BG Pulse Journal USA
ISSN:1947-2536 http://www.bgpulseusa.com/index.php/bg
BG PULSE JOURNAL

COMPLEX PROCESSING OF GTL PLANT WASTE BIOSLIM INTO MINERAL FERTILIZER AND THE PLACE OF MINERAL FERTILIZER IN AGRICULTURE

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Doi: https://doi.org/10.5281/zenodo.23041372

Abstract: The purpose of this work is to develop a technology for obtaining a nutrient biofertilizer for agriculture by complex processing of the secondary product biosludge into nitric acid, potassium and phosphorus fertilizers at the GTL plant and study its effect on crops.

Keywords: GTL, NPK, RZ-PPK 2 and K-PPK 1, SŁ-PPK 4, calcium, magnesium, iron, zinc and copper.

With the development of science and nanotechnology in the world, the demand for various chemical compounds is also increasing. In this regard, biofertilizers enriched with nitrogen, phosphorus and potassium nutrients play an important role. The production and use of this type of liquid and granular fertilizers is considered quite promising and effective from a technological and agrochemical point of view. At the same time, the efficiency of nutrients in liquid fertilizers is very high, which makes them economically effective even in conditions of drought and water shortage. It is important to develop a scientific and technological basis for obtaining this type of fertilizer.

In our republic, certain scientific and practical results are being achieved in the implementation of technologies for processing raw materials containing NPK and providing the chemical industry with NPK-enriched biofertilizer compounds. The new Uzbekistan Development Strategy for 2022-2026 sets out important tasks aimed at “increasing the volume of industrial production by continuing the industrial policy aimed at ensuring the stability of the national economy and increasing the share of industry in the gross domestic product.” In this regard, the development of a technology for obtaining liquid and granular nitrogen-phosphorus-potassium-rich biofertilizers by complex processing of biosludge produced at the GTL plant into mineral acid, potash and phosphate fertilizers is of particular importance.

As a result of laboratory tests, multicomponent mineral-organic fertilizers enriched with secondary nutrients and microelements with an adapted composition for the cultivation of rapeseed, corn and sunflower were obtained. For large-scale tests, a product with the best fertilization parameters was selected for each crop. Fertilizer selection was carried out using a fuzzy logic-based reasoning system. Due to its simplicity and universality, the fuzzy logic system is widely used in science and engineering, as well as in social and economic fields [1].

The obtained products were analyzed for their physicochemical properties and the results were compared with the requirements for mineral-organic fertilizers. The content of primary and

secondary nutrients, trace elements and heavy metals in the fertilizers was determined in an accredited laboratory and is presented in Table 1.

The content of organic matter in the obtained fertilizers cannot be determined using the flame loss method due to the possibility of decomposition of mineral compounds in the fertilizers. Therefore, the organic carbon content of the products was determined and converted to the amount of organic matter. A value of 1.70 was used as the conversion factor. This is the average value of the ratio of organic matter to organic carbon in the GTL biosludge sample, which, according to the rule, should contain at least 20% organic matter based on mineral-organic fertilizers and dry weight. The data in Table 1 show that the fertilizers meet this requirement.

Table 1

	RZ-PPK 2 11,5-5-16,5 (2,3:1:3,3)	**K-PPK 1** 10,5-5-13 (2,1:1:2,6)	**SŁ-PPK 4** 6-4-17,5 (1,5:1:4,4)
Organic carbon, %	11,9	13,9	13,2
Organic matter 3, %	20,2	23,6	22,4
Essential nutrients			
N, %	11,0±0,6	10,5±0,5	6,7±0,3
P_2O_5, %	4,6±0,3	5,1±0,3	4,4±0,3
K_2O, %	16,3±0,7	12,9±0,5	18,8±0,8
Total NPK, %	31,9	28,5	29,9
NPK ratio	2,4:1:3,5	2,1:1:2,7	1,5:1:4,3
Secondary nutrients			
CaO, %	3,3±0,2	3,2±0,2	2,5±0,1
MgO, %	1,5±0,2	1,4±0,1	1,1±0,1
Na_2O, %	0,3±0,04	0,2±0,03	0,2±0,03
SO_3, %	2,2±0,1	5,5±0,1	11,0±0,7
Microelements			
Fe, %	2,90±0,32	3,21±0,35	3,18±0,35
Zn, mg/kg	580±80	600±80	570±70
Cu, mg/kg	160±20	160±20	130±10

The nitrogen, phosphorus and potassium contents of RZ-PPK 2 and K-PPK 1 fertilizers correspond to the tolerance values for multicomponent mineral fertilizers; the total negative deviations from the expected value are 1.1% and 0.1%, respectively (permissible 1.9%). The content of the main nutrients in SŁ-PPK 4 fertilizer is higher than the expected values [2].

The results of assessing the hygroscopicity of the fertilizer were studied (Fig. 1). Placing fertilizer granules in an atmosphere with a relative humidity of 75% led to an increase in the mass of the sample by 18.2% (RZ-PPK 2), 20.2% (SŁ-PPK 4) and 23.0% (K-PPK 1). The hygroscopicity of the granules is associated with the content of nitrogen salts, especially ammonium nitrate, in the

developed fertilizers. To prevent moisture absorption from the air, it is necessary to monitor the loading and storage conditions of the received fertilizers.

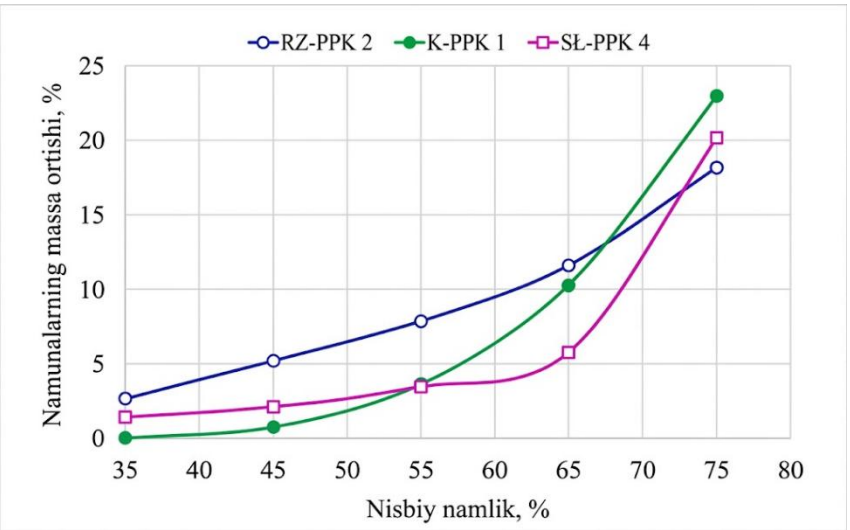


Figure 1. Variation of the mass of fertilizer samples depending on the relative humidity.

To check the effectiveness of fertilizers, a wick test was conducted according to the procedure. A photograph of the wick test of rapeseed is shown in Figure 2.



Figure 2. Experimental photo of rapeseed in a container

Analyzing the characteristics of the selected rapeseed, it can be concluded that they depend on the level of fertilization. Even at the lowest fertilizer dose (10.5 g/container), the average number of branches per tested plant more than doubled. At higher fertilizer doses, this figure increased more than fourfold. The average number of pods per rapeseed also increased with increasing fertilization level. At a fertilizer dose of 10.5 g/container, the increase in fresh plant weight was 138% and 135%, respectively, compared to the control sample. The increase in dry plant weight ranged from 82% to 149%, depending on the level of fertilization. The test results show very good agricultural efficiency of RZ-PPK 2 fertilizer [3].

A photograph of the experiment conducted in a flower bed with corn is shown in Figure 3, and the effect on selected corn characteristics is presented in Table 2.

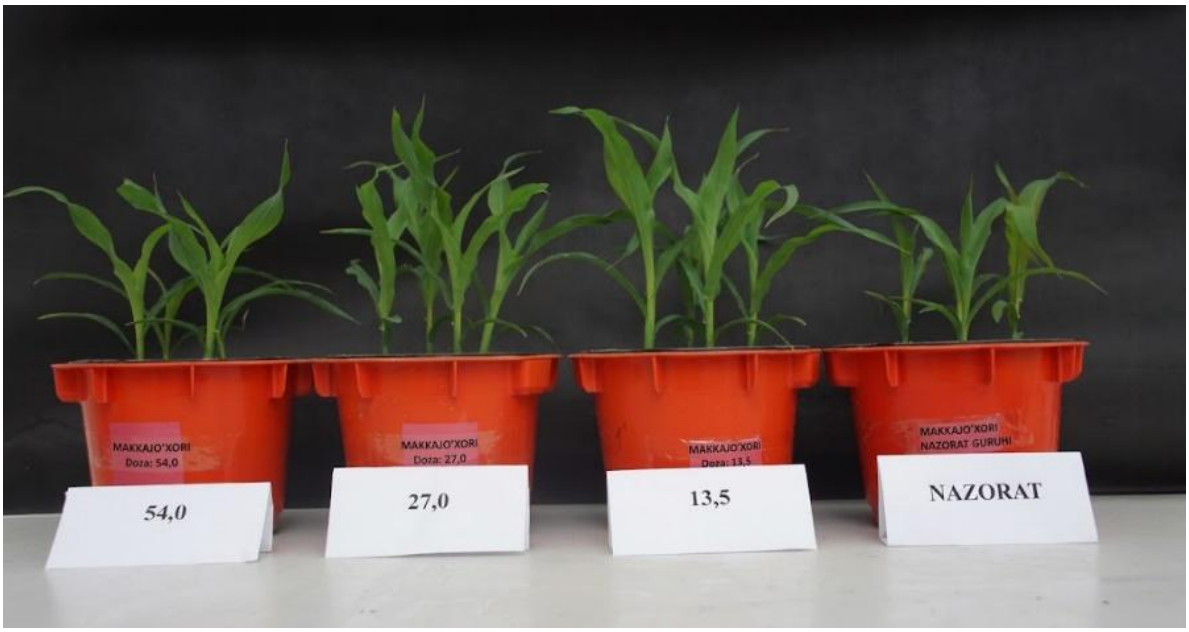


Figure 3. Photo of a corn cob study

The growth and development of the tested plants were significantly affected by the level of fertilization. A fertilizer dose of 13.5 g/pot increased the fresh and dry weight of corn plants by 96% and 128%, respectively, compared to the control plant. The increase in fresh weight at levels II and III was 112% and 138%, respectively, and in dry weight, 154% and 170%, respectively [4].

Table 2.

Effect of K-PPK 1 fertilizer on selected corn traits

Fertilizer dose, g/pot	Fresh plant mass per vase (4 pieces), g	Dry weight of plants per vase (4 pieces), g
Control	246,7	69,6
13,5	482,9	158,4
27	521,8	176,9
54	587,2	188,2

The production process of special mineral-organic fertilizers consists of enriching the biosludge, which is a waste product of the GTL plant, with minerals obtained from traditional and renewable raw materials and granulating the resulting mixture with an acid solution. The fertilizers must have the NPK ratio required by certain plants and meet standard requirements in accordance with the Regulation of the Minister of Agriculture and Rural Affairs on the Implementation of Certain Provisions of the Law on Fertilizers and Fertilization.

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