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Prediction of Normalized Difference Vegetation Index and Spad Chlorophyll Under High Maize Population Density

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Abstract

The study investigates the relationship between the Normalized Difference Vegetation Index (NDVI), SPAD reading and visible color spectra under high maize population density. Utilizing machine learning techniques and RGB colorimeter data from the CIE Lab color space, predictive models for NDVI and SPAD values were developed. The study, conducted at the Bajeng Research Station in South Sulawesi, Indonesia, spanned from October 2023 to January 2024. The experiment involved 78 hybrid maize candidates and five commercial varieties cultivated at a high-density setting of 83,333 plants per hectare. NDVI and SPAD measurements were conducted between 46-52 days post-planting using GreenSeeker and SPAD Konica Minolta devices respectively. Additionally, leaf color data were captured using a commercial LAB colorimeter. A decision tree-based machine learning algorithm was employed for data processing. Results indicate strong predictive capabilities of tree-based machine learning models in predicting NDVI, with a significant association between color components and NDVI. Combining L, A, and B as input features notably improves the model's performance with an R2 value of 0.862, MAE = 0.018, RMSE = 0.023, and MPE = 0.001, underscoring the importance of integrating multiple color channels for comprehensive vegetation characterization. As for SPAD prediction, the machine learning model also exhibits promising results, with an R^2 value of 0.686, MAE = 2.327, RMSE = 3.175, and MPE = 10.081. Integrating visible spectral data from a colorimeter with decision tree algorithms could serve as an alternative approach for assessing plant health.

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