



Bio-effectors from waste materials as growth promoters, an agronomic and metabolomic study

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Nowadays, improving plant performance by providing growth promoters is a main concern of the organic agriculture. As a consequence of increased food demands, more efficient and alternatives of the current plant nutrition strategies are becoming urgent. Recently, a novel concept "bio-effectors" raised on to describe a group of products that are able to improve plant performance and do not belong to fertilizers or pesticides. Agro-Food processing residues are promising materials as bio-effector.

Three plant-derived materials: brewers' spent grain (BSG), fennel processing residues (FPR) and lemon processing residues (LPR) were chosen as bio-effector candidates. Plant-derived materials were characterized in term of total macro and micronutrients content. Green extraction methodology and solvent choice (aqueous; ethanol; and aqueous: ethanol mixture 1:1) was based on the extraction yield as main factor. Optimum extracts, to be used on the tomato test plant, were determined using phytotoxicity test (seed germination test) as main constraint. Thereafter, selected extracts were characterized and secondary metabolites profiling were detected by NMR technique. Selected extracts were applied on tomato in a growth chamber at different doses in comparison to humic-like substances as positive control (Ctrl+) and to a Hoagland solution as negative control (Ctrl-). At the end of the experiment, agronomical parameters were determined and NMR-metabolomic profiling were conducted on tomato seedlings.

Results are summarized as follow: (i) raw showed an interesting content, either at nutritional or biological level; (ii) aqueous extraction resulted higher yield than other used solvent; (iii) at high extraction ratio (1:25 for BSG; 1:100 for FPR; and 1:200 for LPR) aqueous extracts were not phytotoxic on the tomato test plant; (iv) all aqueous extract are differently rich in nutrients, aminoacids, sugars and low molecular weight molecules; (v) all extract exhibited a growth promotion at low application doses; (vi) regarding plant metabolomics study, all treatments showed a different metabolites in respect to Ctrl- treatment. BSG, LPR and Ctrl+ treatments had similar metabolic profile.

Finally, Metabolomic study provided an efficient tool and a key reporter about bio-effectors impact on plants. The visible effect and measured agronomical parameters was emphasized and demonstrated by metabolic profiling which offer insights into the affected plant metabolic pathways. As conclusion, our results supported the prediction that plant derived materials may interfere again in plant production regardless their nutritional content.

Keywords: Bio-effectors; Metabolomics; Nuclear Magnetic Resonance (NMR); Barley; Fennel; Lemon; Tomato.