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PROJECT TITLE: Measurements of CO₂ nocturnal respiration as an indicator of stress response in peanuts

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FINAL REPORT:

Summary of 2005 Results
Research Title: Measurements of CO₂ nocturnal respiration as an indicator of stress response in peanuts
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Introduction
Due to rapid urban development during the last couple of decades in Georgia, demand for water has dramatically soared while competition for water availability between the rural and urban sectors has been on the rise. Furthermore, this water stress is likely to become a problem with numerous years of drought associated with climate variability and climatic changes. Thus, the optimization of irrigation based on available and required water resources and plant physiological thresholds is necessary to maximize water use efficiency.

The objectives are to study the nocturnal respiration rate in a peanut field and its relation with the occurrence of environmental stress and determine whether nocturnal CO₂ flux can be used as a tool for advance warning of water stress and irrigation management.

Methodology
Micrometeorological measurements were carried out over a non-irrigated peanut field near Vienna, Georgia. The measurements included CO₂ flux, evapotranspiration, net
radiation, sensible heat flux, soil water content, soil temperature and soil heat flux. The sensors used were high frequency CO₂ analyzer, three-dimensional sonic anemometer, net radiometer and soil CO₂, temperature and moisture sensors (Figure 1), weather station (Figure 2). The weather station monitored weather parameters such as air temperature and humidity, wind speed and direction, solar radiation, rainfall, etc. The data were logged every 30 minutes over the peanut growing season.

![Figure 1. Experiment setup for CO₂ respiration measurements.](image1)

![Figure 2. The Weather station instrumentation.](image2)

**Preliminary Results**
Figure 3. Preliminary results of CO$_2$ respired at night as a function of canopy temperature and soil water content during one dry period.

\[ F = 0.23e^{0.33T} \]
\[ Q_o = 0.65 \]
\[ R^2 = 0.51 \]

Figure 4. Preliminary results of nocturnal CO$_2$ flux during whole measurement period as a function of volumetric soil water content (PWP: permanent wilting point and FC: field capacity).

Preliminary results as shown in Figure 3 and 4, and help understand the characteristics of nocturnal CO$_2$ fluxes as a function of canopy temperature and soil water content. Without providing a full analysis of the data, the two figures illustrate well the dependence of the amount of photosynthates lost to the atmosphere by respiration and the underlying processes regulating this mechanism.