Assessing Grass Water Use Efficiency Through Smartphone Imaging and ImageJ Analysis

Shen, Aniyah (School: University High School)

Overwatering and underwatering are widespread issues with environmental, financial, and safety consequences. Current approaches to assessing grass water use efficiency (WUE) are inaccessible or indirect to the general public. This project developed an accessible method combining smartphone imaging with ImageJ CIELAB to determine ideal grass watering ranges and assess grass WUE. The method was tested by analyzing how nine watering levels (100-900 mL) affected grass color and growth of nine St. Augustine grass samples over one month (July 2020). In ImageJ analysis, grass color was quantified using a*:b* ratios, growth was tracked using grass area coverage, and pigment composition was analyzed using plot profiles. Three types of smartphone images were analyzed: whole samples in the uncontrolled real-world environment, randomly selected leaves in the controlled environment of a homemade imaging box, and extracted pigments before and after paper chromatography. Results were clustered using mclust Gaussian finite mixture models. Overall trends for grass coverage and a*:b* ratios of all three image types matched real-world observations. Cluster analyses were consistent across all five analysts and all three image types. These results showed that ImageJ CIELAB analysis effectively reduces lighting factors of real-world environments and digital CIELAB unmixing is consistent with the physical unmixing of paper chromatography. Thus, this study demonstrated that ImageJ CIELAB analysis combined with smartphone imaging can effectively assess grass WUE. This method has potential to be applied in automated irrigation systems to improve WUE or an app providing instant grass WUE assessment for public use.

Awards Won:
Fourth Award of $500