

# ALFALFA HAY WINDROW VOLUME AND YIELD MAPPING THROUGH DRONE IMAGERY

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## Abstract

Yield maps provide essential information for growers about their field spatial variability and are considered the first logical step to apply precision agriculture. The objective of this study is to map alfalfa hay yield variability by estimating the hay windrow volume using drone imagery. This study was conducted in a 30-acre alfalfa field located in Tulelake, California. After cutting and raking the alfalfa, drone images were acquired in the oblique mode to create a 3D model for the study field. Using PiX4Dmapper software, both digital terrain and surface models were created, and the difference between these maps was calculated to assess hay windrow volume. Following hay baling using a small hay baler, the average bale weight and moisture content were measured in the field, and another drone image was acquired to measure the inter-bales distance. These measurements were regarded as the ground truthing for alfalfa yield. Results showed a high correlation between hay windrow volume and alfalfa yield with  $R^2 > 0.71$ , which proves the possibility of using windrow volume to assess alfalfa hay yield. Also, the estimated yield map matched well with the grower's observations. In conclusion, both hay volume mapping and the measurements of inter-bales distance through drone imagery are feasible techniques for alfalfa yield mapping.

**Key Words:** hay windrow volume, alfalfa yield mapping, hay baling, drone in agriculture

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