

Wheat Fusarium Head Blight (FHB) Disease Severity Estimation using UAV Multispectral Imagery and Machine Learning

Ubaid ur Rehman Janjua¹, Maitiniyazi Maimaitijiang¹, Bruce Millett¹, Mohammad Maruf Billah¹, Madalyn Shires¹, Dalitso Yabwalo¹, Sunish K. Sehgal¹, and Shaukat Ali¹

¹Affiliation not available

October 31, 2023

Abstract

Wheat is an important primary crop that nourishes billions of people worldwide. Wheat diseases, particularly Fusarium head blight (FHB) disease, often have a severe effect on wheat yield in terms of both quantity and quality posing potential threats to the health of humans and livestock. Traditional methods such as field surveys for monitoring and assessing wheat diseases are time-consuming, costly and inefficient. In recent years, remote sensing approaches, particularly aerial imaging using Unmanned Aerial Vehicles (UAV), have become invaluable tools for rapid field scouting at larger scale, as well of crop growth and health status. This study aims to investigate the potential of combining high-resolution UAV multispectral imagery with machine learning (ML) methods for the estimation of FHB disease severity. Two experimental wheat fields were established at Volga, South Dakota, USA, in 2022. The severity of FHB disease was assessed and rated in the fields; and synchronous UAV flights were conducted to collect multispectral imagery. Canopy spectral and texture features were derived from the UAV multispectral imagery and used as input variables for ML models to predict FHB disease severity levels. Both classification and regression approaches were applied to estimation FHB severity using ML models such as Random Forest, Support Vector Machine, and Deep Neural Networks. The results show that both canopy spectral and texture features are important indicators for monitoring the severity of FHB wheat disease. Furthermore, the use of UAV remote sensing, combined with ML-based modeling, is a sustainable approach for rapid and accurate detection of wheat FHB disease severity.

Ubaid-ur-Rehman Janjua¹, Maitiniyazi Maimaitijiang¹, Bruce Millett¹, Mohammad Maruf Billah¹, Madalyn Shires², Dalitso Yabwalo², Sunish K. Sehgal², Shaukat Ali²

¹ *Geospatial Sciences Center of Excellence, Department of Geography and Geospatial Sciences, South Dakota State University, Brookings, USA*

² *Department of Agronomy, Horticulture, and Plant Science, South Dakota State University, Brookings, USA*

ORCID: 0009-0001-8298-7392

Keywords: Unmanned Aerial Vehicles (UAV); Fusarium Head Blight (FHB); spectral features; texture features; machine learning