EFFECTS OF HOT WATER EXTRACTS OF A COMPOSTED GREEN WASTE AND SEWAGE SLUDGE ON PLANT GERMINATION IN MODEL EXPERIMENT

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Abstract: Application of aqueous extract of different compost materials (called as "compost tea") in horticulture is a well known topic but the agricultural use of these products is a much less investigated subject. Compost tea application improves plant health, crop yield and quality. The primary mechanism of this response is not clearly understood. It is believed that soluble mineral nutrients, organic acids and water-soluble plant-growth regulators extracted in the tea have positive effects on initial root development and plant growth. Living microorganisms present in compost tea may also induce disease resistance as well as stimulate nutrient uptake and plant growth.

This prestudy investigated the effect of hot water extracts on germination and growing rate in laboratory model experiment. White mustard (*Sinapis alba*), spring barley (*Hordeum vulgare L.),* winter wheat (*Triticum aestivum L.*) and triticale (*Triticosecale*) was used as test plant in 4 replications. Optical method was used to investigate the germination and growing rate of the test plants during the test period. This method is based on pixel analysis. Pictures were taken from 8 different angles from the rotated plants. Pixel analysis showed that the plants had different answers to the hot water extracts. Our results show that the extracts have positive effect on seed germination and growing rate.

Keywords: compost extract, compost tea, optical analysis, laboratory model experiment

Introduction

Compost is the product resulting from the controlled biological decomposition of organic material that has been sanitized through the generation of heat and stabilized to the point that it is beneficial to plant growth. Compost is an organic matter resource that has the unique ability to improve the chemical, physical, and biological characteristics of soil or growing media (Debosz et al., 2002). It contains plant nutrients but is typically not a fertilizer. Several publications noticed that composting practice was already known in the Roman times too. Modern composting and the scientific researches started in the early XX's (Reeve et al., 2010). The first compost extract users were the organic farmers who aimed to reduce the chemicals on farms some decades later.

The primary reason for producing "compost tea" from different compost materials is to transfer microbial biomass, fine particulate organic matter, and soluble chemical components of compost into an aqueous phase that can be applied to plant surfaces and soils in ways not possible or economically feasible with solid compost. In our present days we know many things about these extracts but the mode of action is not clearly understood. Compost extracts or "teas" are not fertilizers but can increase the soil fertility. It is not a fungicide, insecticide or herbicide but can prevent, reduce or solve the plant protection problems (On et al., 2015).

 DOI:10.12666/Novenyterm.64.2015.Suppl

Materials and methods

The laboratory model experiment was conducted on July 16 to July 17 in 2014. White mustard (*Sinapis alba*) (M), spring barley (*Hordeum vulgare L.)* (A), winter wheat (*Triticum aestivum L.*) (B) and triticale (*Triticosecale*) (T) was used as test plant. 30 seeds were transferred to petri dishes containing 2 g cotton-wool and wetted with the compost extracts or distilled water. Completely randomized design was used with three treatments, distilled water control (D), green waste compost extract (Z), and sewage sludge compost extract (S). All treatments with all plants were replicated four times. The moisture content of petri dishes during the test was monitored with daily weighing and was watered (distilled water or compost extracts) to weight accordingly.

Compost extracts were made from the compost samples using 200 g dry weight equivalent compost in 1000 cm^3 distilled water. Samples were boiled for 30 min, rested for 2 h., and strained through a 0.45 µm sieve. Initial extracts were diluted with distilled water to 1:10.

Optical method was used to investigate the germination and growing rate of the test plants during the test period. This method is based on pixel analysis. Pictures were taken from 8 different angles from the rotated plants (*Figure 1*.). On the plant images the image processing program counts the green pixels representing the color of leaves. In this way we could convert the plant growing status to numerical data (Tolner et al., 2010). Differences by treatments and plants were analyzed statistically using by Microcal Origin 6.0.The following equation was used which is a composition of a classic Mitscherlich growing function, and a continuous linear decreasing caused by ageing and drying and other effects.

$$y=A*(1-\exp(-(t)*b))+c*t$$

Where: ***y*** is the actual size (in pixels), ***t*** is the time (in days) a ***A*** is a maximal growing (in pixels), ***b*** is a growing constant (in 1 $days^{-1}$), ***c*** is a decreasing constant (in pixels $days^{-1}$)

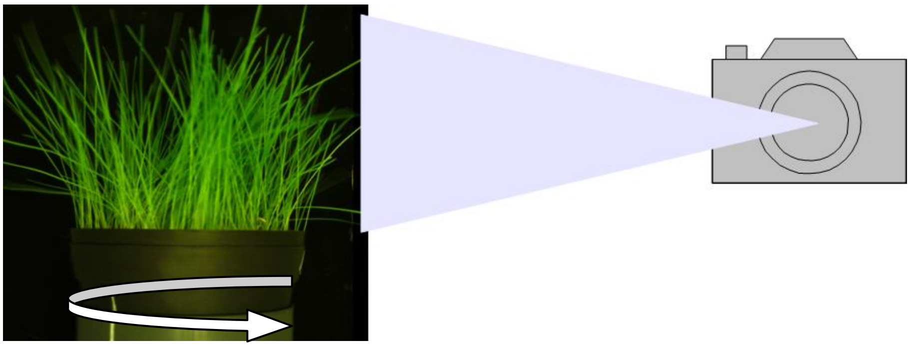

Figure 1. Theoretically operation of optical observer

Results and discussion

Distilled water (D) application did not cause any effect on test plants (*Figure 2*-a.). Growing intensity of test plants originated from the store of seeds. The decreasing tendency of pixels might indicate nutrient deficiency or the opportunity to finish the test. Green waste extract significantly increased the number of pixels in each plant. In case of triticale and white mustard the positive effect of compost extract is clearly visible. The treatment has an effect on growth of spring barley also (*Figure 2*-b.). Sewage sludge compost extract has an effect on test plant also but this increasing was not so outstanding compared to green waste compost extract (*Figure 2*-c.).

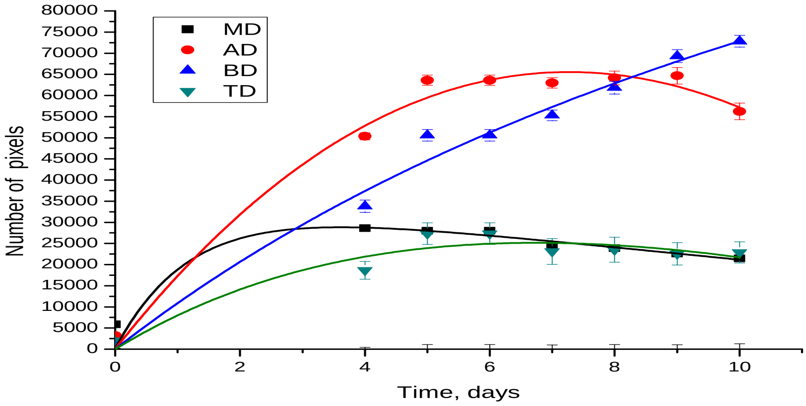

Figure 2-a. Effect of different compost extracts on plants biomass

(white mustard (M), spring barley (A), winter wheat (B), triticale (T), distilled water control (D), green waste compost extract (Z), sewage sludge compost extract (S))

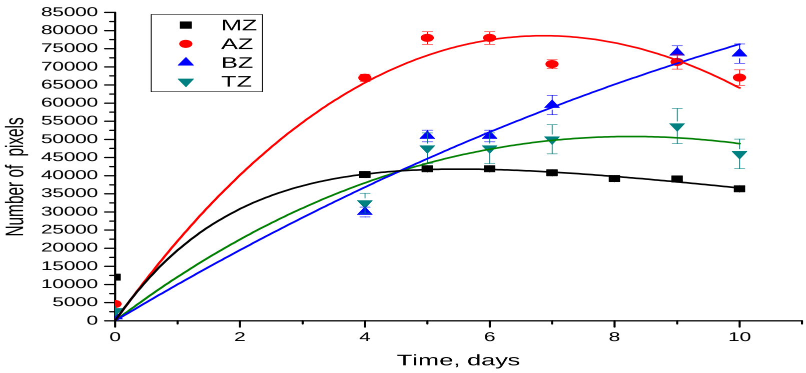

Figure 2-b. Effect of different compost extracts on plants biomass

(white mustard (M), spring barley (A), winter wheat (B), triticale (T), distilled water control (D), green waste compost extract (Z), sewage sludge compost extract (S))

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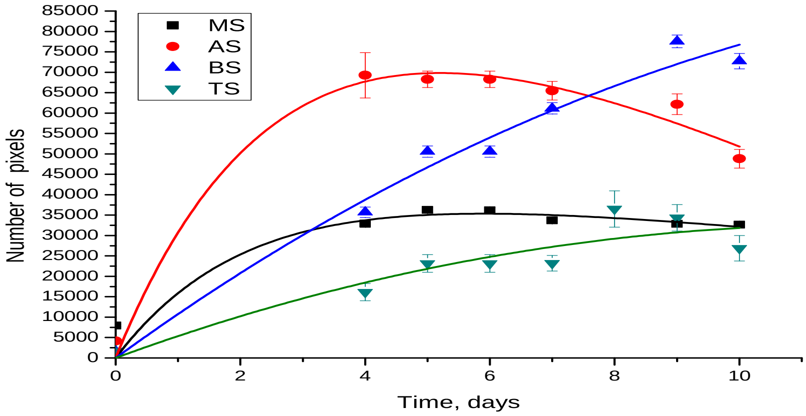

Figure 2-c. Effect of different compost extracts on plants biomass

(white mustard (M), spring barley (A), winter wheat (B), triticale (T), distilled water control (D), green waste compost extract (Z), sewage sludge compost extract (S))

Conclusions

It has been found that this method is suitable to carry out and evaluate short plant tests. Compost extracts have effect on test plants despite boiling. Green waste compost extract has outstanding effect on plant grow. Although sewage sludge compost extract increased the number of pixels, this effect was less than in case of the green waste extract application. Winter wheat did not show any responses. These results create good basis to the further experiments in the near future.

Acknowledgements

This work was supported by the KTIA_AIK_12-1-2013-0015 program of the Hungarian National Development Agency. Special thank to the many people who have made this experiment possible.

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