

DEVELOPMENT OF BIOCADASTRE OF UKRAINIAN PEATS AND ITS USE IN CREATING OF NEW HUMIC PREPARATIONS FOR AGRICULTURE

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SUMMARY

The screening system for assessing the biological activity of peat as a raw material and products derived from it for agriculture have been developed. The biological activity of peat of different Ukraine's deposits have been assessed with the use of the screening system. Based on received results, the new type of cadastre, the Biocadastre of peats of Ukraine, has been developed. Today, the Biocadastre's database is successfully used for the optimal choice of peat deposits and for the development of modern biotechnologies for receiving new humic preparations for agriculture, medicine and other industries. This approach to the selection of raw materials has yielded new biologically active peat products Hydrohumate and Humilid. They can be widely used as a stimulants and regulators of plant growth and development. Hydrohumate and Humilid have been tested and were officially registered in Ukraine as a feed additive to the basic diet of farm animals.

KEYWORDS: peat, humic preparations, Biocadastre of peats, Hydrohumate, Humilid

INTRODUCTION

Extensive studies of the biological activity of peat in the former USSR, the theoretical basis of its use in agriculture, and technology for production of these biologically active agents were laid more than half a century ago by the widely recognized in the world scientific school of professor Christeva Lydiya in Dnepropetrovsk. The increasing number of new preparations of humic nature and peat's mixtures were occurrence last decades, and expanded of spheres of its application in different brunches of agriculture. The choice of deposits for the production of peat humic substances, as is also development and adoption of new technologies for production of peat products should be based on the research of biological activity of both raw peat and biologically active substances manufactured from it. It is necessary also to take into account biological safety of peat of selected deposits, that is to control the extent of their toxic effects on organism of plant and animals. Traditionally, evaluation of biological activity of peat is carried out based on the results of studies of separate kinds of biological activity, for example, growth rate of plants, accumulation of the green mass, etc. Hence, often the entire spectrum of possible biological effects of derived preparations does not immediately appear. In this regard we undertook an integrated approach to determining of the biological activity of peat and to theoretical basis development for peat deposits selection for production of biologically active preparations (Stepchenko et al., 2009b; Stepchenko et al., 2010b).

MATERIALS AND METHODS

The samples of peat from peat deposits of different regions of Ukraine was the object of investigation. Botanical composition, physical and chemical properties of peat, content of humic acids and mineral substances were carried out by conventional methods (Arinushkina 1970). The method we choose for studying possible toxicity of peat is based on toxicity studies quantifying the corresponding reactions of infusorium *Paramecium caudatum* on the toxic components of the studied peat contained in the fine aqueous extract of the sample. Determination of growth-stimulating activity was carried out on peat radicular test, using as a test object of watercress. For the evaluate of the energy-modulation activity of peat we determine the energy of germination, using as a test culture of red radish with white tip. The effect on biological productivity was assessed by the increase in biomass of seedlings. The influence of peat preparation on the system of immunity was tested in a study of the level of immunoglobulines and immunocompetent cells. Determination of catalase activity of peat was carried out by gasometric method, peroxidase activity by titrimetric method, phosphatase activity by the colorimetric method, protease activity by titrometric method (Zvyagintsev 1991).

RESULTS AND DISCUSSION

In order to assess the complex and diverse biological activity of humic preparations and raw peat materials for their manufacture the scrining system of estimation of biological activity was developed in the Research laboratory on humic substances, named by Prof. L.A.Christeva, Dnepropetrovsk State Agrouniversity (Stepchenko et al., 2010a; Stepchenko and Syedykh 2011). The researches we made using this system showed that peats from different deposits of Ukraine differs significantly on the type and intensity of biological effects, in terms of potential toxicity: about 12% of peats deposits in Ukraine are potentially hypotoxic for biological objects. Based on these results, we developed a new concept of cadastre of peats containing the assessment of peat's biological activity and safety as a raw material for producing preparations, called "Biocadastre of peats of Ukraine" (Stepchenko et al., 2010c).

It is shaped like a systematic information system, registry data on botanical composition, physico-chemical properties of peat, content of humic acids and mineral substances, level of potential toxicity (by parabyotyc and infusorial tests; content of heavy metals, radionuclides), biological activity (energy modulative, enzyme, growth-promoring activity; phytobioproductivity; anti-stress, immuno- and enzymomodulative, adaptogenic, antitoxic, antioxidative properties).

The analysis of the data of Biocadastre showed the correlation between physical-chemical properties of peat, its botanical composition and separate kinds of biological activity. The main factor determining the biological active of peat is the number of biologically active substances, first of all humic acids (Christeva 1973; Tomson and Naumova 2009). The highest content of humic acids is observed in peats with a high degree of decomposition. Given the considerable variability of this index, it is expedient distribution of peat in Ukraine in the content of humic acids. In our opinion, they can be divided into three groups: high (35%), middle (30-35%) and low (less than 30%) of humic acid content. The highest percentage of peat with a high content of humic acids was found in the peat of the Forest-steppe zone and the area of Polesie.

Biocadastre of peats also contains the data about enzymatic activity of peat, as an indicators of its potential biological activity, which characterizes the system's ability to maintain homeostasis. To assess the enzymatic activity investigated the activity of enzymes such as amylase, invertase and urease. These enzymes are widely distributed in soils and peats, and play an important role in enriching of plants and microorganisms mobile and available nutrients (Tomson and Naumova 2009). The peats of different deposits significantly differed in activity levels of the studied enzymes. Thus, the activity of amylase has a certain dependence on the botanical composition of peat and the presence of free calcium ions in it. The high urease activity was manifested mainly in reed-sedge peat. In the 10% of peat deposit (in the first place Polesie and Forest-steppe zone), identified all three types of hydrolase activity. In the fifth part of the samples of peat is determined only invertase activity. It was also found a direct correlation between enzyme activity of the oxidoreductases (catalase and peroxidase) and the hydrolases (phosphatase and proteases) to the level of exchangeable acidity, ash content; and protease activity – to the level of ammonium and nitrate nitrogen. It can provide a scientific basis for expanding the use of peat, rational, science-based use of its resources to produce biologically active substances.

Today, database of Biocadastre of peats of Ukraine created in the Dnepropetrovsk State Agrouniversity is successfully used for the optimal choice of peat deposits and the development advanced modern biotechnologies to produce new preparations of humic nature for agriculture, medicine, balneology, pharmacology, microbiology and other industries. (Stepchenko et al., 2008; Stepchenko et al., 2009a; Stepchenko and Syedykh 2010). Based on Biocadastre data, the deposits with high levels of certain types of biological activity were chosen and the preparations of directed action were created in our laboratory. On the basis of new approaches to the selection of raw peat, (depending on the physico-chemical characteristics, biological activity and biological safety) new humic products of the second generation Hydrohumate and Humilid have been created for agriculture. Both preparations are registered in Ukraine as a feed additive to the basic diet of different species of farm animals. This preparations differ in direction and intensity of biological action: Hydrohumate has more pronounced growth-stimulating effects, Humilid shows more pronounced anti-stress and immunomodulatory effects. The experiments established that the Hydrohumate application as an additive to feed for pigs, cows, broiler chickens, ostriches promotes activation of growth and development of animals, increasing their survival, stress resistance, natural resistance, provides an additional number of products. Currently in Ukraine Humilid is being tested as feed additive. It differs from the previously investigated preparations by the more high biological activity, as well as a higher degree of humic substances use in the body of animals in the process of metabolism. This preparation shows high efficiency when applied in various branches of crop production, as well as when used as a feed additive to the basic diet of cows, pigs, broiler chickens, laying hens, and ostriches. Expressed adaptogenic properties of new humic preparations offer the prospect of their widespread use in the production of biologically safe food especially in the conditions of industrially contaminated areas and under extreme environmental conditions.

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