Estimating Alfalfa Biomass Volume from UAV-Based Multispectral Imagery

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Yield is the most important trait for profitable alfalfa production, yet somewhat inexplicably, yield improvement in alfalfa has stalled over the last ~30 years. The process to develop cultivars with improved yield potential involves phenotyping thousands of plots across multiple years and environments. The manual collection of data is often expensive, laborious and time consuming. The incorporation of modern high-throughput phenotyping technologies including unmanned aerial vehicles (UAVs) and multispectral cameras can improve the efficiency of phenotypic data collection in breeding programs allowing for larger trials or skipping manual harvests completely. The goal of this study was to compare forage biomass volume predicted from aerial multispectral images to mechanically harvested biomass yield across a range of alfalfa breeding plot types. A Red-Edge-MTM multispectral camera was flown at 15 m above transplanted alfalfa rows, transplanted mini-sward plots, and sown sward plots immediately prior to harvest. Predictions were calculated using a digital surface model and the normalized difference vegetation index (NDVI) to obtain estimates of the plot-level biomass volume. Plant height and biomass yield measurements were taken for comparison to the remote sensing data. Strong correlations were found between measured and predicted plant height, predicted biomass volume, and biomass yield of the sown sward plots, and moderate correlations were found between predicted biomass volume and biomass yield of the transplanted mini-sward plots. Remote sensing therefore offers a useful alternative to improve the efficiency of phenotyping in an alfalfa plant breeding program allowing for better allocation of resources. We will discuss some trial design parameters that could be altered to further improve the value of drone data.