Ecological Characterization of the Green Areas in Sopron by Plant Chemical Analysis and Hyperspectral Recording

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INTRODUCTION – Urban environmental conditions significantly affect the quality of life. The environmental impacts and their results coming from the operation of the settlement can be characterized by the measurement of the environmental components. The chlorophyll content of photosynthetically absorbed radiation, the canopy water content and soil nitrogen content are important parameters which affect the land ecosystem primary productivity and plant health. Furthermore, leaf chlorophyll content is related to plant stress and senescence (Merzlyak and Gitelson 1995). The decrease of chlorophyll content can be regarded as a useful biomarker for detection of gaseous pollutants. The active oxyradicals generated by CO_2, NO_2 and O_3 react with cell membrane and the membrane molecules resulting the decrease of its amount (Sasaki et al. 1983). Accurate quantitative estimates of biochemical properties of vegetation canopies are important applications of remote sensing for terrestrial ecology (Gao B. C. and Goetz, 1995). Band–ratio indexes are commonly used techniques for estimating vegetation leaf and canopy properties, including pigment concentration (Blackburn 1998). Our objectives included the ecological characterization of the green areas in Sopron by the examination of chlorophyll content distribution of the leaves and the validation of the row chlorophyll values come from hyperspectral images by the results of the laboratory examinations.

EXPERIMENTAL – Leaf samples were collected on five study area at the same time of hyperspectral aquisition on 26th of August 2011. Five samples were taken from each sampling place. Spectrophotometric analysis were taken immediately after ASD hyperspectral spectrophotometer measurments. After the sample preparation and extraction the colouring matters were separated by thin layer chromatography (TLC) and the quantity of chlorophyll a and b were determined. The airborne hyperspectral imagery (AISA Eagle) was used in the range of 400-1000 nm due to this study focuses in visible and near infrared (VNIR) spectral range.

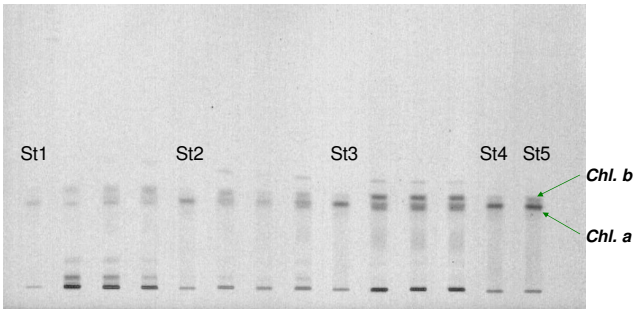

Figure 1. The TLC seperation of the chlorophylles extracted from the leave samples.(Chl.a: chlorophyll a, Chl. b: chlorophyll b ; St1, St2, St3, St4, St5: standard tracks)

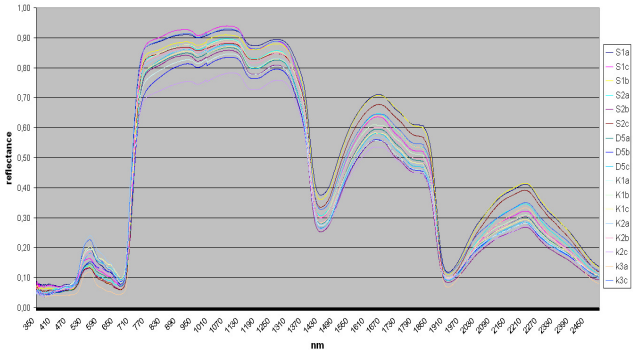

Figure 2. Reflectance spectrums of leaf samples of Acer species.

RESULTS – Correlation analysis was processed to determine the strength of relationships between chlorophyll content (total chlorophyll, chlorophyll a and b) and spectral indices (NDVI, PRI DV1) and spectral wavebands (400-1000nm). Calculation with wavebands itself didn't produce significant correlation with chlorophyll contents. Spectral indices were insensitive for some other properties of leaf, than using of wavebands itself, to evaluate chlorophyll concentration. First derivate was calculated from spectral signal in order to derive red-edge position of leaves. The advantage of derivative spectroscopy is that it is relatively insensitive to variations in illumination intensity and some background properties. Using each leaves samples didn't produce significant ($P<0.05$) correlation coefficient between chlorophyll content and spectral indexes. Hereafter, sample leaves were analysed in species groups. First derivate values (DV2) was shown to be a good predictor ($R^2=0.6288$, $P<0.05$) of *Chl b* of leaves (*Acer* species).

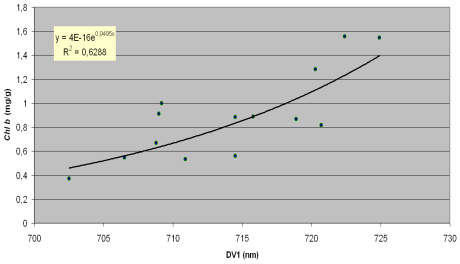

Figure 3. Scatter plot indicates the relationship between second derivate reflectance values (DV1) of Red Edge Position (REP) and Chlorophyll b (mg/g) contents.

CONCLUSION – Hyperspectral field measurements and TLC analysis were applied on leaf samples in order to characterise different types of tree species of urban environment. TLC dataset was applied to quantify ASD hyperspectral spectroscopy. Narrow bands spectral indexes were used to evaluate of chlorophyll contents of leaves samples. Hyperspectral field spectrophotometer (ASD) makes it possible to quickly and non-destructively in situ measurement of the chlorophyll content in leaves. Preliminary results of field measurement produce background dataset for image processing of airborne hyperspectral images. Narrow bands indexes which were calculated based on TLC analysis and ASD measurements can be extend for all hyperspectral images in order to map of biophysical parameters of leaves in the urban area.

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