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TECHNOLOGICAL INNOVATION FOR A SUSTAINABLE TROPICAL AGRICULTURE

PROCEEDINGS

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PROCEEDINGS

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VERMICOMPOST BIOSTIMULANTS: NUTRIENTS AND AUXIN FOR ROOT GROWTH

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Introduction

The use of so-called biostimulants in agriculture has been increasing in recent years. Types of biostimulants comprise amino acids, humic substances, algae extracts, microbial -based products and others (Paradikovi et al., 2011; Ertani et al., 2013). The conversion of organic wastes into valuable earthworm fertilizer either in solid as in liquid form is a interesting alternative path for organic fertilizer production (Zandonadi & Busato, 2012). In fact, it was showed that 36,500 tonnes of waste can be transformed per year in vermicompost by an economic and environmental-friendly technique (Quintern et al., 2013). Agro-industrial residues should to be considered as source of nutrients and plant growth regulators for use as alternative fertilizers or fertilizers additives.

The present study was undertaken to establish if biostimulants differently extracted from vermicompost causes root development and how mineral nutrients and plant growth substances are associated to different extraction methods.

Methods

The biostimulants from vermicompost were isolated as follows: 1. vermicompost leachate (VL), a natural leachate from worm-bed; 2. vermicompost water extract (1:10, vermicompost:water, TEA) and; 3. vermicompost alkaline extract (1:10 vermicompost:0,1 NaOH mol.L^{-1}, HUM). Mineral nutrients, humic substances, indole 3-acetic acid and indolic compounds were analysed by means of inductively coupled plasma emission spectroscopy, *IHSS*-fractionation, high-performance liquid chromatograph and simple spectroscopy methods, respectively. After germination romaine lettuce (*Lactuca sativa* cv Parris Island) seedlings was exposed to 25% (v:v) VL, TEA and HUM in the presence or not of half strength Hoagland's solution, totalling eight treatments during 14 days. Afterwards, seedlings were collected and lateral root number, root area and primary root length were analysed by ImageJ™ software. In adittion, protons extrusion was measured *in vivo* in roots either by means of bromocresol purple gels as pH electrodes as described in Zandonadi et al. (2010). Root growth parameters data were analyzed using ANOVA or two-way ANOVA followed by Dunett or Bonferroni tests, respectively. Principal Components Analysis (PCA) and factor analysis were used as multivariate exploratory techniques in order to comprehend the relation of 17 variables, including mineral nutrients, auxins, humic substances and lateral root number. The Pearson correlation coefficient was also determined following the multivariate analysis.

Results and discussion

The factor analysis has showed that factor 1 explain 67.82% of data variance and presents higher correlation with lateral root number, N, P, K, Ca, S, B, Cu, Fe, Zn, humic substances, fulvic acids and humic acids. Factor 2 explains 19.86% of data variance and is more related to Mg and Mn. The conjoined analysis of the two factors satisfactory explains 87.68% of data variance. Both PCA and Pearson correlation coefficient of variables has showed that lateral root number is highly related to fulvic acids, IAA, indolic compounds and K (Fig. 1). The projection of the case on the factor plane has showed that TEA and HUM could be grouped under the 17 variables analyzed (Fig. 1). On the other hand, CON and VL are isolated and non-grouped. In accordance with the nature of vermicompost treatments, both TEA and HUM vermicompost extracts were grouped.

The increase in the activity of H^+ pumps and in the root growth has been associated with exposure of plants to purified humic acids isolated from vermicompost, auxin and nitric oxide (Zandonadi et al., 2010). In agreement with these results, data presented herein shows that vermicompost extracts (TEA and HUM) and leachate (VL) enhance lateral root number, root area and primary root length (Fig 2). These treatments are complex biostimulants solutions, since are composed by nutrients and organic matter, which has IAA (Fig 1.) and other plant growth regulators. In fact, lateral root number was associated with fulvic acids, IAA, indolic compounds and potassium. Accordingly, potassium is a very important nutrient for auxin-induced acid growth (Hager, 2003). In adittion here the net proton flux measured *in vivo* was higher in lettuce roots treated with vermicompost biostimulants (data not shown) as compared to control plants in the presence of only half strength Hoagland's solution. The presence of IAA in VL, TEA and HUM may account for the greater effect on both rizosphere acidification capacity and root growth. However, we cannot exclude that other compounds not detected here also could be also associated with the stimulant activity observed. Among the three biostimulants developed, the water-soluble extracted is the most simple to formulate. Since TEA has both nutrients and plant growth regulators it is a promising product since its already in use by small farmers in Brazil.

Overall the data presented demonstrate that vermicompost-derived biostimulants might be interesting fertilizers, due its chemical composition and effects on plant growth. It remains to be identified other plant growth molecules likely associated to the stimulant activity, and expands the analyzes performed here to industrial scale vermicomposting products.

Conclusions

Data presented demonstrate that vermicompost-derived biostimulants are very interesting organic fertilizers, since contains plenty nutrients and additionally auxins, thereby affecting both root acidification and growth. Whether other plant growth molecules are associated to biostimulants effects remains to be clarified.

Keywords: Vermicomposting, ATPase, indolic compounds, acid-growth

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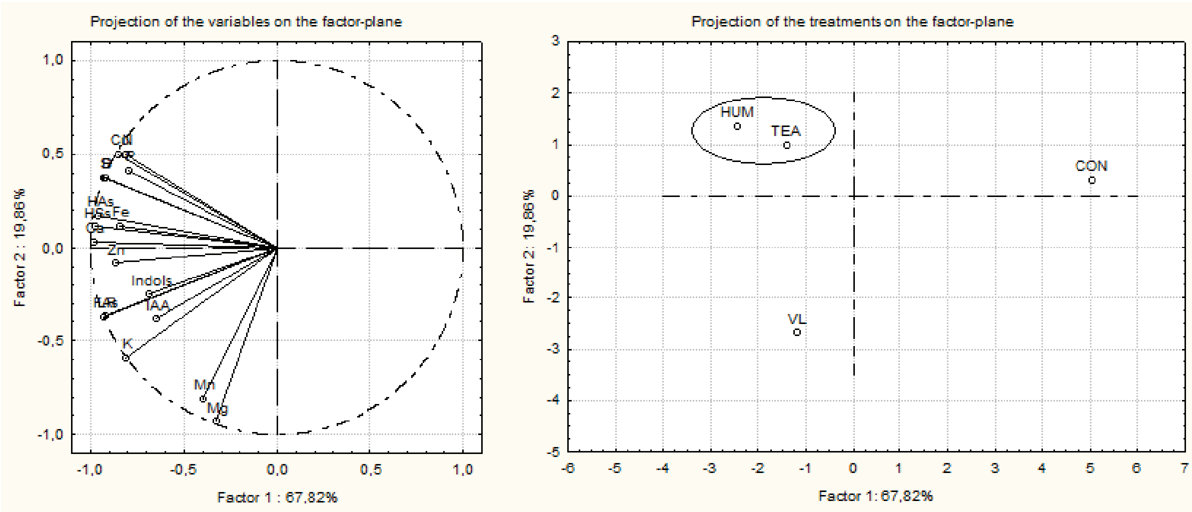

Figure 1. Left ordination diagram shows the projection of the normalized factor coordinates of 17 variables obtained by Principal components analysis (PCA). The treatment of overall data by PCA indicated a clear separation of control (CON) and vermicompost leachate (VL) treatments (right). Both vermicompost extracts (TEA and HUM) were grouped.

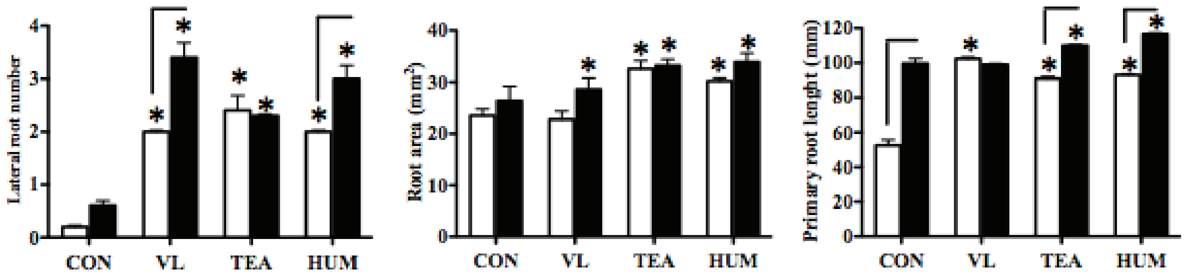

Figure 2. Lateral root number, root area and primary root lenght. Seedlings were treated or not (CON) for 10 days with VL, TEA and HUM in the absence (white) or presence (black) of half strength Hoagland's solution. The asterisk (*) indicates difference between treatments (VL, TEA and HUM) compared to control in the absence (white) or presence (black) of nutrient solution, according to the Dunnett test (P <0.05). The trace denotes the difference represents a minimal significant level for effects of nutrient solution (P <0.05).