NATIONAL PEANUT BOARD / SOUTHEAST PEANUT RESEARCH INITIATIVE

FINAL REPORT for WORK DONE UNDER RESEARCH AGREEMENT # 25-21-RF328-768 GACCP TRISTATE PROJ BEASL

INSTITUTION:	University of Georgia
PROJECT TITLE:	Determination of CO_2 Nocturnal Respiration and Microclimatic Parameters for use in an Early Warning Detection of Environmental Stress in Peanuts
RES. AGR. NO.:	25-21-RF328-768
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FINAL REPORT:

In 2006, micrometeorological measurements were carried over two contrasting large areas of peanut crop, one a non-irrigated peanut field and the second an irrigated peanut field at the SWGA Research and Education Center in Plains, Georgia. The soil respiration separated into autotrophic and heterotrophic respiration was monitored using soil CO_2 gradient method combined with the root-exclusion method. An independent method of examining soil respiration was also used with Li-8100 soil chambers in order to compare soil CO_2 gradient method. The results show that nocturnal CO_2 flux corresponds to ecosystem respiration was demonstrated to be influenced by soil moisture, temperature, and peanut growth stage. Daytime CO_2 flux changed significantly with changes in radiation. The values of soil CO_2 efflux measured by the CO_2 gradient method were higher than the results of the soil chamber method.

Based on the experiments and results of 2006, experiments were designed and carried out in 2007 over two contracting large areas of peanut crop, one a non-irrigated peanut field at Cross sons farm in Unadilla and the second an irrigated peanut field at the SWGA Research and Education Center in Plains. Continuous measurement of CO_2 and water vapor exchanges were carried out using the eddy-covariance technique throughout the growing season (Fig.1). In situ weather station was also carried out. Other supporting measurements conducted include soil temperature, soil water content, soil heat flux, air and canopy temperatures, net radiation, and wind velocity and temperature profiles.

Fig. 1 The eddy-covariance system.

Periodic measurements of soil CO_2 efflux were made using the Li-8100 soil survey chamber (Fig.2). By combining the chamber method and the root-exclusion method, we try to separate total soil respiration into autotrophic and heterotrophic respiration.

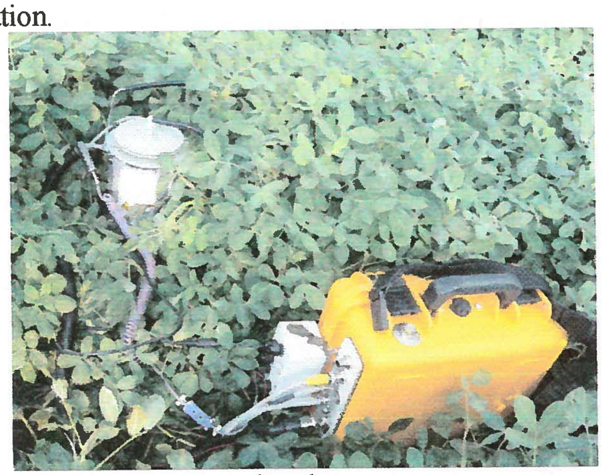

Fig. 2 Li-8100 soil survey chamber.

To understand the response of soil respiration to rainfall variability, soil surface CO_2 flux was continuously measured using a Li-8100 soil automated chamber (Fig.3). This experiment was conducted over an irrigated peanut field. Soil temperature and volumetric soil water content were also measured continuously with the soil CO_2 flux and recorded on datalogger.

Fig. 3 Li-8100 soil automated chamber.

The results indicate that the maximum total soil respiration and autotrophic (root) respiration were predicted at soil water content of about 0.135 m3/m3 and were near zero under extremely dry soil condition (Fig. 4).

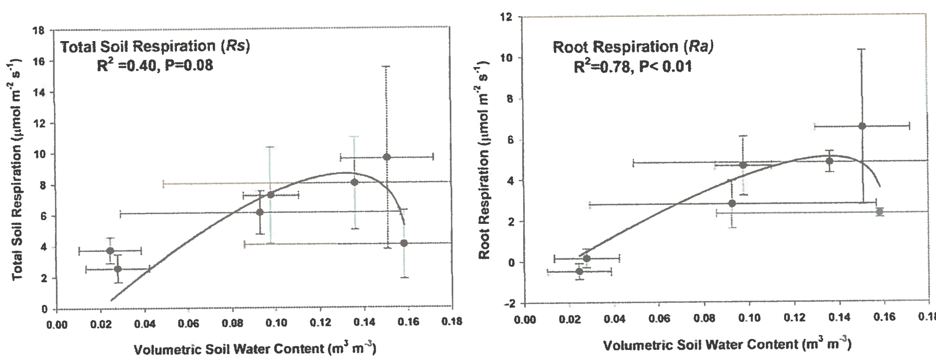

Fig. 4 Response of total soil respiration and root respiration to soil water content.

The seasonal variation of LAI correlated with the seasonal variation of total soil respiration and autotrophic respiration (Fig. 5), suggesting that photosynthetic activity significantly regulates respiratory release of CO_2 from soil.

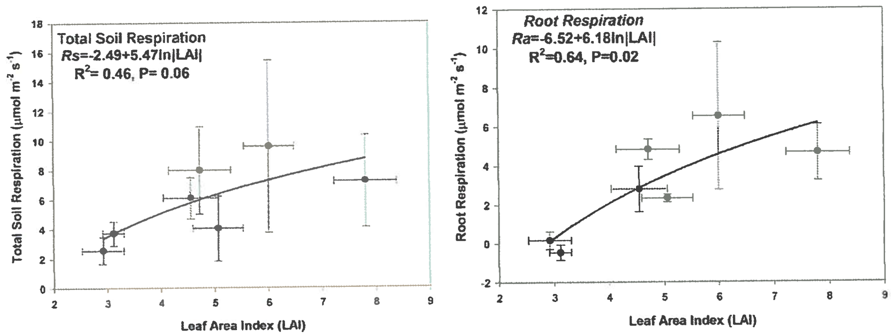

Fig. 5 Response of total soil respiration and root respiration to LAI.

During rainfall, daily soil CO_2 efflux decreased because high soil water content at surface layer decreased soil air porosity and oxygen availability in soil. Soil CO_2 efflux immediately increases after rainfall and then declines to the pre-rainfall value (Fig. 6).

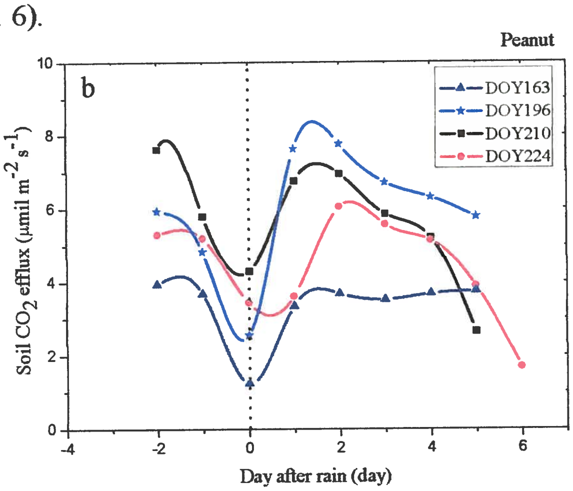

Fig. 6 Response of soil respiration after rain fall event.

We also found that the enhancement of soil CO_2 efflux after rainfall was higher for higher amount of rainfall event and the decrement of soil CO_2 to the pre-rainfall value was slower as compared with smaller amount of rainfall event. The decrement of soil CO_2 efflux to the pre-rainfall value in the peanut field was positively correlated with the amount of rainfall.

PUBLICATIONS

1. Xiaofeng, G., Chayawat, C., Pingintha, N., Zhang, G. and M.Y. Leclerc. Flux-variance method to estimate the heat, water and carbon exchange under convective conditions. Ameriflux Annual Meeting, October 17-19, 2007, Boulderado Hotel, Boulder, Colorado
2. Pingintha, N., M. Y. Leclerc, G. Zhang, J. Hong, A. Karipot, J. P. Beasley, D. Rowland, and C. Senthong. Measurement of CO_2 Exchange in a Peanut Field: Response to Temperature and Soil Moisture. The Southern Branch Annual Meeting, February 2-5, 2008, Dallas, Texas

3. Chayawat, C., M. Y. Leclerc, G. Zhang, J. Hong, A. Karipot, J. P. Beasley, D. Rowland, and C. Senthong. Response of Soil CO_2 Efflux to Rainfall Variability in Wheat and Peanut Fields. The Southern Branch Annual Meeting, February 2-5, 2008, Dallas, Texas
4. Pingintha, N., C. Chayawat, M. Y. Leclerc, G. Zhang, J. Hong, A. Karipot, J. P. Beasley, D. Rowland, and C. Senthong. Measurements of CO_2 Exchange in a Peanut Field: Response to Water Stress. Georgia Peanut Commission Meeting, February 13, 2008, Tifton, Georgia
5. Pingintha, N., M. Y. Leclerc, J. P. Beasley, J. Hong, G., Zhang, N. L. Dias, and C. Senthong. Environmental Controls on the CO_2 Exchange in a Peanut Field. 28th Conference on Agricultural and Forest Meteorology, April 28- May 2, 2008, Orlando, Florida