

# Effects of Potassium Nutrition on Physiological Processes and Derivative Spectrum Characteristics of Corn Plants

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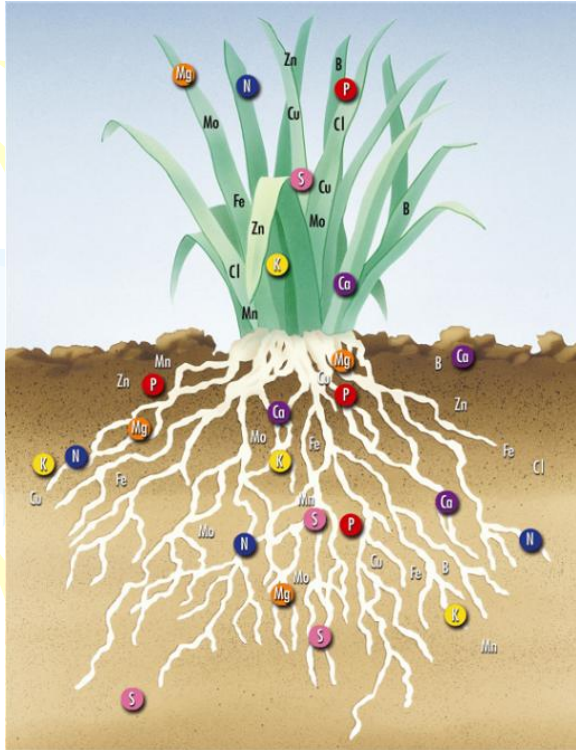
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# Introduction



- Potassium (K) is a macronutrition that is essential for plant growth
- Potassium stress has been reported to reduced leaf area, total shoot mass and final yield of crops such as cotton, potato etc.
- No in-depth study on the quantitative relationship between tissue potassium concentration and physiological process of corn plants has been documented.

# Materials and Methods

- Experiment conducted in Soil-Plant-Atmosphere Research (SPAR) chambers
- Corn seed sown in sand culture using 3.8L pots
- Environmental conditions in the chambers
  - Carbon dioxide concentration: 400 and 750 ppm
  - Day/night temperature: 30/22°C
- Potassium treatments were imposed at 15 days after emergence
  - 0%, 5%, 20%, 40% and 100% potassium levels of full strength Hoagland solution

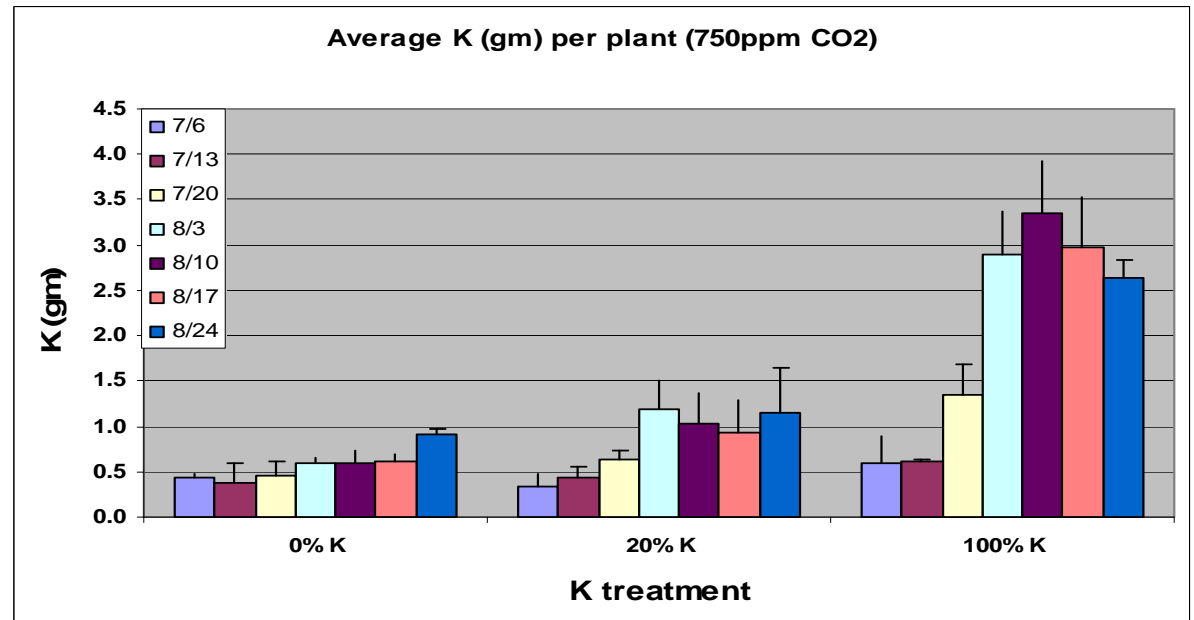
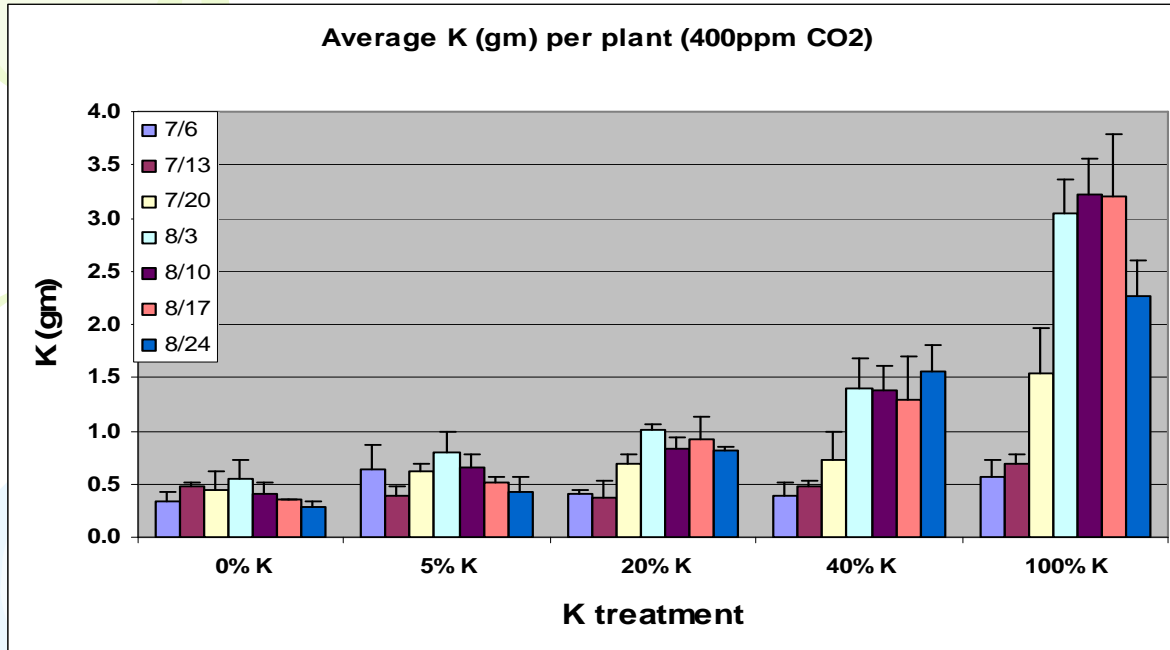


# Materials and Methods (continue)

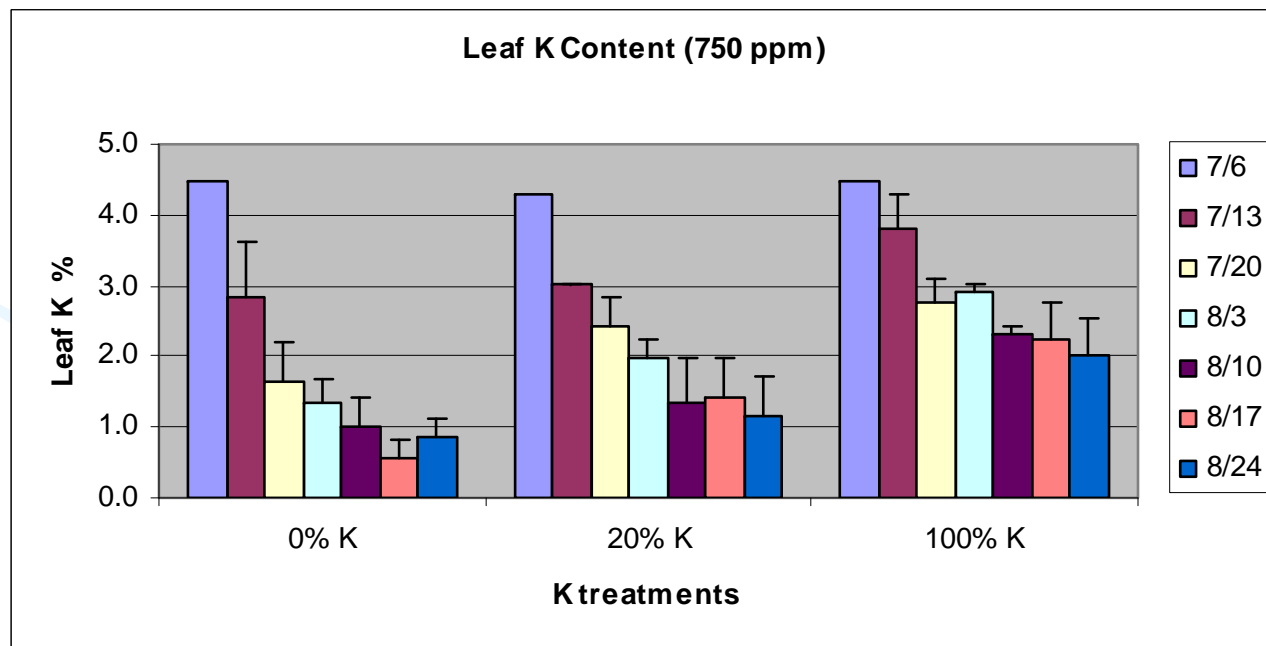
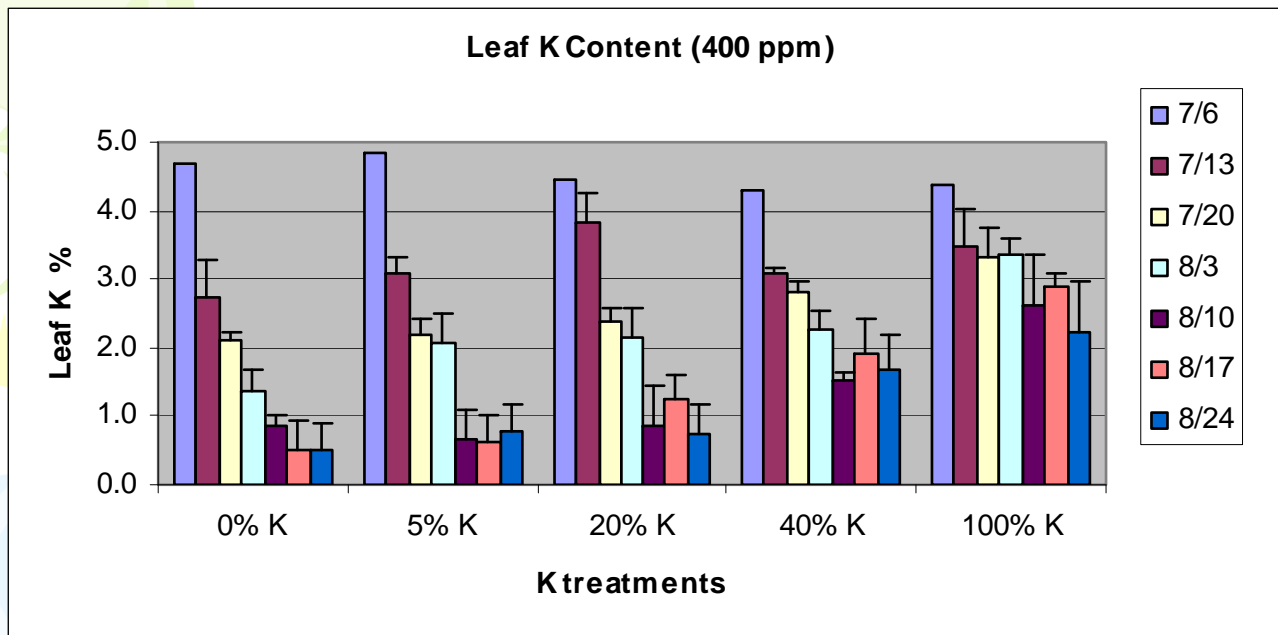


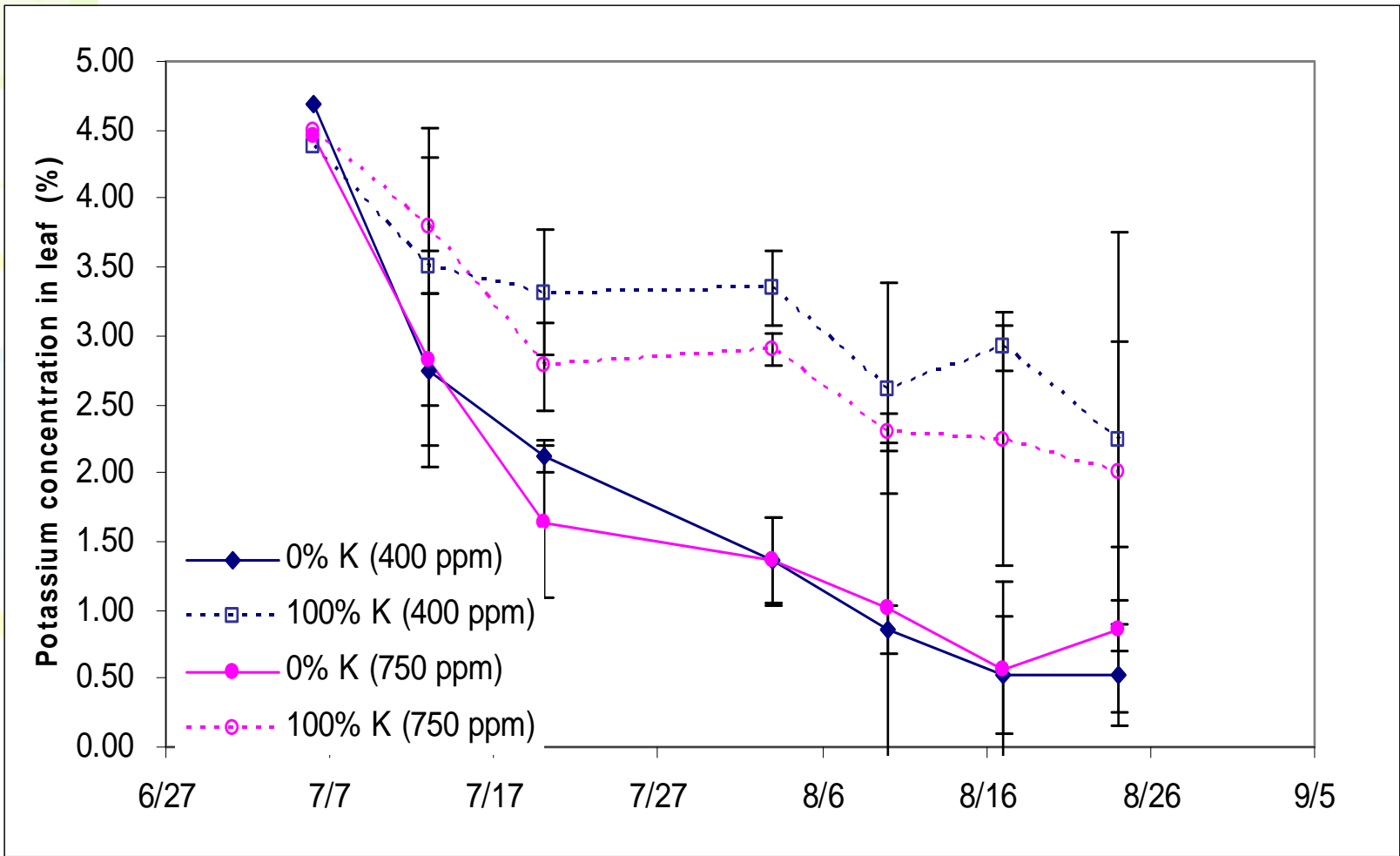
- Measurements were made weekly
  - Major nutrient concentration
    - » Potassium, nitrogen, Phosphorous etc.
  - Growth and development
    - » Plant height, leaf number, leaf area
  - Non-destructive measurements
    - » Stomatal conductance, photosynthesis of top leaf
    - » Hyperspectral reflectance of top leaf

# Average Potassium Content (gm) per plant

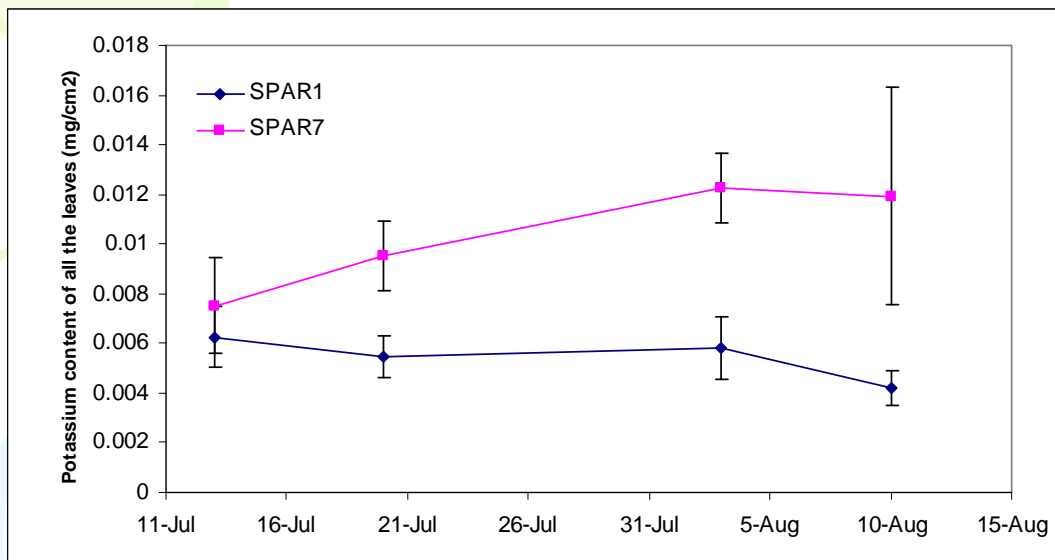


# Leaf Potassium Concentration (%) (400 & 750 ppm CO<sub>2</sub>)





# Leaf Potassium content of 0% & control K treatment (mg/cm<sup>2</sup>)

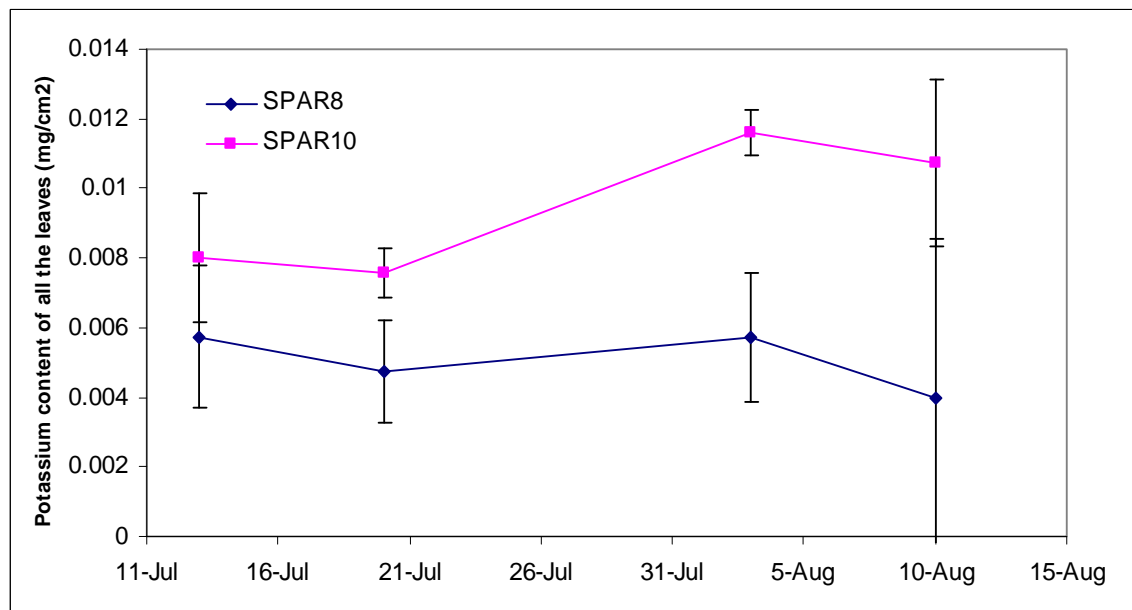


**SPAR 1 - 0%K  
& 400ppm CO<sub>2</sub>**

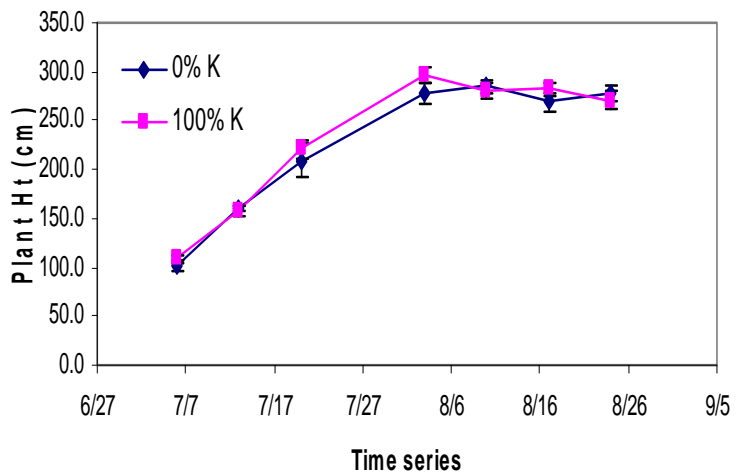
**SPAR 7 -  
100%K &  
400ppm CO<sub>2</sub>**

**SPAR 8 - 0%K &  
750ppm CO<sub>2</sub>**

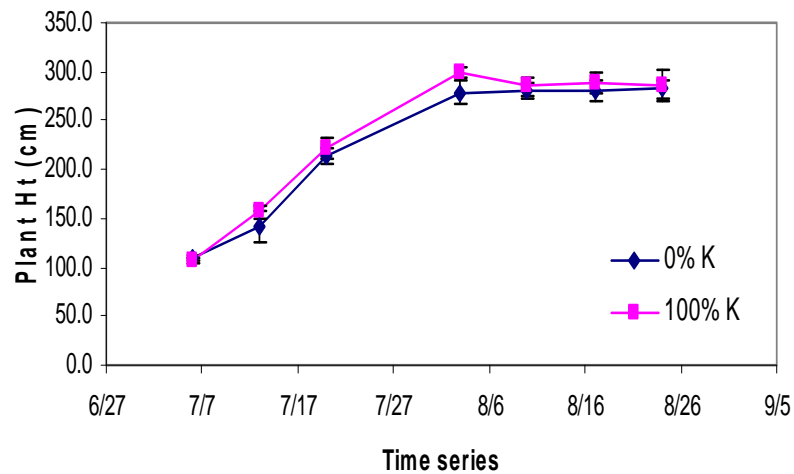
**SPAR 10 -  
100%K &  
750ppm CO<sub>2</sub>**



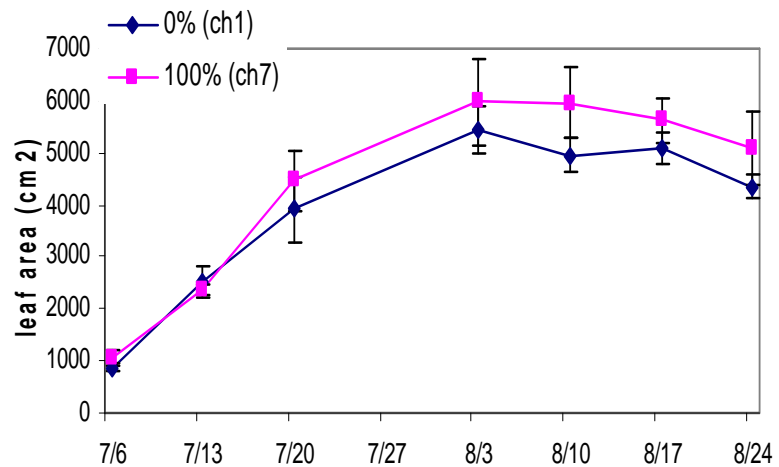
Plant-Ht-(Tip) - K Treatment-(400 ppm CO2)



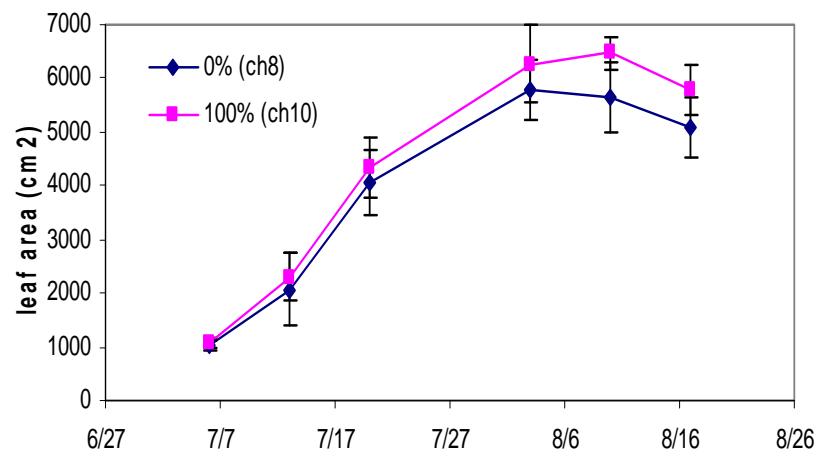
Plant-Ht (Tip) - K treatment (750ppm CO2)



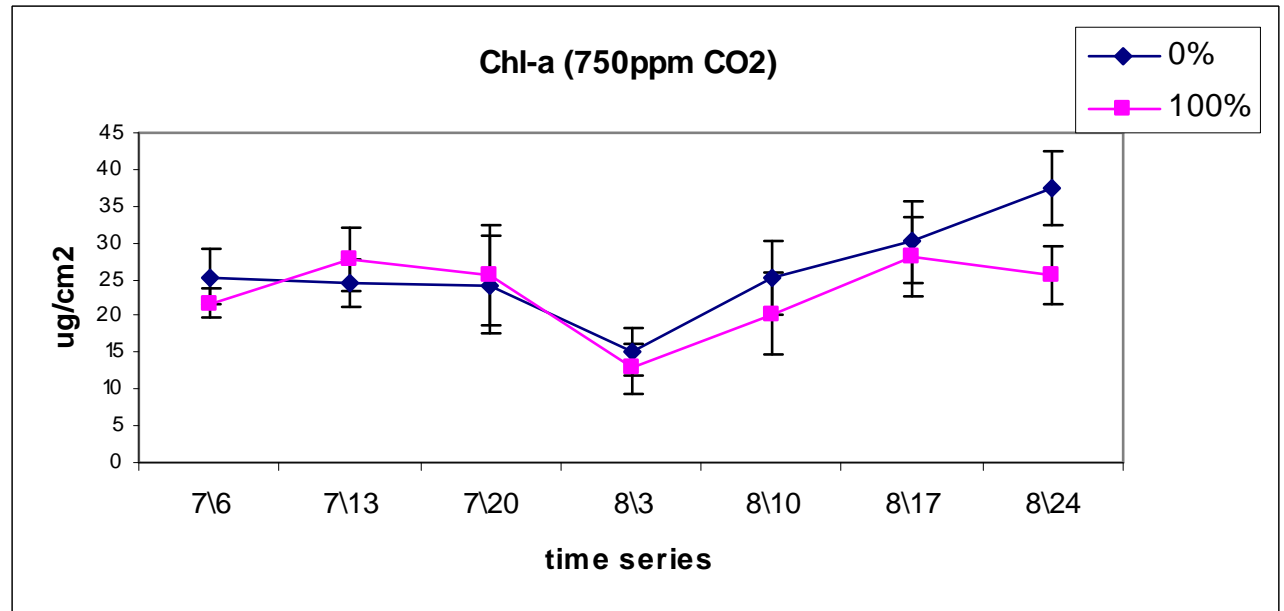
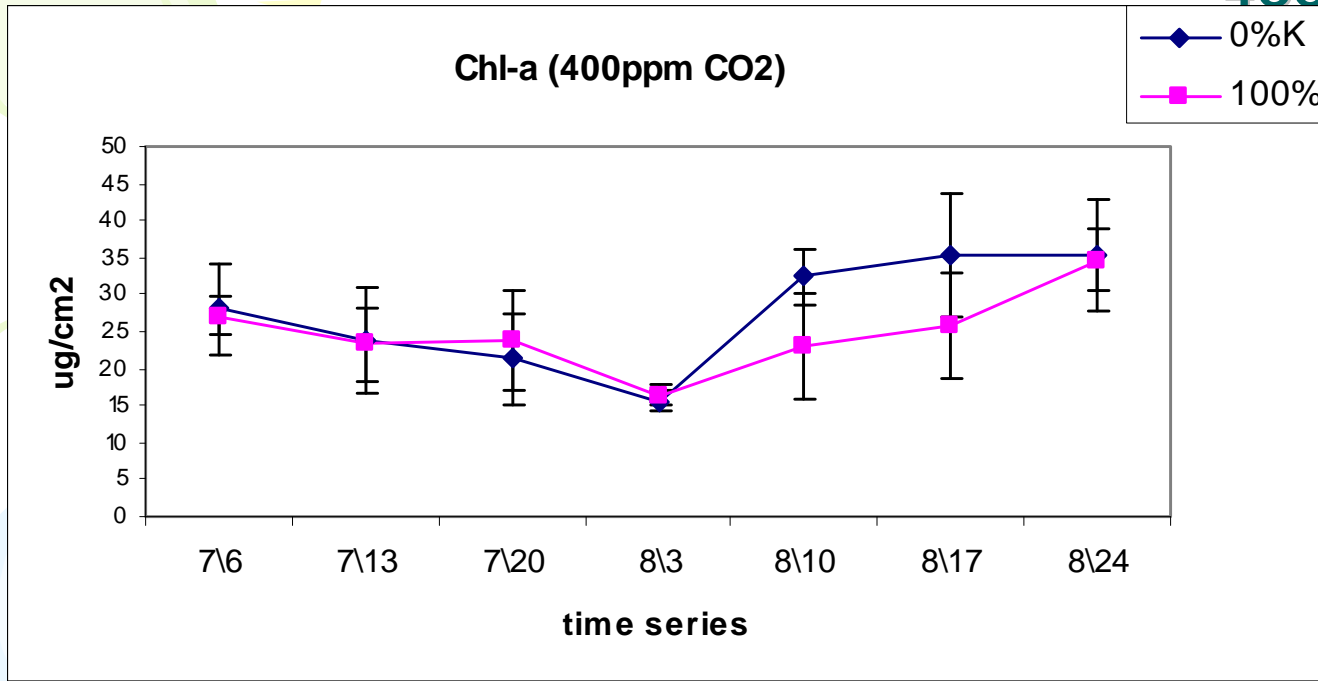
Leaf area (total) ( 400ppm CO2)



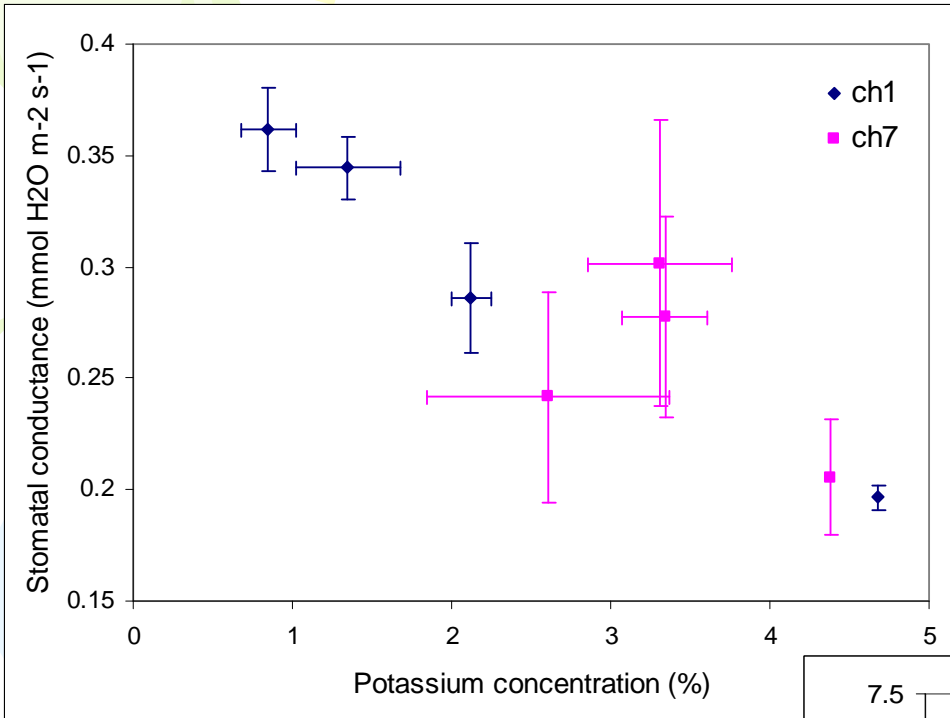
Leaf aera (750 ppm CO2)



# Chlorophyll-a content for 0% & control K treatment for 400 & 750 CO2 level



# Stomatal Conductance & Transpiration for 0% & control K treatment for 400ppm CO<sub>2</sub> level

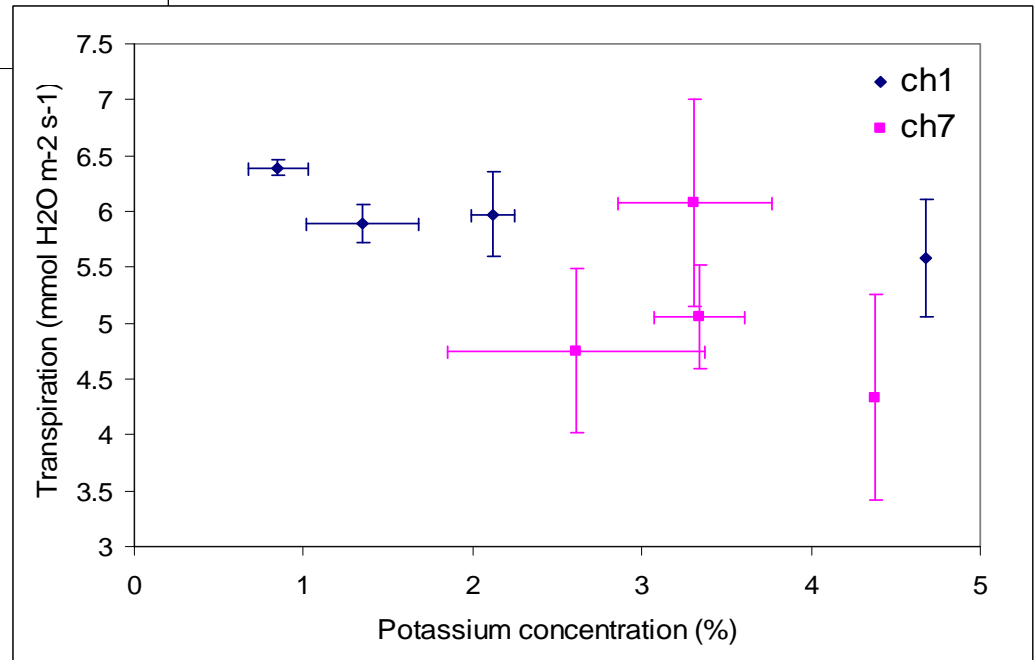


**Ch 1 - 0%K & 400ppm CO<sub>2</sub>**

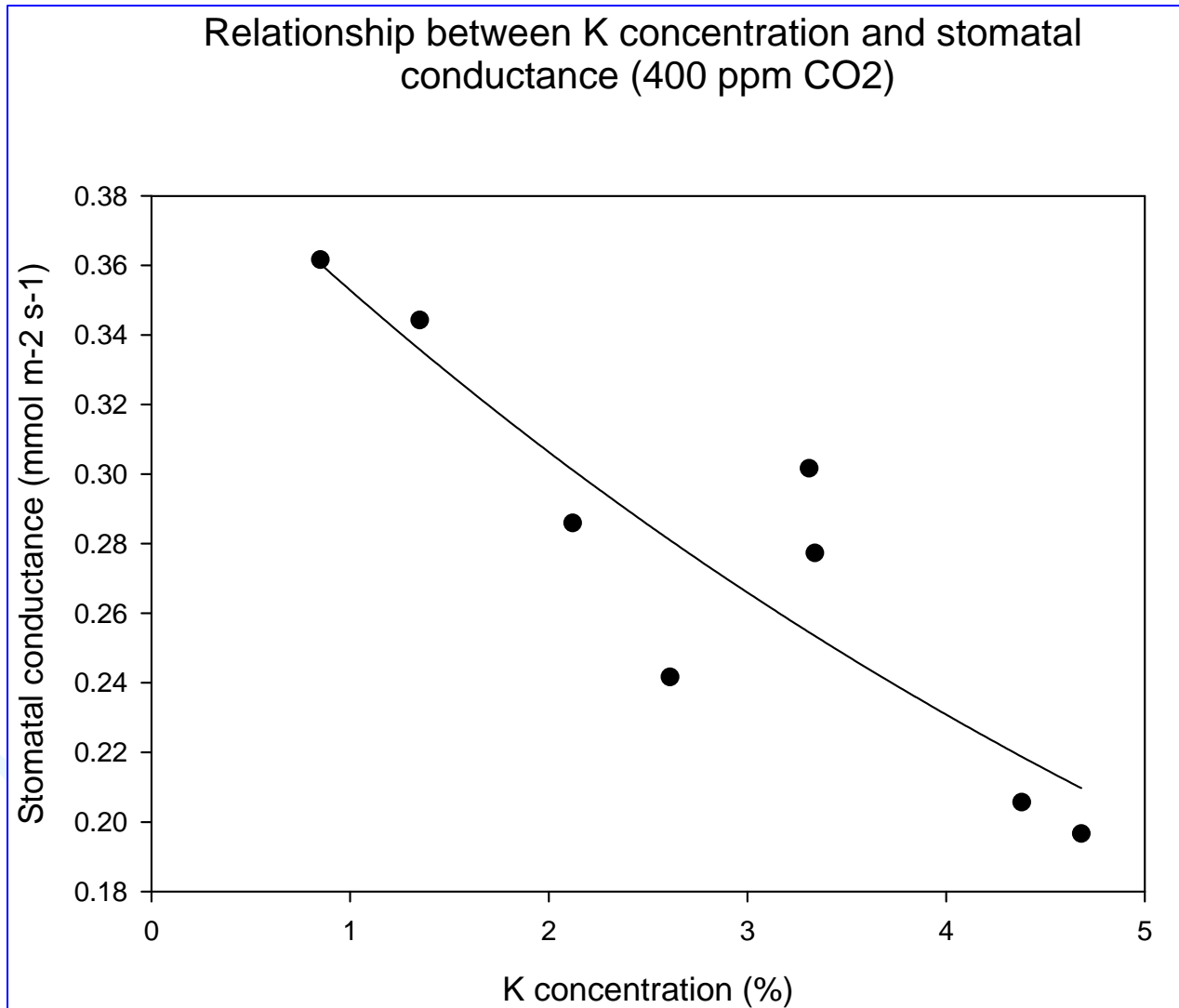
**Ch 7 - 100%K & 400ppm CO<sub>2</sub>**

**Ch 1 - 0%K & 400ppm CO<sub>2</sub>**

**Ch 7 - 100%K & 400ppm CO<sub>2</sub>**

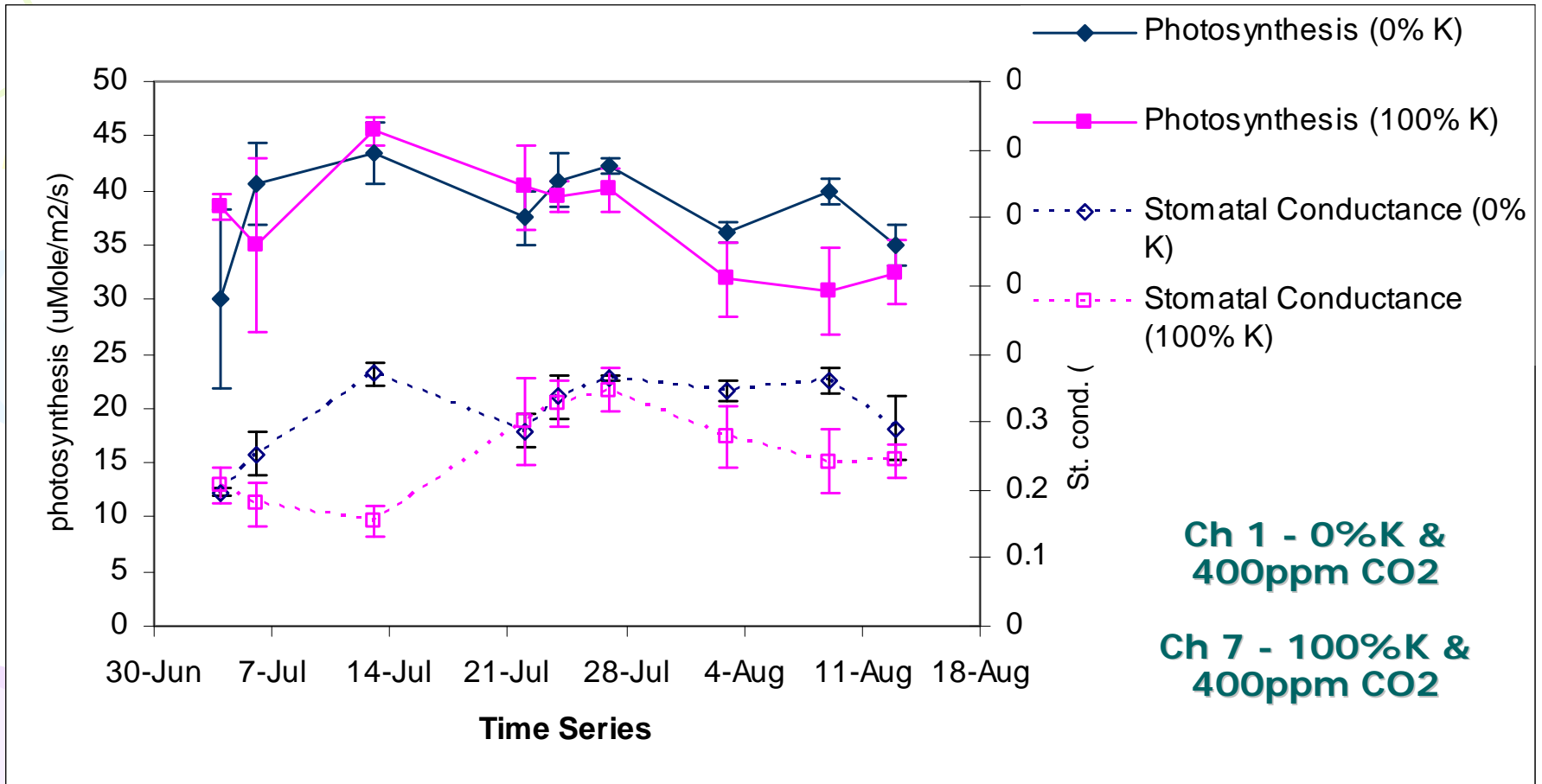


# Relationship between K Concentration and Stomatal conductance for 400 ppm CO<sub>2</sub> level

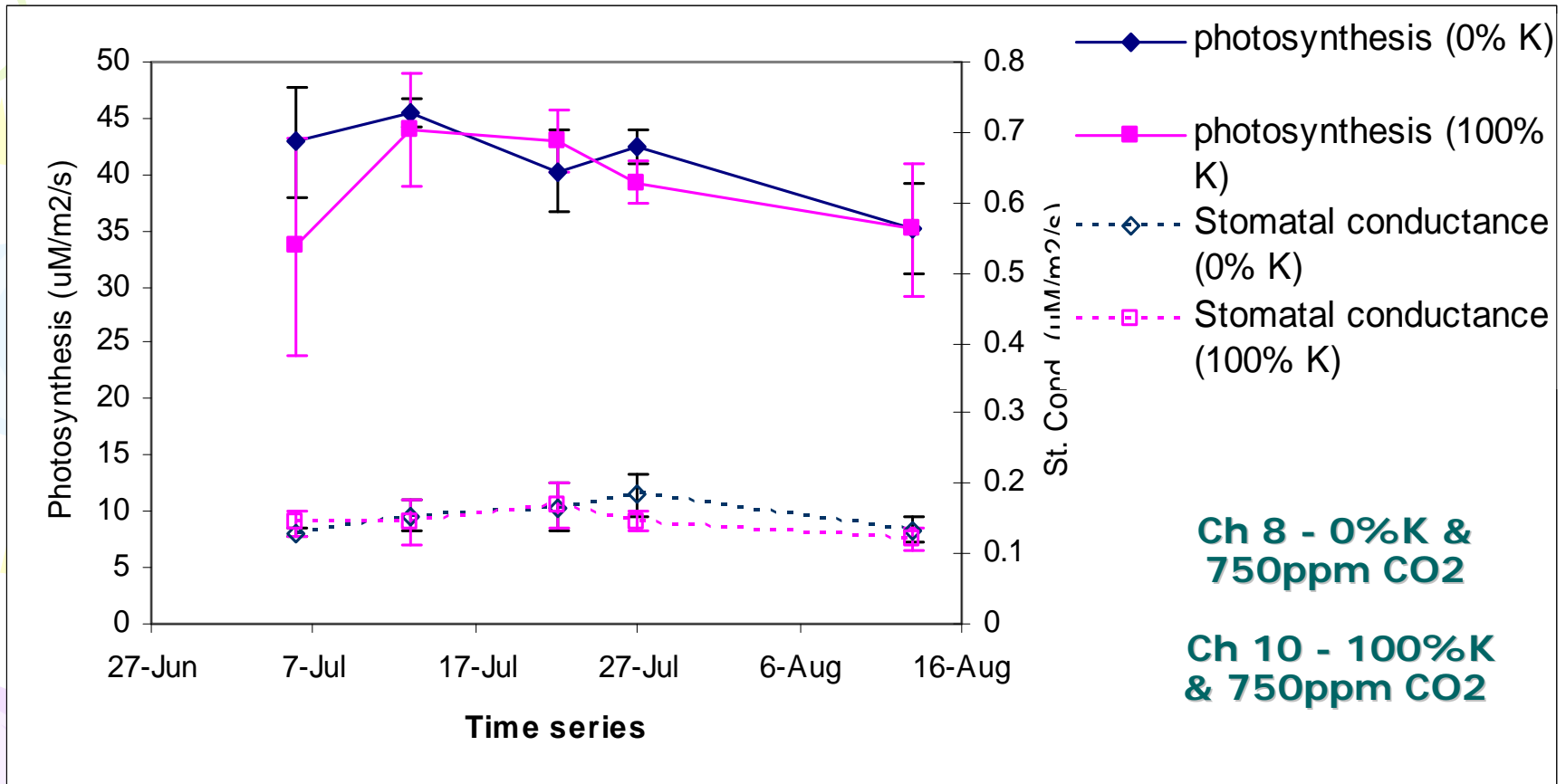


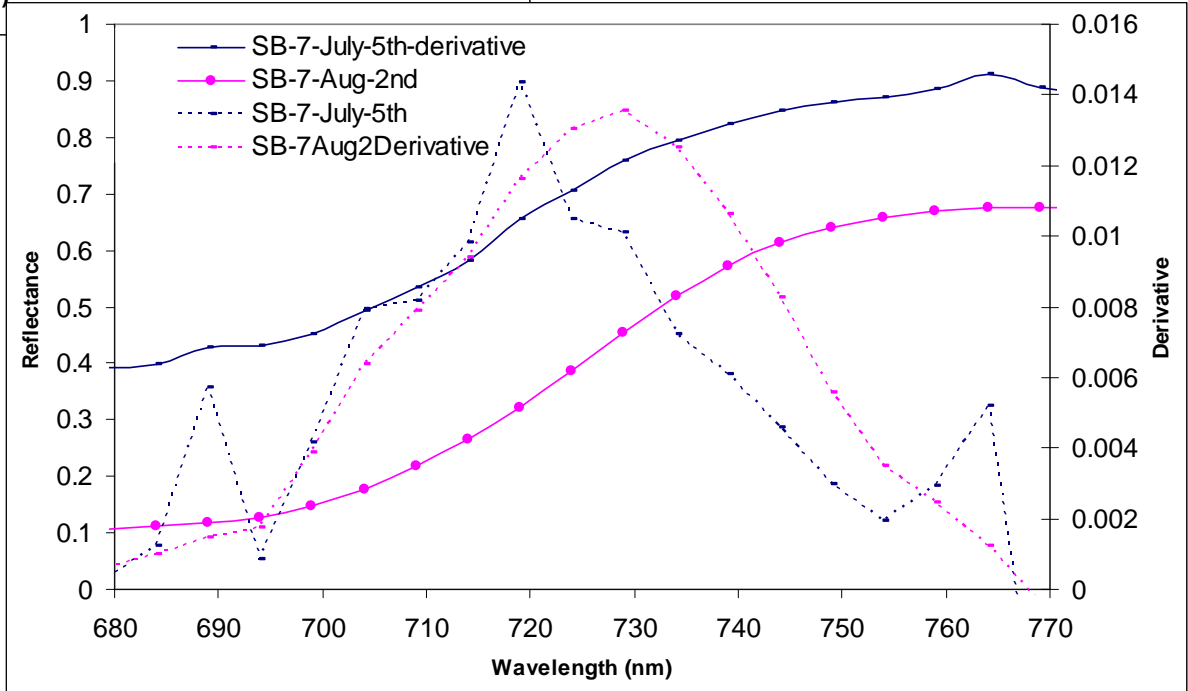
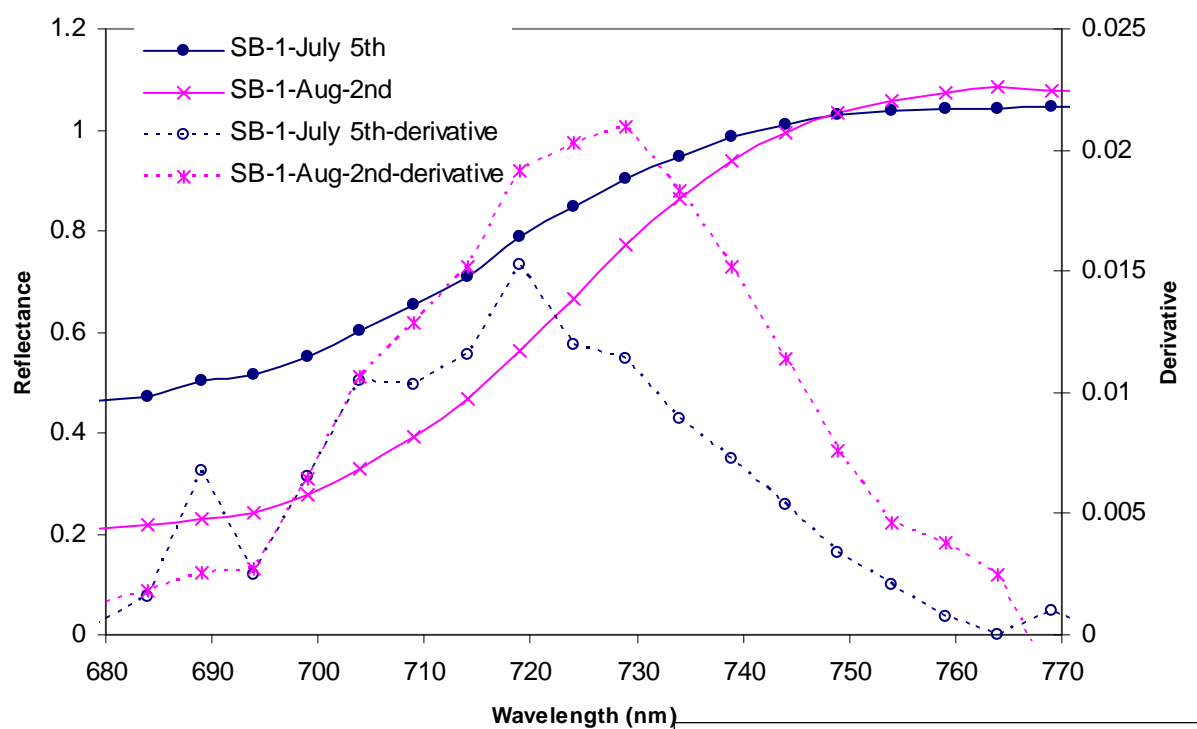
$$f=0.0937*\exp(-0.1414*x)+0.1558*\exp(-0.1415*x)+0.1572*\exp(-0.1415*x)$$

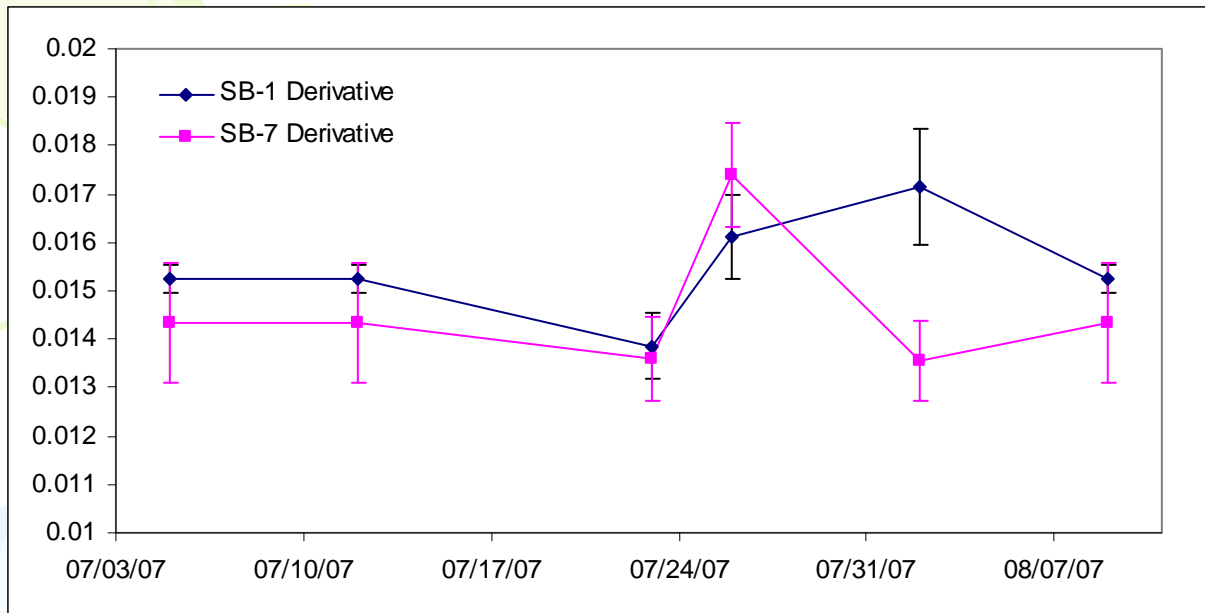
# Photosynthesis & Stomatal Conductance for 0% & control K treatment for 400ppm CO<sub>2</sub> level



# Photosynthesis & Stomatal Conductance for 0% & control K treatment for 750ppm CO<sub>2</sub> level





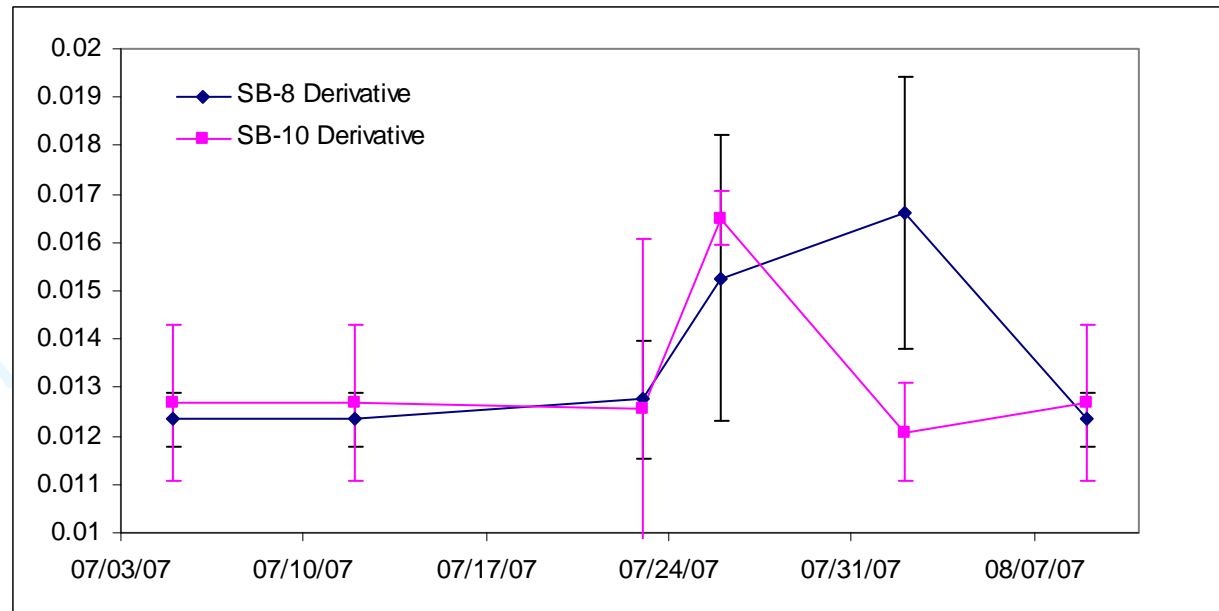


**Ch 1 - 0%K & 400ppm CO2**

**Ch 7 - 100%K & 400ppm CO2**

**SPAR 8 - 0%K & 750ppm CO2**

**SPAR 10 - 100%K & 750ppm CO2**





# Summary

- Potassium concentration decreased as the plants developed, and the overall potassium concentration of the treatment plants was lower than that of the control plants under both ambient and enhanced CO<sub>2</sub> environment.
- Leaf level stomatal conductance rate of the treatment plants was higher than that of the control plants late in the season. The increase in stomatal conductance was correlated to the decrease in potassium concentration. An exponential decay function between leaf potassium concentration and stomatal conductance was obtained.
- As the plants matured, the position of the red edge inflection point (REIP) in both treatment and control group shifted towards longer wavelength, but the magnitude at REIP of the treatment plants was higher than that of the control plants.