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Integrating multi-source remote sensing data and machine learning for large-scale sugarbeet yield forecasting in the Western High Plains region.

Accurate yield forecasting is fundamental for agricultural management, yet existing models and procedures often struggle with scalability. The integration of artificial intelligence with remote sensing technologies presents an opportunity to improve prediction accuracy across large geographical areas. This study focused on developing and validating a predictive model for tonnage, sucrose content, and polarization in sugarbeet fields across the Yellowstone, North Platte, and South Platte River valleys. The model was trained using 1,379 field-seasons of historical data, combining multi-temporal satellite imagery and climate data with geo-referenced yield measurements. The data was processed through the LAYERS® PredTech infrastructure, employing machine learning algorithms to generate field-level predictions. The model achieved Mean Absolute Percentage Error (MAPE) below 5% for all three predicted variables (tonnage, sucrose, and polarization). These results demonstrate the potential for large-scale implementation of remote sensing-based yield forecasting in sugarbeet production. The study was validated through the 2024 season and will continue through the 2025 season.