The effects of planting date on maize growth and development using unmanned aerial vehicle data

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Abstract

Early detection of plant stress is important, particularly in the face of unpredictable climates. Conventional methods of phenotyping, while useful, lack the ability to provide non-destructive early plant stress detection, a capability provided by remote sensing technologies. The aim of this study was to determine the effect of planting date on various commercial maize hybrid growth and development, focusing on changes in spectral reflectance and vegetation indices related to plant health. An experimental study was set up in Pretoria, South Africa, encompassed planting dates spanning from November 2022 (Early) over December 2022 (Optimum) and January 2023 (Late) to February (Very late). Weekly UAV (unmanned aerial vehicle) flights starting four weeks after planting were conducted with the DJI M210 carrying the Micasense Altum multispectral sensor. Preliminary findings identified a higher spectral reflectance of maize, in the visual, red-edge, and near-infrared bands at optimum planting date as compared to the earlier and later planting. These shifts in spectral reflectance were also reflected in increased values of the Simple Ratio Index (SI), Green Ratio Vegetation Index (GRVI), and Normalized Pigment Chlorophyll Index (NPCI) in the earlier planting dates, when contrasted with the later planting dates. The findings confirm that planting date impacts maize health, and that this can be detected through remote sensing methods. This research demonstrates that UAV technology is a feasible alternative to fixed plant phenotyping platforms, especially in the African context where infrastructure stability remains a major challenge.

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