for length uniformity index of upland cotton as estimated using 9 twentieth century cultivars-College Station, TX, 2003/04. Schwartz, B.M. and C.W. Smith. 2007. Crop Sci. 48:1321.



Rates of genetic gain for elongation before break of upland cotton as estimated using 9 twentieth century cultivars-College Station, TX, 2003/04. Schwartz, B.M. and C.W. Smith. Crop Sci. 48:1321.

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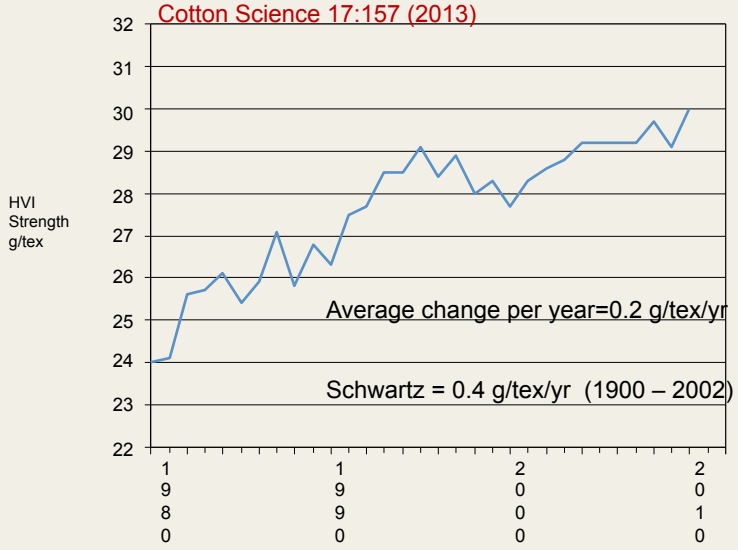
Gains in Breeding Upland Cotton for Fiber Qualtiy
Vasu Kuraparthy and Daryl Bowman
Cotton Science 17:157 (2013)



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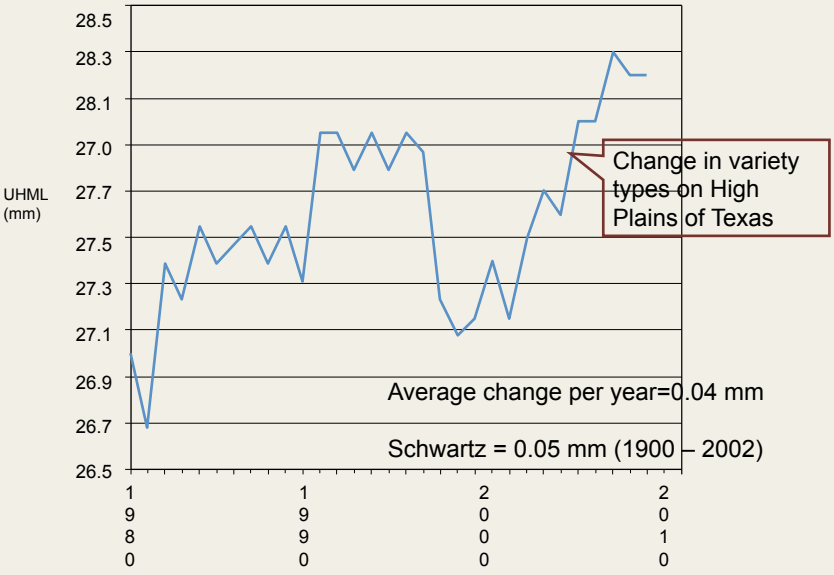
Kuraparthy and Bowman Cotton Science 17:157 (2013)



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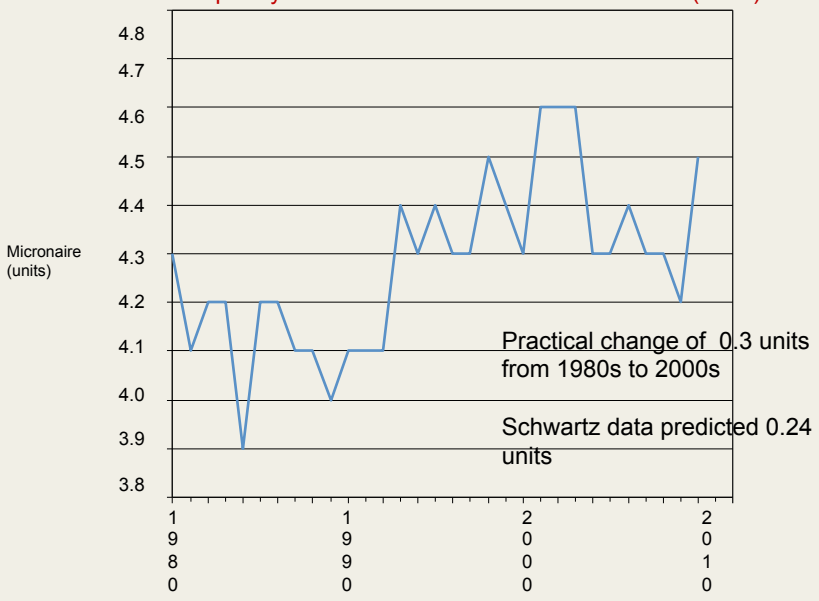
Kuraparthy and Bowman Cotton Science 17:157 (2013)



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Genetic/Realized Gain (or trends) in Upland Cotton in the U.S.

- Higher yield (4 to 8 kg/ha/yr)
- Higher gin turnout (0.08 % per yr)
- Lower boll wt, lower seed wt., & fewer seeds/boll
- Longer UHML (0.04 to 0.05 mm per yr)
- Stronger bundle strength (0.2 to 0.4 g/tex/yr)
- Micronaire is max'ed out
- Improved length uniformity (0.02 % per yr)

- PROBLEM: Elongation decreasing (-0.025 % per yr)

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Cotton Improvement Program-TAMU

Breeding Goal: to enhance exceptional fiber quality traits that lead to improved yarn quality

- Extra Long Staple Upland Trait
- Fiber Bundle Strength

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Selected fiber properties and Ne50 and Ne80 combed yarn quality of two ELS upland strains, FM832LL, & Pima HTO.

Genotype	UHML	Str	Hs	Ten50	Ten80
	mm	g/tex	m'tex	cN/tx	cN/tx
B18234	35.1 a	33.8 b	173 b	18.0 c	17.1 b
B18233	35.6 a	34.7 b	170 c	19.1 b	17.8 b
Pima HTO	33.2 b	39.2 a	164 d	22.0 a	21.2 a
FM832	31.2 c	32.9 c	182 c	16.0 d	NA

Note that we could not spin 80 Ne yarn with Fibermax 832 because the cross section is so small that one can not get enough fibers with enough length for sufficient friction to hold the yarn together.

Smith, W., S. Hague, P. Thaxton, E. Hequet, and D. Jones. 2009. Registration of eight ELS upland cotton germplasm lines. J. Plant Reg. 3:81-85.

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Selected AFIS and Yarn Properties of WE-62 lines

Genotype	UHML	Str	Hs	IFC	MR	Tenacity	Work to break
	-in.-	kN m/kg	-mtex-	-%-	-%-	-cN/tex-	-gf/cm-
WE-62-14	29.5 bc	375 a	170 b	6.0 ab	0.93 bc	21.1 a	569 a
WE-62-1	29.7 ab	379 a	168 b	5.7 b	0.94 b	21.0 ab	560 a
WE-62-5	30.2 a	376 a	168 b	5.5 bc	0.94 b	20.4 b	525 b
WE-62-4	30.2 a	375 a	169 b	6.0 ab	0.94 bc	19.7 c	500 c
FM 832	28.7 b	303 c	176 ab	5.8 ab	0.94 b	15.6 d	373 c
DPL 491	28.7 b	301 c	178 a	6.1 ab	0.93 bc	15.5 d	376 d
Percent Improvement						26-35%	33 – 55%

Bottom Line: Improved yarn quality as measured by tenacity can be improved by slightly improved UHML, slightly improved fiber finess, and improved fiber bundle strength.

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- ✓ **ELS level fiber UHML**
- ✓ **Exceptional strength in TAM WE-62 family**
- ✓ **Other developments and activities**
  - **staple length equal to pima**
  - **fiber strength near pima levels**
  - **more uniform fiber length**
  - **investigating the genetics of fiber elongation or stretchability**
  - **yield potential**
  - **graduate plant breeding student training (13 in breeding pgms: PA (1), IA (2), MO (2), TX (4), AZ (1), CA (1) Turkey (1) Phillipines (1)**

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NEW PARIDIGMS IN PLANT BREEDING EDUATION

OR

HOW WILL PLANT BREEDING EDUCATION CONTRIBUTE TO 2050

WAYNE SMITH
PROFESSOR, PLANT BREEDING
ASSOCIATE DEPARTMENT HEAD

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NEW PARIDIGMS IN PLANT BREEDING EDUATION

Review of Plant Breeding Education and Needs in the U.S.

- **The number of plant breeding faculty at Land Grant Universities is trending downward**
- **Industry demand is trending upward**
- **We currently do not produce enough Ph.D. trained plant breeders to meet replacement needs at a 5% replacement rate in the U.S. alone (no global information).**

- **How will we produce more plant breeders to meet demand?**

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NEW PARIDIGMS IN PLANT BREEDING EDUATION

Spring 2013: Texas A&M, Department of Soil and Crop Sciences, launched a Distance Degree program in plant breeding.

- **M.S. (thesis option and non-thesis option)**
- **Ph.D. (dissertation option only)**

Fall 2013: launched a Continuing Education (non-degree) program in plant breeding.

Only Land Grant University in the U.S. to offer the M.S. thesis option and Ph.D. graduate degrees in Plant Breeding.

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NEW PARIDIGMS IN PLANT BREEDING EDUATION

DISTANCE DELIVERY OF MS (TO & NTO) AND PHD IN PLANT BREEDING FROM TEXAS A&M UNIVERSITY

- **WHAT IS THE SAME:**
  - **COURSES, EXAMS, EXPECTATIONS**
  - **PROFESSORS**
  - **UNIVERSITY ADMISSION STANDARDS**
    - **ENGLISH**
    - **GRE**
    - **GPA**

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NEW PARIDIGMS IN PLANT BREEDING EDUATION

DISTANCE DELIVERY OF MS (TO & NTO) AND PHD IN PLANT BREEDING FROM TEXAS A&M UNIVERSITY

- **WHAT IS DIFFERENT:**
  - **INFORMATION DELIVERY**
  - **INTERACT WITH STUDENTS ELECTRONICALLY**
  - **NO CAMPUS RESIDENCY**
  - **ADDITIONAL APPLICATION REQUIREMENTS**
    - **PROPOSED RESEARCH**
    - **DISTANCE CO-CHAIR**
    - **UPFRONT INTERACTION WITH CO-CHAIR**
    - **ORGANIZATIONAL COMMITMENT**

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- **INFORMATION AVAILABLE AT**
  - **HTTP://SOILCROP.TAMU.EDU**
  - **CWSMITH@TAMU.EDU**
  - **LEANN.HAGUE@TAMU.EDU**

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For the invitation to speak and travel arrangements:

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Latin American Association for Cotton Research and Development

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Fellow cotton breeders and scientists
Technicians

and YOU, for your kind attention and Questions!