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Target-oriented spectral index distribution parameters for estimating leaf chlorophyll content from three-dimensional RGB point clouds in an olive orchard in Tunisia

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Abstract

An important parameter in the site-specific management of an olive orchard is the leaf chlorophyll and nitrogen content. However, the ground-based measurement of these parameters is laborious and time-consuming. Therefore, the field study shown here attempts to model the target parameter from spectral indices based on low-budget RGB imagery collected from drones.

Field experiments took place in July 2022 on an olive orchard in Toukaber (36°42°22 N, 9°30'38 Ë, governorate of Beja, Tunisia) with a size of 0.73 ha and covered 72 trees. A Mavic 2 Enterprise Dual (DJI, China) with a 1/2.3CMOS 12MP sensor chip was used for the drone flight campaign at an altitude of 30 m. The ground sampling distance was about 2.5 mm and the images were taken with an 80 % overlap. On the same day, reference measurements of leaf chlorophyll and nitrogen were taken on 16 trees using the SPAD502+ chlorophyll metre (Spectrum Technologies Inc., USA). This indirect SPAD parameter was subsequently defined as the target parameter for the model estimation. A point cloud was derived photogrammetrically from the RGB image data set and tree-specific spectral indices, the normalised green red difference index (NGRDI) and the green leaf index (GLI), were created for each crown point. Statistical distribution parameters are used to model the mean SPAD value per tree crown.

It can be shown that a general derivation of the SPAD value from drone-based low-budget RGB image data is possible. The optimal model fit uses 6 parameters (NGRDImax, NGRDI1.quantile, GLI1.quantile, GLImean, GLImedian, GLI3.quantile) and achieves a corrected r^2 of about 0.57. With the derived model, the SPAD value can be estimated for each tree at the test site. It remains to be researched whether the model is stable across locations and seasons.

Keywords: Gli, olive, spectral index, Tunisia

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