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Transformacje materii organicznej i składników mineralnych podczas kompostowania wierzby energetycznej

Transformations of organic matter and mineral components during composting of energy willow

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Abstract

The reduction of EU funds for the cultivation of energy willow, used as a renewable energy source, induced Polish farmers to stop cultivating it and liquidate plantations, because from the grower's point of view, its production has become unprofitable. The development of energy willow biomass began to arouse interest in horticultural circles looking for materials for the production of horticultural substrates other than peat, the exploitation of which leads to the reduction of peat areas, especially in the countries of the western part of the European Union. Due to the need to find new materials as horticultural substrates, the concept of compost production based on the available biomass after energy willow cultivation has appeared. An important aspect of the effective and safe use of composts is the thorough knowledge and understanding of the transformation of organic matter that takes place during the composting process, as well as the proper assessment of the stability and maturity of the compost. Therefore, the aim of the research was to analyze the transformation of minerals and organic matter during the composting of energy willow biomass enriched with various additives and to determine the quality and maturity of the obtained composts based on the indexes of chemical and biological parameters, with particular emphasis on the stability of humic substances

The results obtained in this study allowed to affirm that the material composition – decisive for the C/N ratio – has a significant impact on the course and direction of transformations taking place during the composting process. Taking the temperature as a criterion for assessing the maturity of the tested composts, it was ascertained that only in variant B (a mixture of willow and hay) and in variant D (a mixture of willow, hay and mineral nitrogen) all thermal phases were achieved, the occurrence of which determines the proper sanitation of the material. In the second part of the composting process in the piles consisting of a mixture of hay and willow chips, more intensive transformation processes were found, indicating the development of the humification process at that time, which predominated over the processes of decay. In all composted objects, the permissible Cd content was exceeded. The process of composting willow biomass enriched with various additives, allowed to illustrate the directions of transformation of organic matter, to learn the fractional composition of humic compounds, as well as the structure of humic and fulvic acids, formation of which was also influenced by the physical parameters of the composting process. In the conducted research it was found that the highest intensity of organic matter transformation – mainly mineralization – took place in the first days of composting, and it decreased over time. Based on the observation of infrared spectra (FTIR) of humic substances of the tested composts and the elemental

composition of the extracted humic acids, it was found that the decomposition of the willow biomass, without any additives, may lead to a decrease in the proportion of carboxyl groups in the particles of fulvic acids, which consequently will transfer into lowering the sorption capacity of this group of humic substances. Based on the results of EPR spectroscopy and the analysis of the antioxidant properties of fulvic acids with the use of the DPPH radical using UV-VIS spectroscopy, it was found that the transformation processes of organic compounds in prisms consisting only of willow chips marked very weakly, which resulted in a low degree of humification of the final product obtained.

The conducted researches allowed to state that among the studied composts, the most optimal variant that could be considered as a component of plant substrates is variant B, which is a mixture of willow and hay chips, however, due to exceeding the permissible limit of Cd content, its use in the form of fertilizer is unacceptable. In future application studies, it would be advisable to carry out additional tests with the use of ingredients that may contribute to lowering the content of the limiting factor.