

# Cotton and Climate Change

## The Untold Story

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International Cotton  
Advisory Committee



# What Causes Climate Change?

Deforestation for Land Use

Energy: Electricity & Petroleum Products

Chemicals: Fertilizers, Pesticides, Synthetic fibres, Dyes etc.,

## What Changes Most?

Greenhouse gases (CO<sub>2</sub>, CH<sub>4</sub>, N<sub>2</sub>O etc.) ↑

Temperature anomalies ↑

Rainfall patterns ↑ ↓

Drought intensities ↑

Frequency of extreme events ↑



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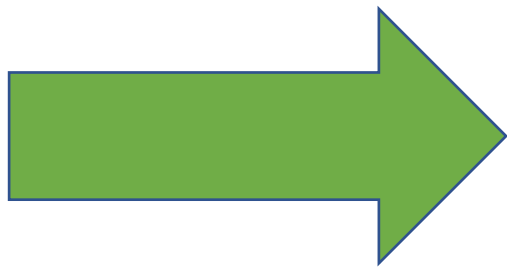
Green house gases ( $\text{CO}_2$ ,  $\text{CH}_4$ ,  $\text{N}_2\text{O}$  etc.) ↑↑

Temperature anomalies ↑

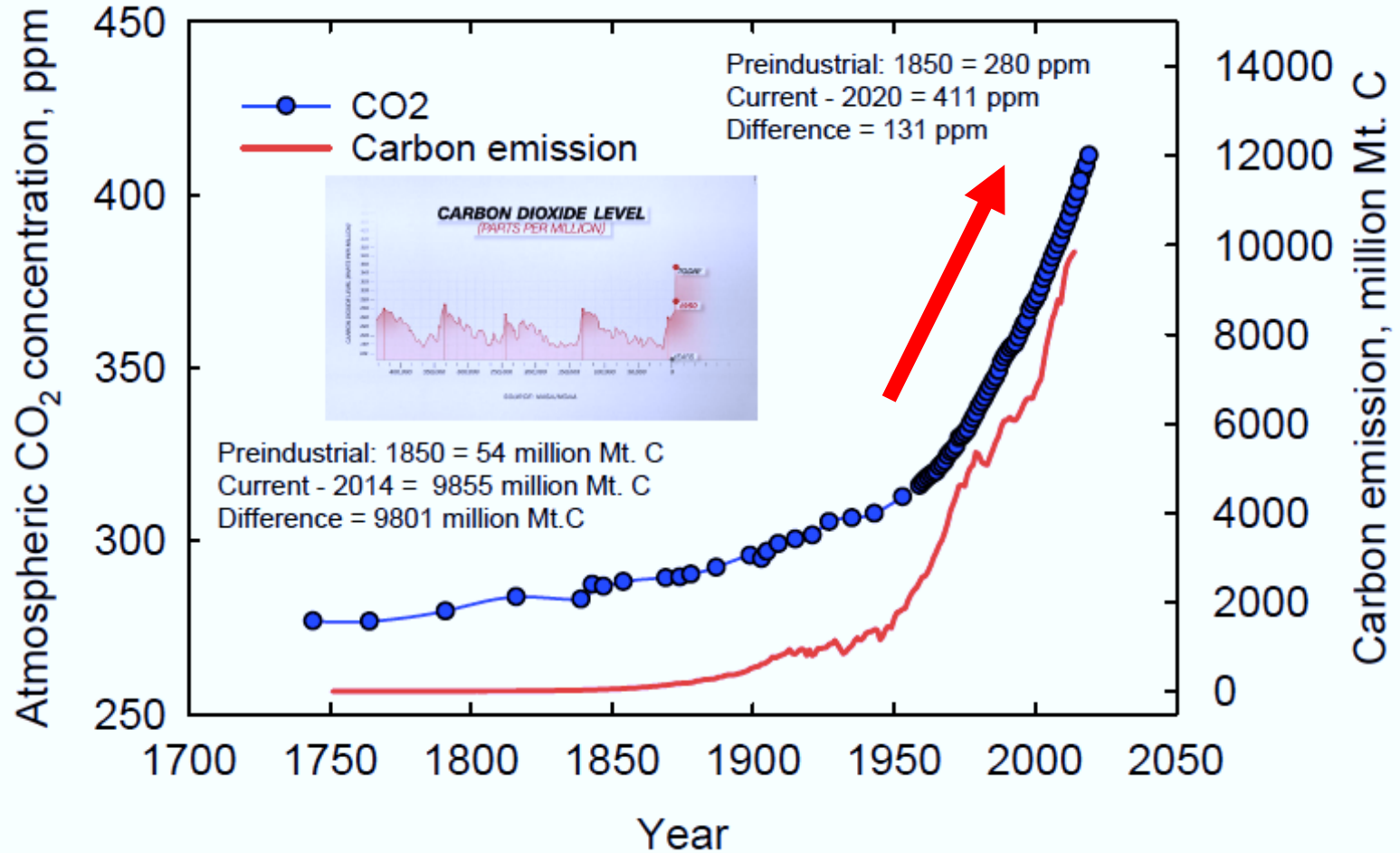
Rainfall patterns ↑↓

Drought intensities ↑

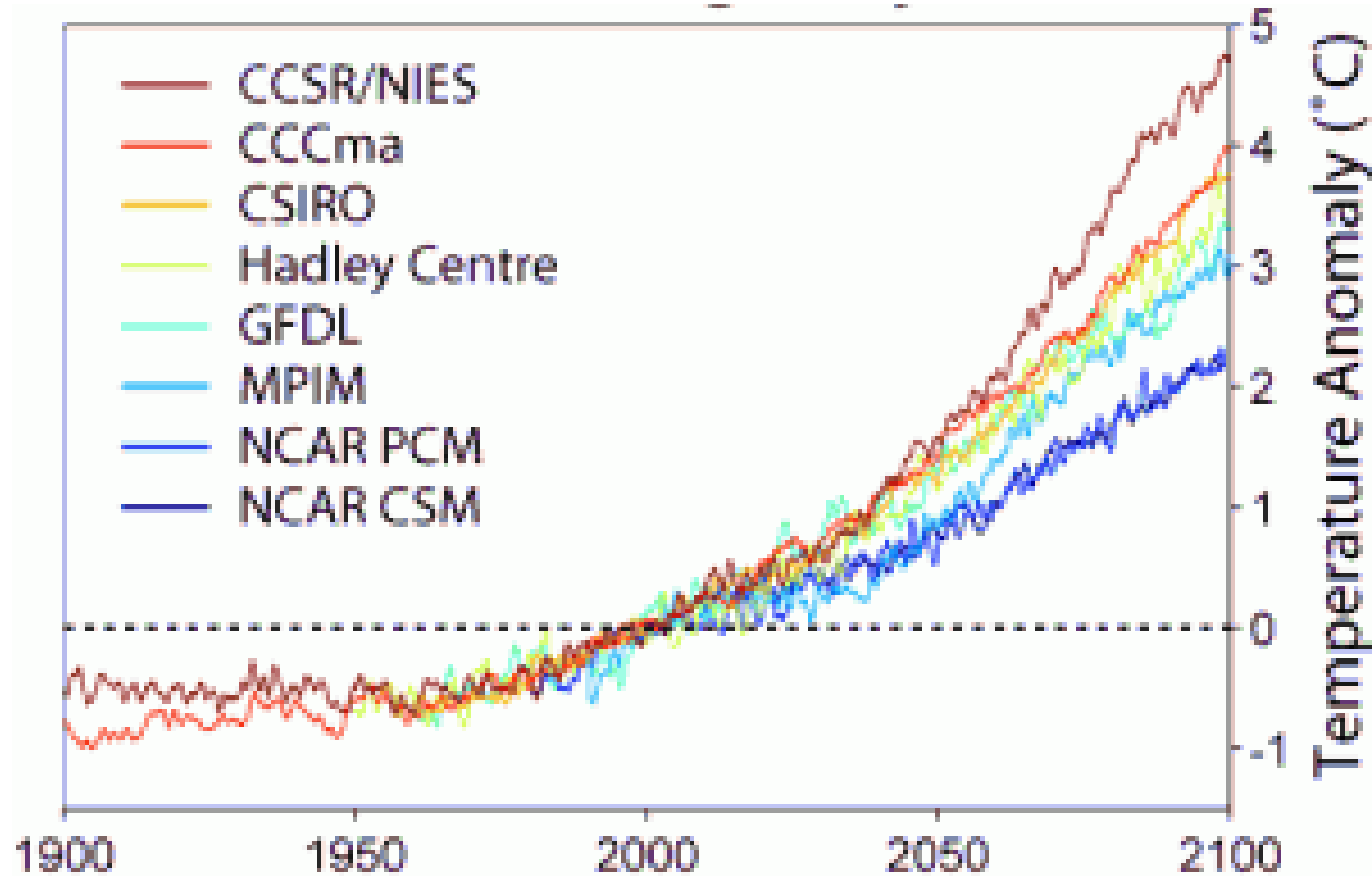
Frequency of extreme events ↑



# Atmospheric CO<sub>2</sub> Concentration

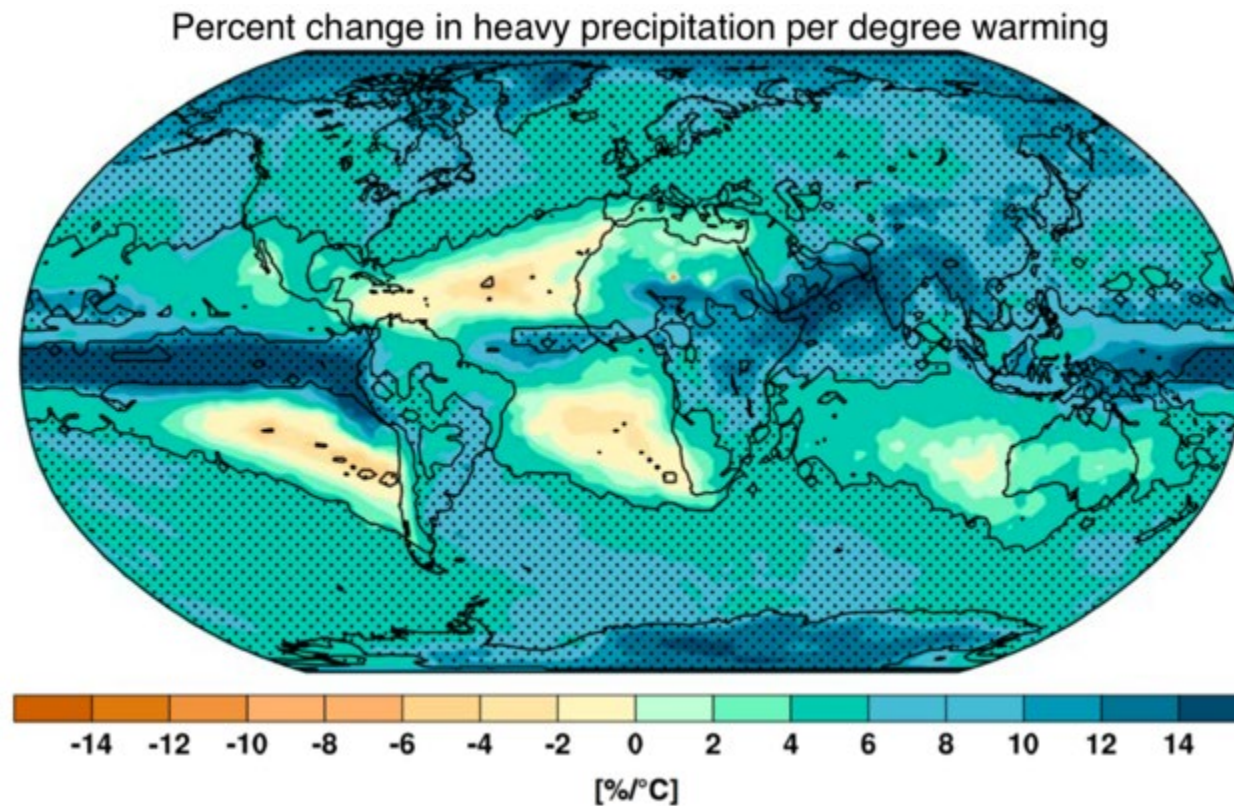


# Global Warming Projections



# Rainfall Patterns Are Strongly Influenced by Global Warming

Erratic Monsoon, Frequent Floods & Drought



# Cotton Is a Victim of Climate Change

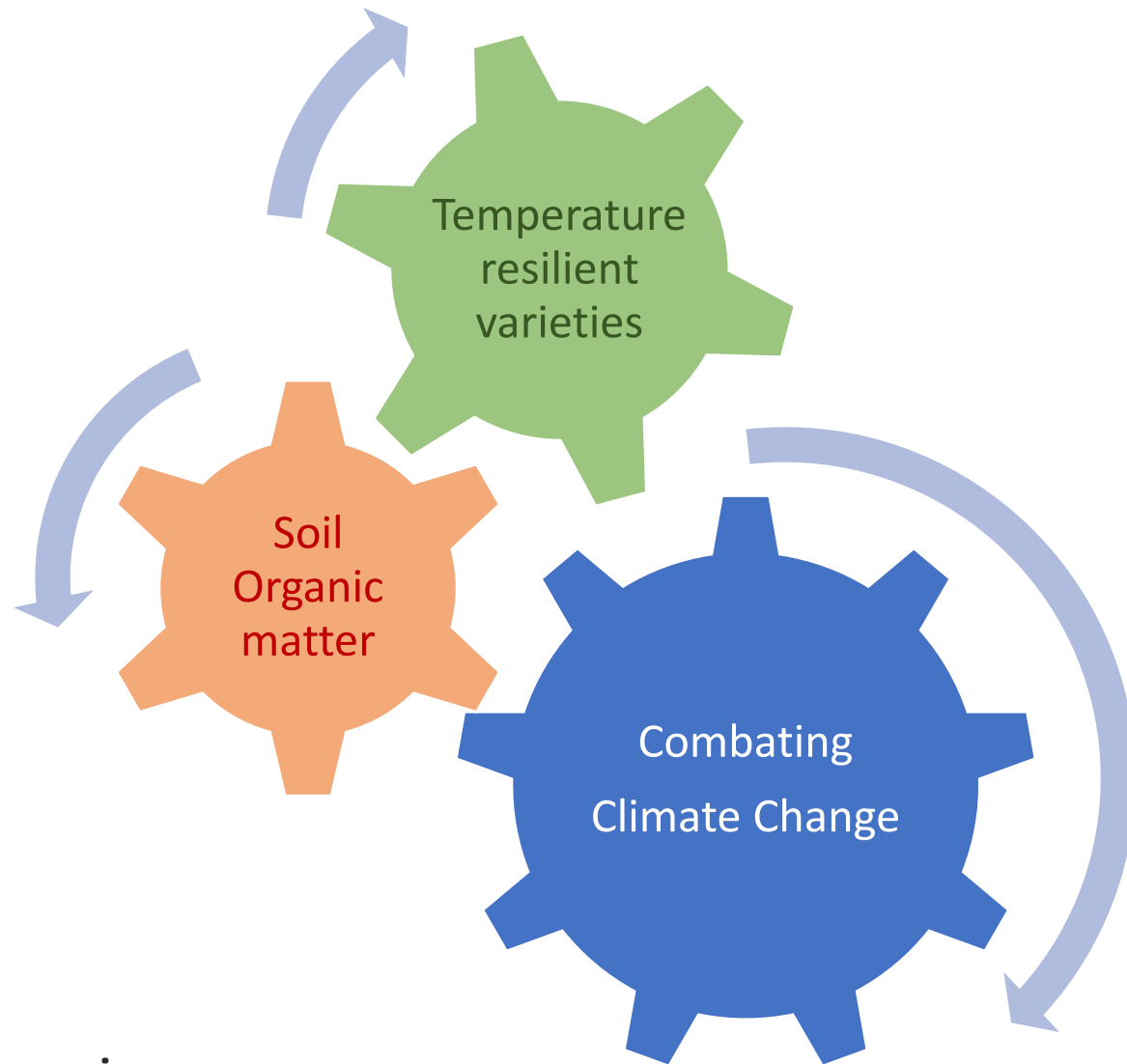
# Cotton Helps to Mitigate Climate Change



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# COMBATING CLIMATE CHANGE



- **Breeding for Temperature Tolerant Cultivars**
- **Promote Regenerative Agricultural Practices**





# What Does Climate Change Mean to Cotton?

- Increase in atmospheric CO<sub>2</sub> even up to doubled levels of 840ppm benefits cotton<sup>1</sup>
- But even a small increase in mean temperatures (1°C) depresses yields and quality<sup>1</sup>
- Global warming significantly influences rainfall patterns<sup>2</sup>. Therefore, rainfed cotton farms such as those in Africa will be worst affected



# Impact of CO<sub>2</sub> and Elevated Temperatures on Cotton

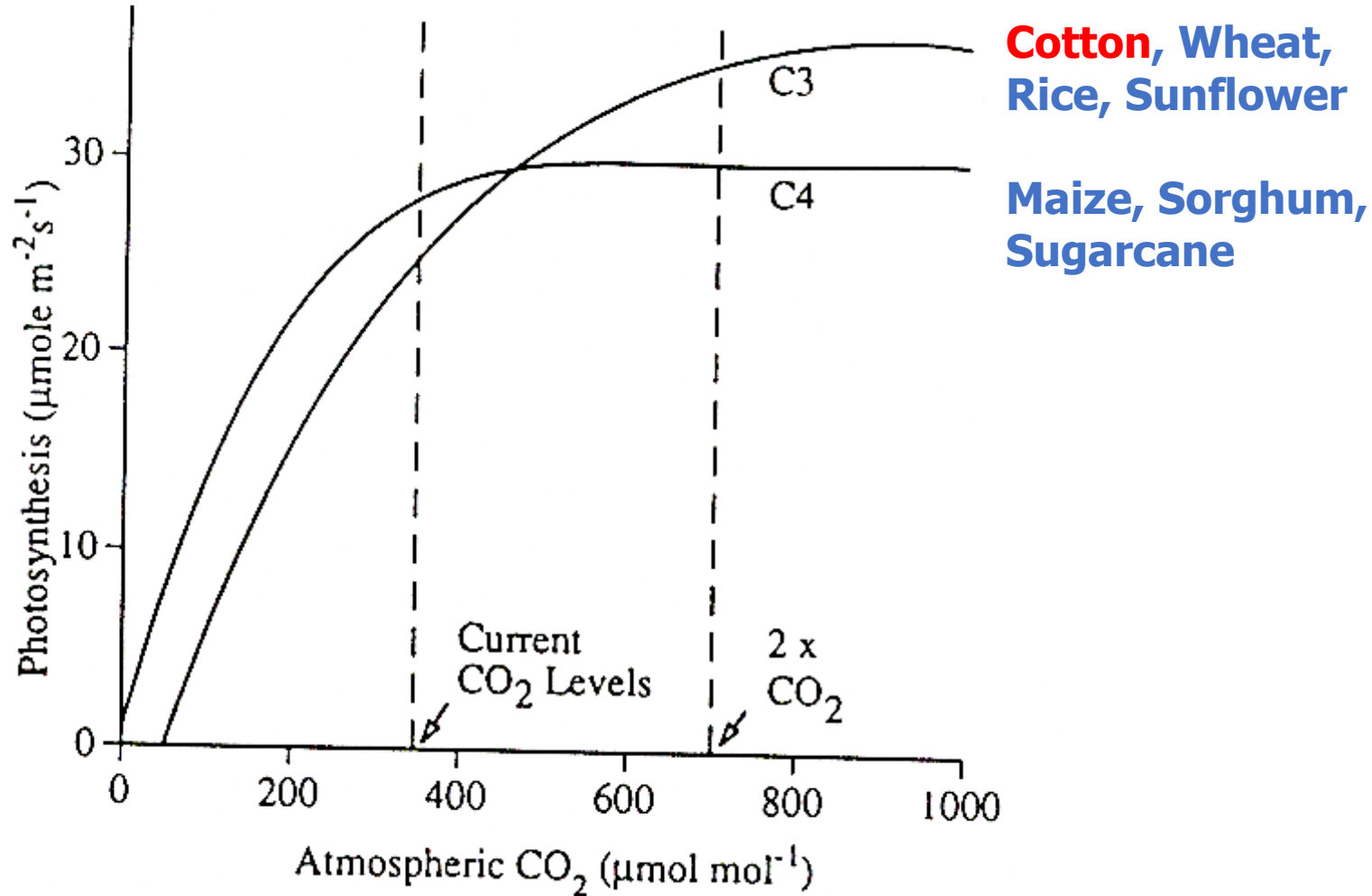


[www.icac.org](http://www.icac.org)

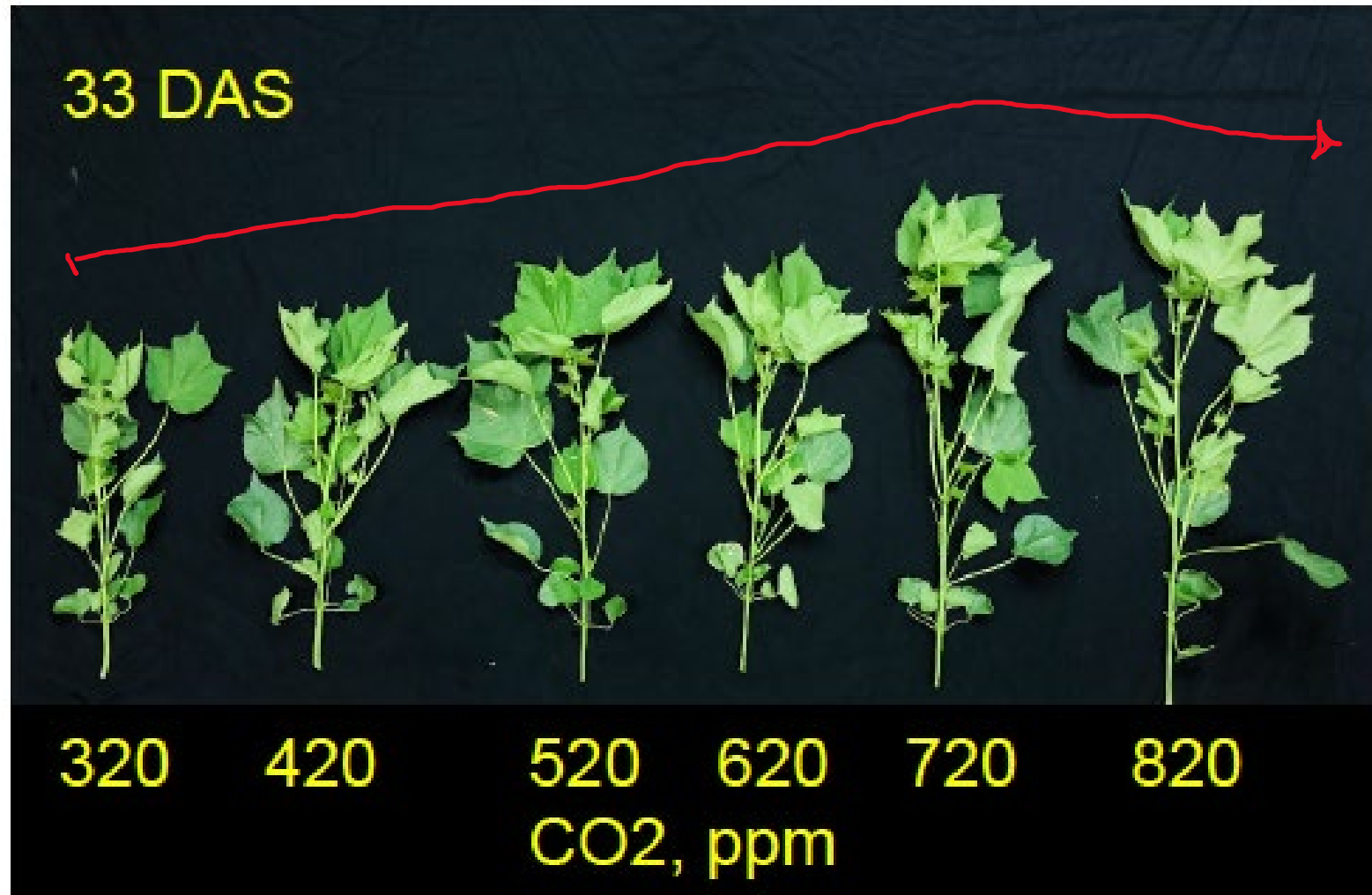
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# Cotton is a C3 plant

It can use high levels of CO<sub>2</sub> (900 ppm) for photosynthesis

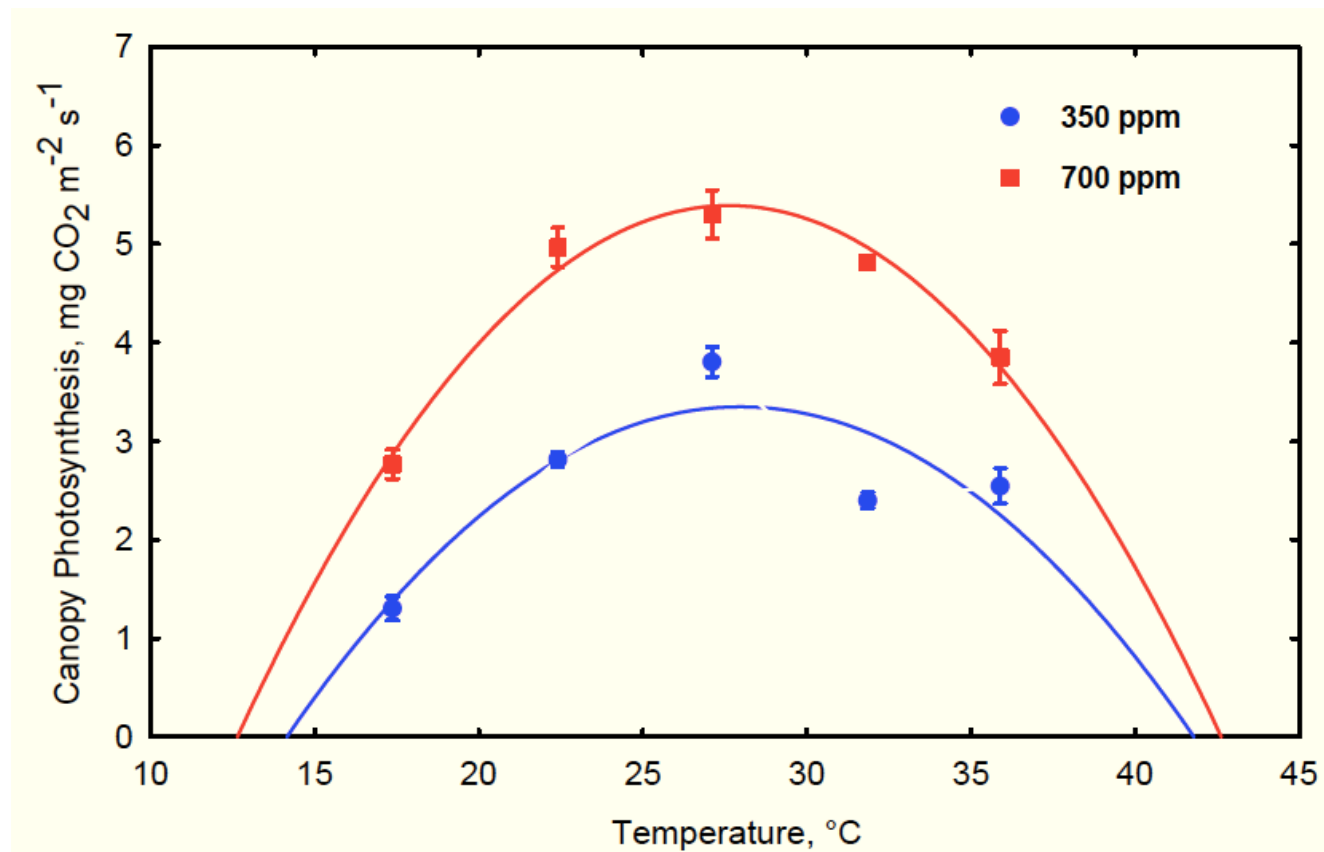


# Cotton grows well even at 820 ppm of CO<sub>2</sub>



# Scientific Studies

## Higher CO<sub>2</sub> Levels Benefit Cotton but High Temperatures can Lower cotton Yields



# Optimum Temperature °C

**28-30**

Germination

**27-35**

Seedling growth

**27-32**

Square growth

**24-27**

Boll size and retention

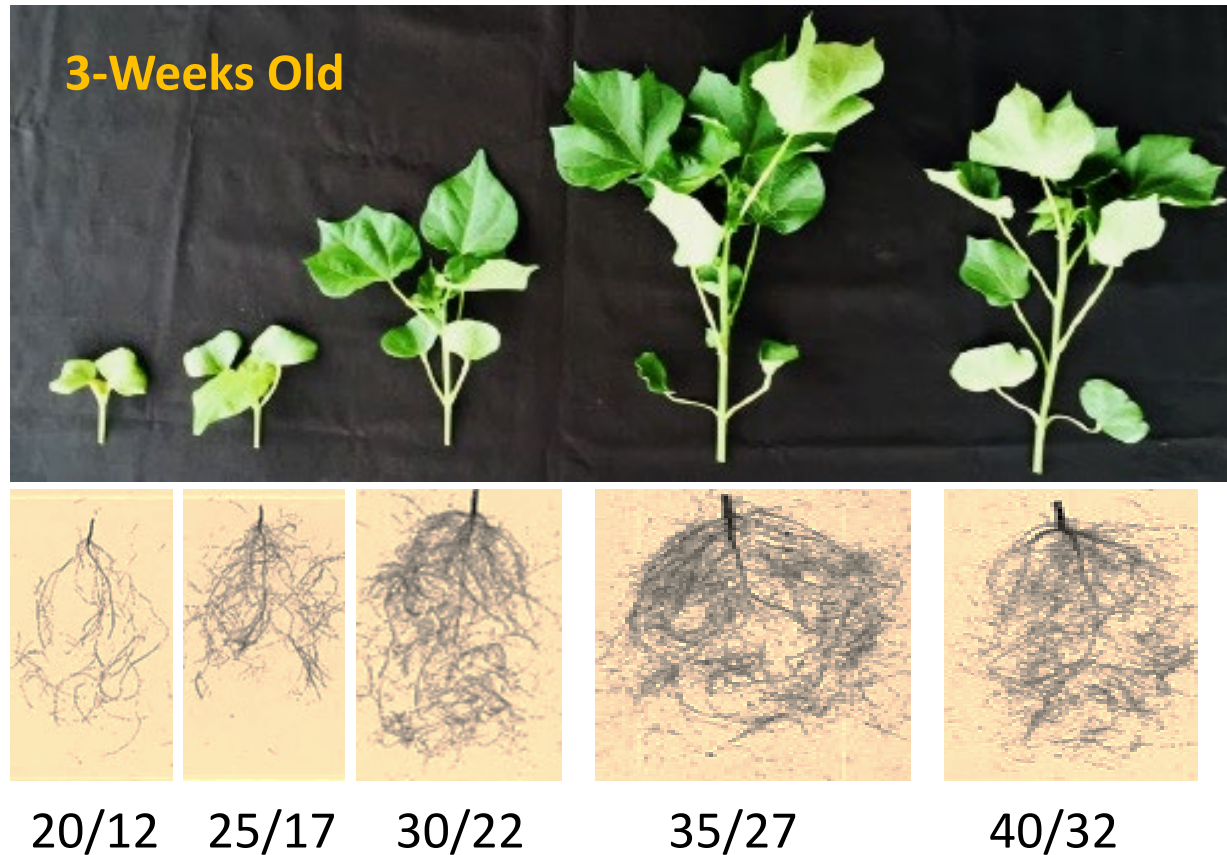


**>30°C reduces germination%**

**>38°C impedes growth rate**

**Min Temp (night) >27°C causes sterile pollen, small bolls & boll shedding**

# Seedling Growth at Different Temperatures

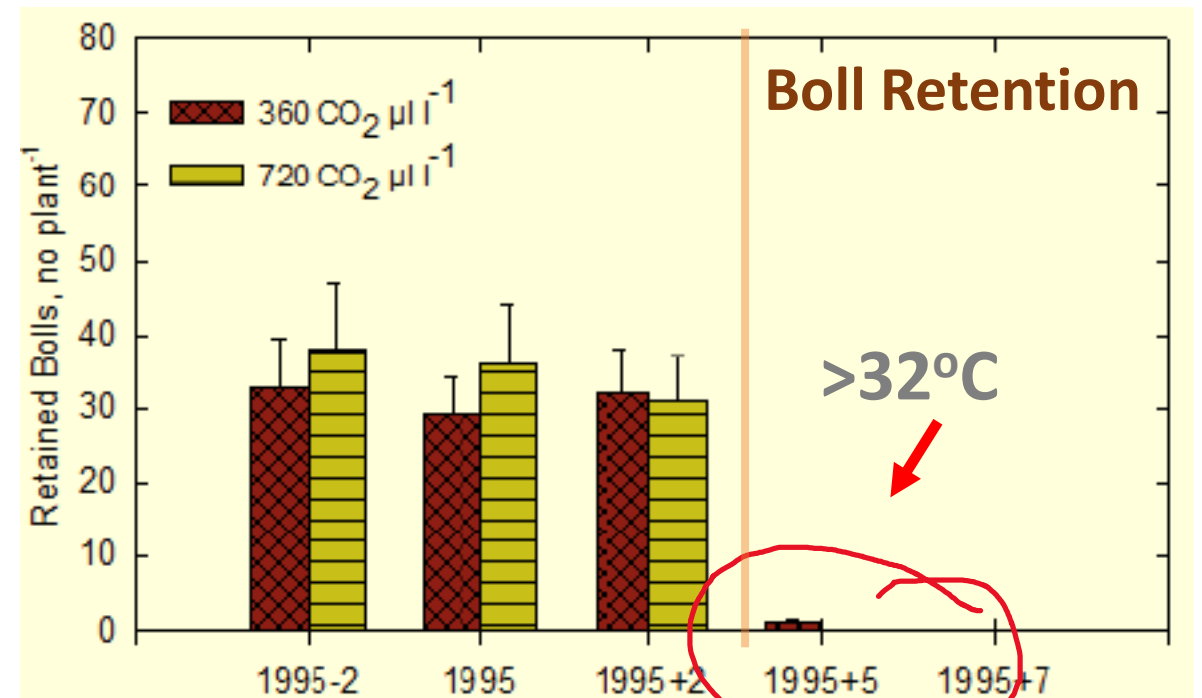
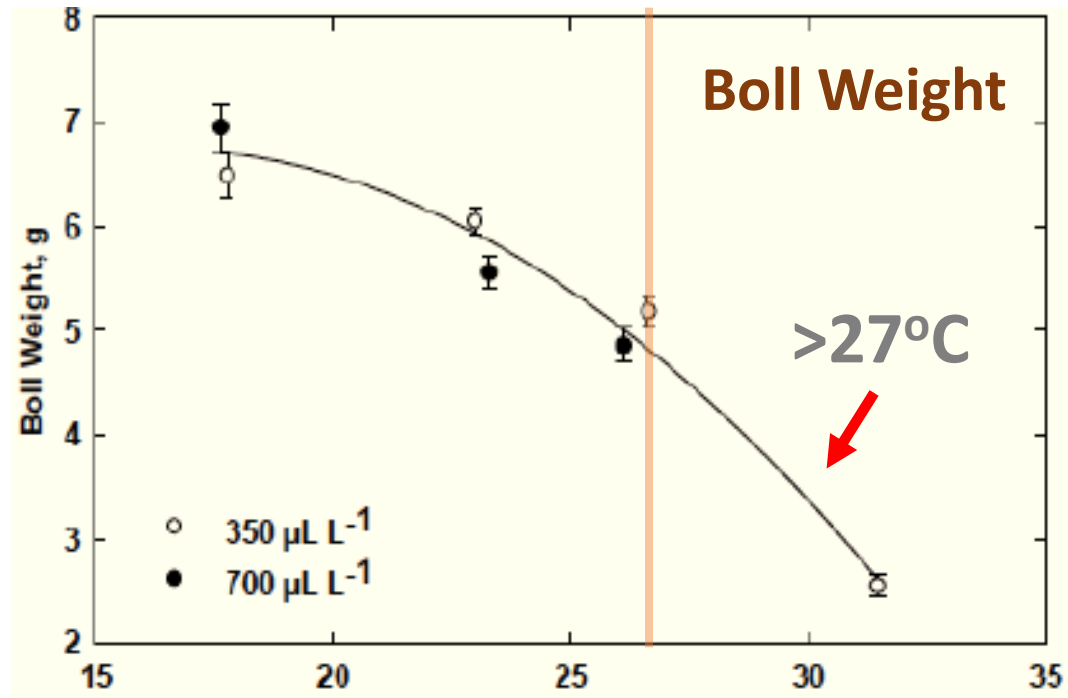


**Day / Night Temperatures °C**



# Higher Temperatures Decrease Boll Weight & Cause Poor Boll Retention

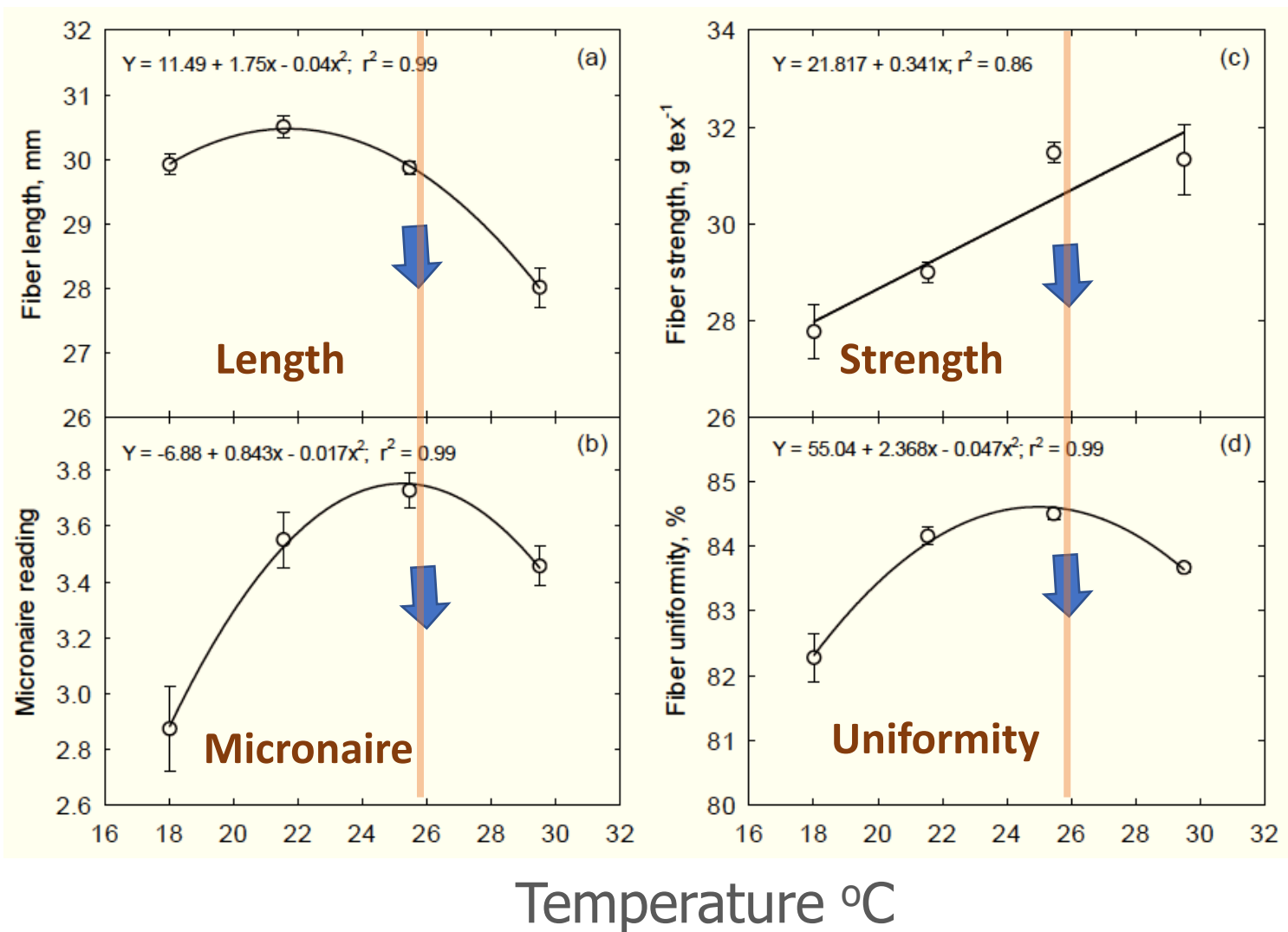
Optimum 24-27°C





# Fibre Qualities

Higher Temperatures Affect Fibre Quality



# Rainfed Cotton Could Be Most Affected

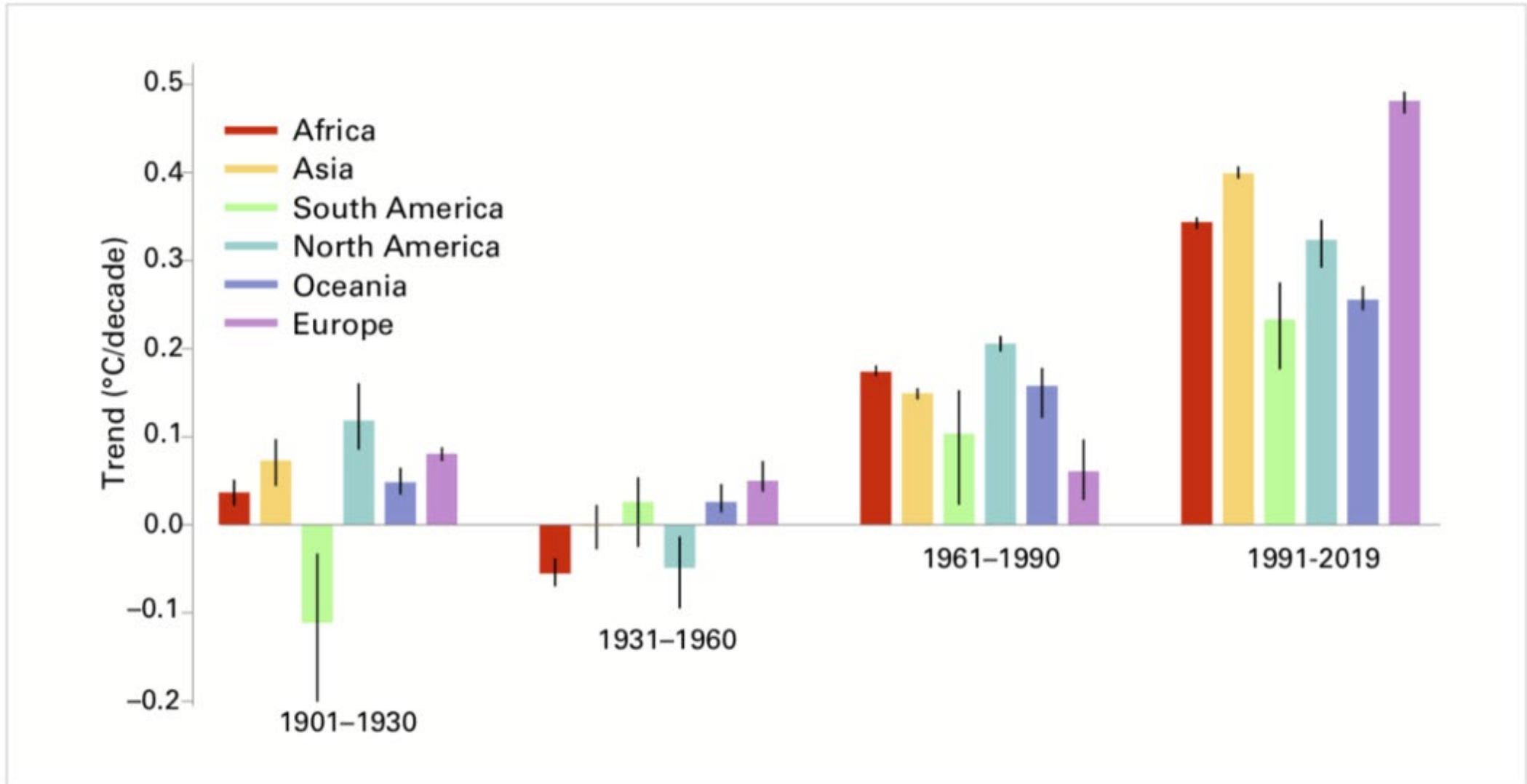
>98% African Cotton Is Rainfed



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# Global Warming Patterns



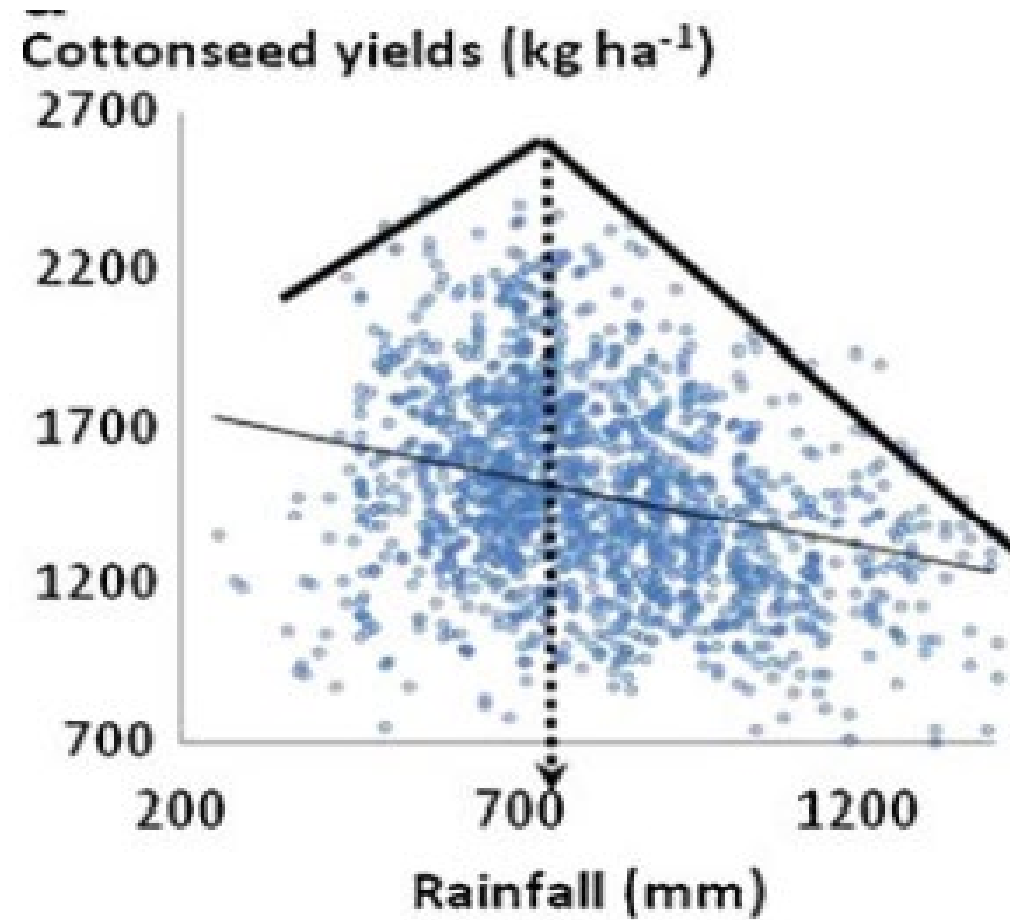
# Predicted Climate Change, GDP Interactions Across Africa

Subregions	GDP (% Change/Year)			
	1° C	2° C	3° C	4° C
North (n = 7)	-0.76 ± 0.16	-1.63 ± 0.36	-2.72 ± 0.61	-4.11 ± 0.97
West (n = 15)	-4.46 ± 0.63	-9.79 ± 1.35	-15.62 ± 2.08	-22.09 ± 2.78
Central (n = 9)	-1.17 ± 0.45	-2.82 ± 1.10	-5.53 ± 1.56	-9.13 ± 2.16
East (n = 14)	-2.01 ± 0.20	-4.51 ± 0.34	-7.55 ± 0.63	-11.16 ± 0.85
Southern (n = 10)	-1.18 ± 0.64	-2.68 ± 1.54	-4.40 ± 2.56	-6.49 ± 3.75
Whole of Africa (n = 55)	-2.25 ± 1.52	-5.01 ± 3.30	-8.28 ± 5.12	-12.12 ± 7.04

Source: Adapted from Economic growth, development and climate change in Africa, published by the African Climate Policy Centre (ACPC) of the United Nations Economic Commission for Africa (UNECA)



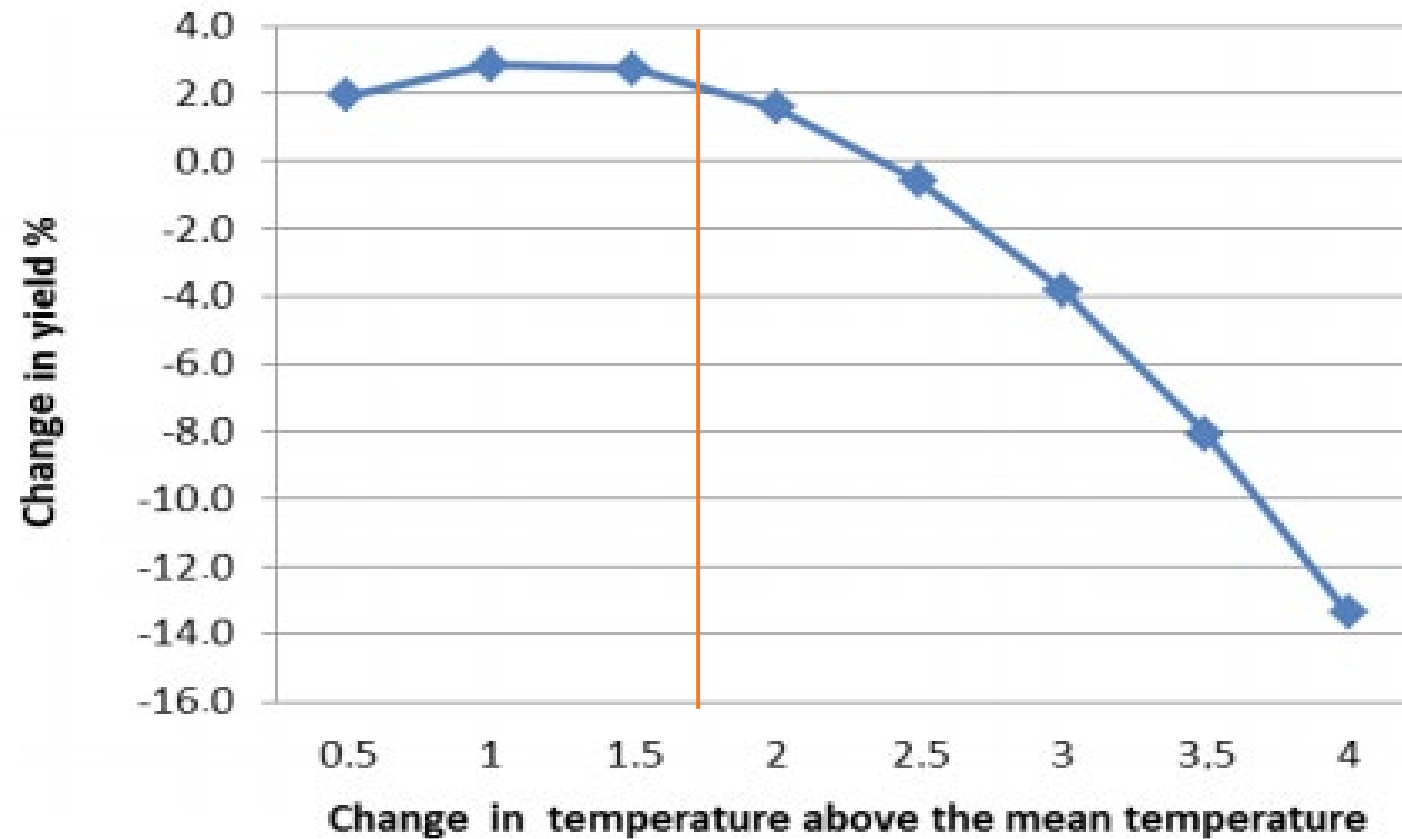
# 45-year Data in Cameroon



Géardeaux, E., et.al.,2013. *Agronomy for sustainable development*, 33(3), pp.485-495.



# Global Warming will Decrease Seed Cotton Yield in Burkina Faso



# The Role of Cotton in Mitigating Climate Change Effects



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# Cotton Can Minimise Climate Change Effects!

- Cotton farming can help in mitigating the effects of climate change<sup>1</sup>
- Cotton sequesters 23% more CO<sub>2</sub>eq of GHGs than it emits<sup>2</sup>
- With regenerative agricultural practices the crop can sequester even more CO<sub>2</sub>eq of GHGs<sup>2</sup>
- Cotton fabrics biodegrade in soil within 4-12 weeks, whereas synthetic fabrics do not<sup>3</sup>

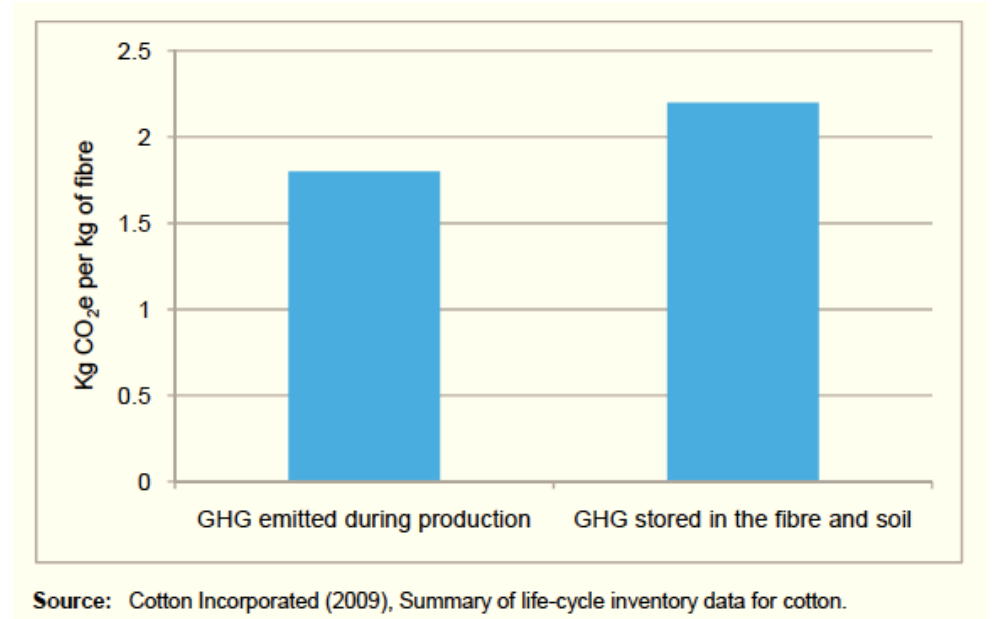
<sup>1</sup> Cotton Incorporated, LCA UPDATE OF COTTON FIBER AND FABRIC LIFE CYCLE INVENTORY, 2017

<sup>2</sup>Fischer et al., Geophysical Research Letters, 2014

<sup>3</sup>Source: Cotton Works



# Cotton Is Special in Reducing Atmospheric CO<sub>2</sub>



- Plants absorb CO<sub>2</sub> and sequester carbon in their biomass
- Cotton plants do more...they use CO<sub>2</sub> and H<sub>2</sub>O to create cellulose
- Cotton fibres are 96-98% pure cellulose (C<sub>6</sub>H<sub>10</sub>O<sub>5</sub>)<sub>n</sub>
- Cotton sequesters 0.5 Kg additional CO<sub>2</sub> per Kg fibre produced
- Cotton is a C3 plant and has great capacity to use CO<sub>2</sub>
- Organic cotton has very low carbon footprint



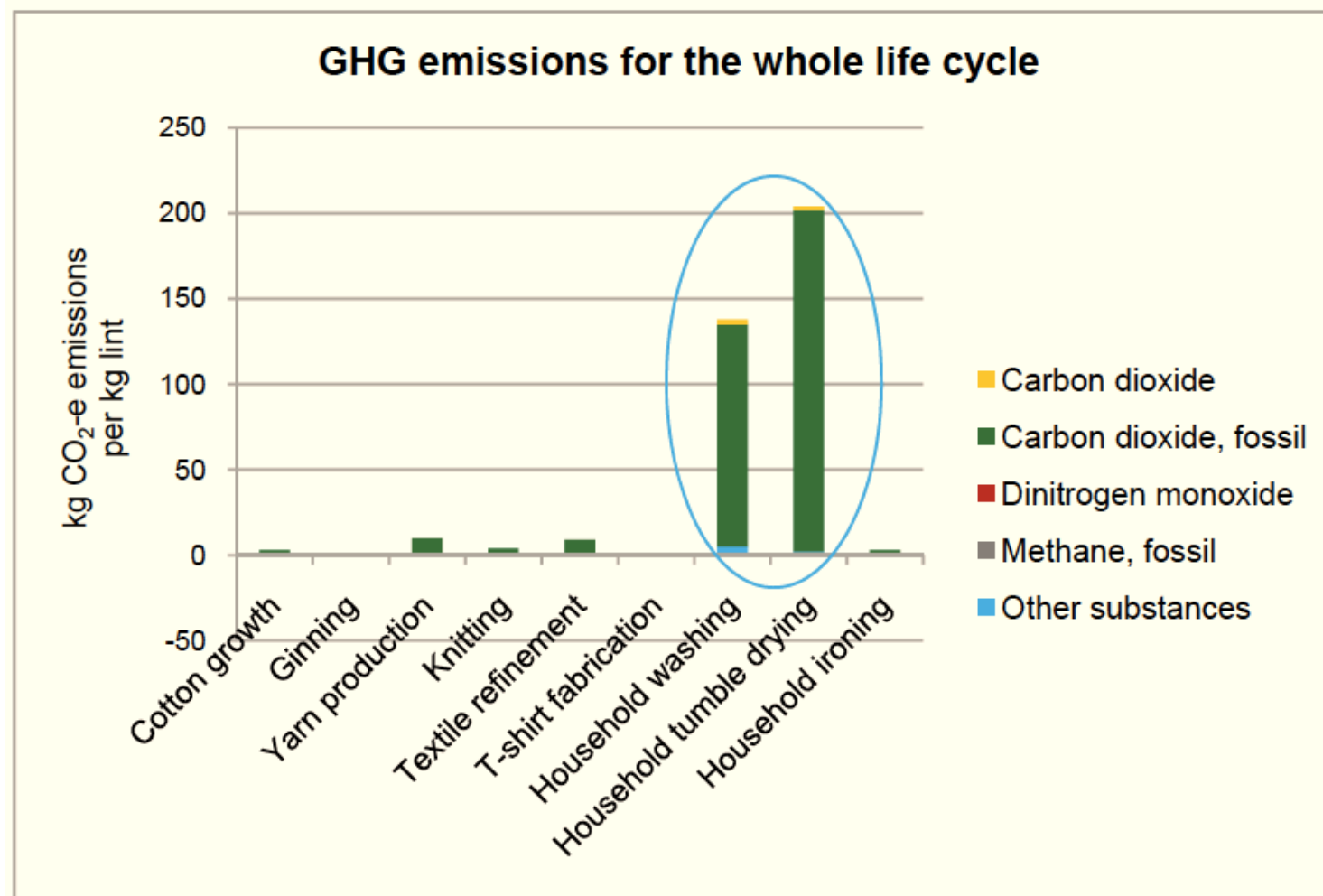
# Greenhouse Gas Emissions in the Cotton Value Chain

Cotton Production	5-10%
Manufacture	20-30%
Consumer Use	30-60%

**Irrigation, Fertilisers, Pesticides and  
Energy in Production, Processing and  
Consumer Use Are the Main Contributors**



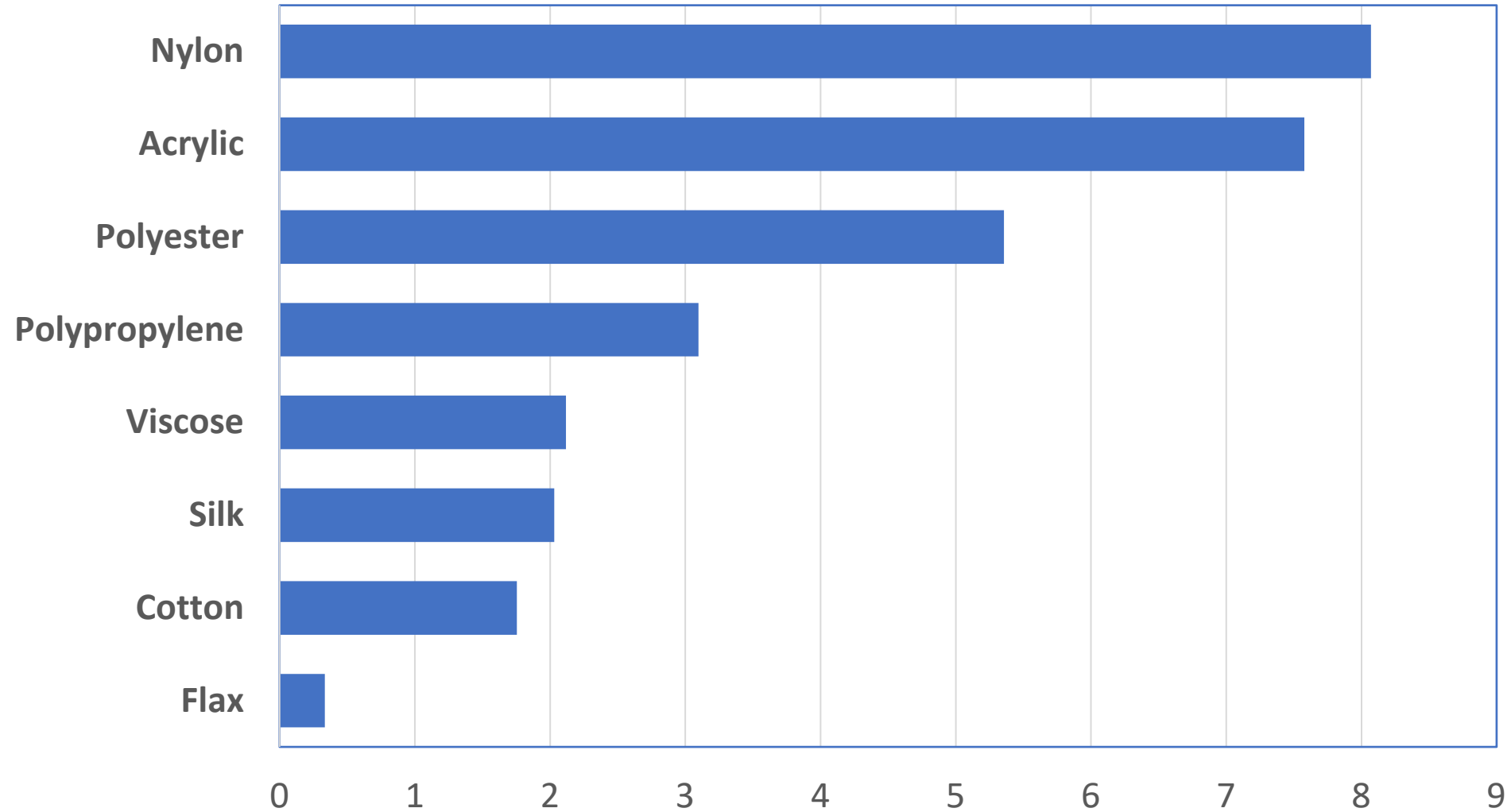
# CO<sub>2</sub> eq Emissions in Life Cycle of a T-Shirt



Grace (2009). The impacts of carbon trading on the cotton industry.



# Cotton Emits Fewer CO<sub>2</sub> eq of GHGs per Kg Fibre in Production

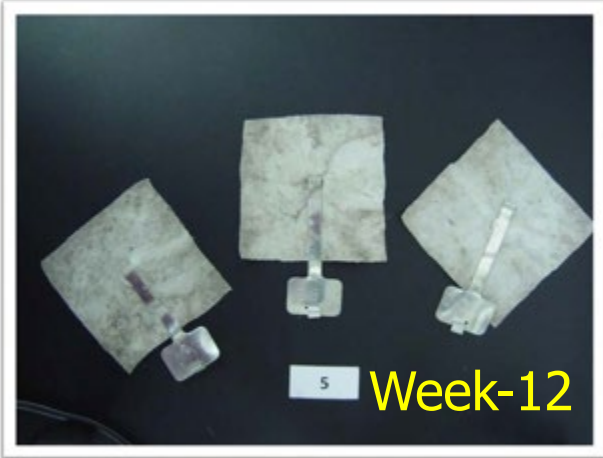


# Cotton Biodegrades in Soil in 12 Weeks, Polyester Does Not

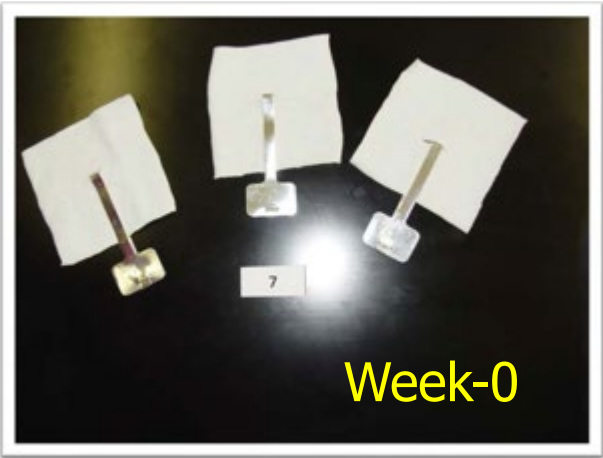
**Recycled Polyester T-Shirt**



**Recycled Polyester T-Shirt**



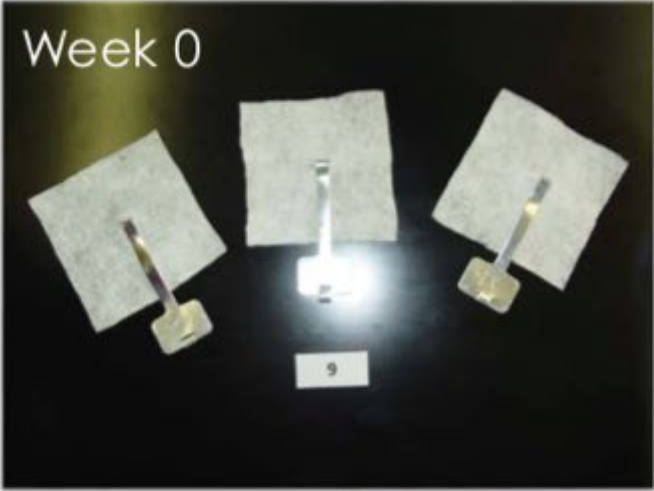
**Cotton Jersey, Bleached, Softened**



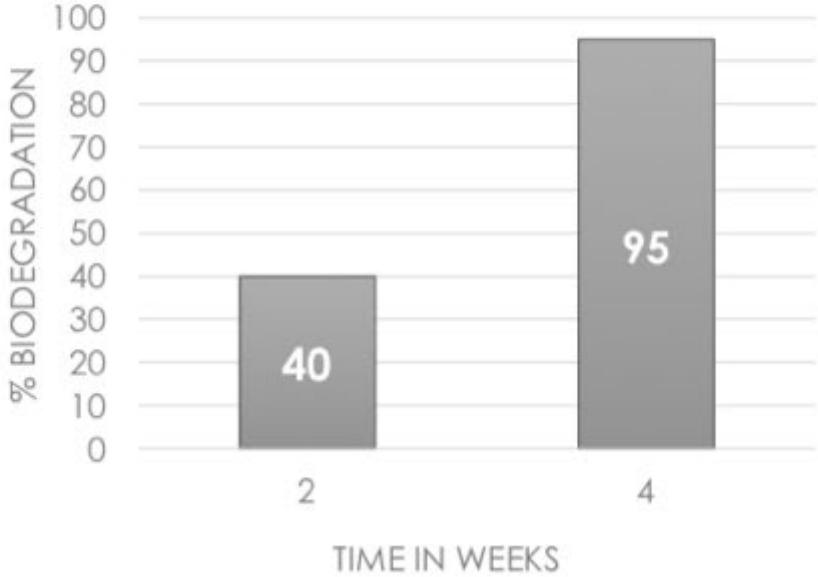
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# 100% Purified Cotton Composting (ASTM D6400)

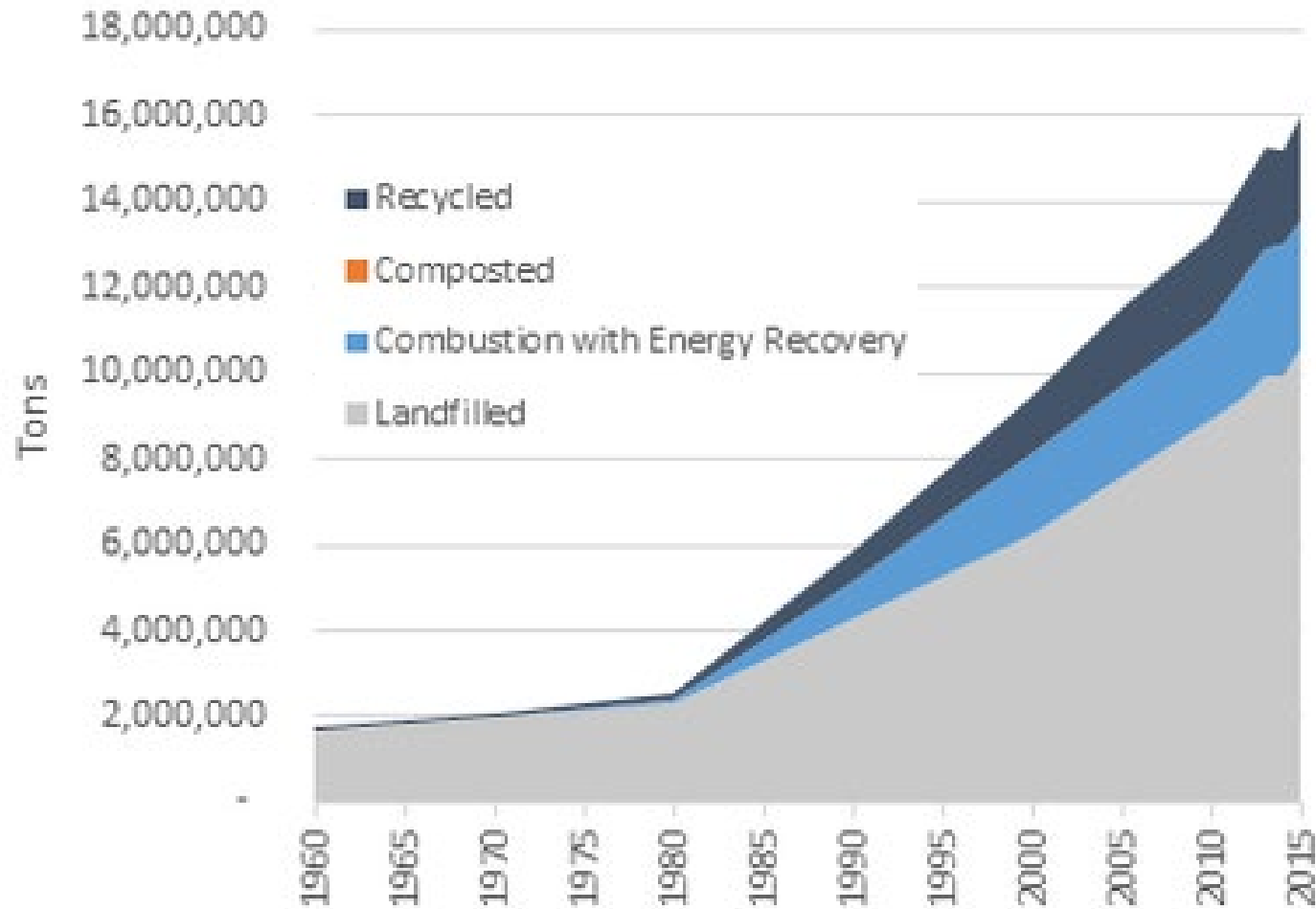


Sample #9



Cotton wipes biodegrade quickly in a composting container  
100% cotton: 92 – 95% in four weeks  
Blend: Cotton biodegraded; Polypropylene did not

# Textile Waste Management 1960-2015



In 12 weeks the landfills will be left with only the poorly-degradable synthetic textiles



# What Can We Do to Make Cotton Resilient to Climate Change?

- Breed temperature tolerant cultivars
- Reduce dependence on fertilisers & chemical pesticides
- Rejuvenate soil health through regenerative agriculture practices
- Promote cotton as a carbon sequestering crop and an eco friendly biodegradable fibre





# Thank You



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