UNIVERSITY OF MINNESOTA
Driven to Discover℠

# Predicting Crop Yield and Quality Using Canopy Reflectance and LiDAR Sensors

Technology No. 20170017

**IP Status:** Pending US Patent; **Application #:** 15/663,112

## Remote Crop Assessment

A new crop assessment tool leverages canopy reflectance and Light Detection and Ranging (LiDAR) sensors for remotely estimating crop height and predicting yield and quality. A spectrophotometer attached to an unmanned aerial vehicle (UAV) or ground vehicle periodically scans alfalfa in the field and measures canopy reflectance values to predict alfalfa yield and quality, while LiDAR remotely measures crop height and facilitates yield predictions. Multiple linear regression equations predict forage quality parameters such as crude protein and fiber digestibility (primary indicators of hay value). The UAVs or ground vehicles equipped with these sensors travel through the field collecting and mapping data correlated to the current status of the entire crop. The measurements and predictions can help alfalfa farmers:

- predict expected yield and market price,
- strategically adjust fertilization and watering to produce a higher forage quality, and
- determine the ideal time to harvest to maximize price.

## Combines LiDAR, Spectral Reflectance and Current Climate Data

While physical, destructive sampling currently provides the most accurate and consistent indicators of quality, these methods are time consuming, labor intensive, and often do not represent the whole field. New precision agriculture applications use UAVs equipped with GPS technology and sensors/cameras to assess crop health, progress, disease/insect pressure and nutrient deficiencies. However, none of these current methods integrate measurements from LiDAR and spectral reflectance together in one predictive model. This new approach also improves model predictions by combining remotely sensed data with current climate data such as cumulative growing degree units (GDUs), a function of daily high and low temperatures. Another unique aspect of this new technology is that it introduces a simple index using only a few wavebands, while recent publications on using canopy reflectance to predict forage quality rely on an entire range of spectral data with high resolution from very expensive sensors

unlikely to result in an economically viable tool.

**BENEFITS AND FEATURES:**

- Light Detection and Ranging (LiDAR) sensors
- Remotely assesses crops, measures canopy reflectance and crop height
- Spectrophotometer and sensors attached to unmanned aerial vehicles (UAV) or ground vehicles
- Measures canopy reflectance values to predict alfalfa yield and quality
- Multiple linear regression equations predict forage quality parameters
- Collects and maps data of an entire crop
- Determines expected yield and expected market price
- Helps farmers strategically adjust fertilization and watering to produce a higher forage quality
- Determines ideal time to harvest to maximize price

**APPLICATIONS:**

- Alfalfa crops, hay crops
- Precision agriculture
- Crop remote sensing
- Measuring canopy reflectance
- Predicting alfalfa yield and quality

**US Patent Pending** US20180039600

**Phase of Development** - Prototype developed

**Researchers**

Scott Wells, PhD
*Assistant Professor, Agronomy and Plant Genetics*
External Link (agronomy.cfans.umn.edu)
Craig Sheaffer, PhD
*Professor, Agronomy and Plant Genetics*
External Link (agronomy.cfans.umn.edu)
Reagan Noland, PhD
*Assistant Professor, Crop and Soil Sciences, University of Georgia*

**Interested in Licensing?**

The University relies on industry partners to scale up technologies to large enough production capacity for commercial purposes. The license is available for this technology and would be for the sale, manufacture or use of products claimed by the issued patents. Please contact us to share your business needs and technical interest in this technology and if you are interested in licensing the technology for further research and development.

https://license.umn.edu/product/predicting-crop-yield-and-quality-using-canopy-reflectance-and-lidar-sensors