NCR-101 Report from Georgia

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Envirotron

Rainout Shelters. In 2004 the Envirotron acquired four rain-out shelters on the Griffin Campus. These shelters provide a facility for researchers to conduct experiments on drought tolerance of plants growing on plots measuring 12 by 4 meters. When the facility was acquired it was in need of renovation which has been carried out over the last two years. Each shelter consists of a steel framed shed covered in fiberglass roofing. The shelter moves on six castors, running on steel tracks. A 12V DC motor is driven by a deep cycle marine battery, turning two drive wheels at one end of the shelter. The motor is actuated by a rain gauge and the shelters then roll over the plots to shield them from rain.

Envirotron Chambers. The chambers were upgraded with CMP400 V3 controllers in 2004. To date one of these new controllers has failed and required replacement. There have been no other equipment changes or upgrades.

Envirotron Greenhouses. In 2004 six of the eight greenhouses at the Envirotron were retrofitted with Wadsworth step 50 controllers. In 2005 the remaining two greenhouses were fitted with the new controllers. All greenhouses were retrofitted with aluminum housing around the evaporative pads to reduce leaking of air around the pads and thereby increase airflow (and so cooling) through the pads.

INTERACTIVE EFFECTS OF ELEVATED CO_2 AND TEMPERATURE ON GROWTH AND DEVELOPMENT OF A SHORT- AND LONG-SEASON PEANUT CULTIVAR

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Temperature and CO_2 are two environmental factors associated with climate change. It is expected that elevated CO_2 will increase crop production. However, other environmental factors such as temperature, along with management practices (e.g. cultivar) could modify a crop's response to CO_2. This study was conducted to determine the effects of elevated CO_2, temperature, and their interaction on growth, biomass production, partitioning and seed yield of two peanut (Arachis hypogaea L.) cultivars. It was our goal to find the magnitude and direction of mitigation effect of CO_2 while peanut plants were exposed to above optimum temperatures and if there was any variation in response between these two cultivars. Peanut plants were grown under non-limiting water and nutrient supply, and exposed to day/night air temperatures of 33/21˚C (T_A), 35.5/23.5˚C (T_A+2.5˚C), and 38/26˚C (T_A+5˚C). Light was provided by a mixture of high pressure sodium and metal halide lamps, giving an average *PPF* at canopy height of 650 µmol $m^{-2}s^{-1}$. Carbon dioxide levels of 400 and 700 µmol mol^{-1} were used. The selected range of temperatures was based on summer temperatures experienced in Southwest Georgia. LAI of both cultivars responded positively, 28.3% and 49.3% for Pronto and Georgia Green respectively, to elevated CO_2. Overall, elevated CO_2 alone resulted in a significant increase in total biomass at final harvest across all temperatures ($P < 0.0001$), but decreased seed yield ($P < 0.0005$), except for Georgia Green at T_A + 5˚C. At ambient CO_2, increasing temperature to T_A + 2.5˚C, increased the biomass at harvest, but a further increase in temperature by T_A + 5˚C decreased biomass. Both higher temperatures compared to T_A reduced the relative response of total biomass to CO_2 of both cultivars. The two cultivars responded differently to CO_2 for seed yield across temperatures. For Pronto the relative response to CO_2 increased at T_A + 2.5˚C but decreased at T_A + 5˚C. Georgia Green showed an increasing trend of relative response to CO_2 when the temperature increased. The two cultivars responded differently to CO_2, temperature and the interaction of these factors for various growth traits. Final seed yield response to CO_2 depends on the sensitivity of individual cultivars to temperature, especially during the reproductive stage.

COTTON GROWTH AND DEVELOPMENT UNDER DIFFERENT IRRIGATION REGIMES

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The main goal of irrigation scheduling is to use water efficiently and to obtain high and stable yields. Most of the cotton irrigation studies have been conducted under rainfed conditions, where supplemental water was provided through irrigation, if needed. There is insufficient information about the response of cotton when all water applications are completely controlled throughout the growing season. The objectives of this study were a) to determine the impact of different irrigation scheduling regimes under dry conditions on cotton growth and development; b) to evaluate the performance of the CSM-CROPGRO-Cotton model for simulating growth and development of cotton under different irrigation treatments and for simulating irrigation scheduling. Four rainout shelters were used, corresponding to four different irrigation thresholds (IT) treatments - 30%, 40%, 60%, and 90% of threshold along with variable irrigation management depths according to the development of the crop. The irrigation events were triggered when the soil water content in the irrigation management depth dropped below the specified IT. The Cropping System Model CSM-CROPGRO-Cotton model was used to define the IT treatments by estimating the timing of irrigation and the amount of water to apply. The model requires daily weather data, including maximum and minimum temperature, solar radiation and precipitation as input. Thus, actual weather data were used until the current date and historic daily weather data from the past 10 years were used to project until the end of the growing season. Growth analysis, including leaf area index (LAI), plant height and dry matter accumulation was conducted every 18 days. Yield and yield components were obtained at final harvest. In 2004, cotton seed yield ranged from 1,981 kg ha^{-1} for the IT of 40% to 2,963 kg ha^{-1} for the IT of 60%. The dynamic crop growth model CSM-CROPGRO-Cotton can be a promising tool for irrigation scheduling. However a variable irrigation management depth should be used and a correct characterization of the soil properties is needed.

A NOVEL IRRIGATION CONTROLLER FOR WATERING AND SIMULATING DROUGHT STRESS IN POTTED PLANTS

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Efficient watering systems which can irrigate substrate to a desired level and supply plants with just the amount of water required for normal plant growth are currently not available. These systems, if developed, can reduce wastage of irrigation water due to excess application, and subsequent leaching and runoff, and aid growers to cope up with the ever increasing restrictions on water-use by many state governments in US. In this study, we developed an irrigation controller that irrigates substrate to a set-point (volumetric water content, θ) and maintains θ close to set-point for several weeks. The controller uses calibrated ECH_2O moisture sensors (Decagon Devices, Pullman, WA) interfaced with a CR10x datalogger and solenoid valves connected to SDM CD16 AC/DC controller. The datalogger measures the θ of the substrate every 20 min. When the θ of the substrate drops below the set−point, the controller opens a solenoid valve, which results in irrigation. Substrate volumetric water content is maintained near a constant level as the datalogger is programmed to increase θ by 2 to 3 % during each irrigation. Using this controller with bedding plants *(Salvia splendens, Catharanthus roseus, Petunia hybrida,* and *Impatiens walleriana)* , we were able to maintain four distinct levels of θ for a prolonged period (40 days), regardless of changes in plant size and environmental conditions. The daily average θ maintained was slightly higher (within 2 to 3% on any particular day) than the set-point. When the θ measured and maintained by ECH_2O probe was tested in a separate experiment using measurements by another ECH_2O probe placed in the same container, the θ measured by both probes was found to be similar.