

Experiences in the high throughput phenotyping of forage and turf grasses for semiarid landscapes: challenges and expectations

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Abstract

The Forage and Range Lab (FRRL) is implementing a high throughput phenotyping (HTP) project using unmanned aerial vehicles (UAV), multispectral sensors, and programmatic pipelines for computational automation. Here we report on different HTP experiences for forage and turf grasses. Phenotypic traits (plant height, biomass, leaf area index, etc.) have been measured during two field seasons (2022 and 2023), and time series of multispectral imagery have been collected, processed, and used in different regression modeling strategies for sparse and dense forage grass canopies. We also provide examples of automatic classification of turf grasses visual ratings using close-range UAV imagery (infrared and multispectral). Accuracy results from our independent validations have been highly variable for the field-measured traits with excellent results for traits like biomass, and moderately acceptable results for other important features such as grain yield. We describe challenges that impact our ability to model certain traits, and expectations from using hyperspectral and light detection and ranging Lidar sensors in the near future to a) expand the number of phenotypic traits, b) simplify workflows, and c) upscale current models from experimental plots to landscapes. Our HTP work aims at accelerating the process of selecting plant material that scientists at FRRL develop to restore disturbed semiarid landscapes in order to augment their resilience to the impacts of climate change and other global processes.

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