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Reuse of wasted bread, bioprocessed and not, as soil amendment

Claudio Cacace[1], Carlo Giuseppe Rizzello[2], Michela Verni[1], Gennaro Brunetti[1], Francesco De Mastro[1], Andreina Traversa[1], and Claudio Cocozza[1]

[1]Department of Soil, Plant, and Food Science, University of Bari, 70126-Bari, Italy
[2]Department of Environmental Biology, "Sapienza" University of Rome, 00185 Rome, Italy

In an era characterized by land degradation, climate change, and a growing population, ensuring high-yield productions with limited resources is of utmost importance. In this context, the use of novel soil amendments and the exploitation of plant growth-promoting microorganism's potential are considered promising tools for developing a more sustainable primary production. In fact, several soil properties are positively influenced after the addition of organic amendments, as the organic matter content that represents a limiting factor for the growth and production of crops in the Mediterranean basin. In this regard, bread and bakery products represent up to 20% of the total daily food waste produced, and only a little quantity is reused, mainly to feed livestock. In this study, a bioprocessed wasted bread, obtained by an enzymatic treatment coupled with fermentation using a selected lactic acid bacterium, together with unprocessed wasted bread were used as amendments in a pot trial, with and without plants. An integrated analytical plan aimed at assessing *i)* the modification of the physicochemical properties of a typical Mediterranean alkaline agricultural soil, and *ii)* the plant growth-promoting effect on escarole (*Cichorium endivia* var. *Cuartana*), used as indicator crop, was carried out. Compared to the unamended soils, the use of biomasses raised the soil organic carbon content (up to 37%) and total nitrogen content (up to 40%). Moreover, the lower pH and the higher organic acid content, especially in bioprocessed wasted bread, determined a major availability of micronutrients in amended soils. In contrast, the availability of P was reduced by the treatments. The escaroles from pots amended with raw and bioprocessed bread had a number of leaves 1.7- and 1.4-fold higher than plants cultivated on unamended pots, respectively. In addition, the yield of escarole resulted 1.95 and 1.70 times higher in the amended pots with raw and bioprocessed bread, respectively, than control soils. Therefore, no apparent phytotoxicity has been observed, confirming the possible re-utilization of such residual biomasses as agriculture amendments. Finally, since lactic acid bacteria cause an acidification of biomasses, the latter are suitable for the application as alkaline soil amendment through beneficial effects on the bioavailability of several nutrients.