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Felipe Guilayn, M Benbrahim, M Rouez, M Crest, Dominique Patureau, Julie Jimenez

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F. GUILAYN*[1], M. BENBRAHIM[**], M. ROUEZ, M. CREST, D. PATUREAU, J. JIMENEZ

* LBE, Univ Montpellier, INRA, 102 avenue des Etangs, 11100, Narbonne, France. felipe.guilayn@suez.com
1. SUEZ, CIRSEE, 38 rue du Président Wilson, 78230, Le Pecq, France
** RITTMO Agroenvironnement, ZA Biopôle, 37 rue de Herrlisheim, CS 80023, F-68025 Colmar. second author's address, email address. mohammed.benbrahim@rittmo.com

Abstract:

Humic-like substances (HS*) extracted from six different digestates were used for the biostimulation of hydroponic culture of *Lactuca sativa*. A preliminary dose-screening trial was performed with the application of extracts from two digestates (from sewage sludge and manure) and a commercial reference of HS* from leonardite. In this test, the application of extracts from digestate performed statistically better than a commercial reference when compared to the blank. The preliminary study has confirmed the interest of extracting HS* from digestates for application as biostimulants in hydroponic systems. The full-test with the extracts from six different digestates is being carried out for 3 months and will include aerial and root biomasses and root architecture assessment.

Keywords: digestate valorization; biogas effluent; biostimulation,

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Introduction

Digestate management is a key challenge and is a major lever of improvement of Anaerobic Digestion both in terms of economic viability and environmental benefit. Digestate landspreading is a typical option but it is not always possible and, in some cases, may rise concerns on environmental issues (Nkoa, 2014).

Biostimulants are substances leading to indirect positive effects on plant development, including germination enhancement, root growth and architecture, aerial biomass, ornamental value, abiotic stress resistance, among others (Calvo et al., 2014). Humic-like substances are one type of biostimulants that can be recovered from fossil sources (leonardite) or anthropogenic organic materials and residues, including compost and anaerobic digestates (Calvo et al., 2014; Fascella et al., 2015). Indeed, digestates have been successfully post-treated to be valorized as a pool of complex soluble organic substances referred as "humic-like substances", "soluble biopolymers", "biobased organic substances", and other names (Fascella et al., 2015; Montoneri, 2017; Prevot et al., 2015; Salati et al., 2011).

The application of digestates in hydroponics systems as source of nutrients have been reported (Krishnasamy et al., 2012) and the biostimulation of hydroponics systems by HS* have been demonstrated with HS* from fossil sources (Conselvan et al., 2017) and from anthropogenic organic materials (Morard et al., 2011; Palumbo et al., 2018). However, there is currently very few studies testing digestate-extracted humic-like substances (HS*) for biostimulation, the few ones are mostly restricted to ornamental plants (. In the scientific literature, the studies of (Fascella et al. 2015; Massa et al. 2017).

After a first test for screening HS* dose (Guilayn et al., 2018) with the HS* extracts from only two different digestates, the objective of this ongoing study was to test HS* extracted from six different types of digestates on root architecture and root and aerial growth of *Lactuva sativa*

in a hydroponic (soilless) system, using a commercial humic substances solution (from leonardite) as reference.

Material and Methods

Humic-like substances were extracted from six different digestates with an alkaline treatment. Five of the six digestates were from full-scale plants: a centralized facility treating food/agri-industrial waste and sewage sludge, a sewage sludge digestate from a wastewater treatment plant, two organic fraction of municipal solid waste digestates and a farm-based manure digestate. The remaining digestate came from a 5 L pilot treating food waste.

Digestate and its HS* extracts were characterized in agronomic value (Total N, total ammoniacal nitrogen, total P, total K, total Ca, total Mg, total S) and trace elements (Cr, Cr, Cu, Hg, Ni, Pb, Zn) by and accredited external laboratory (Aurea Agrosciences, Ardon, France). HS* quality was assessed trough 3D fluorescence (Perkin Elmer LS55), 90-day soil incubation tests (FD U44-162) and fractioning into humic-like acids, hydrophobic substances, transphilic substances and hydrophilic substances as described by Baccot et al. (2017). As indicated by the International Humic Substances Society, fulvic-like acids were considered as the hydrophobic fraction retained in the DAX-8 resin.

The biostimulation tests consisted in 3-month hydroponic culture of *Lactuca sativa* in quadruplicate (independent systems) containing three plants each (Figure 1). Detailed germination and semi-controlled conditions are described elsewhere (Guilayn et al., 2018). Biostimulation was assessed through aerial and root wet and dry biomass and root architecture analysis through scanning and analysis by the software WinRHIZO™.

Results and Conclusions

The tests are ongoing and will be carried out until half-december 2018. No intermediary analysis is performed since the analyzed parameters need the interruption of the culture.

Figure 1 Picture of the system in starting conditions.

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