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 2018. 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 (70-130 DAP), and late-season stress (130-145 DAP). Due to hurricane Michael early October, late-season stress was not applied to 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 enzymatic and nonenzymatic antioxidants from the defense system pathway and pigments, as well as for photosynthetic performance. After the stress treatments, the stressed plants were well watered as needed.

Genotypes varied in metabolic and photosynthetic responses to drought. Not all enzymes from the defense system pathway were used by peanuts as a mechanism to tolerate a drought period. Pigment content increased in stressed plants likely due to a concentration effect. Photosynthetic efficiency of the leaves was affected by drought, more drastically in plants under water-deficit stress for 40 consecutive days. Yield was highly variable. Since plants were not harvested until November 30 due to excess of rainfall, yield data will not be associated with the physiological and biochemical responses of peanut plants to drought. A more detailed analysis of the dataset is being conducted to identify and group the traits that are more associated with tolerance to drought conditions. Further studies are required to assess and validate the contribution of metabolic mechanisms in drought tolerance in peanut plants.