Anatomical Features Contributing to Higher Peanut Yields under Drought and Heat Stress

Cristiane Pilon, Craig K. Kvien, Corley Holbrook, and Peggy Ozias-Akins

Many anatomical features related to crop adaptation to drought have been suggested as traits that might aid development of improved drought tolerant cultivars. Root architectural traits including fine root diameters, root length, and root length densities in lower soil layers are particularly well established as traits likely to improve crop adaptation to water limitations. Changes in leaf epidermal tissue and cell structure during drought are also known to affect whole plant water use in response to drought and heat. The identification of peanut lines with root anatomical traits with enhanced tolerance to periods of drought and heat could potentially assist in breeding and biotechnology programs on the development of new peanut cultivars with improved tolerance to drought and heat conditions.

To this end, three peanut genotypes, Georgia-06G, C76-16, and C431-1-1, were planted in rhizoboxes in a greenhouse located at the University of Georgia, Tifton Campus in 2018. The irrigation treatments consisted of a well-watered treatment and water-deficit stress. The drought treatment was imposed at 21 days after planting for 20 days. At the last day of stress, aboveground measurements of gas exchange and growth were performed. Roots were assessed for growth and distribution as well as anatomical features.

Drought impaired aboveground growth of the three genotypes by reducing leaf area, plant height and dry matter of leaves and stems. Gas exchange was also affected by drought, with higher stomatal closure in stressed plants and lower photosynthetic activity, being more noticeable for the C76-16. Photosystem II was not affected by the water deficit conditions. With regards to root anatomy, the overall stele area as well as the vascular bundle area were not negatively affected by drought. However, the xylem vessel area was smaller in roots from stressed plants of all genotypes. Maximum xylem vessel size differed between water regimes for Georgia-06G and C76-16, whereas no difference was observed in maximum xylem vessel size between well-watered and drought-stressed plants from C431-1-1. Minimum xylem vessel size was not significantly different between water regimes for all genotypes. A more detailed analysis of the dataset is being conducted to evaluate whether these root anatomical changes could serve as a mechanism of tolerance to drought in peanuts. Further studies are being planned to assess the contribution of this adaptation mechanism on final yield of peanut genotypes.