High-Throughput Approach for Phenotyping Alfalfa (*Medicago sativa* L.) Yield

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Unmanned aerial systems (UASs) equipped with sensors have become an approach for fast and non-destructive high-throughput phenotyping (HTP) in plant breeding programs. Alfalfa (*Medicago sativa* L.) is grown in more than 30 million hectares worldwide and breeding alfalfa for herbage accumulation (HA) requires frequent phenotyping across multiple years. The objectives of our study were: i) phenotype an alfalfa breeding population for HA using ground-based manual sampling and utilize a UAV for HTP ii) to find out the correlation and prediction efficacy of HTP with ground-based manually collected data. The alfalfa breeding population was composed of 145 full-sib and 36 half-sib families, and 3 varieties used as controls (Bulldog805, 'FL99' and an advanced breeding line from UF). The experiment was established in November 2017 and HA data was collected in 2018 and 2019. A UAV (DJI Matrice 100) equipped with a multispectral camera (RedEdge, MicaSense) was used for HTP, prior to each harvest event. Four vegetation indexes (NDVI, NDRE, GNDVI and GRVI) provided high correlations with HA and the regression analysis indicated that the HA can be predicted moderately by those VIs. Hence, HTP represents a reliable method to phenotype alfalfa breeding lines for HA, resulting in reductions in costs and labor for phenotyping and speeds up the selection process which will benefit our alfalfa breeding program.