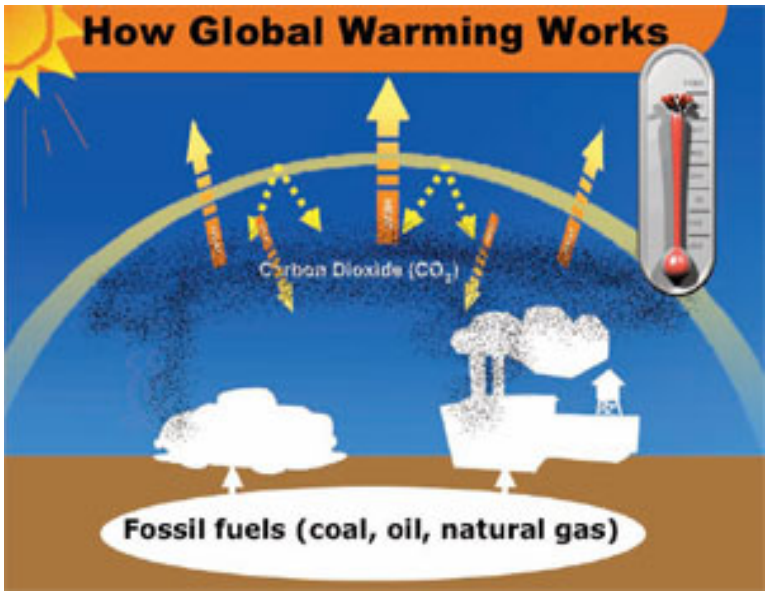
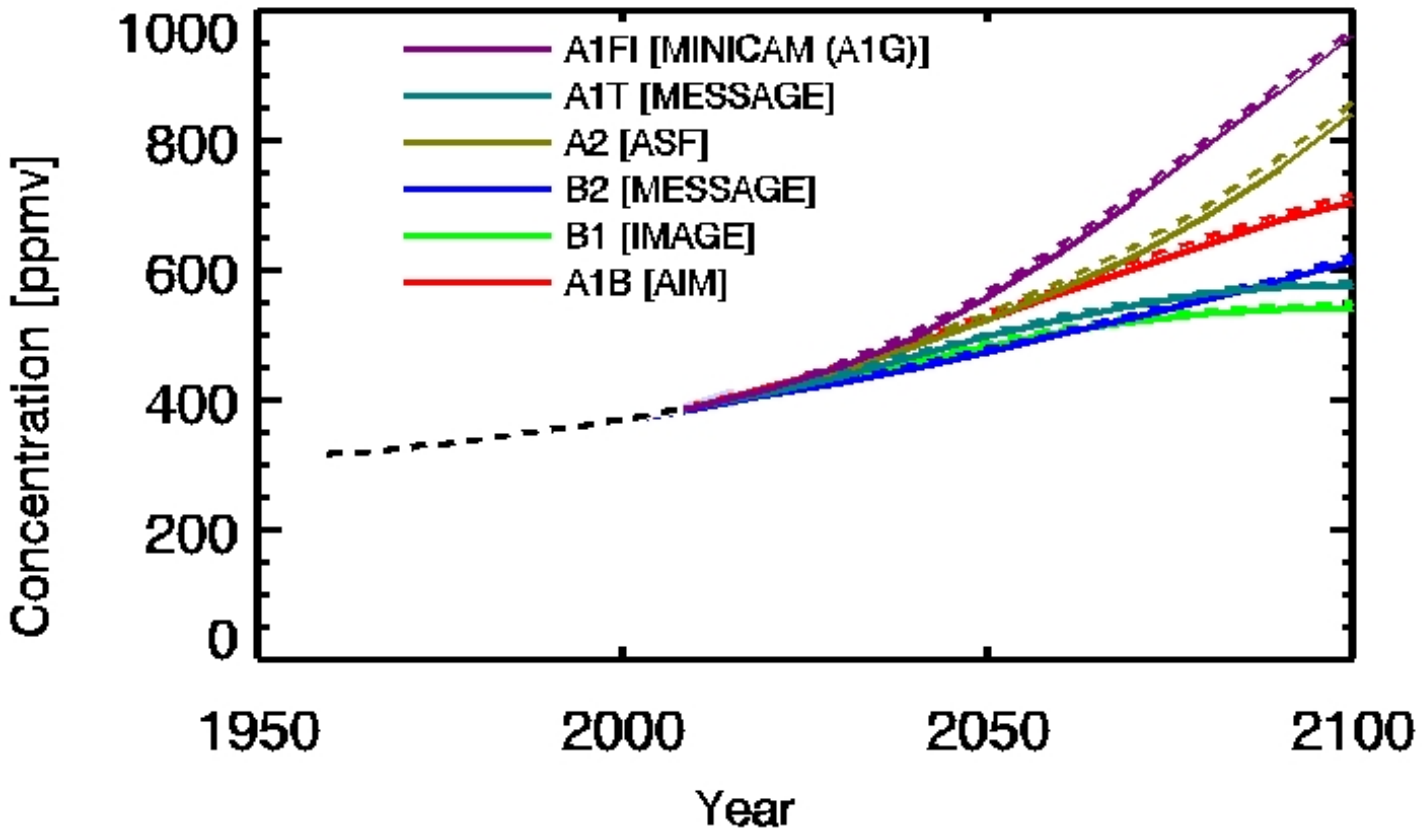
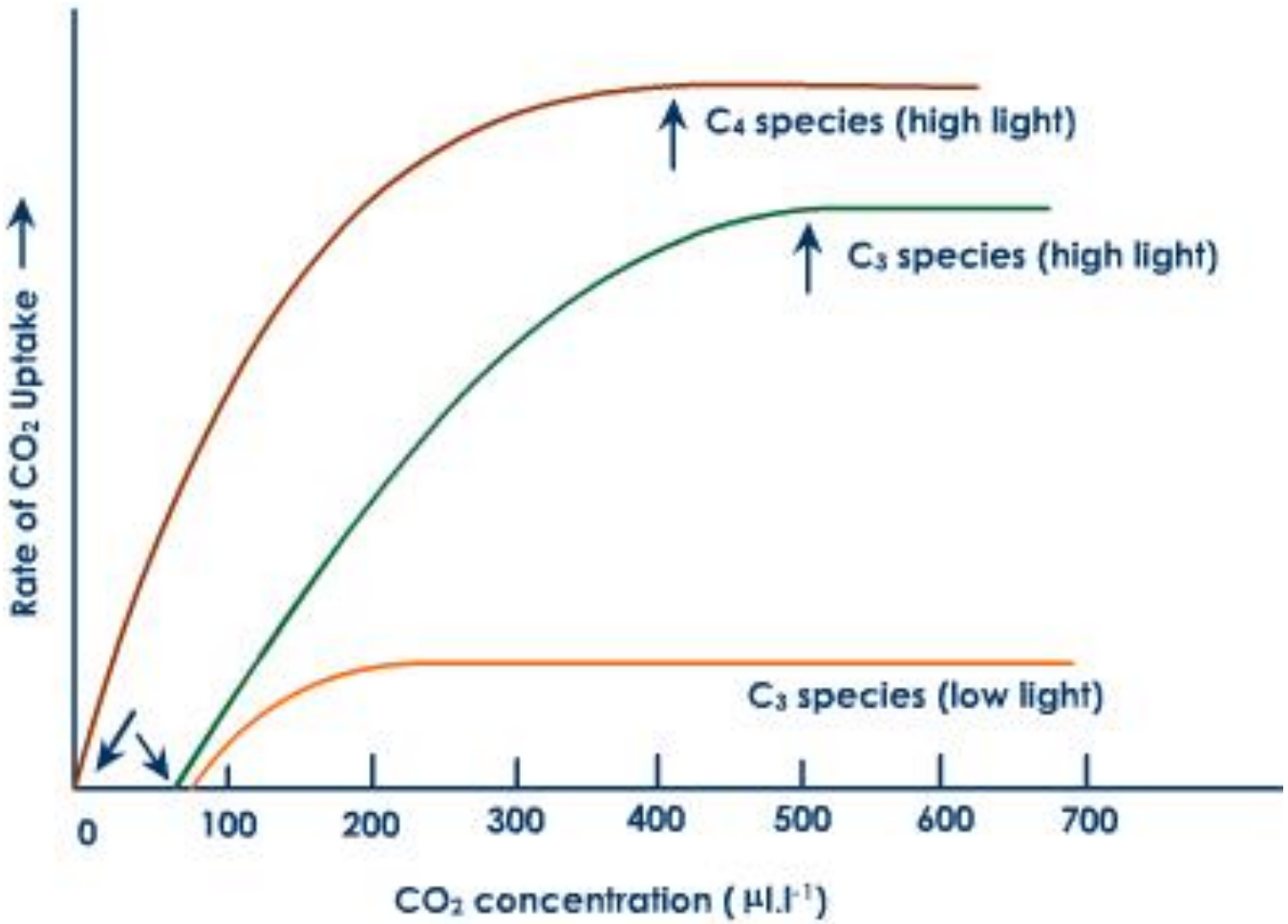
Global Climate Change (in 2050)

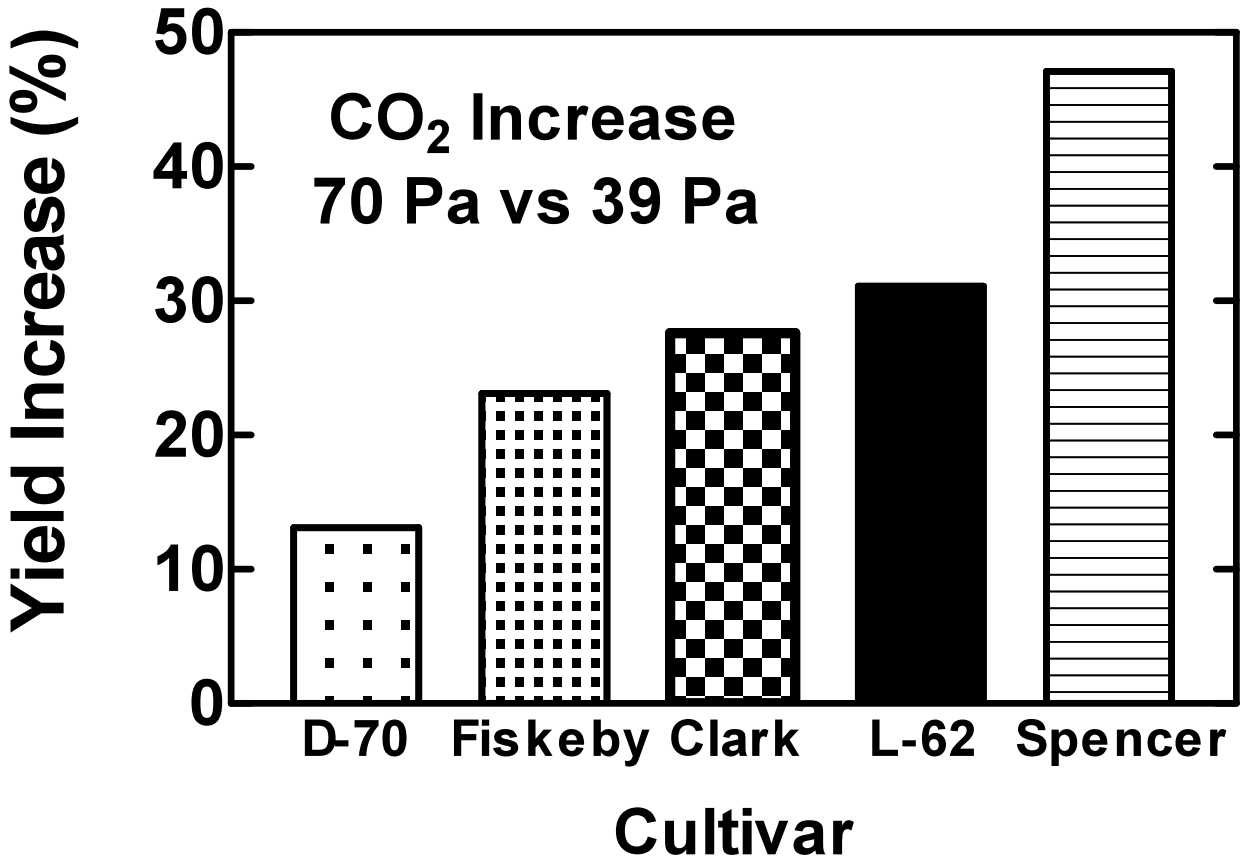


1. Atmospheric increase in CO_2
2. Increase in temperature
3. Altered precipitation patterns

1. Atmospheric increase in CO_2

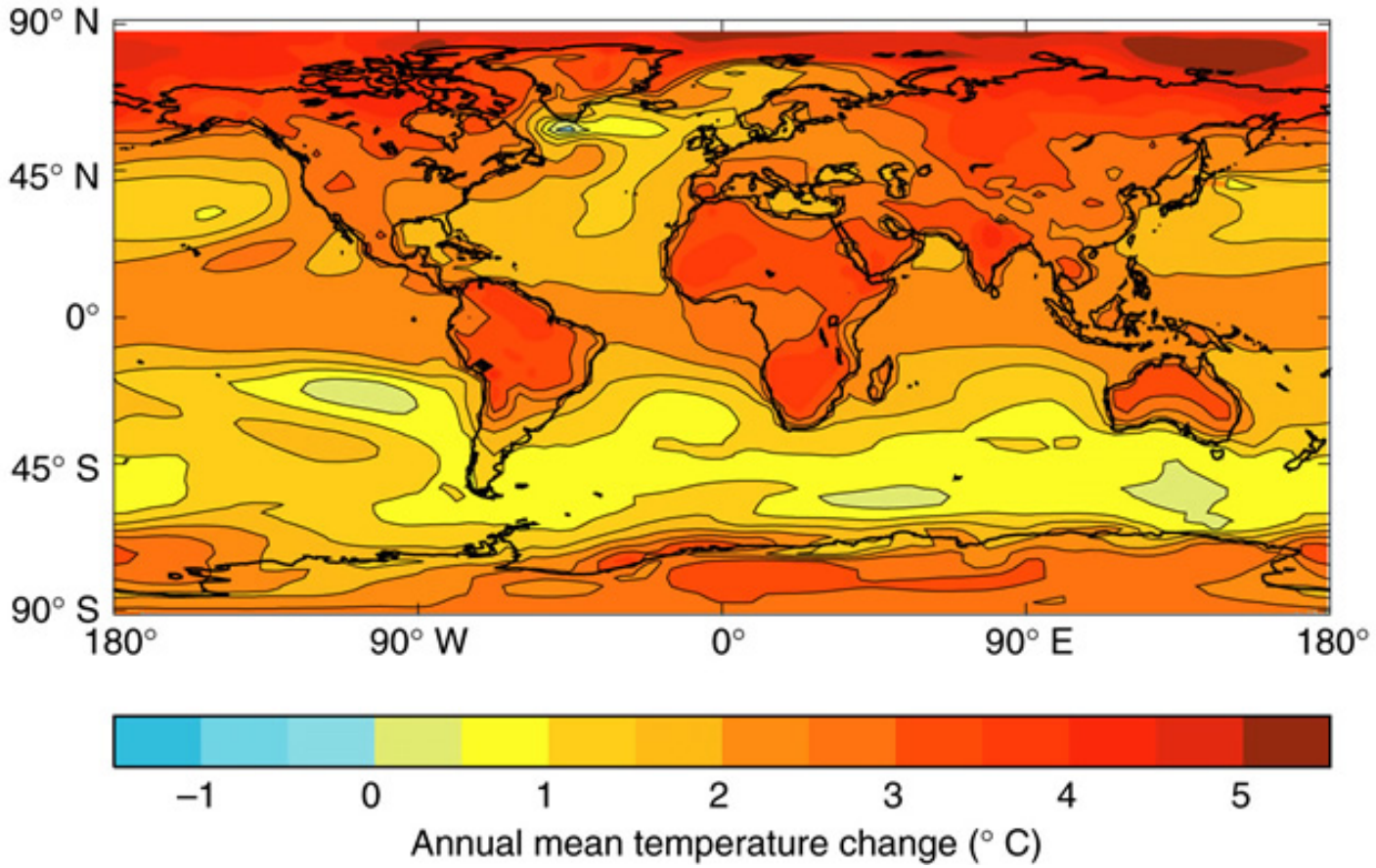



C4 species (high light)
C3 species (high light)
C3 species (low light)
Rate of CO2 Uptake
0
100
200
300
400
500
600
700
CO2 concentration (μl.l-1)



Ziska et al. (1998) Aus. J. Pl. Physiol. 25:801

2. Increase in Temperature (2050)



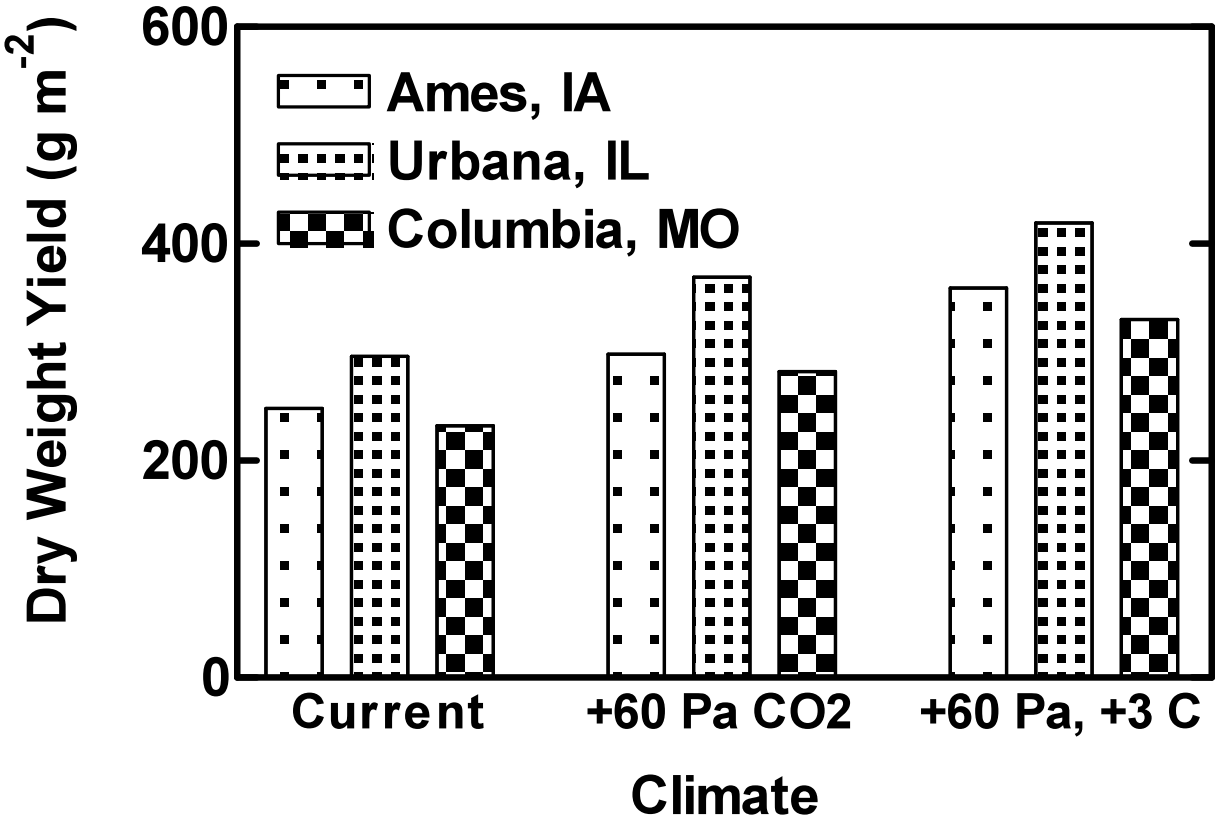
Mid-South Model

1. Earlier sowing to maximize radiation interception

2. Shorter season cultivars to avoid late season heat and drought

► Readily accommodated in 40 year time frame

Average 24 years of weather data (1965-1988)



Note: +3 C includes 2-week earlier sowing date

Sinclair & Rawlins (1993) Agron. J. 85:406

3. Precipitation: Currently, main factor in inter-annual yield variation

$$Y_{max} \leq HI\ (k_d / (e^* - e))\ W$$

HI = harvest index

k_d = transpiration coefficient

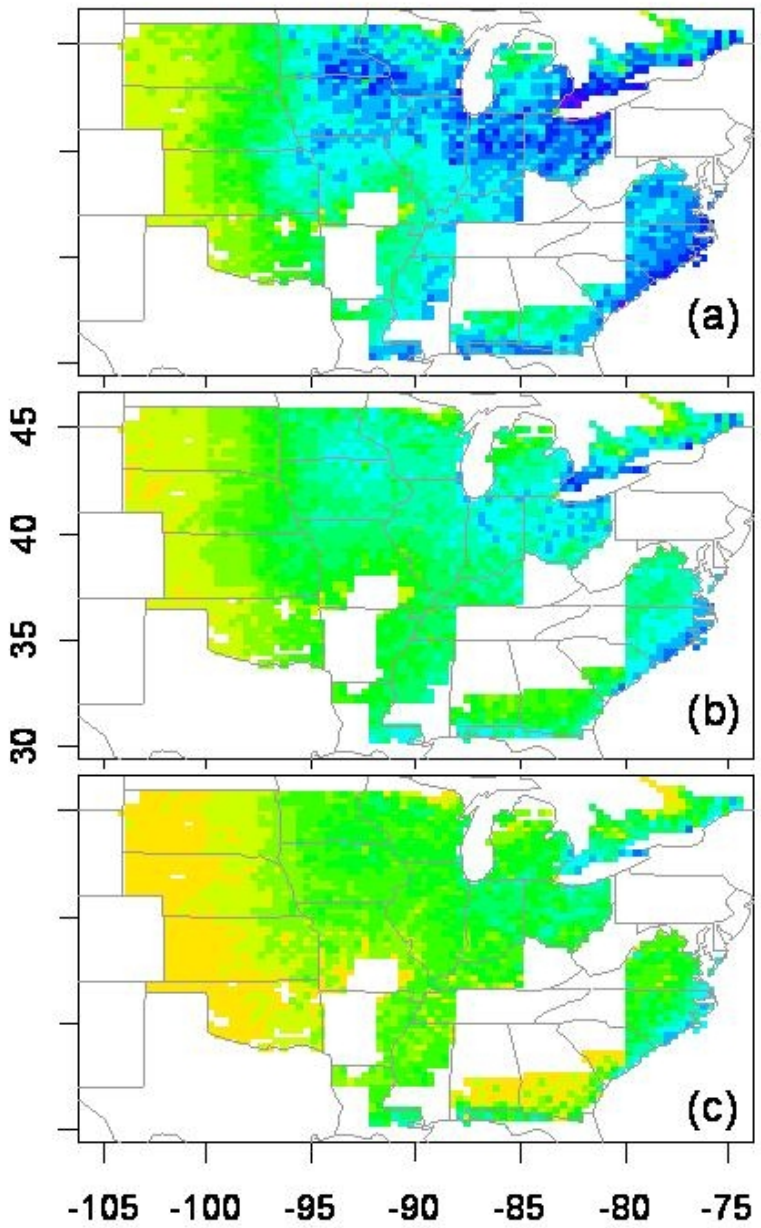
$(e^* - e)$ = vapor pressure deficit

W = water for transpiration

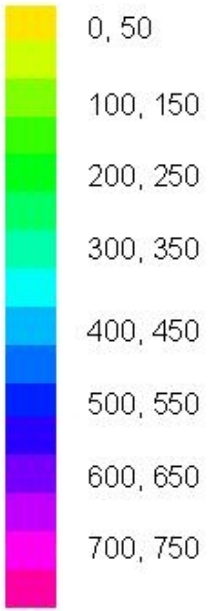
75%
(wet)

Median

25%
(Dry)



Soybean Yield
(g dry m^{-2})



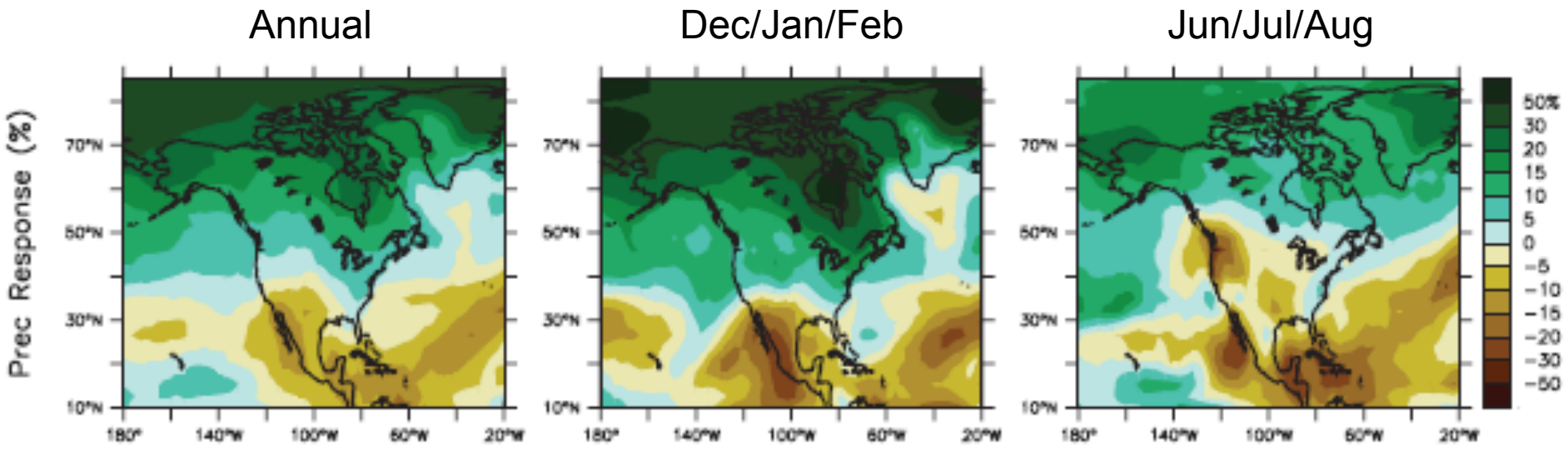
Climate Change Precipitation: The Thousand-Pound Gorilla

Change in Storm Patterns

- **Frequency: May decrease resulting in more drought periods**

- **Intensity: May increase resulting in increased runoff losses**

Changes in seasonal precipitation a concern



Intergovernmental Panel on Climate Change Fourth Assessment. 2007.
Working Group I Report “The Physical Science Basis”
Chapter 11. Regional Climate Projections

Vapor Pressure Deficit unchanged from 1949 to 1996

(Szilagyi et al., J. Water Res Planning & Manag., 127:354)

$$VPD \approx 0.75 (e_{Tmax} - e_{Tmin})$$

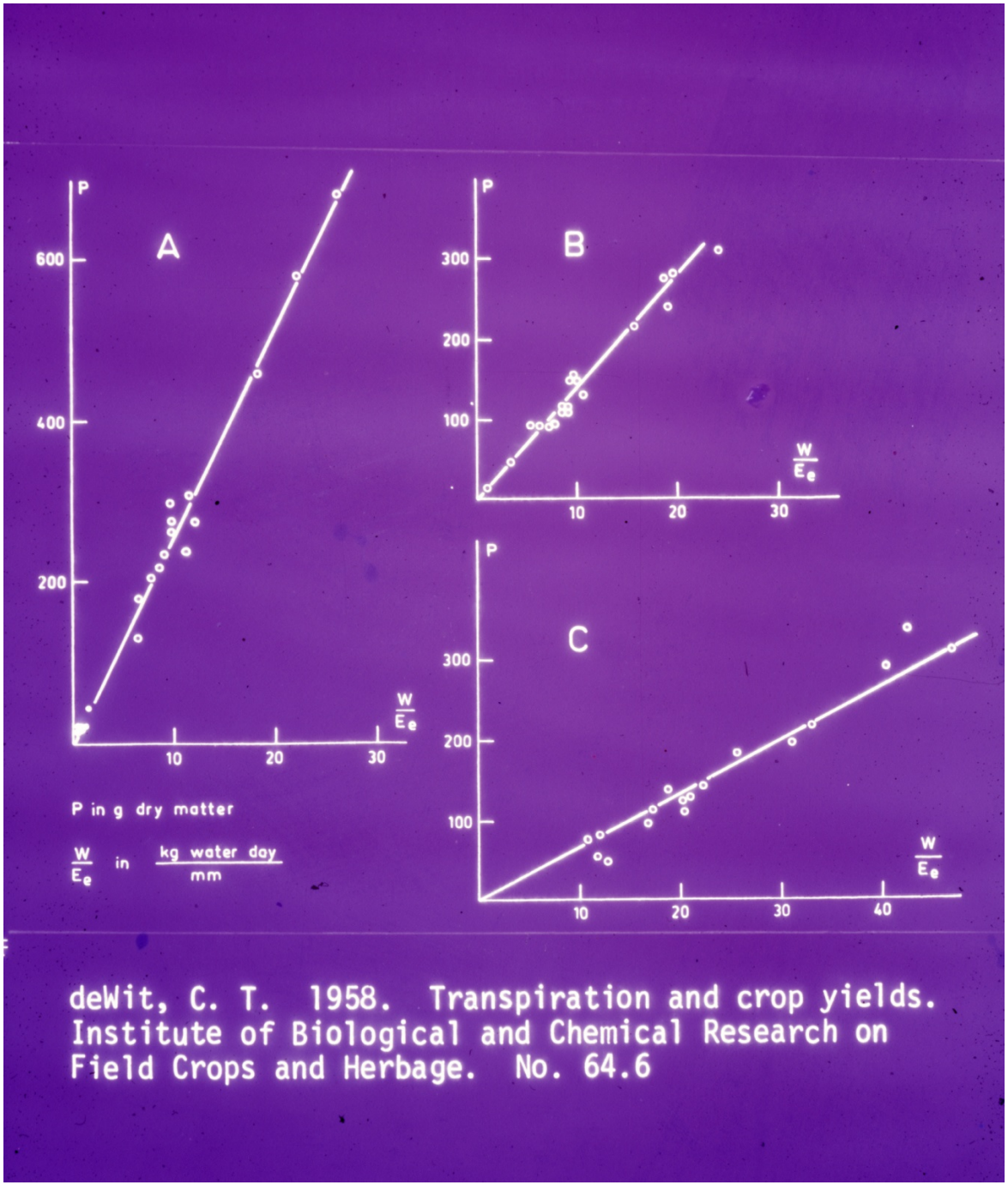
$$T_{min} \text{ increase} > T_{max} \text{ increase}$$

Genetic Focus for Climate Change: Drought Tolerance

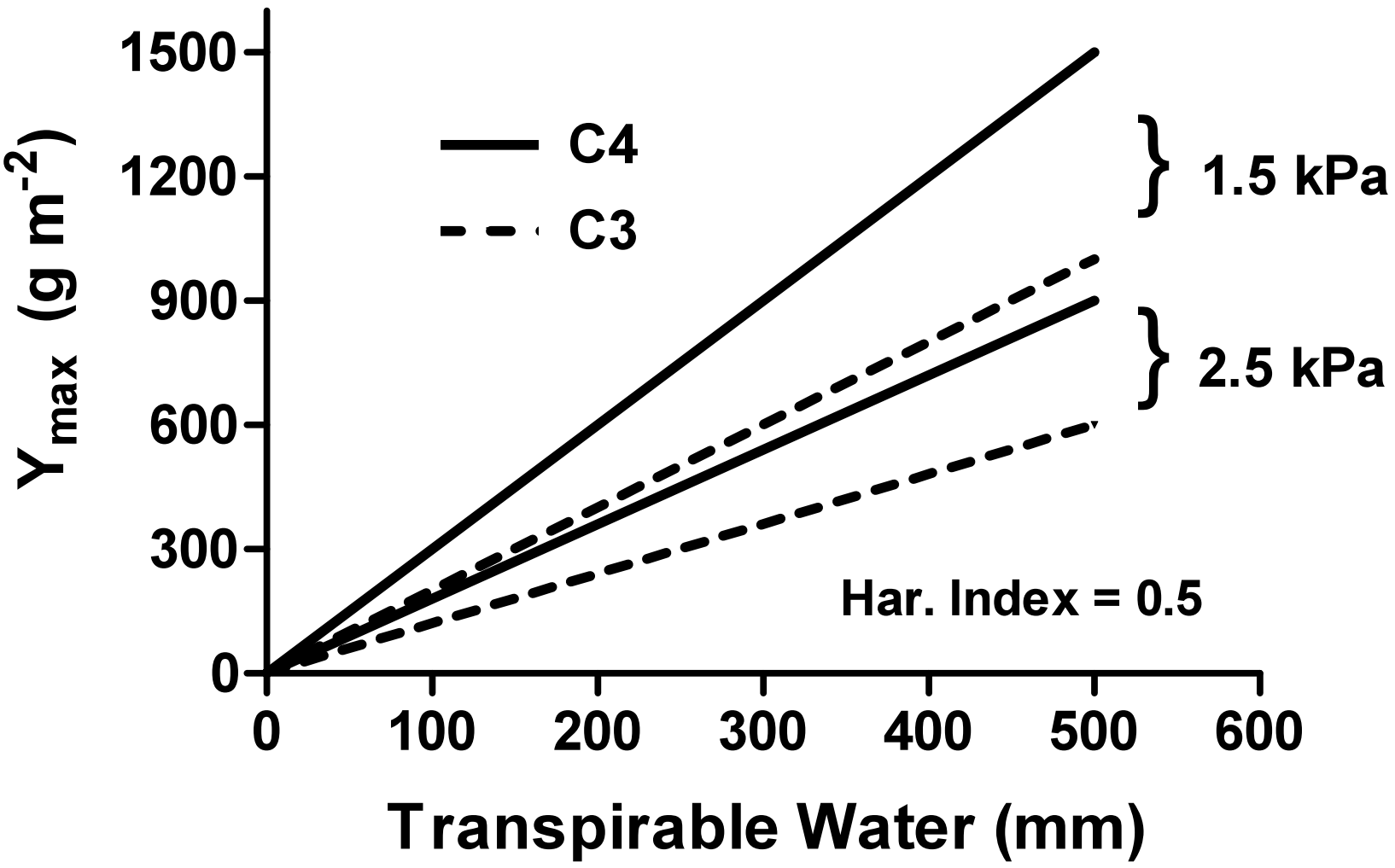
- Access More Water
- Conserve Water
- Special Sensitivity: N_2 Fixation Drought Tolerance

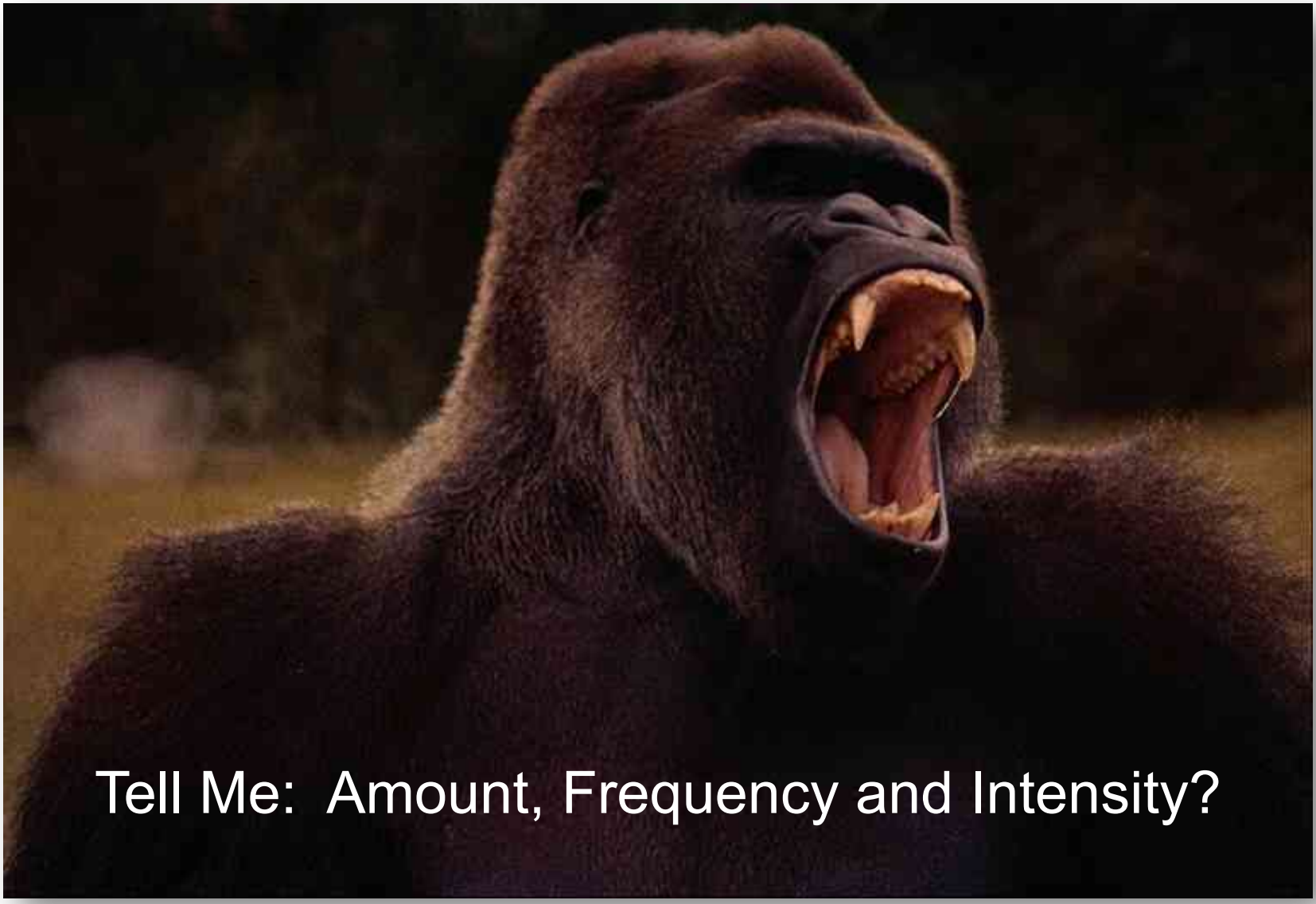
Transpiration Efficiency Coefficent (k_d)

C_4 (maize, sugarcane)	9 Pa
C_3 grasses (wheat, rice)	6 Pa
C_3 legumes (soybean, peanut)	5 Pa



deWit, C. T. 1958. Transpiration and crop yields. Institute of Biological and Chemical Research on Field Crops and Herbage. No. 64.6


1500
1200
900
600
300
0
Y_{max} (g m^{-2})
C4
C3
1.5 kPa
2.5 kPa
Har. Index = 0.5
0
100
200
300
400
500
600
Transpirable Water (mm)


Tell Me: Amount, Frequency and Intensity?