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APPLICATION OF SAPROPEL IN AGRICULTURAL PRODUCTION

SUMMARY

Organic agriculture is related to the production which is regulated by law and it includes monitoring and certification of entire production process and the products themselves. Opportunities for development of agriculture in certain regions of the Balkans can be found in the promotion of organic farming. The basis of this type of agricultural production are the inputs being used, ie, by avoiding the use of artificial, chemical substances and encouraging the use of fertilizers and additives that are based on natural substances. The main advantages of organic production are reflected in the healthier final output and positive impact on the environment by reducing pollution, rational use of resources, preservation of soil fertility, etc. The organic production points out the huge importance of organic fertilizers being used because they improve the properties of the soil and final products. This work refers to the introduction of organic fertilizers, which are based on sapropel and its impact on growth and development of plants. Sapropel refers to the sediments at the bottom of lakes, and this type of fertilizer is relatively new concept in agricultural production.

Keywords: organic farming, organic fertilizer, soil fertility, Sapropel

INTRODUCTION

One of the most important factors of agricultural production is land and its fertility. Fertile soil contains high levels of nutrients and a physiologically active layer which is crucial for the development of root and root's system. In addition, water-air, thermal regime and pH value are essential for plant growth and development. However, conventional agriculture often has a negative impact on long-term soil fertility, by violating its structure, water-air and thermal regime, reducing the number of microorganisms that have a positive impact on the development of the plants, reducing the amount of organic matter and other negative consequences arising from the intensive use of mineral fertilizers and chemicals. To avoid this negative impact on the land, it is necessary to use organic matter, and to conserve the soil microorganisms that promote the growth and development of crop plants.

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In this paper, emphasis is given to the relatively new product- organic fertilizer, which is based on the lake sapropel from Latvia, which has a beneficial impact on the land and preserving its fertility.

With regard to the situation in the sector of agriculture in Montenegro, as well as in neighboring countries, it is important to mention that it is not at a high stage of development, due to the process of industrialization, excessive use of chemical fertilizers and chemical plant protection a product which is leaving a negative impact on arable land.

Organic fertilizers based on sapropel which also has the property of the substrate and the soil conditioner can present an important contribution to the solution of the conservation of soil fertility, organic food production and environmental conservation.

Organic farming in the EU has an upward trend, so that in the last ten years it has increased production area for about 500,000 ha. Taking into account that organic fertilizer based sapropel holds a certificate that confirms that it is the appropriate input for organic production, this products and its application can have an important role in the transition period from conventional farming to organic farming.

RESULTS AND DISCUSSION

Sapropel and its characteristics

The fact is that the world is increasingly concerned about food shortages, caused mainly by factors such as rapid population growth, climate change impacts and weather conditions, so the need to maximize the potential of land is growing. The last fifty years of farming was based on uncontrolled application of mineral fertilizers and chemical plant protection products which have left a large negative impact on agricultural land and the environment.

The development of organic food production is based on the use of fertilizers and plant protection products based on organic origin. Today there is an alternative that combines the efficiency of the first ones with environmental responsibility of other types of fertilizers. This alternative is based on the sapropel, which refers to deposits of sludge from a lake (Fig. 1).

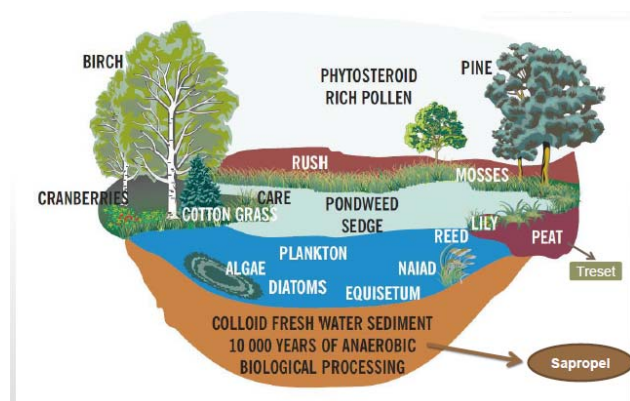


Figure 1. Sapropel and peat in nature

Because of the way of forming, sapropel contains large amounts of organic matter, such as complex of lignin, humus, carbohydrates and bitumen in a colloidal state.

Sapropel contains various minerals of organic origin. Its main advantage is related to the content of bio-active substances, amino acids, vitamins and enzymes. Sapropel is a biological product that is relatively unknown in many countries of the world, especially in countries with tropical climates. Application of sapropel in these areas could largely increase yields of agricultural products. This organic fertilizer consists of colloidal sapropel and active peat, and for its production a clean, environmentally-friendly and patented technology has been used.

This product is completely environmentally friendly, due to the fact that the colloidal sapropel is exploited from the bottom of lake located in national park in Latvia, which has no contact with industrial pollution. The second component, ie, active peat is subjected to a sterilization process on the temperature of 70 °C before mixing with the sapropel.

Sapropel based organic fertilizers

Organic fertilizers based on sapropel, present the biologically active soil conditioners obtained with environmentally-responsible and patented technology based on the interference of two natural ingredients: colloidal sapropel and active peat. The combination of these two components is such that one improves the another. Sapropel contains a rich complex of natural vitamins, minerals and bacteria that stimulate the formation of humus in the soil, activates metabolic processes in the soil and leads to restoration of fertility. Peat improves the structure and aeration of soil, enriched soil humic acids and increases the ability to retain moisture in the soil. Substances that are found in sapropel are shown in Figure 2.

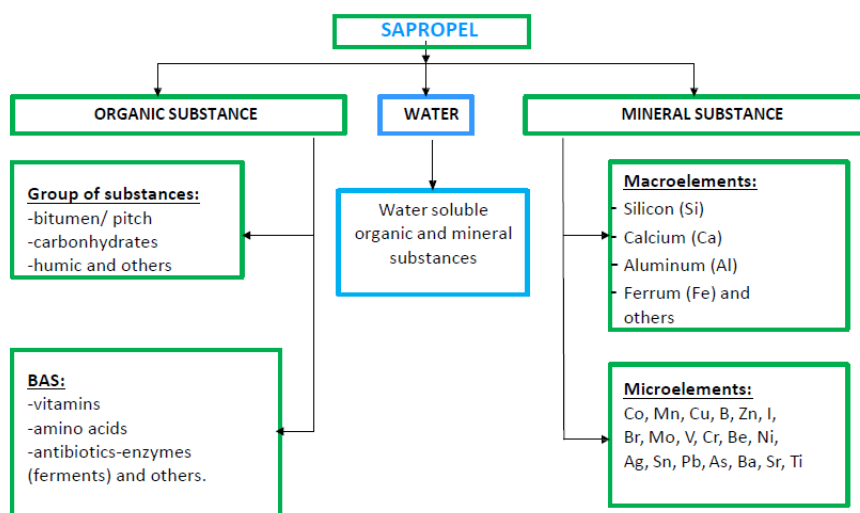


Figure 2. Sapropel substances

Organic fertilizer based on sapropel contains:

- nitrogen-fixing and nitrifying bacteria;
- natural water soluble vitamins: carotene (provitamin A), B1, B2, B3, B5, B6, B12, E, C, D, and folic acid;
- 16 natural water soluble Amino Acids: Histidine, Glutamine, Glycine, Valine, Arginine, Aspartine, Alanine, Serine, Leucine, Isoleucine, Phenylalanine, Tyrosine, Lysine, Methionine, Threonine, Cystine;
- natural enzymes: Catalase, Peroxidase, Reductase, Protease;
- humic complex: Humic Acids, Fulvic Acid;
- microelements: Mn, Cu, B, Zn, I, Mg, Cr, Ag, Sn, Ba, Ti, Br, Mo, V, Be;
- Nitrogen (N) not less than 10 000 mg/kg;
- Phosphorus (P) not less than 150 mg/kg;
- Potassium (K) not less than 250 mg/kg;
- Organic Carbon (C) not less than 40%;
- Essential elements: Si, Ca, Al, Fe;
- Organic matter (OM) not less than 75%± 10%;
- Moisture not more than 70% ± 5%;
- pH 3÷7 (by requirement);

Features of this kind of fertilizers are multiple. These fertilizers increase the content of humus in the soil and they prevent its erosion, and thus this restores fertility of the soil and improves its structure. Application of these fertilizers leads to the increasing of the moisture content of the soil (4-5 times). In addition to the above mentioned facts, these fertilizers significantly increase yield and reduce the period of maturation of agricultural products.

Organic fertilizers based on sapropel significantly neutralize excessive concentration of radioactive substances, excessive concentrations of heavy metals, pesticides and chemical fertilizer salts in the soil. Traditional forms of organic fertilizer (manure of poultry, pork and beef origin) include: weed seeds, pathogens and other unwanted chemical ingredients, which are reflected in the health and safety of products. Unlike the others, fertilizers based on sapropel are completely decontaminated from pathogenic organisms, and in addition they increase the mobilization of nitrogen, they clean soil of pathogenic fungi and harmful microorganisms. Fertilizers based on the sapropel contain about 1012-1014 micro-floral colonies / g, while being fully released from the pathogenic organisms, and thus they affect the rapid growth of plants.

Manure which is used as an organic fertilizer contains small quantities of microorganisms 10⁹ colonies / g. This refers to a variety of microorganisms, including pathogens. Manure and other organic matter require the implementation of long-term preparation (6-12 months) before application to the soil. Useful substances found in manure are partially being lost, and the rest of the nutrients is available to the plants in 2-4 years after the application to the soil. During the season, about 80% of manure is flushed out of the soil and therefore it is necessary to re-apply it each year in large quantities. Unlike manure, sapropel based fertilizers, due to its active form of organic material, is accessible to plants

immediately after application to the soil. Organic fertilizer based on sapropel has the ability to provide the necessary plant nutrients gradually over an extended period of time, thereby reducing its "wash-out". As a result, small amount of organic fertilizer based on sapropel applied to the soil, remains active from 8-14 years.

Sapropel based fertilizers contain natural humus complex, that includes humic, fulvic, and amino acids. Humic acids from sapropel unlike peat humic acids have a higher content of nitrogen and hydrogen, nitrogen and 60% of nitrogen humic acid refers to amino acids. Humic substances of sapropel have adhesive properties so they associate minerals in the soil, which significantly improves the structure of the soil and affect the growth and development of plants.

When compared to the peat, sapropel has a greater content of readily-hydrolyzable materials, including hemicellulose and nitrogen compounds. Sapropel-fertilizer in comparison with other fertilizers, has a higher content of nitrogen (N), which is longer stored and better accumulated in the soil. This is very important because the lack of nitrogen reduces the resistance of the plants to various diseases. Due to the anaerobic process of the formation of sapropel, the total amount of nitrogen is completely preserved, and moreover, the content of water-soluble nitrogen - (NH₄) - is increased by 10-15%.

Sapropel contains many biologically active substances and microelements, available for the plant in its natural form. They are balanced and have a high degree of humification of organic substances. Mobile forms of potassium, phosphorus and hydrolyzed nitrogen (that sapropel is rich with), are simply assimilated by plants. Sapropel is naturally rich in vitamins and contains: carotene (provitamin A), B1, B2, B3, B5, B6, B12, E, C, D, P, and folic acid. Sapropel contains a larger amount of amino acid (histidine, glutamic acid, glycine, valine, arginine, aspartic acid, alanine, serine, leucine, isoleucine, phenylalanine, tyrosine, lysine, methionine, threonine, cysteine), enzymes (catalase, peroxidase, reductase, Protease). Sapropel is rich in microelements: Co, Mn, Cu, B, Zn, I, Br, Mo, V, Cr, Be, Ni, Ag, Sn, Pb, As, Ba, Sr, Ti.

Organic fertilizers based on sapropel increase the humus content in the soil and microorganisms and enzymes contained in these fertilizers can revive "dead" land and turn them into fertile. Fertilizers based on sapropel are ecological fertilizers that have a positive impact on the environment, improve the soil structure and its water-air regime, reduce water consumption, binding of heavy metals, radionuclides, pesticide residues. All of this enables the production of food in degraded and contaminated soils. Figure-3 presents the results of the application of organic fertilizers based on sapropel in several countries.

In Saudi Arabia, the experiments were carried out with products based on sapropel. On Figure 3. a) visible results are seen, experiments are made with celery, where it is evident that sapropel based fertilizers have a positive impact on the development of the root system of the plant. Positive effect of sapropel on other cultures can also be seen (Figure 3 b, c, d, e, f). Quantity of sapropel per

hectare (kg / ha) depends on the chemical analysis of soil, soil structure and culture that are produced. Larger quantities of sapropel in the amount of 20-40 t / ha, were necessary for crops that were grown in desert conditions, like in Saudi Arabia and Jordan.



A: TADCO S
B: 1:9 SAPR
with TADCO
C: 1:7 SAPR
with TADCO

a) Celery, Saudi Arabia



b) Tomato, Jordan



c) Cucumber, Jordan



d) Leek, Latvia



e) Tomato, Latvia



f) Potato, Latvia

Figure 3. (a,b,c,d,e,f) Application of organic fertilizers based on sapropel (source: Conference „Sapropelis: ieguve, pārstrāde, izmantošana“)

CONCLUSIONS

On the basis of chemical and biological properties of sapropel, and sapropel based fertilizers, it can be concluded that their application could find a significant role in the production conditions of Balkan region, in conventional farming and organic farming at: nursery production of field and vegetable crops, fruit trees, vines, as well as in the production of healthy products, vegetables and fruits.

When it comes to the application of the fertilizer and the quantity required per area unit, studies have shown that different types of soil, depending on the chemical analysis, require different amounts of sapropel based products, also depending on the culture is grown. Tests that were carried out in the mentioned desert areas used applied amount of (20-40) t/ha.

It is important to note that the pH value as well as microelements of organic fertilizers based on sapropel can be adjusted according to the needs of producers, and the projected production technology.

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PRIMJENA SAPROPELA U POLJOPRIVREDNOJ PROIZVODNJI

SAŽETAK

Organska poljoprivredna proizvodnja je proizvodnja je regulisana zakonom koji podrazumijeva kontrolisanje i sertifikaciju cjelokupne proizvodnje i samih proizvoda. Šansa za razvoj poljoprivrede u pojedinim regijama na Balkanu se ogleda upravo u promociji organske proizvodnje hrane. Osnovu organske proizvodnje predstavljaju inputi kojim se izbjegava korišćenje vještačkih, hemijskih materija (mineralnih đubriva i sredstava zaštite) dok se podstiče korišćenje đubriva i aditiva koja su bazirana na prirodnim organskim materijama. Prednosti organske proizvodnje ogledaju se u zdravim finalnim proizvodima hrane kao i pozitivnom uticaju na prirodnu sredinu, kroz smanjenje stepena zagađenja, racionalnije korištenje resursa, i očuvanje plodnosti zemljišta. U organskoj proizvodnji hrane ogroman značaj se daje organskim đubrivima, jer ona poboljšavaju strukturu i plodnost zemljišta, kao i kvalitet i ispravnost proizvoda. Ovaj rad se odnosi na proučavanje i primjenu organskih đubriva koja se baziraju na spropelu, i njegov uticaj na rast i razvoj biljaka. Organsko đubrivo Spropel predstavlja organske sedimente koji se nalaze na dnu jezera, a njegova eksploatacija i tehnološka obrada sa tresetom predstavlja novitet u poljoprivrednoj proizvodnji.

Ključne riječi: organska proizvodnja, organska đubriva, plodnost zemljišta, spropel