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_2, CH_4, N_2O etc.) ↑

Temperature anomalies ↑

Rainfall patterns ↑↓

Drought intensities ↑

Frequency of extreme events ↑

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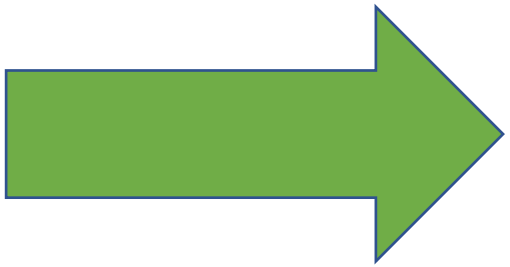

Green house gases (CO_2, CH_4, N_2O etc.) ↑

Temperature anomalies ↑

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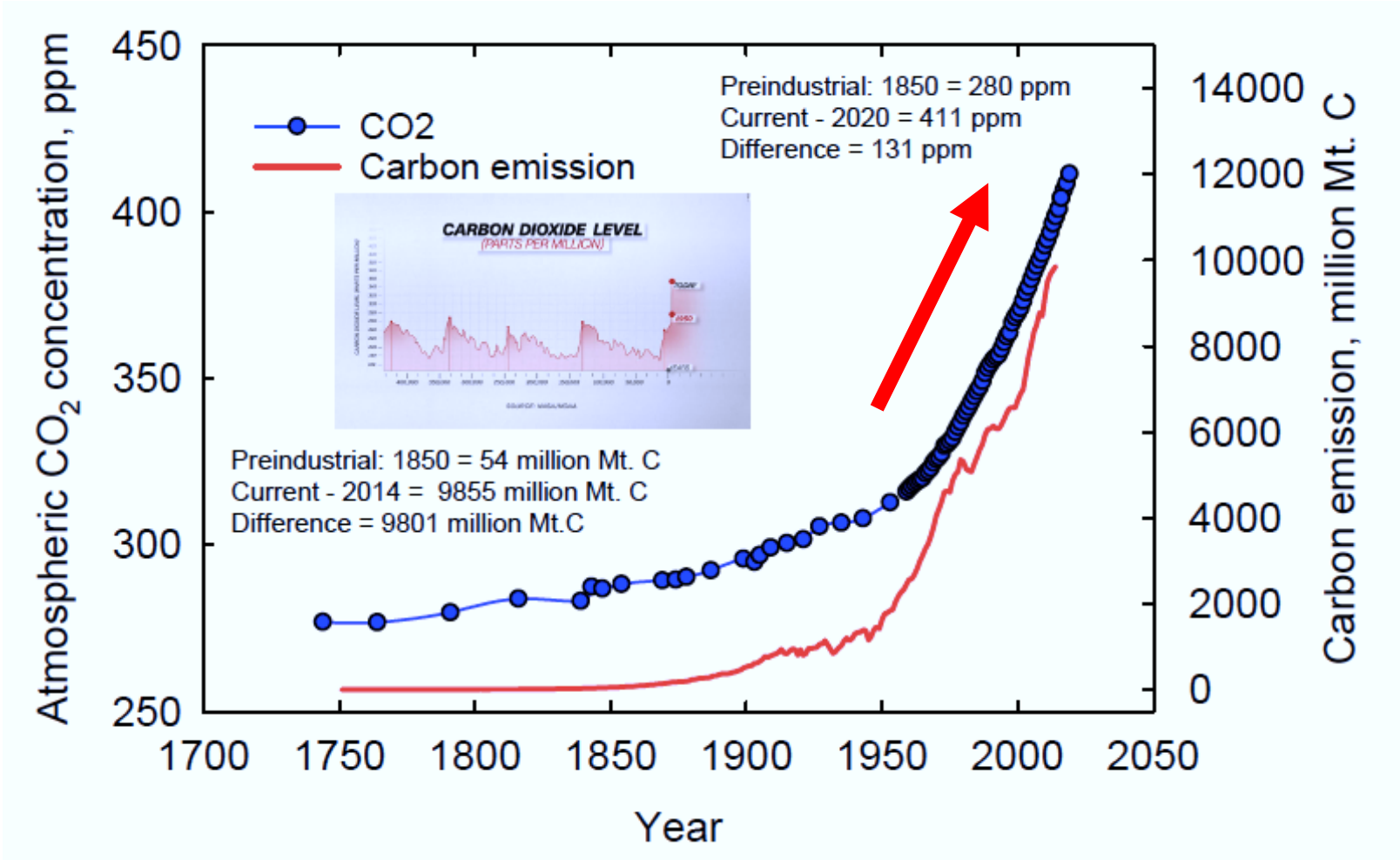
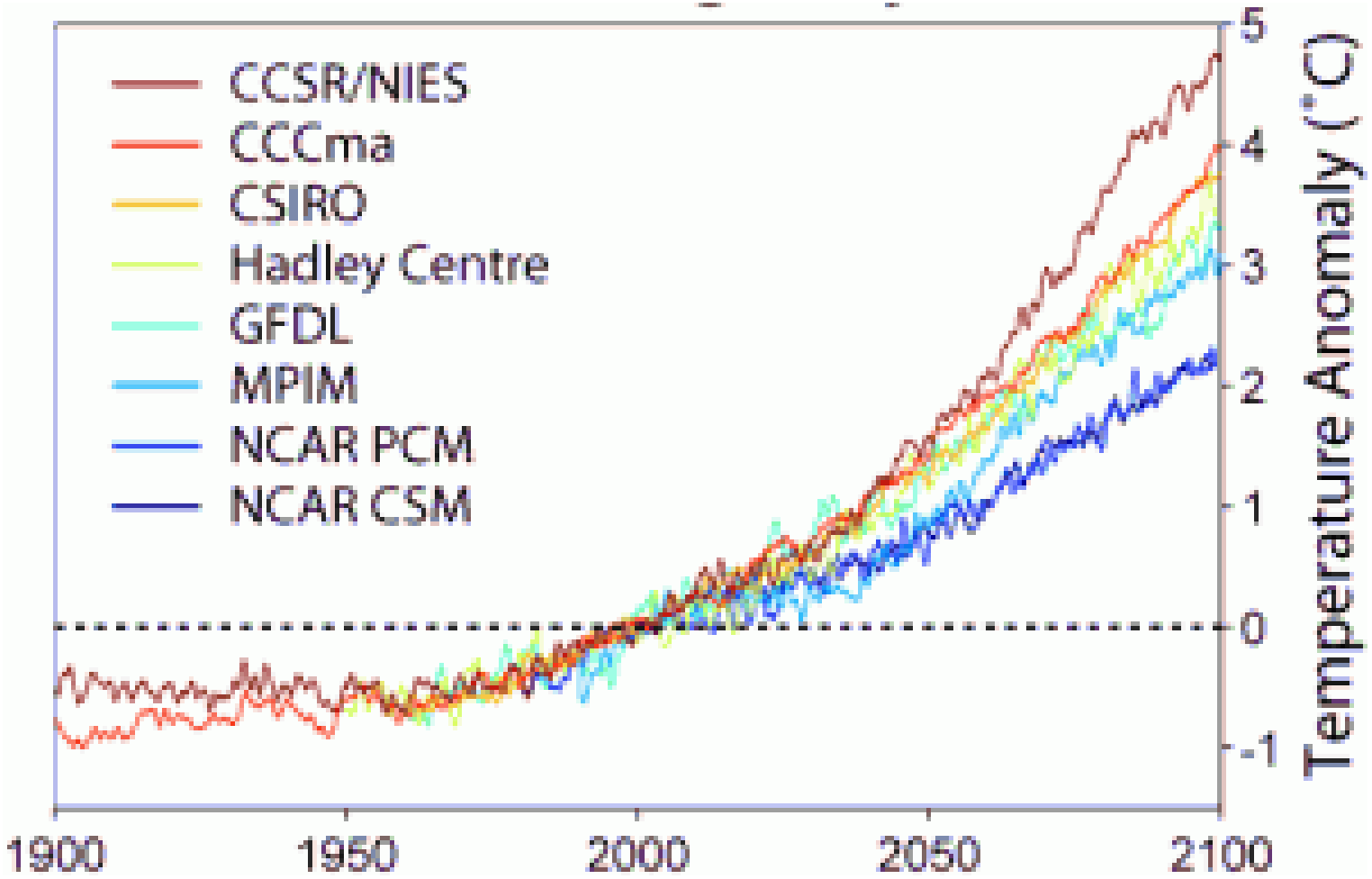
Atmospheric CO_2 Concentration

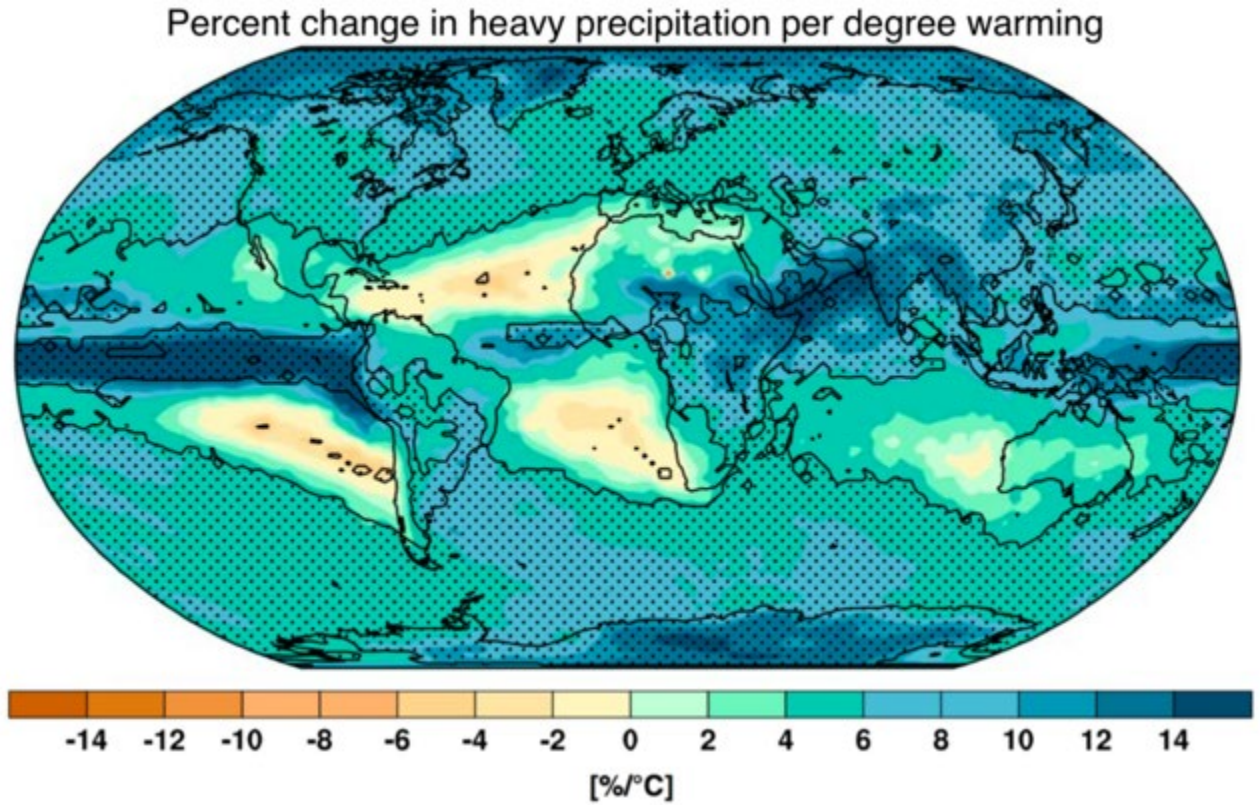


Global Warming Projections



Rainfall Patterns Are Strongly Influenced by Global Warming

Erratic Monsoon, Frequent Floods & Drought



Fischer et al., Geophysical Research Letters, 2014

Cotton Is a Victim of Climate Change

Cotton Helps to Mitigate Climate Change

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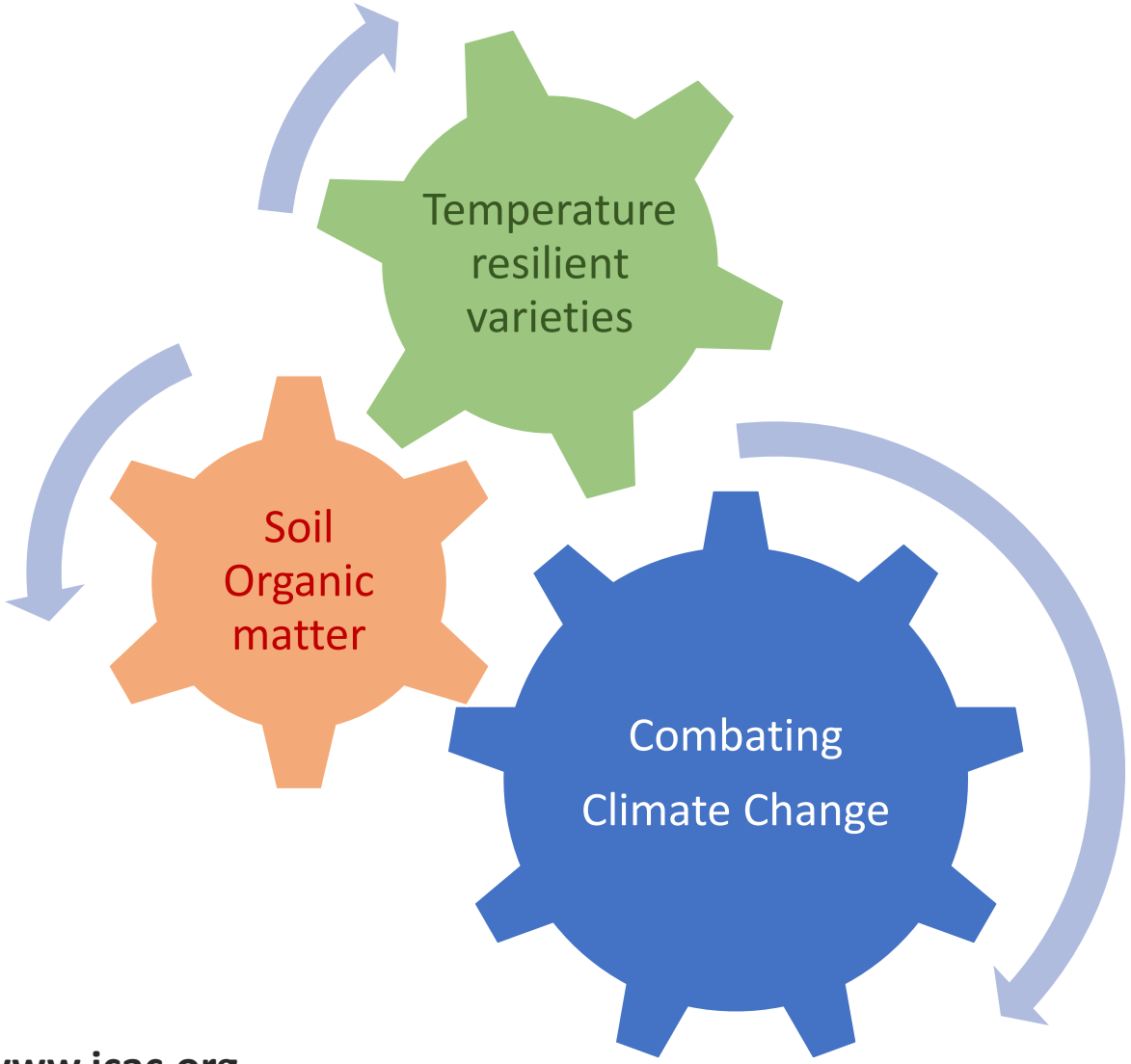
COMBATING CLIMATE CHANGE



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

What Does Climate Change Mean to Cotton?

- Increase in atmospheric CO_2 even up to doubled levels of 840ppm benefits cotton[1]
- But even a small increase in mean temperatures (1°C) depresses yields and quality[1]
- Global warning significantly influences rainfall patterns[2]. Therefore, rainfed cotton farms such as those in Africa will be worst affected

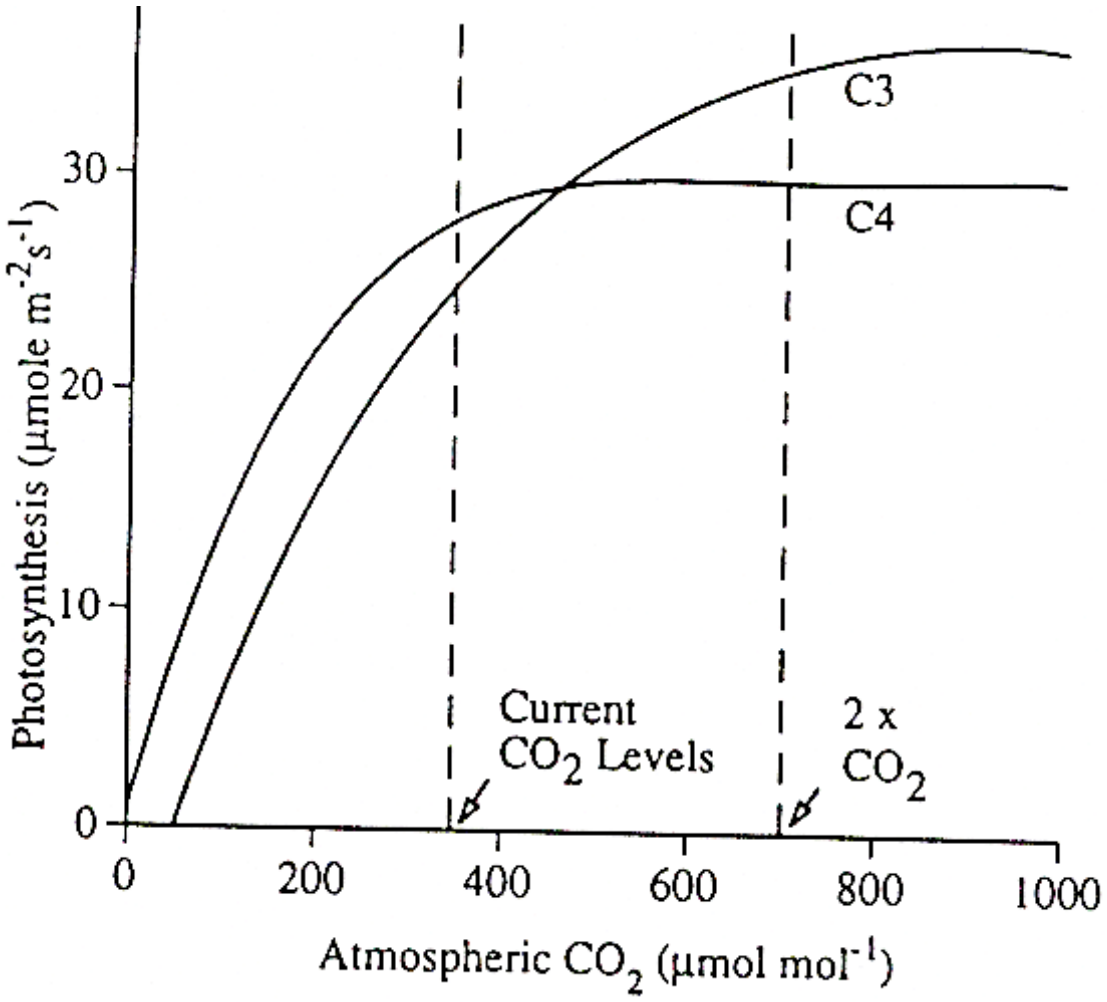
[1]Raja Reddy, 2020
[2]Fischer et al., Geophysical Research Letters, 2014

Impact of CO2 and Elevated Temperatures on Cotton

www.icac.org

Cotton is a C3 plant

It can use high levels of CO_2 (900 ppm) for photosynthesis

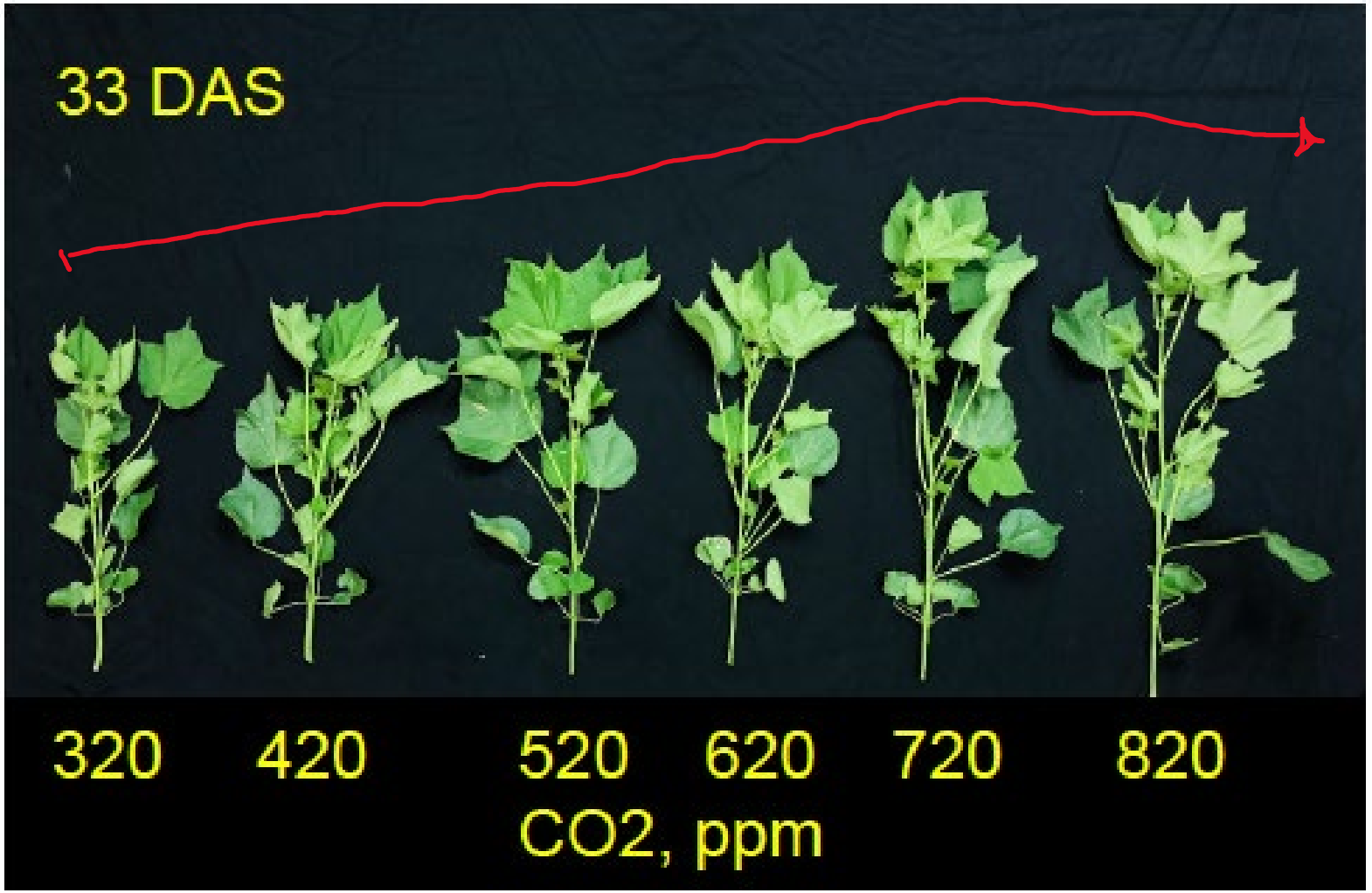


Cotton, **Wheat, Rice, Sunflower**

Maize, Sorghum, Sugarcane

Raja Reddy, 2020

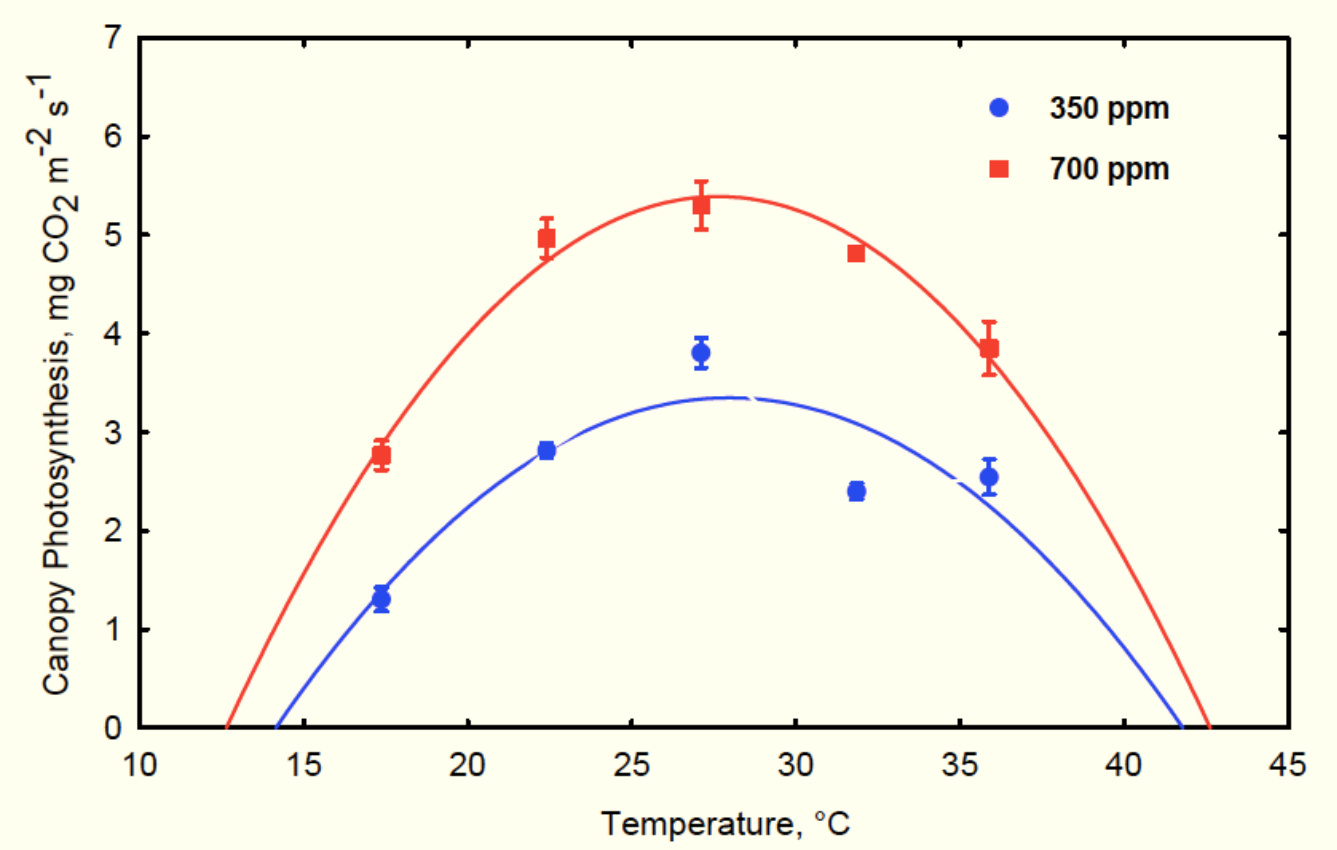
Cotton grows well even at 820 ppm of CO_2



Raja Reddy, 2020

Scientific Studies

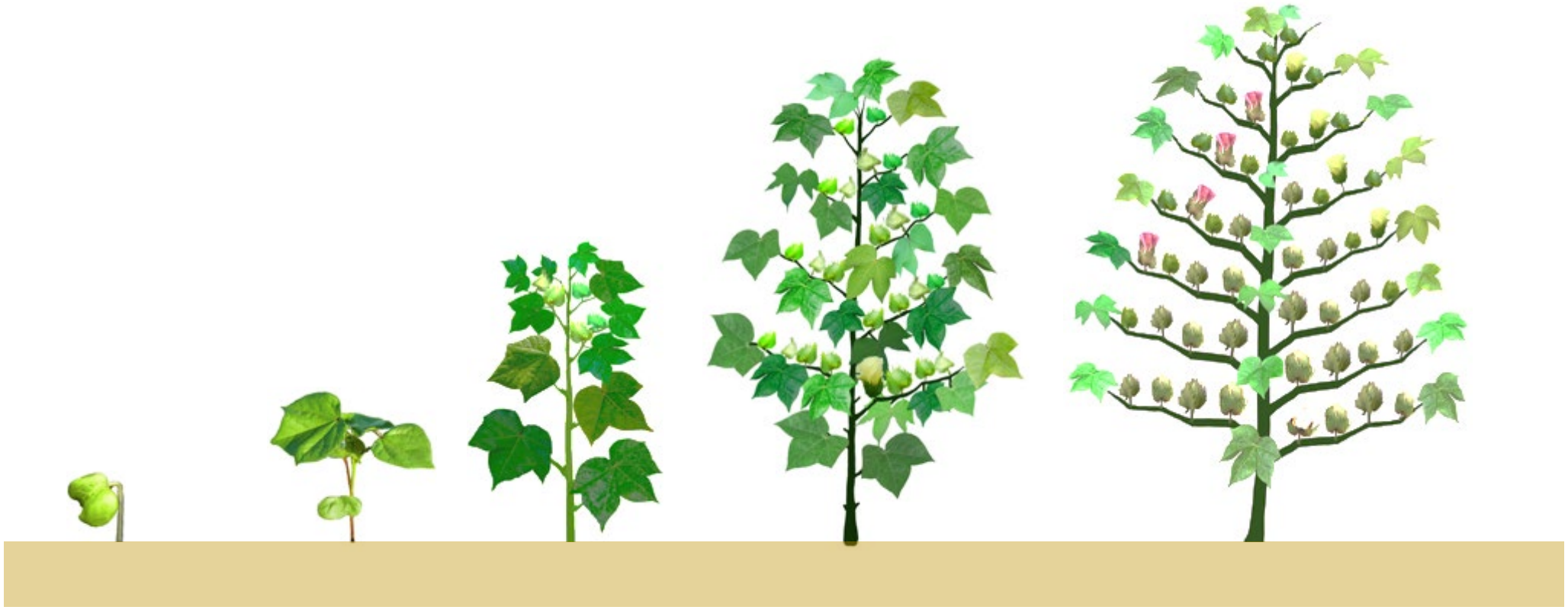
Higher CO_2 Levels Benefit Cotton but High Temperatures can Lower cotton Yields



Raja Reddy, 2020

Optimum Temperature °C

28-30	27-35	27-32	24-27
Germination	Seedling growth	Square growth	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

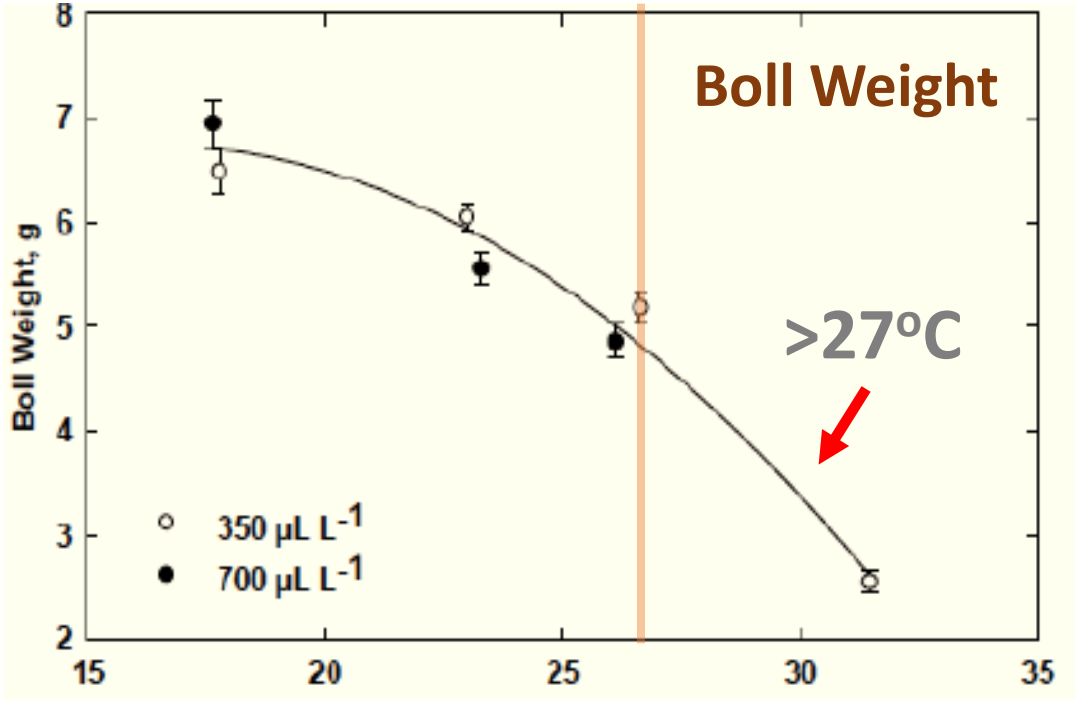
Seedling Growth at Different Temperatures

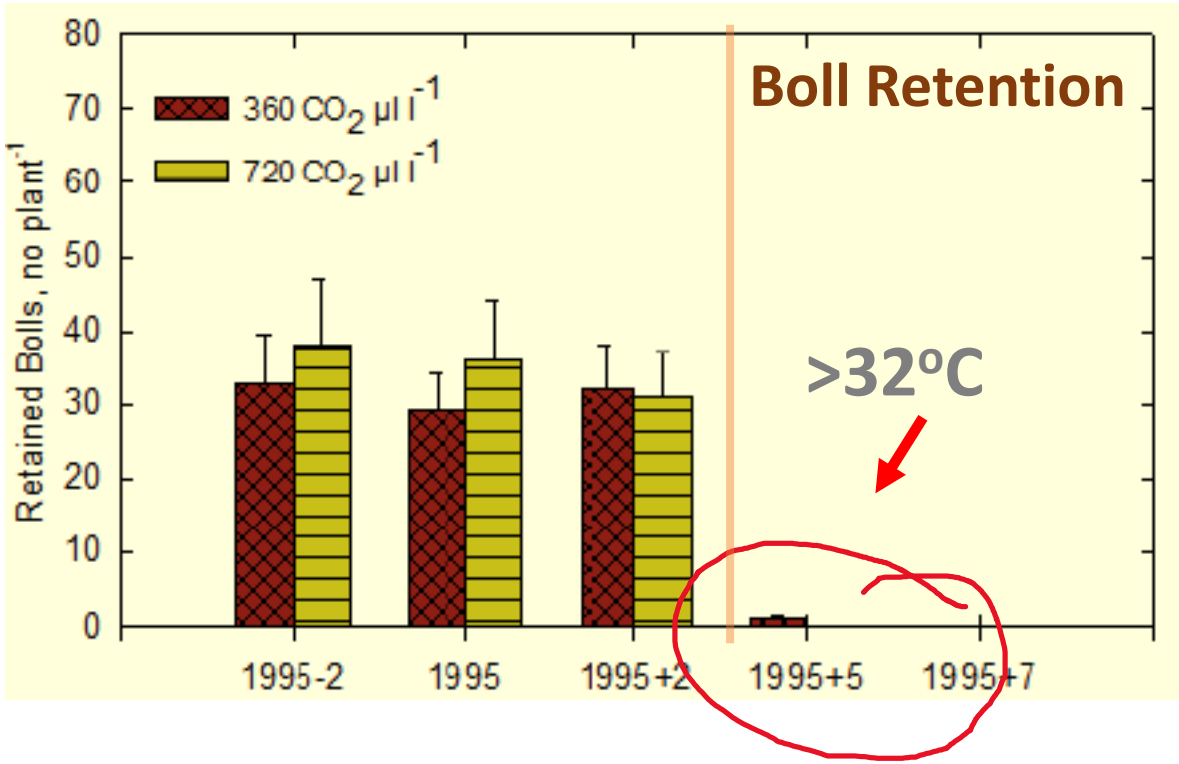
Day / Night Temperatures °C

Raja Reddy, 2020

Higher Temperatures
Decrease Boll Weight & Cause Poor Boll Retention

Optimum 24-27ºC

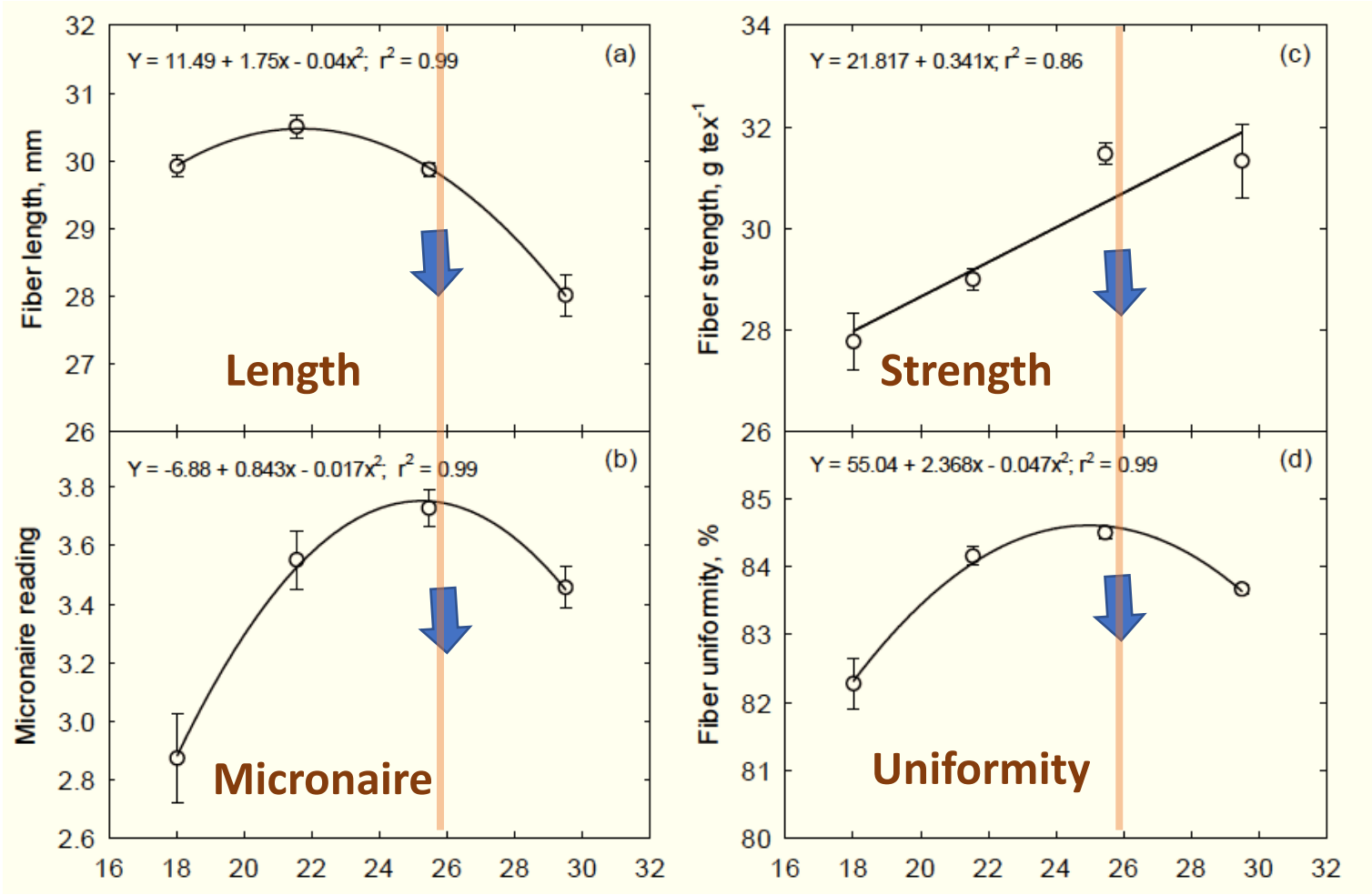




Recalculated from Raja Reddy, 2020

Fibre Qualities

Higher Temperatures Affect Fibre Quality



Raja Reddy, 2020

Rainfed Cotton Could Be Most Affected

>98% African Cotton Is Rainfed

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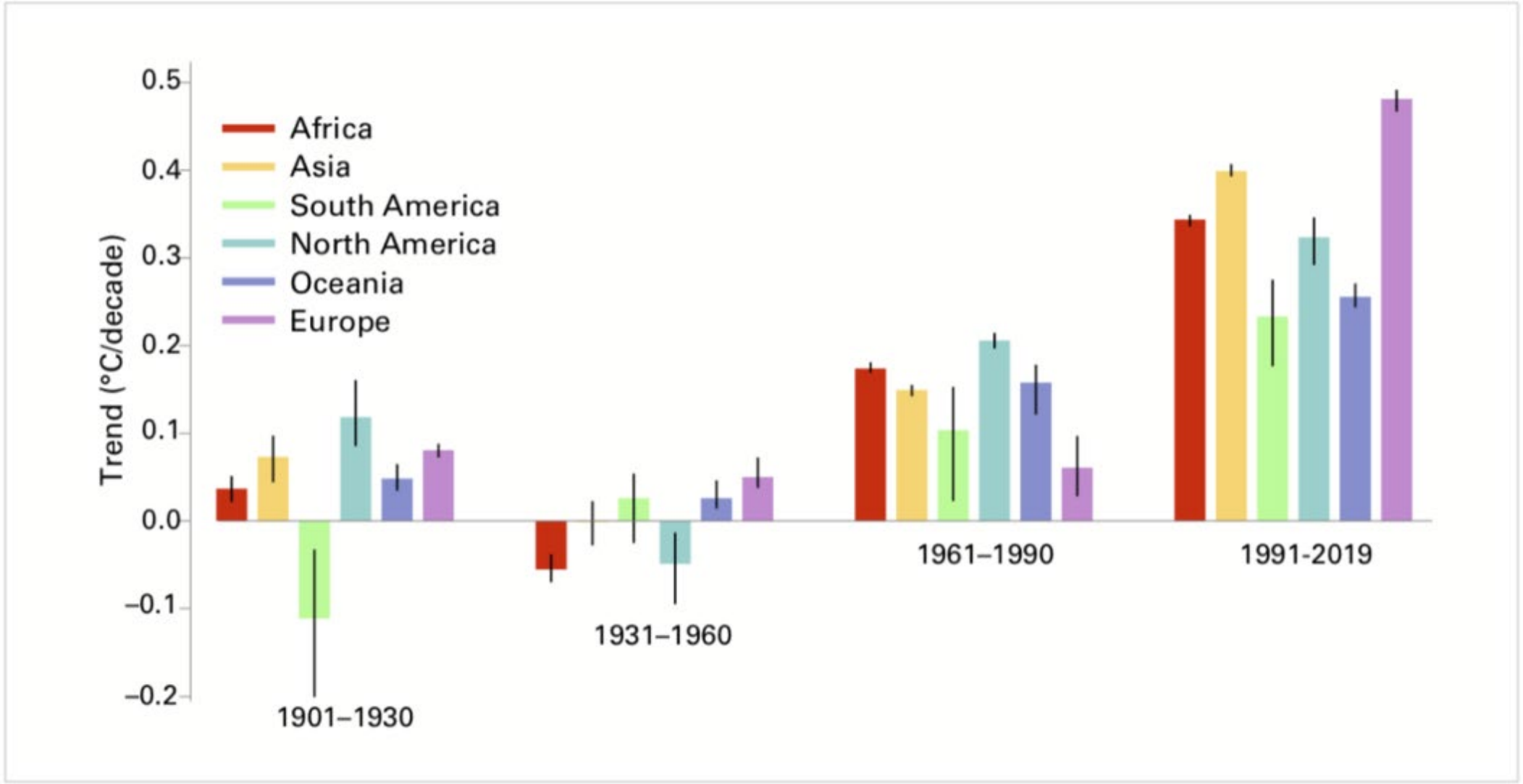
Global Warming Patterns



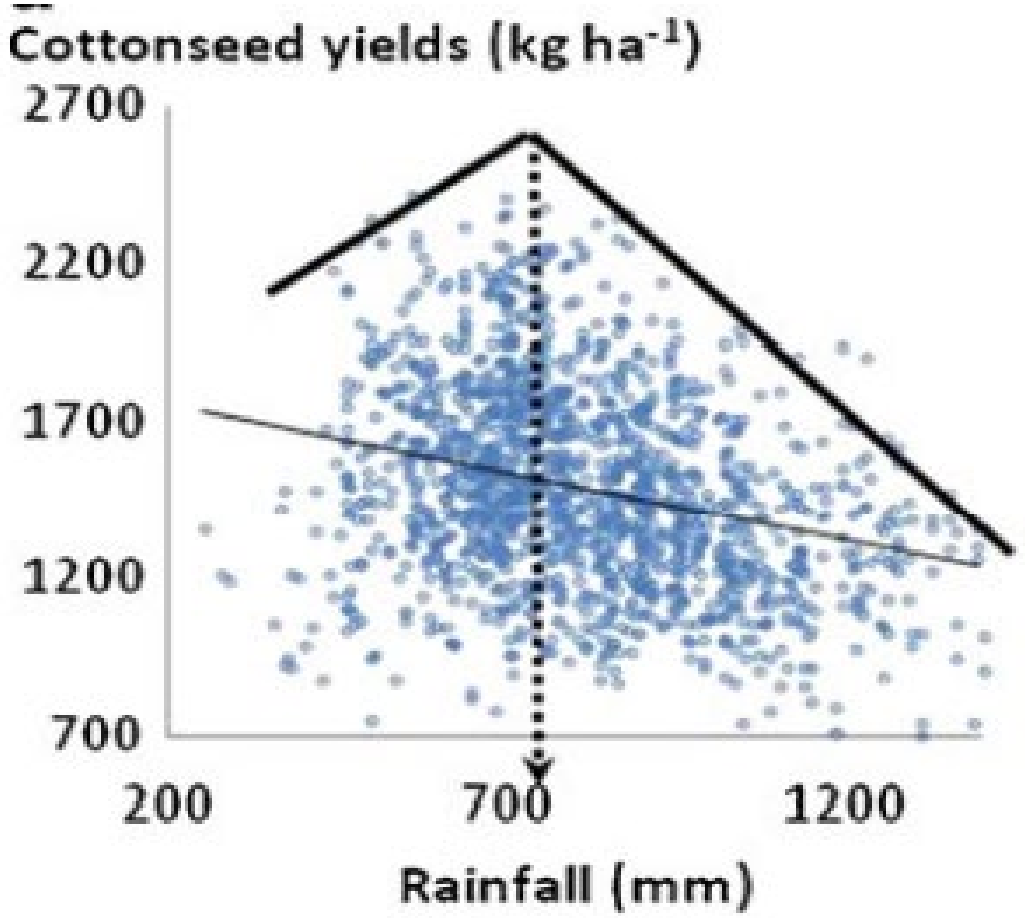
https://public.wmo.int/en/media/press-release/earth-day-highlights-climate-action

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

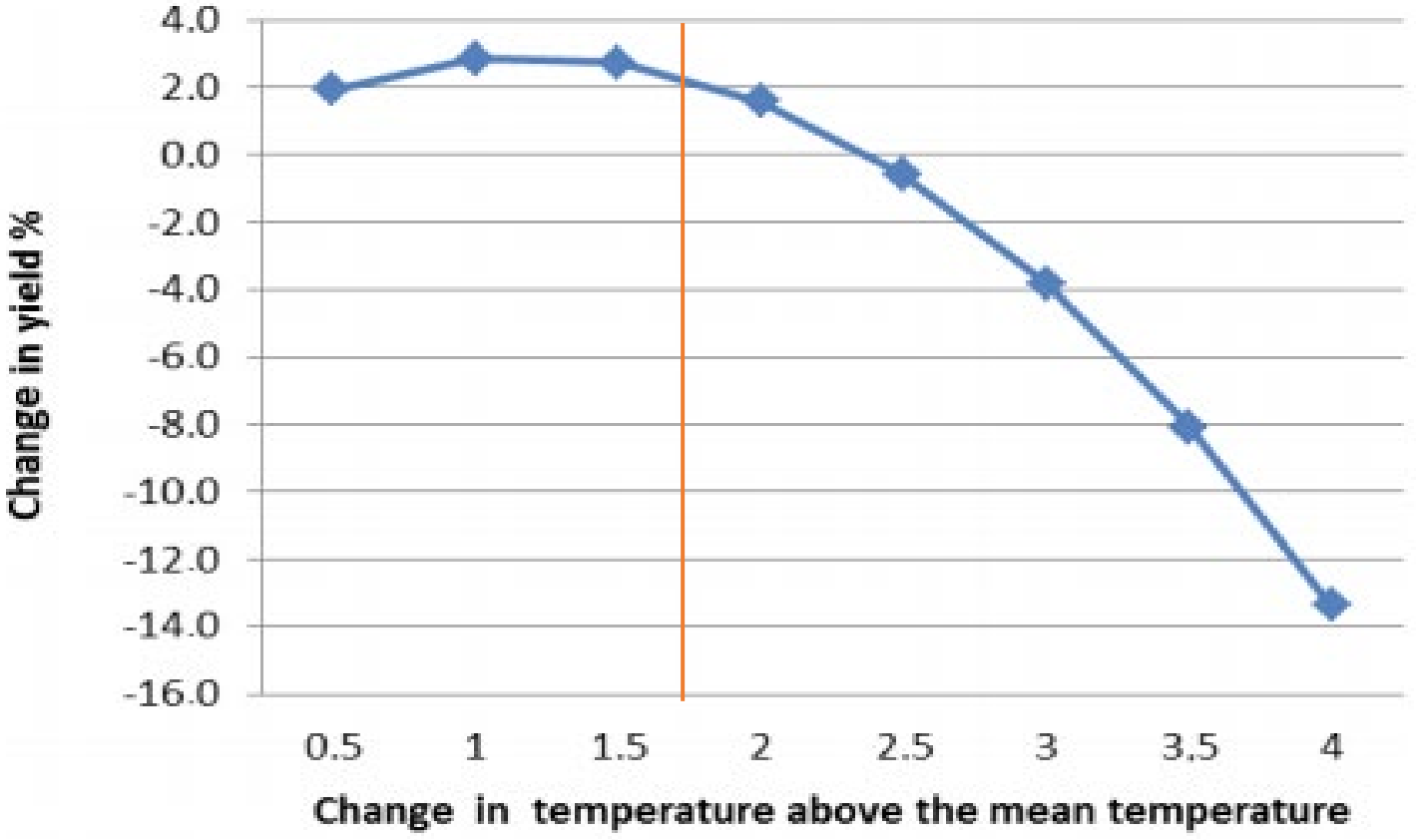
Source: Adapted from Economic growth, development and climate change in Africa, published by the African Climate Policy Centre (ACPC) of the United Nations Economic Commission for Africa (UNECA)

45-year Data in Cameroon



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

Global Warming will Decrease Seed Cotton Yield in Burkina Faso



Diarra, A et. al., 2017. *African Journal of Agricultural Research*, *12*(7), pp.494-501.

The Role of Cotton in Mitigating Climate Change Effects

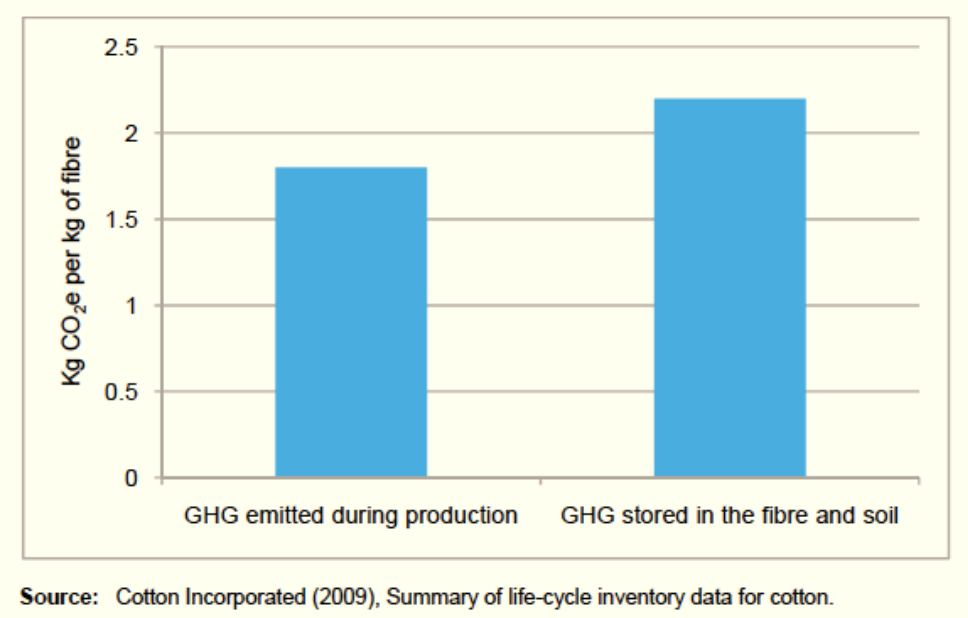
International Cotton Advisory Committee

Cotton Can Minimise Climate Change Effects!

- Cotton farming can help in mitigating the effects of climate change[1]
- Cotton sequesters 23% more CO_2eq of GHGs than it emits[2]
- With regenerative agricultural practices the crop can sequester even more CO_2eq of GHGs[2]
- Cotton fabrics biodegrade in soil within 4-12 weeks, whereas synthetic fabrics do not[3]

[1] Cotton Incorporated, LCA UPDATE OF COTTON FIBER AND FABRIC LIFE CYCLE INVENTORY, 2017
[2]Fischer et al., Geophysical Research Letters, 2014
[3]Source: Cotton Works

Cotton Is Special in Reducing Atmospheric CO_2



Source: Cotton Incorporated (2009), Summary of life-cycle inventory data for cotton.

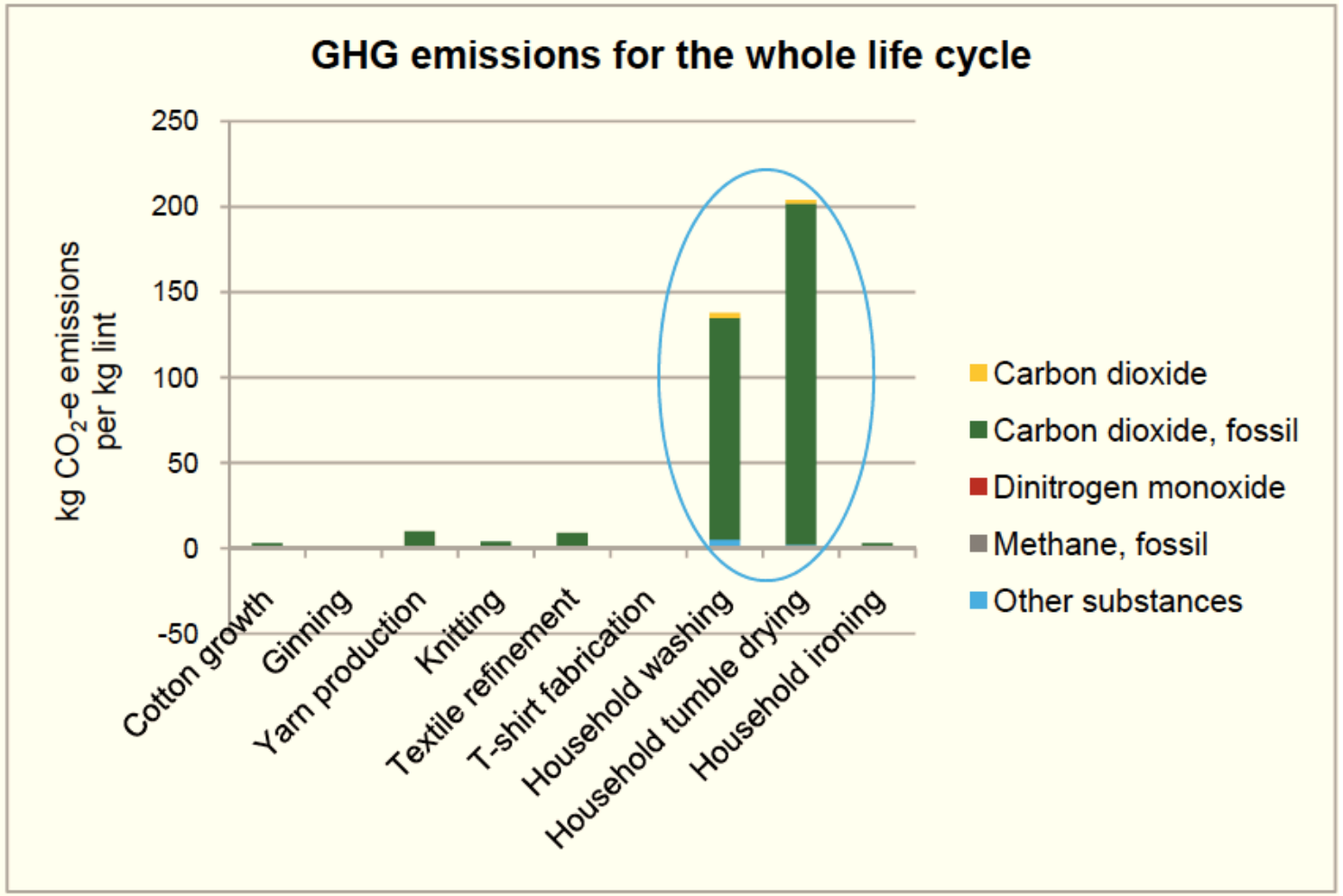
- Plants absorb CO_2 and sequester carbon in their biomass
- Cotton plants do more…they use CO_2 and H_2O to create cellulose
- Cotton fibres are 96-98% pure cellulose $(C_6H_{10}O_5)_n$
- Cotton sequesters 0.5 Kg additional CO_2 per Kg fibre produced
- Cotton is a C3 plant and has great capacity to use CO_2
- 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%

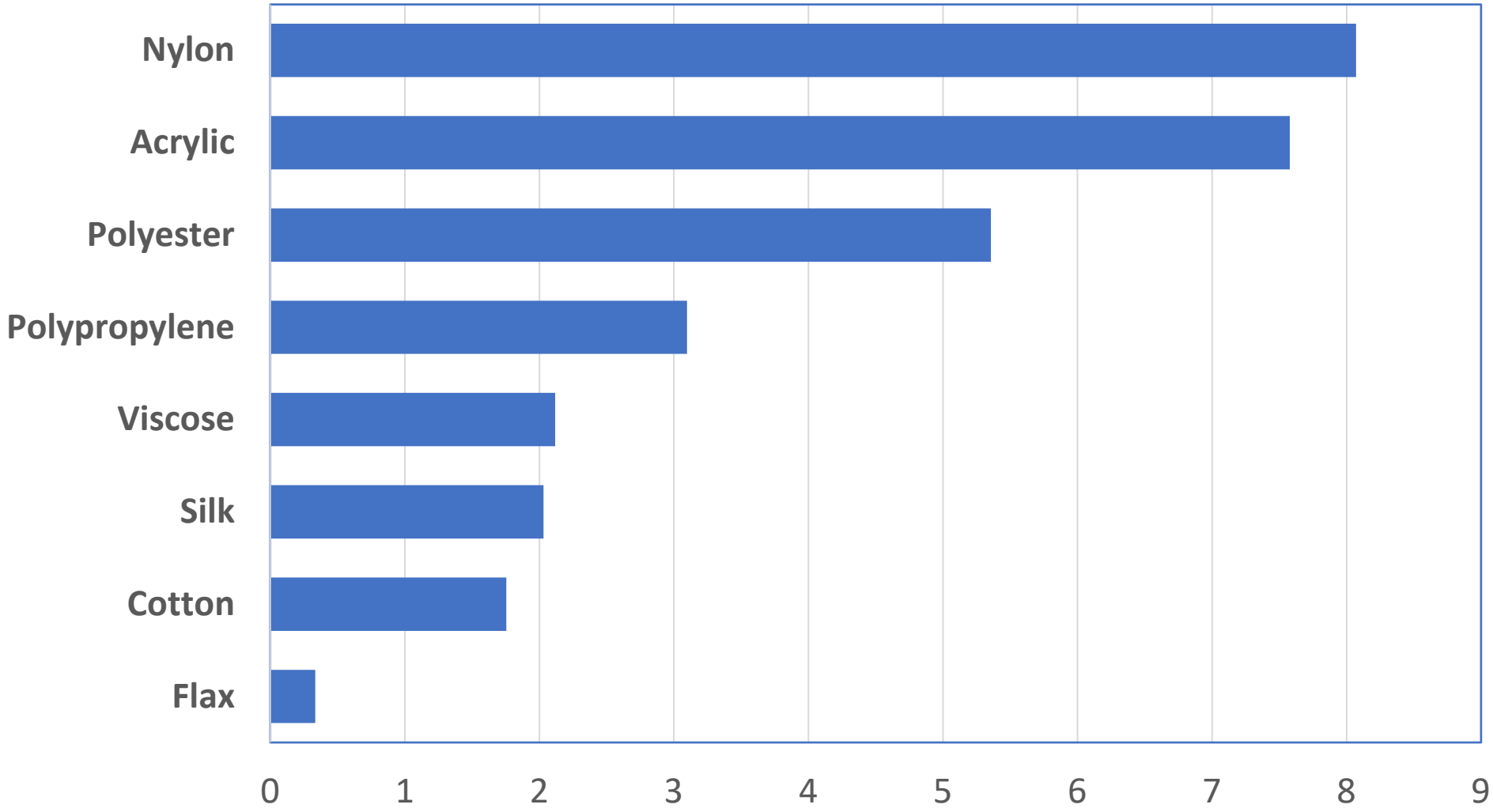
Irrigation, Fertilisers, Pesticides and Energy in Production, Processing and Consumer Use Are the Main Contributors

CO_2 eq Emissions in Life Cycle of a T-Shirt



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

Cotton Emits Fewer CO_2 eq of GHGs per Kg Fibre in Production

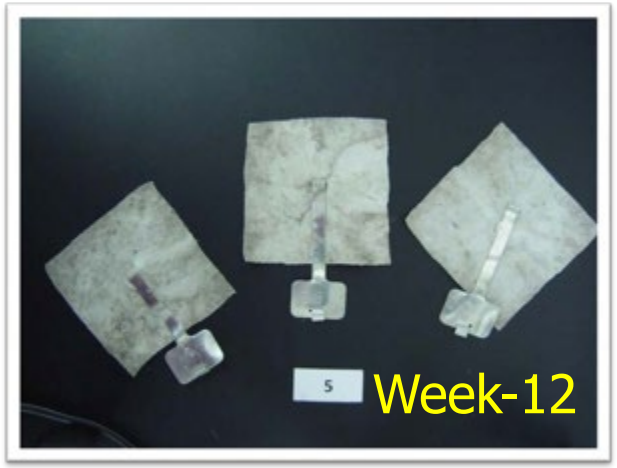


Moazzem et al., Journal of Fiber Bioengineering and Informatics 11:1 (2018)

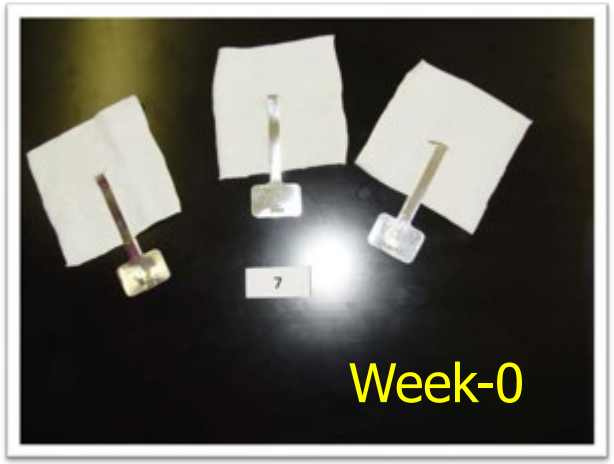
Cotton Biodegrades in Soil in 12 Weeks, Polyester Does Not

Recycled Polyester T-Shirt

Recycled Polyester T-Shirt



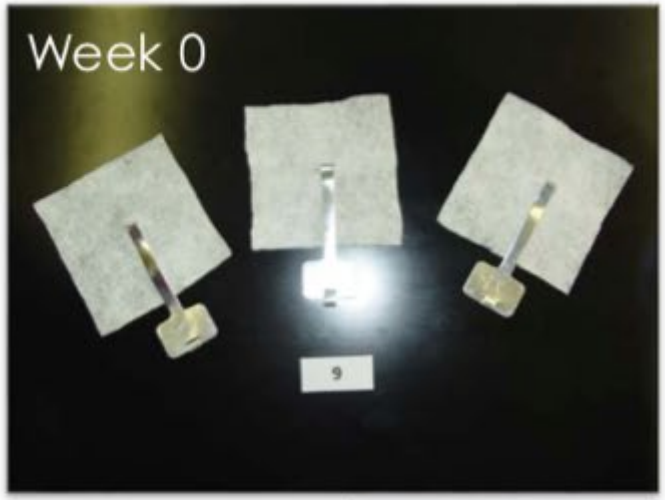
Cotton Jersey, Bleached, Softened



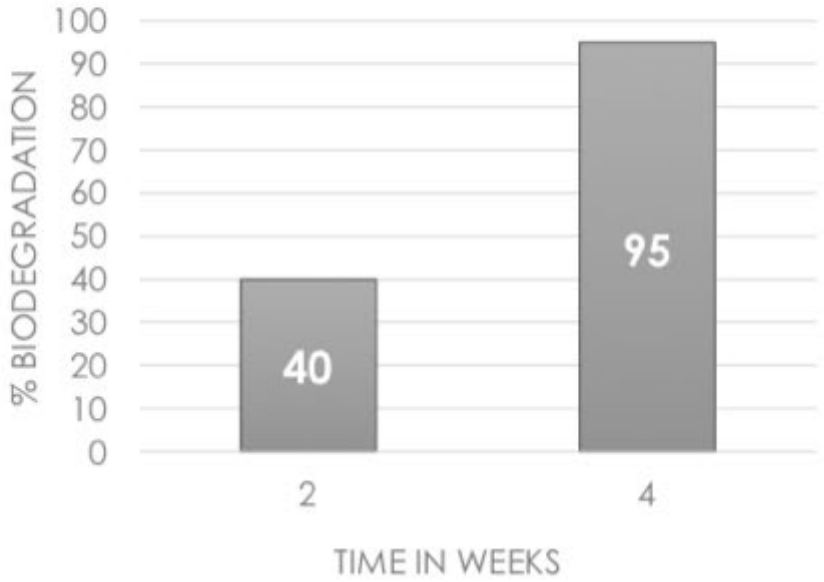
Cotton Jersey, Bleached, Softened

Source:
Cotton Works

100% Purified Cotton
Composting (ASTM D6400)

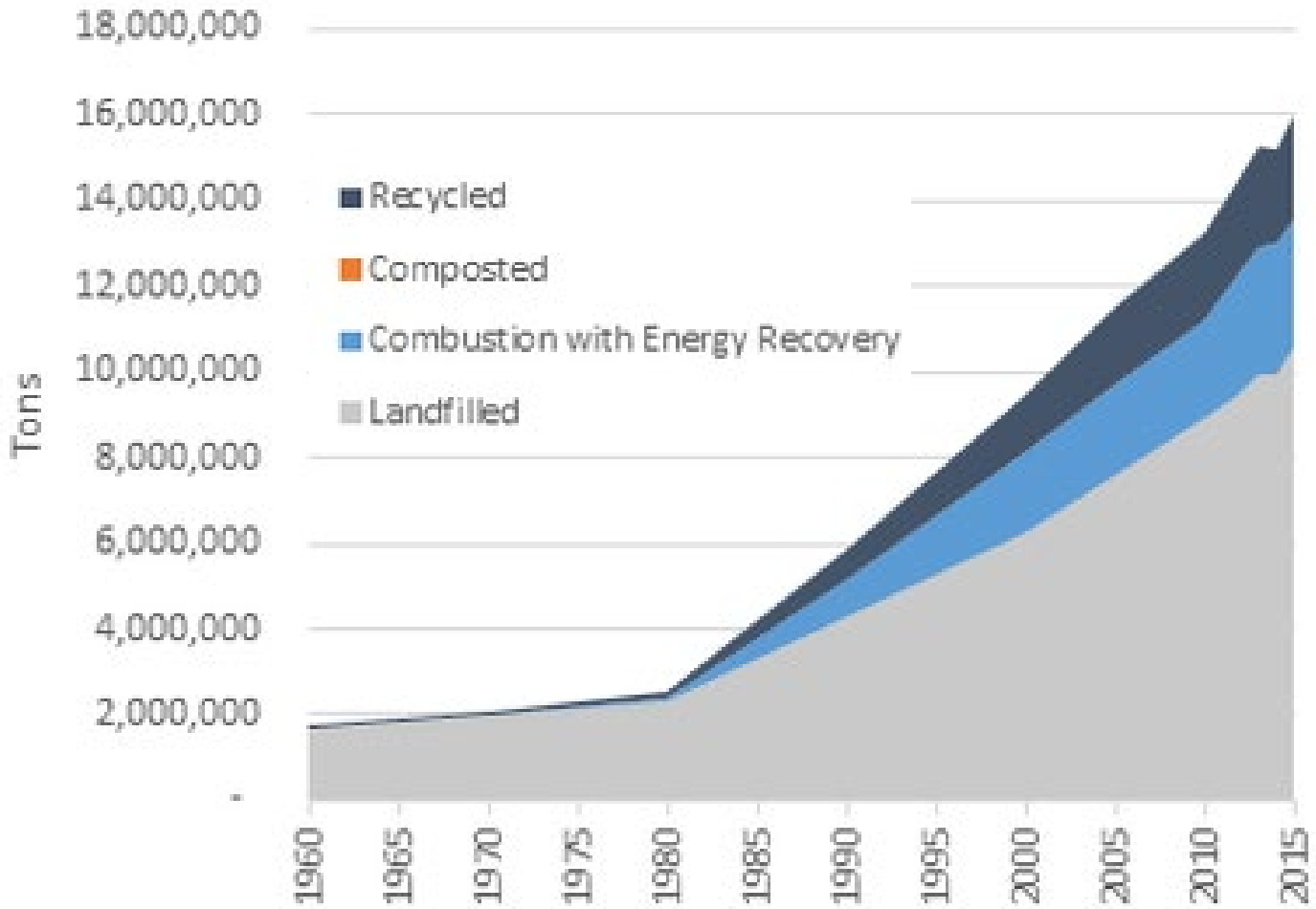


Sample #9



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

https://www.sewdynamic.com/pages/polyester-industry

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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