Remote sensing study of the influence of herbicides on the spectral reflectance of pea plant leaves (*Pisum sativum L.*)

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Results from a remote sensing study of spectral reflectance of leaves of pea plants (Pisum sativum L.) treated by the herbicides atrazine, 2.4-D, glyphosate, fluridone and chlorsulfuron are reported. According to the classification of the Herbicide Action Committee reflecting their mode of action they belong to different groups: photosystem II bloker - C1 (atrazine), synthetic auxins - O (2.4-D), inhibition of EPSP synthase - G (glyphosate), photobleaching - F1 (fluridone), and inhibition of acetoctate synthase - B (chlorsulfuron). The plants studied were grown hydroponically in a growth chamber in a nutritious medium to which every herbicide was added at three low concentrations (1 μM, 0.1 μM and 0.01 μM) with respect to the field dose applied in the agricultural practice. The spectral measurements of the leaf spectral reflectance were carried out in laboratory using a multichannel spectrometer in the visible and near infrared regions of the spectrum (480÷810 nm). Data was registered in 128 channels at a high spectral resolution of 2.6 nm (halfwidth) and a spatial resolution of 2 mm^2. The reflectance spectra were obtained from the leaf-reflected radiation referenced against a standard (white screen). To assess the changes arising in the leaf spectral reflectance under the herbicide action the developed by us approach based on discriminant analysis and other statistical methods was applied. The spectral reflectance characteristics (SRC) were investigated in three spectral intervals: 520÷580 nm (region of maximal reflectivity of green vegetation), 690÷730 nm (red edge) and 740÷810 nm (near infrared region). Statistically significant differences were found between SRC of leaves of control and treated with herbicides plants at a significance level $p < 0.05$ for all concentrations of herbicides. The changes occurring in the physiological state of the plants were assessed also through biometric parameters such as the fresh weight of the above-ground part of the plants and their roots, and endogenous markers for stress. A comparative analysis of the potential of SRC and the biometric parameters used was performed to evaluate the action of all herbicides applied.