Seed Composition Estimation using Satellite Fusion and Machine Learning

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Abstract

Predicting the composition of soybean seeds while the plants are growing in the field is very important to understand how different genotypes, field condition and environment influence different seed composition parameters. Knowing this information at global scale is even more important to understand the dynamics of food insecurity and the interaction of seed composition with global environmental changes. This study aims to develop a machine learning-based soybean seed composition model from the fusion of PlanetScope, Sentinel and Landsat satellite images. Although satellite images provide global coverage throughout the year, it suffers from coarser spatial resolution. However, PlanetScope provides four-band (i.e., red, green, blue, and near infrared) multispectral imageries at approximately 3m spatial resolution daily. Alternatively, Sentinel-2B and Landsat-8 have coarser spatial resolution (10 - 30m), they provide enriched spectral resolution. Therefore, the objectives of this study are to 1) fuse the PlanetScope image with corresponding Landsat and Sentinel images, 2) evaluate several machine learning algorithms (e.g., partial least squares, support vector machine, random forest, and deep neural network) to predict protein and oil content of soybean seeds from the fused satellite images. Two soybean fields were established in 2020 and 2021 at Bradford, MO to perform the experiment. Corresponding PlanetScope, Sentinel, and Landsat images were downloaded and processed for the entire growth seasons. Current results indicate that deep neural network provide the best performance in predicting both protein and oil content of soybean. Future step is to assess different fusion algorithms and predict seed composition at regional or global scale.

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