Final Report

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Report on the project entitled "Identification and Development of Peanut Varieties with Increased Drought Tolerance for Virginia- Carolina Region"

In spite of its general drought tolerance, peanut can be affected by reduced precipitation especially at certain growth stages such as flowering. In Virginia where irrigation availability is limited, precipitation amount or its distribution are major limiting factors for peanut yield and production every year. To increase production under dryland cropping systems, peanut cultivars would have to be drought tolerant and use water more efficiently.

Our long-term research goal is to develop physiologically- and molecular-based selection criteria to identify peanut cultivars with increased adaptation to water-limited environments and short seasons, and the short-term objectives for the first proposed phase of our research are 1) To identify the most drought tolerant genotypes in the Peanut Variety and Quality Evaluation (PVQE) tests for yield, value per acre, grade and quality characteristics, and 2) To determine what physiological characteristics are associated with the agronomic ones.
In 2009, thirty peanut cultivars and advanced breeding lines were planted at 6 locations in VA, NC, and SC. At one location in VA, Tidewater AREC, 3 planting dates were considered: April 20, May 1, and May 15. At one location in NC, 2 planting dates were considered: April 30 and May 14. At all other locations only one planting date was performed, starting from April 24 to May 15. At all locations each cultivar and planting date were replicated 3 times, and the experimental design was a randomized complete block. Agronomic, quality, and grade characteristics are being evaluated for all locations. They are being compared with physiological characteristics measured throughout the 2009 growing season at TAREC and Martin County, NC. Physiological characteristics measured this summer are presented in Table1. Even though this growing season was very humid, the end part of June was dry for many crops including peanut. We managed to take physiological measurements before drought, during the moisture stress period and post stress, after rains returned (Table 1). Except for the specific leaf area, significant differences were found among peanut varieties for all the physiological measurements. There were significant differences for pod yield among the 30 genotypes with no interactive effect due to location and planting time. The first 10 genotypes with greatest yield at Suffolk, Martin, and Southampton in 2009 were Bailey (6118 lb/A), N05018 (6115 lb/A), NC-V 11 (6017 lb/A), VT 024077 (6083 lb/A), VT 003194 (5984 lb/A), VT 003200 (5954 lb/A), N05008 (5953 lb/A), N05024J (5940 lb/A), Phillips (5932 lb/A), and N05007 (5917 lb/A). These yields are not yet adjusted for the grade characteristics; at this time we are in the process of grading the peanut samples. Genotypes with the greatest WUE measured as the ratio of leaf CO_2 assimilation rate and stomatal conductance (WUE_{CO2}) were N04074FCT, N05006, N05008, N05024J, VA-98R, VT003191, and VT024051. Genotypes with more vine production (biomass) had a greater number of pods than the ones with less vine growth. Based on the step wise regression statistic, the physiological characteristics closest related to yield in 2009 were leaf

CO_2 assimilation rate, WUE_{CO2} and pod number at post-stress, biomass before stress, and the number of stomata per cm_2 of leaf.

Table 1. Drought events and physiological measurements schedule at TAREC in 2009

Physiological Measurement	Date of Measurement	Drought event	Relevance to Drought Tolerance
Biomass	June 20, 28 July 2, 13 August 3, 7 October 23 @ harvest	Pre-drought Drought Post-drought Post-drought	Greater biomass produces greater yield
Pod Number	July 2, 13 August 3, 7 October 23 @ harvest	Drought Post-drought Post-drought	Important component of harvest index (more biomass towards pods than vines)
Stomata Density	June 15 August 21	Pre-drought Post-drought	Leaves with greater stomata density transpire more and uses soil moisture faster
Gas Exchanges - CO_2 Assimilation Rate - Transpiration Rate - Stomata Conductance - Transpiration Ratio	June 16, 27 July 9	Pre- and Drought Post-drought	Under drought, stomata close (low conductance), transpiration ceases (high leaf temperature), and sugar production is low due to low CO_2 assimilation Intrinsic water use efficiency (WUE)
Chlorophyll Content (Relative leaf color)	June 3, 22 August 9	Pre- and Drought Post-drought	Drought decreases chlorophyll content and, because of it, CO_2 assimilation
Specific Leaf Area	June 3, 22 August 9	Pre- and Drought Post-drought	Leaves with less specific area are thicker and more drought tolerant
Leaf (canopy) temperature	June 10, 17, 24, 29, 30 July 1, 7, 8, 9	Pre- and Drought Post-drought	Hotter leaves denote more stress
^{13}C discrimination	Post harvest	Cumulative	A measure of the WUE, and it is less when efficiency is higher

Very interesting was that average pod yield obtained in 2008 at 5 locations was correlated not only with vine biomass and pod number obtained this year, but also with the relative leaf color. This data suggest that biomass, leaf CO_2 assimilation rate, WUE_{CO2}, pod number, the number of stomata per cm_2 of leaf, and leaf color can be used as indicators of pod yield in peanut. However, to fully understand the relationships between the agronomic and physiological traits an additional year of research is necessary.