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MONITORING MAIZE CROP PHENOLOGY USING SPATIAL DATASETS DERIVED FROM A LOW-COST UNMANNED AERIAL SYSTEM.

Abstract

Crop production significantly contributes to global greenhouse gas emissions, mainly through the release of gases from synthetic the use of fertilizers. Creating a system that tracks crop growth stages could help limit the release of hazardous chemicals into the environment from agricultural processes. In order to manage farm inputs, this study assessed the growth stages of SUWAN-1-SRY maize variety and developed spatial datasets for its phenological stages using a low-cost Unmanned Aerial Vehicle (UAV). The study also evaluated how well the spatial parameters could be used to track the various stages of maize growth. In the early and late growing seasons of 2020 and 2021, the selected maize variety was planted at an experimental site in a mapped 2000 m2 land area. The maize seeds were manually sown in rows with three (3) seeds per hole at 75 cm spacing between rows and 50 cm spacing between seed holes. While observing other relevant cultural practices in this region, the seedlings were thinned to two stands per hole at 14 Days After Sowing (DAS) to obtain a density of 53,333 plants/hectare. An aerial survey was conducted over the cropland every 5-days from the sowing date using DJI Phantom 4 advanced quadcopter, which has an onboard 20MP optical camera and an attached 12MP AGROCAM multispectral camera. The aerial photographs obtained were processed using Pix4D photogrammetry software to derive digital orthophotos. The Normalized Difference Vegetation Index (NDVI) and Variable Atmospherically Resistance Index (VARI) derived from the spatial products were extracted onto a 4 m by 4 m management zones drawn over the experimental plot. The cropland growth profiles were created using NDVI and VARI of the management zones. The results of the aerial surveys produced 1.6 cm/pixel and 2.0cm/pixel for the true-colour and false-colour digital orthophoto, respectively. These images' high spatial resolution allows for identifying water and nutrient-deficient regions that may require intervention in the cropping season. The growth profiles showed an increase in NDVI and VARI values from 0.001 at planting to a maximum value of 0.192 at the doughing stage (R4), with an appreciable reduction at the senescence stage (R6). The crop profile's unique nature strongly indicates its reproducibility across growing seasons; therefore, the study concluded that low-cost UAVs could provide high-resolution geospatial datasets suitable for monitoring maize growth characteristics in the cropping season.