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Cultivation of C. cardunculus For Biomass And Oil Production On Brownfield Pre-washing Soil and Post Washing Sludge Assisted With Compost Amendment And Microbial Biostimulants

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Introduction

The Bagnoli-Coroglio NIPS of Naples is a brownfield of one of the largest Italian steel production plants, named ILVA (Fig.1). This sites of 300 ha, which concentration of potentially toxic elements (PTEs) in soils are above the Italian screening values for residential use, was the subject of a remediation project started in 1994 based mainly on excavation and soil-washing techniques. The resulted soils and sediments were potentially contaminated by Pb, Zn, and As. Here we present the results of the first year of experimentation of a mesocosm experiment with *Cynara cardunculus* L..

Figure 1: ex-ILVA

Figure 2: Cardoon

Materials and Methods

The experiment was carried out in the experimental facilities of the Dep. of Agricultural Sciences of Naples University, from Oct. 2018 to Sept. 2020 (Fig.2). Mesocosm were filled with soil (S) and sludge from soil washing (F) in a complete randomized design with 3 replicates. Half of the pots were treated with compost (C), 50 t/ha, while the other half remained untreated (NoC). Three commercial biostimulant levels were evaluated: TA (Lifestrong Vam Superb, containing a microbial consortium of AMF and PGPR; TB (Aegis microganulo, containing AMF); NoT as non-inoculated control. At harvest, plants were cut and divided in leaves, shoots and capitula.

Results

The analysis of variance showed that compost application resulted in significant increased aboveground dry weight (Fig.3) resulting in almost doubled biomass production for both substrates (+52%). Besides, productivity was higher, corresponding to implemented dry weight of capitula and seeds (+ 53 and + 58%, respectively). The application of TB resulted in significantly increased biomass (+42%) compared to untreated ones. Conversely, the application of TA resulted similar to NoT. Biostimulants did not affect the plant productivity, i.e., seeds d.w., number and capitula d.w. Plant growth parameter were significantly affected by substrate. Particularly, post-washing sludge resulted the best substrate for cardoon growth, significantly increasing biomass production by 35%. Moreover, capitula and seeds d.w. were enhanced by 40% and 44% respectively. Substrate influenced nitrogen uptake in the whole plant (544.18 g/plant d.m. for F compared to 301.79 g/plant d.m) and particularly in capiS: 46.02 g/plant d.m., F: 113.58 g/plant d.m, tula (+59%). Compost application significantly influenced nitrogen uptake for leaves (+47%), plant (+50%) and capitula (+59), but not for shoots. The application of biostimulants did not significantly alter the nitrogen uptake compared to the control.

Conclusions

C. cardunculus L. confirmed its adaptability to marginal environments, low input cultivation in degraded soil. Compost application has proven to be capable of achieving satisfactorily biomass yield. Moreover, its economic low cost and its sustainable production qualify it as main product for sustainable brownfield remediation. Compost application and inoculation with TB increased up by 56% the aboveground production, implying that both approaches can be adopted on substrates with restraining condition. Nevertheless, this study is based on the first productive cycle of the thistle, the least prolific. Further studies are needed to evaluate the biomass production of this plant on the same substrates in subsequent production cycles.

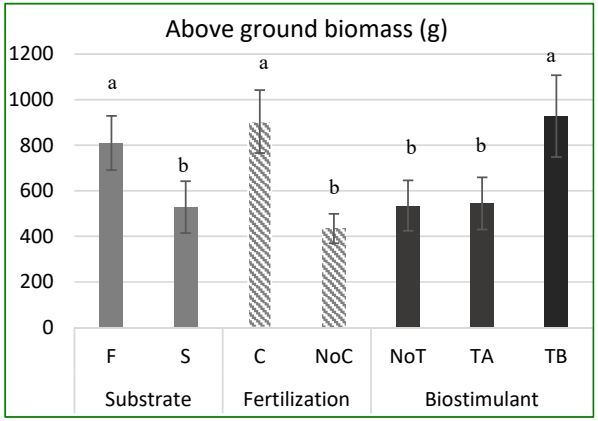

Figure 3: Mean effect of the applied treatments. Mean values with the same letter are not different (p<0.05)