Report on validation of remote sensing to predict important parameters for pasture management under tropical conditions

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RESEARCH PROGRAM ON
Livestock

Improved feed & forage germplasm and new tools and technologies for breeding

Report on validation of remote sensing to predict important parameters for pasture management under tropical conditions

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Rationale

Currently, there are a number of tools aimed to remotely deploy traits associated with forage quantity and quality in pastures and grasslands. Such information is important for pasture and livestock management and relevant for screening purposes of large number of genotypes. Previous research has shown the implementation of proximal sensing for screening purposes in *Urochloa* grasses. Nowadays, the use of Unmanned Aerial Systems (drones) are increasingly being used for the same purposes but at larger spatial scales. Multispectral images or spectral sensors can be used to calculate a number of vegetation indexes that are associated with forage quantity and quality. Among them, NDVI (Normalized Difference Vegetation Index) is probably the most widely used. Values of NDVI close to 0 represent mostly bare soil or very low vegetation, whereas values close to 1 represent vigorous plants (green and vigorous plants).

One of the largest problems in the determination of forage quantity and quality is that they are highly dynamic, they change over development of the plants, and are sensitive to external stresses and management (e.g. cutting intervals). The use of vegetation indexes can be used to track changes of forage as a way to support pasture management. Traditionally, pasture management in the tropics rely on visual inspections of height of plants. Height is an important parameter, particularly to manage rotational grazing where forages are clipped to a target height as a way to manage maturity, nutrient concentration and forage digestibility. Less often, samples of forage biomass are taken to estimate productivity of the pasture and its livestock carrying capacity. Thereby, the objective of this work was to test the feasibility of use of NDVI as a proxy for parameters relevant for pasture management such as height and biomass.

Materials and methods

- Plant material consisted of three *Urochloa* spp. Cultivars (Marandu, Mulato 2 and Tully). Cultivars Marandu and Mulato 2 form tussocks, whereas cv. Tully is a strongly stoloniferous plant. Cultivars Marandu and Mulato form larger and taller plants than cv. Tully.
- Plant material was established under field conditions at the regional campus of the Alliance Bioversity-CIAT in Palmira, Colombia in a three replicate complete randomize block. Each replicate consisted in 400m2 of planted material.
- A standardization cut was applied at a height of 10 cm and then, cuts every 7 days for 17 weeks were performed within each replicate. To each genotype and replicate, four samples for fresh biomass were randomly sampled in an area of $0.25m^2$.
- Every week, recording of plant height and NDVI with and active sensor (Greenseeker, Trimble, US) were performed at each sample size. Collection of

NDVI from a modified RGB camera with the infrared filter removed (Mapir, Mapir, US), attached to a drone (Phantom IV, DJI, China) were collected at midday. NDVI from images was calculated to each replicate (400m^2).

Key results

- Figure 1 summarizes the obtained results.
- Overall three growth stages were recognized: 1) weeks 1 to 6: period of greater leaf growth and moderate stem elongation; 2) weeks 6 to 12: period of elongation of tillers and leaves; 3) weeks 12 to 15: flowering and 4) weeks 15 to 17: seed ripening accompanied by senescence of older leaves.
- The results showed that NDVI obtained from active sensor or image resembled the time courses changes in biomass and height during early growth (weeks 1 to 6). This suggests that the use of NDVI can be used as a proxy for biomass or height at these (first 6 weeks after cutting or grazing), but not at later stages.

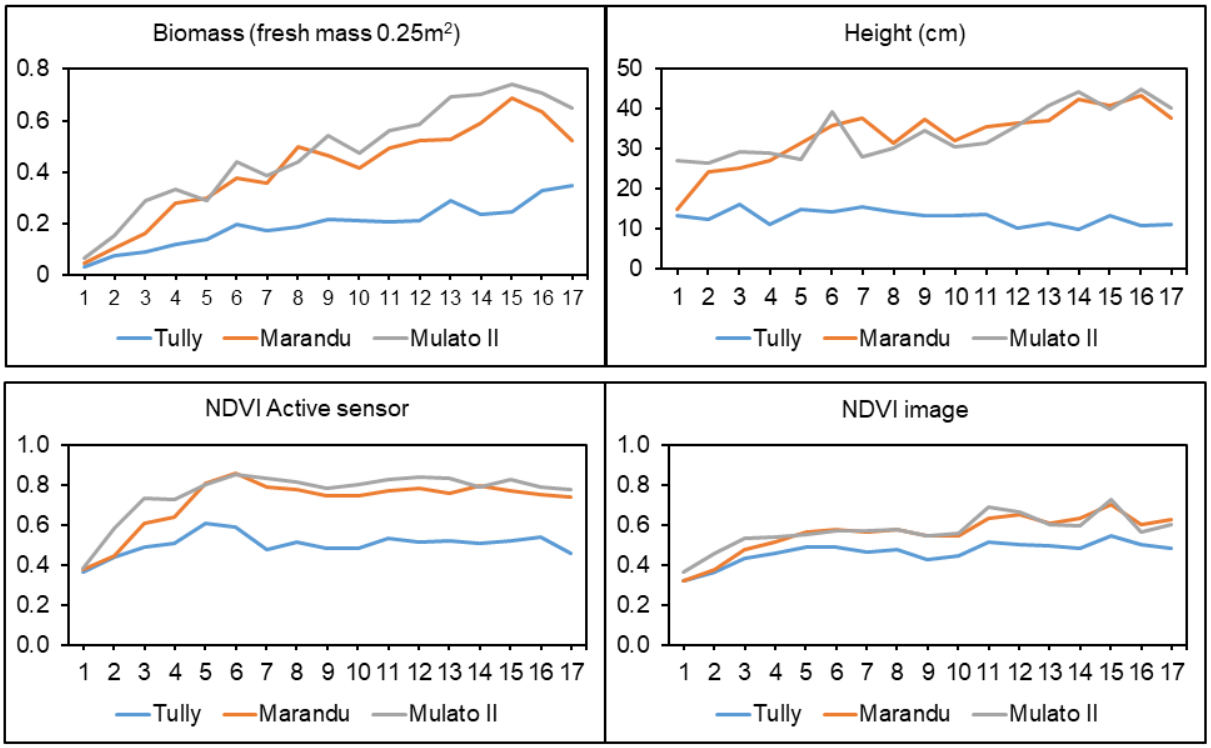

Figure 1. Time course changes in forage biomass, height and NDVI from active and passive sensor (camera) over 17 weeks under field conditions.

Future outlook

- Albeit the sensitivity of NDVI from images was lower than NDVI from active sensor, NDVI from images as a management tool might be more attractive for their use under larger spatial scales (e.g. a UAS can cover an area of 9 ha with a single flight).
- Efforts to further expand the use of remote sensing to estimate other forage traits of interest (i.e., crude protein, in vitro dry matter digestibility) are currently underway.
- Barriers of this kind of technology uptake by neutral scale livestock producers is currently studied across several regions in Colombia

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