Pasture monitoring with vegetation indices: a remote sensing approach

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Integrated Crop-Livestock Systems (ICLS) offer a sustainable alternative to enhance food production. Effective pasture management is crucial for optimizing animal performance and improving food production efficiency in these systems. However, assessing pasture management at the farm level can be challenging. Vegetation indices present a cost-effective and practical solution for monitoring plant growth, providing detailed information. However, it is important to determine whether these indices maintain consistent accuracy throughout the grazing cycle. The objective was to assess the accuracy of vegetation indices in estimating herbage mass (HM) and sward height (SH) throughout different phases of the stocking period using remote sensing techniques. The experiment was conducted in southern Brazil as part of a long-term study on ICLS. The summer phase involved cultivating soybean (*Glycine max*), while the winter phase consisted of annual ryegrass (*Lolium multiflorum* Lam.) pasture. The treatments included different pasture grazing intensities: 10, 20, 30, and 40 cm, along with an ungrazed control (designated as G10, G20, G30, G40, and UG, respectively). The experimental design was a randomized complete block with three replicates. The correlation between HM, SH, NDVI (Normalized Difference Vegetation Index), and NDRE (Normalized Difference Red-Edge) was performed using R software. HM (kg dry matter/ha) was determined by clipping plants at the ground level within five randomly placed 0.25 m² quadrats per paddock during the stocking period. SH was measured using a sward stick, taking five georeferenced measurements inside each quadrat. Data were collected at four different periods throughout an annual ryegrass growth cycle - approximately every 28 days from 17 July to 24 October (designated as P1, P2, P3 and P4). Vegetation indices (NDVI and NDRE) were obtained from PlanetScope satellite imagery. Images were processed using QGIS Desktop 3.28.8. NDRE showed higher correlations compared to NDVI for SH and HM. The correlation coefficients between SH and NDRE decreased in the last period for all treatments (G10= -0.26, G20= 0.229, G30= 0.203, G40= 0.431 and UG= -0.26). Treatment G20 consistently exhibited the strongest correlations across all periods, suggesting that sward height can be accurately estimated using NDRE up P3 (P1= 0.498, P2= 0.75 and P3= 0.66), and subsequently by HM (P2= 0.5, P3= 0.53 and P4= 0.44). Moreover, G20 not only demonstrated higher correlations but is also recommended for pasture management as it optimizes forage and animal production without compromising the succeeding crop grain yield. These findings highlight that vegetation indices are valuable tools to help with pasture monitoring. However, to facilitate management using these indices, it is necessary to develop models capable of converting these estimates into actionable values.

Keywords: satellite images, NDVI, NDRE, sward height, herbage mass.

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