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Enhancing sustainability of a processing tomato cultivation system by using bioactive compost teas

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ABSTRACT

Compost teas are compost-derived liquid products that may potentially induce positive effects on treated crops, including disease suppressiveness and biostimulation of the overall improved plant status. In this work four teas, produced from agricultural and municipal waste compost, were applied in a processing tomato cropping system to gain sustainable diseases management. Field trials showed that teas had a positive impact on health and vegetative status of the plants subjected to natural leaf blights, and induced significant increases of yields. The occurrence of combined suppressive and biostimulation mechanisms, sustained by microbial communities, nutrients supply and carbon-based bioactive compounds, was assumed to underlie the observed effects of tea on plants. Furthermore, NMR spectra suggested that the supramolecular organic structures contained in compost teas may be involved in the inductive processes of biostimulation, including an auxin-like activity. Molecular profiles of organic matter dissolved in teas indicated that the interaction between hydrophobic groups and polysaccharidic moieties could be related to vegetative responses of treated plants. This study provides new insights concerning the comprehension of the overall functionality of compost teas and their applicability in a timely disease management of crop systems.

1. Introduction

Tomato (*Solanum lycopersicum* L.) is a worldwide spread vegetable crop for its edible fruits with a global production that amounted to around 159 million tones in 2011 (Faostat, 2015), 37 of which were required from processing industry (WPTC, 2013). The consumption of canned tomato is regularly increasing due to easier preservation and durability in the use of products in respect to fresh ones. Italy is the major European producers of processing tomatoes that account for more than 4.7 million tones (WPTC, 2013). Nevertheless, the cultivated areas showed, in few years, a downward trend passing from 94,346, in 2007, to about 84,000 ha, in 2011 (Istat, 2015) because of the excessive growth in production costs.

Since tomato plants are susceptible to several pathogens, diseases remain one of the main production-limiting factors: therefore, chemical control is intensively used despite the hazardous effects and high cost of the fungicides. However, the increased concerns for food security of consumers, which prefer safe products completely free of synthetic residues, are leading toward the complete substitution of synthetic fungicides with natural products. This solution, moreover, is particularly encouraged by the latest EU policies aimed at reducing the use of chemicals in agriculture.

There are intensive efforts worldwide to use organic derived products to provide valid biological alternatives to agrochemicals for plant protection and to enhance sustainability of the crop management (De Corato et al., 2015). Among these, compost teas (CTs) may represent an effective tool for a valuable development in this field. CTs are oxygenate compost water extracts obtained

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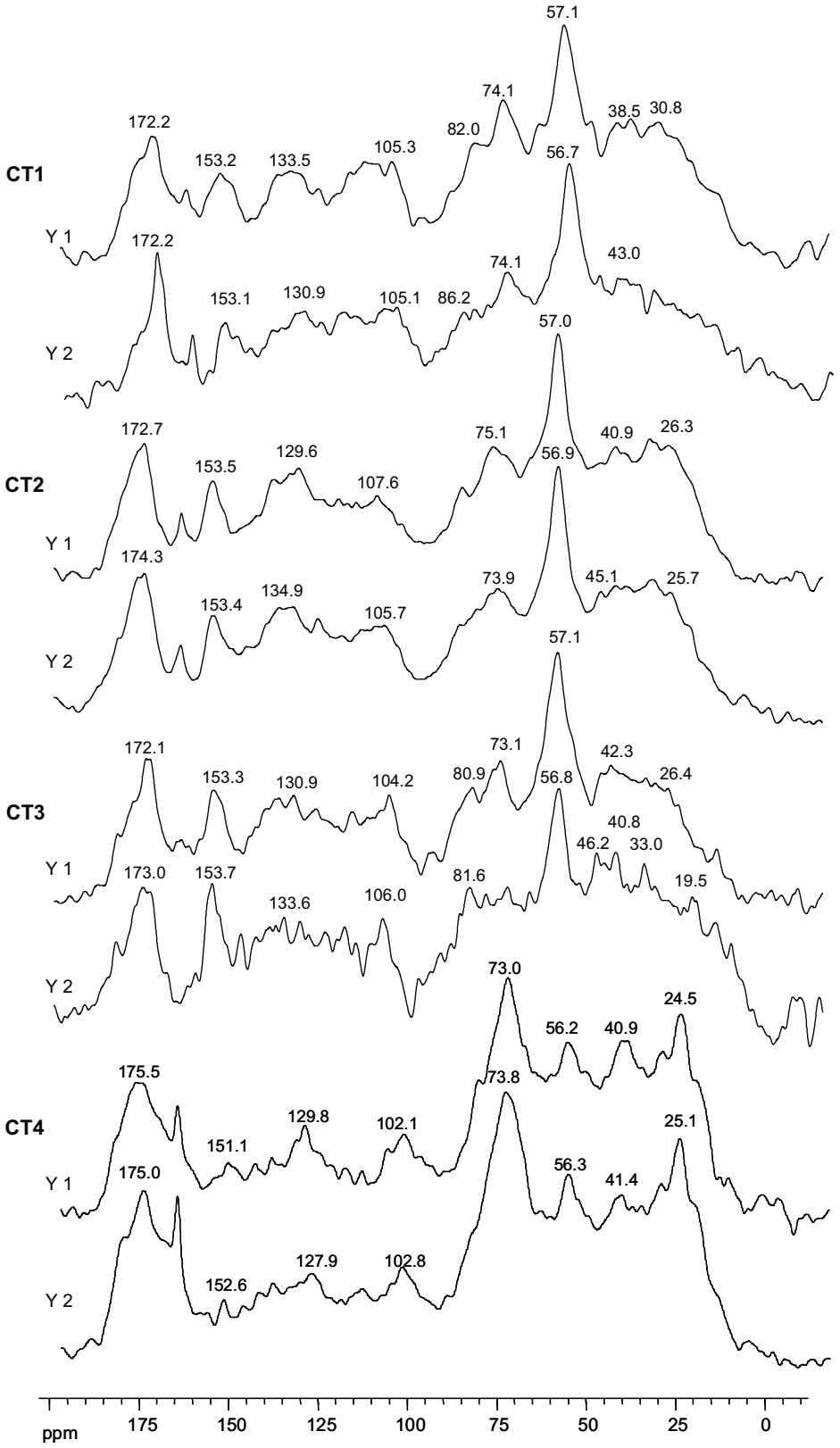

Fig. 1. ^{13}C-CPMAS-NMR spectra of CTs (1–4) obtained in each experimental seasons (Y1 and Y2).

through a suitable liquid-phase blowing process. The product can be applied to the plants to get benefits in terms of enhanced protection from pathogen and/or to improve their physiological status (Siddiqui et al., 2008). CTs can be proposed as powerful alternative to chemical fungicides conventionally used in agriculture to reduce detrimental effects of diseases. Their suppressive properties are essentially related to microbiota proliferating in the liquid through the typical biological control mechanisms (Pane et al., 2012). Most