Physiological Responses of Amaranth Genotypes Subjected to Heat and Drought Stress on a DiTech Automated Phenotyping System

Understanding crop species' physiological responses to abiotic stress is critical for improving climate resilience. This study, conducted at the Donald Danforth Plant Science Center in collaboration with Tennessee State University, examined the growth and stress adaptation of three amaranth genotypes: TSU Tiger Amaranth, Hopi Red Amaranth, and Redroot Pigweed under controlled environmental conditions.

Plants were transported from Tennessee State University to the Danforth Center, where they were acclimated before placement into DiTech phenotyping system in two growth chambers. Chamber 252 (optimal temperature chamber) subjected plants to drought (250 g water nightly) and control (1 kg water nightly) treatments at a stable 30°C day/22°C night. Chamber 253 (heat chamber) evaluated heat stress (38°C day/30°C night) alongside the same drought and control treatments. The experiment lasted from August 13 to September 5, with 40 plants total (20 per chamber), including 8 TSU Tiger, 8 Hopi Red, and 4 Redroot Pigweed per chamber.

At the start of the experiment, three plants per genotype had their roots washed to assess initial root-to-shoot biomass ratios. Plants were grown in ProMix-FPX soil, and environmental conditions were continuously monitored. The DiTech system recorded canopy area, height, and biomass estimation via automated imaging every three minutes. Additional monitored parameters included soil moisture, temperature, relative humidity, light intensity, water used, soil weight, water weight, and water use efficiency. Root and shoot biomass were measured again at the experiment’s conclusion.

Time-series ANOVA was used to analyze treatment effects. Results suggest TSU Tiger exhibits greater drought resistance, while Hopi Red accumulates more biomass under optimal conditions, contributing to amaranth breeding and agronomic strategies for climate adaptation.