

Abstract

During water-deficit stress, antioxidant enzymes use anthocyanin molecules as co-substrates to scavenge for reactive oxygen species leading to reduced anthocyanin content and ultimately loss of purple leaf pigmentation in tea. Anthocyanins are an important class of flavonoids responsible for liquor color and market acceptability of processed tea from the anthocyanin-rich purple tea cultivar 'TRFK 306'. However, the color in pluckable shoots fade and turn green during the dry and hot season, before rapidly reverting back to purple when weather is favorably wet and cool/cold. Our study revealed that loss of purple leaf pigmentation correlated well with reduced precipitation, high soil water-deficit, increased intensity and duration of sunlight and temperature. Richly purple pigmented leaves harvested during the cool, wet conditions recorded significantly higher anthocyanin content compared to faded samples harvested during the dry season. Similarly, individual anthocyanins were affected by seasonal changes with malvidin being the most abundant. Comparative transcriptomics of two RNA-seq libraries, dry/discolored and wet/colored seasons, revealed depression of most metabolic processes related to anthocyanin accumulation in dry conditions. Specifically, transcripts encoding pathway regulators, MYB-bHLH-WD40 (MBW) complex, were repressed possibly contributing to the suppression of late biosynthetic genes of the pathway. Further, suppression of anthocyanin transport genes could be linked to reduced accumulation of anthocyanin in the vacuole during the dry season. However, slight increase in expression of some transporter and reactive oxygen species (ROS) antioxidant genes in the discolored leaf suggests non-enzymatic degradation of anthocyanin, ultimately leading to loss of purple color during the dry season. Based on increased expression of ROS antioxidant genes (especially catalase and superoxide dismutase) in the discolored leaf, we speculate that anthocyanins are used as co-substrates by antioxidant enzymes to scavenge for ROS (especially hydrogen peroxide) that escape from organelles, leading to reduced anthocyanins and loss of pigmentation during the dry season.