Identification of physiological and metabolic mechanisms as indicators of drought tolerance in peanut plants

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Drought stress often leads to yield losses in crops with great monetary impact for producers. Breeding programs are constantly seeking for traits in cultivated peanut plants or wild types that could potentially benefit the plant with higher tolerance to drought without reducing yield. One of the most common methods of selection for improved drought tolerance is based on yield. In addition to yield, physiological and metabolic mechanisms could be identified as components of drought tolerance for selection of new lines. Identification of these mechanisms related to drought tolerance in peanut plants could potentially assist in breeding and biotechnology programs on the development of peanut cultivars with improved tolerance to drought.

To this end, ten peanut genotypes, including commonly grown in Georgia and lines selected at the ARS/USDA and the University of Georgia that vary in drought tolerance/sensitivity, were planted under field conditions at Gibbs Farms, University of Georgia, Tifton Campus in 2017. The irrigation treatments consisted of a well-watered treatment and water-deficit stress. The drought treatment was initially planned to be imposed at three different timing: early stress [30-70 days after planting (DAP)], mid-season stress (70-110 DAP), and late-season stress (110-145 DAP). Due to hurricane Irma early September, early drought was the only stress period for this season. A rainout shelter was used to cover the water-deficit stressed plots and prevent rain/irrigation on the plants from this treatment. Leaf samples were collected for biochemical analyzes, such as enzymatic and nonenzymatic antioxidants from the defense system pathway and pigments, as well as for thermal tolerance of photosystem II. After the stress period, the stressed plants were well watered as needed.

Pigments concentration increased with progress of drought followed by a decrease after recovery. Photosystem II seemed to be tolerant to high temperatures. Pod weight was decreased by early drought. Analysis of antioxidant from the defense system pathway is currently being performed in the laboratory. Variation in drought and heat tolerance exists among the genotypes, and further studies are required to clarify and validate the contribution of metabolic mechanisms in drought tolerance in peanuts.