Measurements of CO_2 nocturnal respiration as an indicator of stress response in peanuts

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Introduction

Water stress is one of the most important factors affecting peanut yield and quality. Due to climate change, water stress is likely to become a problem of increasing importance in Georgia. Thus, the optimization of irrigation based on available and required water resources is necessary to maximize water use efficiency. Water stress reduces leaf transpiration rate, resulting in the rise of canopy temperature and enhance nocturnal respiration rate. Measurements of the nocturnal CO_2 flux and combination with micrometeorological approach over peanut field will give an indication of water stress.

The objectives are to study the nocturnal respiration rate and its relation with the occurrence of environmental stress and determine whether nocturnal CO_2 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 CO_2 flux, evapotranspiration, net radiation, sensible heat flux, soil water content, soil temperature and soil heat flux. The sensors used were high frequency CO_2 analyzer, three-dimensional sonic anemometer, net radiometer and soil CO_2 , temperature and moisture sensors, weather station (Fig.1. and 2.), and sodars (Fig. 3.).

Figure 1. Experiment setup for CO_2 respiration measurements.

Figure 2. Weather station.

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 3. Solar-powered sodar setup for wind speed and direction measurements.

Preliminary Results

• Nocturnal CO_2 flux during drying period was plotted as a function of air temperature, canopy temperature and volumetric soil water content in Fig. 4.

• During the flowering period (DAP: 48-55), a positive relation between nocturnal CO_2 flux and air temperature (Fig. 4a) and canopy temperature (Fig. 4b.) were found while a negative relation was found between nocturnal CO_2 flux and volumetric soil water content (Fig. 4c.)

• Nocturnal CO_2 fluxes during throughout the measurement period were plotted as a function of volumetric soil water content (Fig. 5).

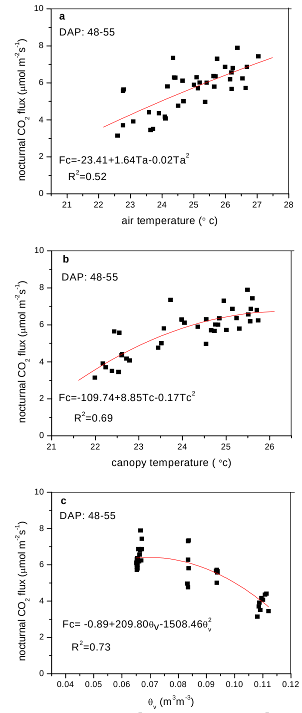

Figure 4. Preliminary results of nocturnal CO_2 flux during drying period (flowering) as a function of a) air temperature b) canopy temperature c) volumetric soil water content.

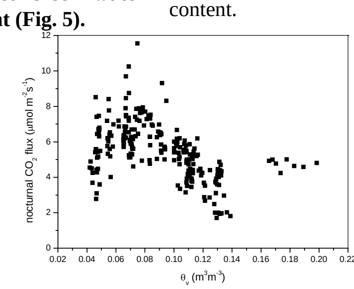

Figure 5. Preliminary results of nocturnal CO_2 flux during whole measurement period as a function of volumetric soil water content.

Experiment Planning

•This summer, we propose to use a new method to separate soil respiration from the respiration of the peanut plant. We propose to collect further data showing the sensitivity of CO_2 fluxes to climatic parameters for peanuts grown in different soils and climatic conditions. We will also make more frequent leaf area index measurements.

A nocturnal boundary layer budget experiment which makes use of Helium filled balloons tethered and on which CO_2 concentration sensors are mounted will be used to determine the nighttime CO_2 budget of the peanut field.

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