Principal Component Analysis of Heat and Drought Stress Comparing Two Cultivated Grain Amaranth Varieties to Native Pigweed Amaranth.

Amaranths are C4 plants mostly native to the New World. They are classified into weed amaranths known as pigweeds (e.g. Amaranthus.retroflexus) and cultivated pseudo-cereal species known as grain amaranths (A¡.cruentus and A¡.hypochondriacus). This study examined the physiological responses of three amaranth types —cv. TSU Tiger, and cv. Hopi Red, versus wt. (wild type) Redroot Pigweed—which were transplanted from field conditions in Nashville TN and then grown under heat and drought stress using a DiTech physiology platform. Eight plants each of the cultivars and four of the weed were grown in the system for a three-week period during which the DiTech platform automatically weighted the plants and pots every three minutes to derive key traits about plant biomass accumulation, water use efficiency and evapotranspiration. Comparisons were made between optimum temperature growth chamber maintained at 26°C average, versus a heat stress chamber at 34°C average. Within each chamber, half the plants each were subjected to drought and well-watered treatments. Principal Component Analysis (PCA) analyzed physiological responses based on key traits, including net plant weight (biomass accumulation), stress degree (growth reduction under stress), and resilience rate (recovery capacity). Additional factors were assessed, including DryPot_Res_Insert, DryPot_Res_Insert_Comps (resilience under dry soil), Res (overall recovery), and SoakAllSoil (total soil water retention), The PCA revealed distinct stress response patterns: TSU Tiger exhibited strong heat resilience, maintaining growth despite temperature stress. Hopi Red, while high in biomass under control conditions, showed significant biomass reduction under drought, indicating reliance on water availability. Redroot Pigweed demonstrated high plasticity, clustering with drought-stressed plants, reinforcing its adaptability to water-limited environments. These finding provide valuable insights into amaranth adaptation to climate stress and resilience in natural ecologies or cultivated agronomic environments.