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IMPROVING THE TECHNOLOGY OF OBTAINING HUMIC SUBSTANCES FROM PEAT

Abstract: *The study of the extraction of humic substances from peat is considered in the work. During the studies of various mode parameters of extraction, the optimal one was determined, which obtained a higher yield of humic substances.*
For decades, the arguments of plant growers about which forms of fertilizers are more useful for soil fertility and more effective for plants – organic or mineral – have not subsided. Each of these types has its own disadvantages and advantages, and as it turned out later, it is possible to keep the soil healthy and get the maximum benefit only with a competent combination of them.

Keywords: *humic substances, extraction, technology.*

Introduction

Humic substances are specific complexes of organic compounds with a complex structure. They are divided into two main groups: the group of dark-colored humic acids, which includes humic acids (gray), ulmic acids (brown), and alcohol-soluble hematomethane acids, and the group of yellow-colored fulvic acids. Humic and fulvic acids, taken together, are called "humic substances".

Humic acids have high biological activity, which determines the possibility of their use as plant growth stimulants and components of microfertilizers. As already mentioned, humic acids with alkali metals form easily soluble salts that increase the activity of enzymes, increase the permeability of cell membranes, stimulating the processes of respiration, synthesis of proteins and carbohydrates in plants. That is why their use allows to increase the yield of agricultural crops in stressful conditions.

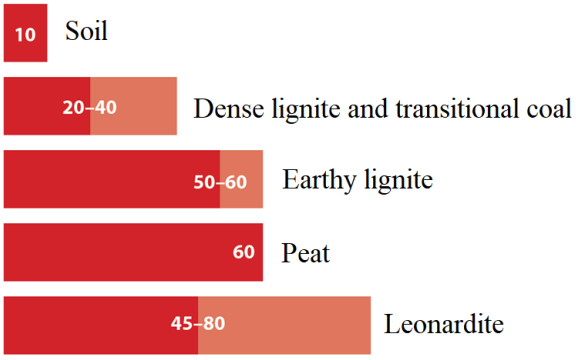

Figure 1. *The content of humic substances in different sources, %*

Humic acids are one of the most common carbon-containing materials on Earth's surface, as well as one of the most complex substances on the planet. It is very difficult to artificially synthesize humic acids, but there is no urgent need for this today, since these substances are widely distributed in nature. They are found in soils, coal, sea and fresh water, peat and sapropels, some number of humic acids is even in the air. Figure 1 shows the content of humic substances in various sources. In soils, humic substances are 1-10%, while the most of them are in chernozems. The leaders in terms of the content of these compounds are organogenic rocks, which include coal, peat, sapropel, and oil shale.

An important source of humic substances is peat. Basically, peat is used for fuel and local fertilizers. If humic substances are removed from it, and the rest is burned, then this unique natural resource can be used more rationally. The main method of obtaining humic substances is an alkaline reaction with ammonia solutions or potassium or sodium hydroxides. Such processing turns them into water-soluble salts – potassium or sodium humates with high biological activity. The composition of functional groups and the structure of molecular fragments of humic acids depends on the method of their production [1].

Despite the fact that quite a few sources of humic acid extraction have been found in Ukraine, fertilizers with their content continue to be imported in significant quantities. These are fertilizers based on humic and fulvic acids, made from leonhardite, potassium and sodium humate, as well as microbiological means for fertilizing and improving the soil.

Today, preparations made from the ash of various agricultural crops (granulated sunflower ash), the production of which has been established in Ukraine, are gaining more and more relevance. Microbiological preparations based on soil bacteria, which do not undergo chemical treatment, are also announced on the country's organic fertilizer market.

Figure 2 shows the countries from which fertilizers with humic acids are imported into Ukraine: China, Germany, Spain, Turkey, Slovakia, the Russian Federation, the USA.

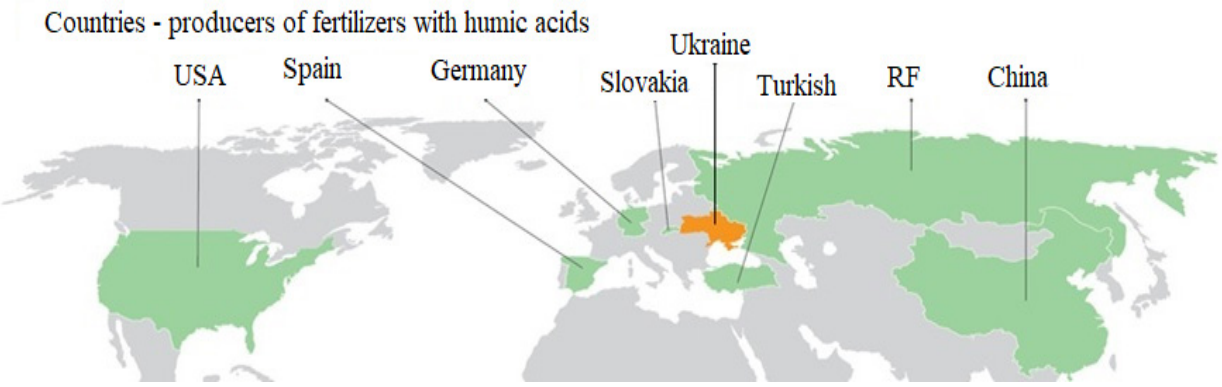

Figure 2. *Countries from which fertilizers with humic acids are imported into Ukraine*

The production of organic fertilizers in Ukraine is represented by preparations made from vermicompost, based on chicken droppings and cattle manure, biohumus, as well as organo-mineral fertilizers of plant origin. Domestic fertilizers are mainly exported to Lithuania.

The effectiveness of applying preparations based on HA depends on the biological activity of the constituent substances. More biologically active humic acids have the greatest effect on increasing yield. It can be natural raw materials: manure, sapropel, peat, brown coal, as well as artificial ones produced from the by-products of the wood processing and paper industries. Of course, naturally occurring humates are more active and have a much stronger effect on the plant.

Materials and methods

Peat from various deposits in the city of Chernihiv and the floodplain of the city of Irpin was used for the research.

The classic technology for extracting humic substances is based on high temperatures of 130-140°C, which destroy the organic component of fertilizers. Experiments were carried out on the EI-10 laboratory stand, which reproduces the operation of a pulsating disperser with an active diaphragm in the dispersion and extraction modes during the processing of aqueous mixtures of lowland peat for the purpose of extracting biologically active humic substances. The mode of extracting the humus component with an ambient temperature of 60°C and a hydromodule of 1:15 with an alkali concentration of 1% was proposed [2].

Research was also carried out to improve this technology with a change in the hydromodule of 1:6 and a temperature of 60°C with intensive mechanical stirring for 20-30 minutes and an alkali concentration of 2%. A weight of milled peat is loaded into the receiving container, poured with 2% alkali in a ratio of 1:6, and the components of the mixture are mixed with a mechanical device for 20 minutes at 20°C. The mixture is heated to a temperature of 60-70°C and kept for 40-60 minutes. After that, the mixture is settled for 10-12 hours. Then the mixture is centrifuged. Also, samples of extracts of humic substances obtained by the traditional method were taken for comparison.

Results

Studies were conducted on the extraction of humic substances from various peat deposits. Peat from the deposit of Chernihiv and the floodplain of Irpenyu was used for research. As can be seen from Table 1, different deposits do not have the same concentration of humates, which differs by several times.

Table 1. *The number of humic substances in native peat depending on the deposits*

Peat	The number of humic substances, %
Floodplain of Irpin	43
Chernihiv deposit	9

Studies on the completeness of humic component extraction using improved technology from various deposits are presented in Figure 3. As can be seen from Figure 3, the content of humic substances in native peat is 43% and 9%, depending on the deposit. After extraction, the maximum yield of humic substances is 39%, which is more than 80% of the amount in native peat from the Chernigov deposit. Humic substances in the solid residue of peat are 4%, which indicates effective extraction and an optimally selected mode.

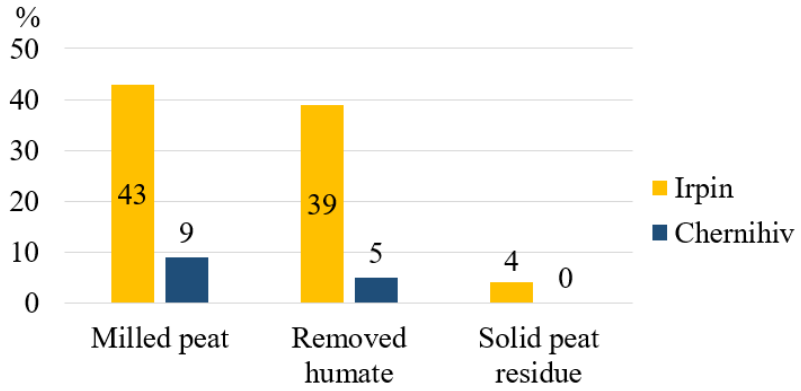

Figure 3. *The number of humic substances on 100% dry basis according to the improved technology*

The amount of 100% dry humic substances extracted from milled peat samples of the Irpin floodplain using discrete-pulse energy management technology and improved technology are presented in Figure 4.

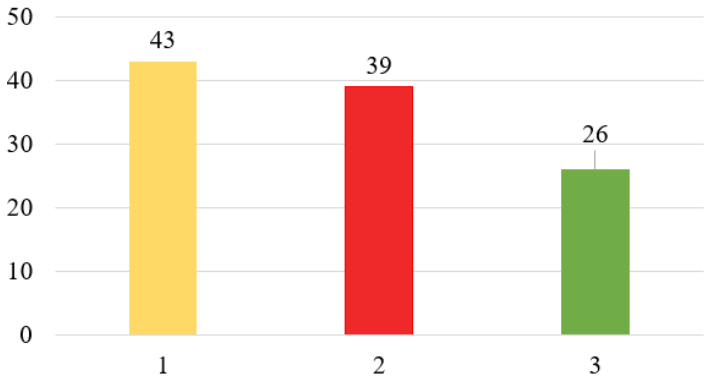

Figure 4. *Amount of 100% dry humic substances from the Irpin floodplain: 1 – milled peat in its native state; 2 – milled peat of the Irpin floodplain using improved technology with regime parameters of hydromodule 1:6 and lye concentration of 2%; 3 – the technology of using devices for discrete-pulse energy input and mode parameters hydromodule 1:15 and alkali concentration 1%*

As can be seen from Figure 4, the yield of humates with the improved technology is 1.5 times higher than with the use of discrete-pulse energy management devices, this can be explained by the fact that the extraction of 12 hours is the best among the studied values, regardless of the source of peat. This time interval is necessary for breaking bonds between inorganic components and organic matter of peat and depolymerization of complexes with high molecular weight [3].

Conclusions

Conducted research on the extraction of humic substances using various technologies made it possible to obtain their maximum output according to the developed requirements by 9.7 times.

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