NIR calibrations to predict stress related parameters in rice plants fertilised with sewage sludge

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Sewage sludge (SS) from municipal solid waste is rich in organic and inorganic plant nutrients. When adequately treated, SS can be used as fertilizers with beneficial effects on soil properties (Donatello and Cheeseman, 2013). The impact of this kind of innovative fertilizers was evaluated on rice plants (*Oryza sativa* L. var. Sirio CL) and compared to standard soil nutrition. A pot experiment (30 pots) was carried out with five treatments: unfertilized soil (control), soil with the addition of urea, soil with SS treated with: CaO; CaO + CO2; CaO + H2SO4. The amount of urea and SS were calculated to provide the same total nitrogen level for each treatment. The control did not receive any nitrogen fertilization. Biochemical analyses and non-destructive NIR analyses were carried out at tillering stage, booting and panicle emergence on the last fully expanded leaf. The NIR spectra were collected in reflectance mode using a portable MicroNIR OnSite-W spectrometer (VIAVI Solutions S.r.l., Italy) in the spectral region between 900 and 1600 nm. For each pot, 60 spectra were acquired. The raw spectra and the results of Principal Component Analysis showed evidence of minimal differences in NIR spectral profiles between treatments. A good separation resulted between the first stage of growth and the following development stages. Partial least square analyses showed good prediction ability for chlorophyll (CHL) content and ascorbic acid/dehydroascorbic acid ratio (AsA/DHA). The model for CHL showed good performance in independent validation (R2val=0.87). The model for AsA/DHA ratio showed R2Xval = 0.89 but did not give the same performance in independent validation (R2 val = 0.64). These preliminary results, besides confirming the potential of SS as alternative fertilizer for rice, suggested the usefulness of NIR as a fast and non-destructive technique for the simultaneous prediction of multiple parameters related to physiological state of the plant.

**Keywords:** rice, sewage sludge, NIR, PLS, chlorophyll, AsA/DHA ratio

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