NON DESTRUCTIVE ESTIMATION OF FOLIAR CAROTENOID CONTENT OF TREE SPECIES USING MERGED VEGETATION INDICES

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THEME: Forests, biodiversity and terrestrial ecosystems

KEY WORDS: carotenoids; non-destructive assessment; leaf optics; reflectance; angular vegetation index

ABSTRACT:

Leaf pigment content indicates plant status and serves to assess the vigor and photosynthetic activity of plants. Spectral information gathered from laboratory, field and remote sensing-based spectrometers can be applied to nondestructively assess total chlorophyll (Chl) content of higher plants. This has been demonstrated in earler studies. However, the precise estimation of carotenoid (Car) content with nondestructive spectral measurements has not been accomplished with accuracies comparable to the results obtained for Chl content. In this study, we examined the potential of an angular vegetation index (AVI) to estimate total foliar Car content of three tree species. Based on an iterative search, we identified a best candidate AVIcar. AVIcar showed quite close but essentially non linear relation with Car contents of the examined species with increasing sensitivity to high Car content and a lack of sensitivity to low Car content. For low Car content earlier proposed vegetation indices (VI) performed better. To make use of the advantages of both VI types, a simple merging procedure was developed, which combined the AVIcar with two earlier proposed carotenoid indices. These merged indices showed close linear relationship with total Car content and outperformed all other examined indices. The merged indices accurately estimated total Car content with a percental root mean square error (%RMSE) of 8.12 % and a coefficient of determination of 0.88. Our findings were further strengthened by simulations using the radiative transfer model PROSPECT 5. For simulated data, the merged indices again showed a quasi linear relationship with Car content. Further studies applying the proposed indices to further datasets to estimate foliar Car content of other plant species is desirable to prove the general applicability of the index for non-destructive estimation of Car from leaf reflectance data.

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