**Development of a Multiscale XGBoost-based Model for Enhanced Detection of Potato Late Blight Using Sentinel-2, UAV, and Ground Data**

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***ABSTRACT***

Potatoes, a crucial staple crop, face significant threats from late blight, which pose serious risks to food security. Despite extensive research using ground and UAV hyperspectral data for crop disease monitoring, satellite-scale identification of diseases like Potato Late Blight (PLB) is limited. This study integrates Sentinel-2 data with UAV and ground spectral data for a multi-scale monitoring of PLB. The research found consistent spectral patterns across scales, with notable valley values in Blue and Red bands and peaks in Near Infrared bands, showing a decrease in reflectance with increasing disease severity. Furthermore, the study highlights scale-dependent spectral variations, significant differences in actual reflectance values were observed. Based on the developed Red Edge Index and Disease Stress Index with a suite of machine learning algorithms, we proposed a XGBoost-based model integrating spectral indices for PLB monitoring(PLB-SI-XGBoost). Notably, the proposed model demonstrated the highest average evaluation score of 0.88 and the lowest root mean square error (RMSE) of 13.50 during ground scale validation, outperforming other algorithms. At the UAV scale, the proposed model achieved a robust R-squared value of 0.74 and an RMSE of 18.27. Moreover, the application of Sentinel-2 data for disease detection at satellite scale yielded an accuracy of 70% in the model. The results of the study emphasize the importance of scale in disease monitoring models and illuminate the potential for satellite-scale surveillance of PLB. The exceptional performance of PLB-SI-XGBoost model in detecting PLB suggests its utility in enhancing agricultural decision-making with more accurate and reliable data support.

**Keywords:** Multiscale remote sensing, Potato late blight, XGBoost, Machine learning