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Using the Extract of “Saprolin” for Enhancing Grain Crops

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Abstract. The solution to the problems of enhancing the yield of grain crops in current agriculture development is not conceivable without applying new land processing technology and using mineral fertilizers. Simultaneously, to obtain environmentally friendly products in organic farming, it is required to use mineral organic fertilizers in large quantities. For these purposes, we developed manufacturing technology and proposed the extract of “Saprolin.” This extract, obtained from organogenic lake storage, is supposed to be used for pre-sowing seed treatment, contributing to providing the planting material with biologically active substances, macro- and microelements, and natural soil conservation. During the production of the extract from the obtained source material, solutions of different concentrations were prepared, and their features (viscosity, density, electrical conductivity, refractive index, and pH of the medium) were studied. Using the wheat seeds “Novosibirskaya-31” and barley “Astana-2000” as an example, under the influence of solutions of the obtained extract, the germination and vigor of seeds were determined. As it was proved in experiments, the obtained extract is a good germination stimulant for grain crop seeds. It has a greater effect on seed vigor. Nevertheless, seeds with high vigor are the most viable, give good yield, and provide high-quality products. The germination rate significantly affects plants’ survival, shows the speed of their growth, and characterizes the ability of seeds to germinate in the field evenly (good uniformity). The research determines the germination and vigor of seeds using processing solutions of different concentrations. The research shows that the obtained extract of “Saprolin” increases the germination of seeds of grain crops by 1%–9% and vigor by 12%–19%. The extract of “Saprolin” is classified as a herbal stimulant containing a water-soluble natural mineral substance for improving plant nutrition.

Keywords: Food production · Extract of “Saprolin” · Organic fertilizers · Environmental pollution · North Kazakhstan region

1. Introduction

As an environmentally friendly and high-quality mineral organic fertilizer, sapropel can be used for all types of soils and plant species, an essential condition for increasing yields, including those prone to soil degradation and decreased humus in them [4, 5]. Some works are devoted to researching the stability of the soil cover of Northern Kazakhstan under long-term agrogenic load [6]. Moreover, the concentrated extract of “Saprolin” prepared based on sapropel is a saturated formation that feeds the seed material.

The extract of “Saprolin,” obtained from organogenic lake storage, is supposed to be used for pre-sowing seed treatment, which will help provide the planting material with biologically active substances,



macro-and microelements, and natural soil conservation. This additive's economic efficiency will increase the yield of organic agricultural products while reducing its production cost.

2. Materials and Methods

Pre-sowing seed treatment is one of the easiest ways to improve the quality of seed material and increase grain crops' yield. Despite the wide variety of such methods used worldwide, chemical seed treatment is used most widely. A necessary condition for suppressing seed infection, root rot, and other diseases is creating a protective zone in the plant and soil, which is achieved by treating the seeds with chemicals. To date, several protectants were developed for each crop. However, their use is related to environmental pollution by toxic substances and a risk to people and animals' health.

Modern crop production is being challenged to ensure sustainable growth in productivity and quality of agricultural products through more energy-intensive technologies, reducing resource intensity, and the level of technogenic and anthropogenic pollution of the environment and outputs.

Pre-sowing seed treatment with microelements and foliage applications are the most effective and economical ways to use micro fertilizers. Microelements, getting into the soil, form poorly soluble compounds. That is why water-soluble microelements are recommended for seed and foliage treatment. Nevertheless, in practice, it is often necessary to treat seeds with several microelements. For this purpose, various compositions of microelements are produced. Such mixtures have a beneficial effect on improving the quality of seed material and plant development at all stages of growth [1].

In general, a significant number of negative factors affect the quality of crop production. To reduce the impact of these factors, technologies that would increase qualitative and quantitative indicators in various climatic conditions and regardless of the state of the seed material need to be found.

In this regard, there is a need to develop non-pesticide crop growing technology. One of the ways to increase the disease resistance of plants is the use of biological preparations, biologically active substances, and macro- and microelements.

Even though biological preparations are inferior in efficiency to chemical ones, they can practically give results not inferior to chemical preparations in economic efficiency and surpass them in environmental terms at low and medium levels of distribution and harmfulness of phytopathogens.

Organic fertilizers play a special role in increasing crop yields. Their significance is that they are a rich source of the most valuable fertilizer elements for plants (nitrogen, phosphorus, potassium, calcium, magnesium, sulfur, and others) and that they activate microbiological processes in the soil, increase the concentration of carbon dioxide in the soil air, and enrich the soil with humus. Thus, soil buffering increases, its physical and chemical properties, structure, water, and air conditions improve, and the acidity and content of mobile aluminum decrease. This creates the basis for the effective use of mineral organic fertilizers.

We developed and proposed a methodology for using the sapropel extract – “Saprolin.” During its manufacture, solutions of different concentrations were prepared from the obtained source material, and their features (viscosity, density, electrical conductivity, refractive index, and pH of the medium) were studied.

Laboratory tests, which meet the “GOST 12038-84. Agricultural Crops. Methods for Determination of Germination” (GOST 12038-84), were carried out. For the experiment, the wheat seeds of the variety “Novosibirskaya-31” and barley seeds of the variety “Astana-2000” of the second reproduction were taken. These grain varieties are the most common for cultivation in Northern Kazakhstan. Samples weighing one kilogram were germinated on filter paper at a temperature of 20 °C. Seed vigor was determined after three days, and the germination rate – after seven days.

The solutions of “Saprolin” of the following concentrations were used for the wheat seeds “Novosibirskaya-31”: 0.69 g/l, 0.52 g/l, 0.35 g/l. The solution of “Saprolin” of the concentration of 0.18 g/l was used for the barley seeds “Astana- 2000” (table 1).

Table 1. The results of the analyses for germination of wheat seeds of the variety “Novosibirskaya-31” and barley seeds of the variety “Astana-2000.”

No.	Concentration	Seed germination before the experiment, %	Seed germination after the experiment, %
Wheat seeds of the variety “Novosibirskaya-31”			
1	Stock solution 0.69 g/l	49	47
3	Solution 0.52 g/l	49	50
4	Solution 0.35 g/l	49	50
Barley seeds of the variety “Astana-2000”			
1	Solution 0.18 g/l	63	72

Source: Compiled by the authors.

The research results show that the treatment of seeds with the solutions of “Saprolin” of the concentration of 0.69 g/l, 0.52 g/l, and 0.35 g/l increased the germination by 1%. The germination of barley seeds using treatment with a solution concentration of 0.18 g/l increased by 9%, which is explained by different absorption duration. For example, barley absorbs nutrition elements in 30–35 days and wheat in 48–55 days. Barley is extremely active in the consumption of nutrients. It responds well to the application of organic fertilizers. Wheat is most demanding on the conditions of mineral nutrition and growth than other grain crops.

Wheat and barley are crops requiring high soil fertility. Such soil needs organic fertilizers. As a rule, high yields of wheat are obtained on soils with a neutral or near-neutral reaction (pH 6.0–7.5), while barley grows well on slightly acidic soils (pH 5.5).

The treatment with the extract of “Saprolin” of the seeds of grain crops affected the greater germination of barley seeds than wheat because when measuring the pH of the solutions, it was determined that the reaction of the medium was acidic and even closer to neutral. Somewhat different results were obtained when analyzing the seed vigor of the same varieties (table 2).

Table 2. The vigor of wheat seeds of the variety “Novosibirskaya-31” and barley seeds of the variety “Astana-2000.”

No.	Concentration indicator	Vigor before the experiment, %	Vigor after the experiment, %
Wheat seeds of the variety “Novosibirskaya-31”			
2	Stock solution 0.69 g/l	25	42
3	Solution 0.52 g/l	25	44
4	Solution 0.35 g/l	25	44
Barley seeds of the variety “Astana-2000”			
1	Solution 0.18 g/l	47	59

Source: Compiled by the authors.

The vigor of wheat seeds of the variety “Novosibirskaya-31” increased by an average of 18%, and the energy of germination of barley seeds – by 12%. On average, during the experiment, the seed vigor increased 1.5 times.

Therefore, the obtained extract of “Saprolin” is a good germination stimulant for grain crop seeds. It has a greater effect on the vigor. Seeds with high vigor are the most viable. They will give a good yield and high-quality products. The germination rate significantly affects plants' survival, and means the speed of their growth, shows the ability of seeds to germinate evenly in the field (good uniformity).

3. Results

As we already noted, sapropel is an environmentally friendly and high-quality mineral organic fertilizer. It is concentrated in large quantities in numerous shallow, fresh, and drainless lakes of the North Kazakhstan region [7]. These lakes belong to reservoirs with a high concentration of sapropel, which saw a significant increase after the development of virgin and fallow lands due to the increasing supply of biogens from the catchments used for farming and livestock rearing.

Each basin of a drainless lake is a storage system contributing to the deposition of lake sediments. During the growing season, organic matter does not have time to be disposed of in the cold season. In this connection, there is an intensive overgrowing of the reservoir, its silting, until the lake basins are filled with organic mineral mass. The removal of excessive mineral organic components for the manufacturing of the “Saprolin” can have a beneficial effect on water bodies. Nevertheless, these lake resources are not yet used in the national economy of Kazakhstan.

The widespread use of significant amounts of mineral fertilizers based on sodium, phosphorus, and potassium in various combinations and ratios contributes to high yields. Moreover, from an environmental point of view, their use is less desirable than introducing organic fertilizers into the soil. The concentration of mineral fertilizers depresses the natural processes of soil formation, reduces the amount of microflora in the soil, and undermines their natural fertility.

Improving plant nutrition through local natural resources of organic origin is more environmentally acceptable. This is a step towards the so-called organic farming, which is admittedly progressive in terms of environmental protection. On the one hand, organic farming allows getting environmentally friendly products, which is of the utmost importance for the population's health. On the other hand, it helps to increase the soil cover's natural fertility, the preservation of which is a universal task. Cleaning the numerous reservoirs of Northern Kazakhstan from excess mineral organic mass gives the reservoirs a new lease of life and makes them suitable for fisheries [2].

4. Discussion

Based on the results of the experiments, the use of the extract of “Saprolin” and the use of non-traditional fertilizers such as sapropel will help to solve many problems of maintaining high soil fertility, obtaining a stable yield of high-quality environmentally-friendly agricultural products, and putting in order aquatic lake geosystems.

During the experiments, a positive effect of the extract of “Saprolin” and organic fertilizers on the morphometric parameters of grain, their growth dynamics, and final crop yield was observed, while there was no adverse effect on the quality of the products. Soil reclamation based on local raw materials, due to its affordability and cheapness, will give an impetus to the development of agriculture in the North Kazakhstan region, making it more profitable and competitive.

5. Conclusion

1. The extract of “Saprolin” obtained from organic mineral storage of lakes, used for primary processing of grain seeds, is an effective tool for increasing the yield of a high-quality agricultural product.
2. The research results show that the obtained extract of “Saprolin” helps increase the germination of grain seeds by 1%–9% and the vigor by 12%–19%.
3. The extract of “Saprolin” is classified as an herbal stimulant containing a water-soluble natural mineral substance, improving plant nutrition. The improvement of plant nutrition through local natural resources of organic origin is environmentally friendly. This is organic farming, which is admittedly progressive in terms of environmental protection.

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