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TECHNOLOGY FOR OBTAINING BIOLOGICALLY ACTIVE HUMIC PREPARATIONS FROM BROWN COAL

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Annotation

The Republic of Kazakhstan belongs to the desert zone, and the steppe belt to the third reclamation zone with regimes and methods of irrigation characteristic of each of them. Desert soils are intensively used for the cultivation of zoned agricultural varieties. Large agricultural areas are degraded due to soil salinity. The consequences of the dried-up bottom of the Aral Sea and toxic emissions from rockets from the Baikonur Cosmodrome negatively affect agricultural yields. An example is the use of piedmont sloping proluvial-alluvial plains where winter and spring wheat crops are located. Grain crops are cultivated mainly in unsecured rainfed areas with an annual rainfall of 200-250 mm, in the zone of semi-sufficient rainfed areas (400 mm) and only about 10% - in irrigated agriculture

Since the water resources of the arid regions of the south and south-east of Kazakhstan are close to exhaustion, it is obvious that the most promising measure for further increasing the production of grain and other agricultural products compared to their current level is the use of special agro-reclamation techniques on the fields on a humic basis, increasing the environmental plant resistance.

The purpose of this work is to develop a technology for producing a plant growth stimulant drug from Kazakhstani brown coals with a low degree of metamorphism and to experimentally confirm its effectiveness in increasing the yield of cultivated plants on low-productive soils. The results of testing a sample of the drug and agricultural practices on various types of low-productive soils are presented.

The biotesting method was used to determine the concentrations of aqueous solutions of a humic preparation for treating agricultural seeds, technological parameters for preparing seeds for sowing (duration of treatment with a humic preparation, seed storage, drying), and to determine the optimal conditions for sowing seeds into the soil (humidity, temperature, salinity, etc.).

Laboratory experiments were carried out according to the method of B.P. Stroganov; the seeds of rice, wheat, barley, soybeans, sorghum and corn were studied, which were germinated in a thermostat in fivefold repetition on highly saline and non-saline soil substrates in accordance with the requirements of GOST (GOST 10250-80, GOST 12038-84).

In conclusion, it can be noted that the effectiveness of the preparation from coal increases the yield of grain crops, which reaches 24.2 - 42.1%, rice 76.2 - 78.6%, and soybeans - 34.8%. on low-productive soils with a salinity level of 0.8 – 2.2%.

Introduction

Kazakhstan has significant reserves of brown coal, which is a raw material for processing to produce various plant growth stimulants. Despite the presence in the Republic of large brown coal deposits and a sufficiently developed infrastructure for the production of such products, their production has not been established. Therefore, the development and industrial implementation of technology for producing modified humic preparations from natural hydrocarbon raw materials is an urgent task, and the creation of production of such products helps expand the export potential of the Republic and import substitution. At the same time, not only economic problems are solved, but also social problems such as creating additional jobs, developing regional infrastructure, and increasing the well-being of the population.

Extensive irrigation development of soils in the desert and foothill desert-steppe zones of Kazakhstan without sufficient scientific justification led to the tragedy of the Aral Sea, the Ili-Balkhash problem, irrational use of water resources, their almost complete exhaustion, soil degradation, in particular progressive secondary salinization, waterlogging and desertification landscapes, contamination of soils and drainage waters with pesticides and salts of heavy metals, reduction in the profitability of agricultural production.

The problem of "waste" land and unpromising villages has emerged. In the Kzylorda and Almaty regions alone, more than 30 thousand hectares of rice lands due to intense secondary salinization turned into salt deserts, covered with rare bushes of salt-tolerant halophytes. Lands saturated with destructive salt turn into meager pastures and a source of aerosol bitter-salty dust, which is carried by air masses for thousands of kilometers, poisoning all living things.

In connection with the current situation, ecologists, soil scientists, land reclamation specialists and other specialists of the republic were faced with the difficult task of developing environmentally friendly, water- and resource-saving agricultural technologies that would make it possible to do without preliminary leaching of saline soils with the corresponding consumption of scarce irrigation water and combine the reclamation period with the operational period. .

To solve these complex mutually exclusive problems, fundamentally new scientific and theoretical developments and methodological approaches are required.

A novelty is the technology for obtaining plant growth stimulants from Kazakhstani brown coals with a low degree of metamorphism, increasing the yield of agricultural crops on highly saline soils.

Currently, about 400 coal basins, deposits and large coal occurrences have been explored in Kazakhstan with a reserve of about 34 billion tons (9th place in the world) and production of over 100 million tons per year (6th place in the world) and the question rational use of these coals is always relevant.

The purpose of this work is to study, develop and test agro-reclamation techniques aimed at increasing the environmental sustainability of cultivated plants in low-productive soils based on the rational use of physiologically active sodium humate in combination with other methods of complex and differentiated agricultural technology.

Since 2018, in the laboratory of physical and chemical processes of processing mineral raw materials of the Institute of Mining named after. D.A. Kunaev is developing a technology for producing physiologically active sodium humate from brown coal, enriched with macro-, microelements and wormwood extract, which increases the environmental resistance of agricultural crops to extreme environmental factors.

The results of tests of an experimental sample of the drug obtained using the developed technology and agricultural practices on various types of low-productive soils in the arid zones of the republic are presented. The biotesting method was used to determine the optimal concentrations of aqueous solutions of a humic preparation for treating agricultural seeds, the optimal technological parameters for preparing seeds for sowing (duration of treatment with a humic preparation, seed storage, etc.); the optimal conditions for sowing seeds into the soil (substrate humidity, temperature, salinity) were determined. This will reduce fluctuations in crop yields from year to year due to fluctuations in atmospheric precipitation, as well as unfavorable soil and reclamation conditions caused by progressive salt accumulation with low natural drainage of landscapes.

1 Development of a new technology for producing humic preparation

Mining and processing enterprises pollute the atmosphere with various emissions. Dust-like pollution received from various sources is transported by air currents from one layer of the atmosphere to another (from the troposphere to the stratosphere). The average residence time of non-settling dust (light) is about 2 years in the stratosphere, 1-4 months in the upper troposphere and 6-10 days in the lower troposphere. In the process of anthropogenic impact on nature, the area of pastures and arable land is constantly decreasing.

The purpose of the research is to eliminate the negative consequences of mining operations by carrying out reclamation measures while restoring biological balance. Reducing dust emissions from and tailings of processing plants is achieved through biotechnical reclamation. Biotechnical reclamation involves sowing seeds and shrubs on tailings and waste rock dumps using physiologically active drugs - plant growth stimulants obtained from coal deposits in Kazakhstan.

Currently, the following measures for the protection of land during the development of minerals and their processing at processing plants and metallurgical plants are known and applied both in the Republic of Kazakhstan and in neighboring and foreign countries:

- prevention and reduction of the area of disturbed and contaminated lands. rational placement of industrial sites and other various structures;
- improvement of mining technology, including dumping,
-disposal of waste generated during the production process, elimination of soil pollution, etc.;
- restoration of the landscape - returning to it the properties and functions it had lost;
- transforming the landscape by giving it new functions for the purpose of rational use and environmental protection.

Land reclamation is usually carried out in two stages: technical and biological. During technical reclamation, land is prepared for its intended use (agricultural, forestry, water management, fisheries, recreational, construction and other uses of restored lands). Technical reclamation includes terracing and formation of slopes, transportation and application of fertile rocks to reclaimed lands, radical reclamation of roads, special hydraulic structures, etc.

Biological reclamation includes a set of agrotechnical and phytomeliorative measures to restore the fertility of disturbed lands. The main measures for biological reclamation include the application of increased doses of organic and mineral fertilizers and sowing of perennial crops.

All biotechnological methods for reclamation of disturbed and contaminated lands can be divided into methods with the application of a new soil cover (layer), consisting of fertile loams and/or glauconitic sand, as a potassium fertilizer, and without their application. Applying new soil cover is expensive, labor-intensive, and technically challenging.

In practice, four types of biotechnological methods are used in the world: reclamation without applying a new soil cover. The first method includes restoring the fertility of disturbed and weeded lands through nitrogen-phosphorus-potassium fertilizers and sowing pioneer plants. The average period of generation of a stable fertile soil layer with this method is that large doses of mineral fertilizers (700-1200 kg/ha) are introduced into disturbed and contaminated soils, and high-yielding plants are used as pioneer plants. The duration of soil formation with this method is 8-10 years.

The third direction of restoring the fertility of disturbed and weeded lands is carried out by inoculation (introduction) of active soil microflora into the soil surface with a period of restoration of land fertility within 3-5 years. And finally, with the fourth method, stabilization and restoration of soil fertility over 4-6 years is carried out by adding a bioactive drug to the soil in an amount of 5-50 g/ha.

All these methods and directions have their advantages and disadvantages in different soil and climatic conditions, as is known in Kazakhstan, the arid zone and arid climate predominate. The main disadvantage of all of these methods is the need to use energy costs to add various ingredients (mineral fertilizers, microflora, bioactive preparations) to the soil. Other disadvantages of these methods are the relatively long period of soil restoration. The third group of disadvantages includes the low efficiency of methods when used in clogged, saline and toxic soils, as well as in extreme conditions - drought, lack of snow.

The method we propose is the most economical and efficient in terms of labor, material and financial resources.

Institute of Mining named after. YES. Kunaev developed a technology for producing humic preparations from brown coal. A representative batch of the resulting drug was tested as a growth stimulant for various crops in the extreme conditions of the Republic of Kazakhstan, which was studied in laboratory conditions and tested at a pilot industrial site.

According to Professor L.A. Khristeva (Ukraine) [1] the physiological effect of humates is more effective when there are adverse external influences on plants or their habitat (excess or lack of moisture, light, heat, nutrients).

The arid climate, scarcity of water resources and the significant participation of saline soils in the structure of the soil cover of Kazakhstan are a serious obstacle to increasing the productivity of land using classical methods.

From the analysis of known methods it follows that at present, none of the technologies for producing humates has been brought to industrial production due to objective reasons. The basic requirements for the feedstock have not been worked out, the L:T ratio, the concentration of the alkali solution, the fractional composition of the feedstock and the duration of its treatment with alkali, temperature conditions, etc. have not been determined.

We have studied a number of lignite deposits in Kazakhstan with satisfactory characteristics, especially in terms of the content of humus components. Among the numerous raw material objects, the Oy-Karagayskoye and Kiyaktinskoye deposits were selected. The yield of humates is respectively 15-30%, 65-69%. The diversity of the feedstock is explained by the fact that coals not only from different deposits differ in composition, but also within the same deposit there is a significant variation in indicators.

Basically, the new technology for producing humates involves the following operations: mechanical cleaning of the feedstock from foreign inclusions, crushing the feedstock to the required fraction with simultaneous drying. Treatment of the resulting mass with an alkaline solution with a concentration of 1 to 10%, for 2-10 hours and a L:S ratio of 5 to 10, at a temperature of 60-800C, filtration with washing, drying, grinding, sifting.

The use of humic stimulants in agriculture opens up wide opportunities for increasing the yield of grains, vegetables, fruits and berries, melons and industrial crops.

The action of humic preparations is especially effective in the initial period of plant development and during the period of greatest tension in biochemical processes, as well as when the external conditions of plant growth deviate from the norm due to drought and frost, excess nitrogen in the soil, etc.

2 New technologies for increasing the fertility of saline soils

2.1 Literature review

Saline soils are an essential component of territories. The presence in them of high concentrations of specific mineral substances, accumulated in the conditions of effluent water in the active part of the root layer, causes extremely unfavorable conditions for cultivated plants and constitutes a characteristic feature of their low natural fertility [2]

According to academician V.M. Borovsky [3], saline soils in Kazakhstan occupy 111550.1 thousand hectares, or 41% of all soils in the Republic.

In accordance with the climatic characteristics of soil zones, their number is steadily increasing in the direction from north to south. Thus, in the forest-steppe zone they occupy 29-30, steppe - 37, dry-steppe - 40-51, desert-steppe and desert - 46-55, and foothill desert-steppe - 5% of the area of zonal soils.

With such a wide distribution of soils of the saline series in the zonal aspect, the ratio between solonchaks and solonetzes in the steppe zones is on average 1:50, in desert zones - about 1:3.

It is known that when the content of water-soluble salts in the root layer of soil is up to 0.4-0.8%, most cultivated plants develop poorly and produce a reduced yield, and when the salt content is more than 1.2-1.5%, the plants do not produce agricultural products. Therefore, on such soils a set of special reclamation techniques is usually used to ensure the effective reproduction of the fertility of the reclaimed lands.

Fertility is an integral qualitative property of any soil, expressed by a complex functional dependence on the elements and life support conditions of plants, reflecting the interaction of a complex of soil formation factors. In the process of natural soil formation, various levels of natural soil fertility are formed, measured by the levels of biological productivity of phytocenoses. Different plant species react specifically and ambiguously to deviations of soil fertility components from optimal to extreme values. This determines the cyclical nature of soil formation with evolutionary variability and the leading role of the biological factor, thanks to the adaptive reactions of plant communities to new environmental conditions.

The vegetation cover of saline soils is sparse and poor in species composition. The sparse grass stand is dominated by salt-tolerant plants, which in the process of evolution have developed mechanisms for maintaining ionic homeostasis, as a result of which the level of accumulation of ballast salt ions and their ratio when life support conditions change are maintained within physiological norms [4].

According to A.A. Shakhov, the adaptive evolution of halophytic plants to high concentrations of salts in soil solutions is a consequence of the physiological restructuring of plants in generations with the creation of a halo-resistant type of metabolism in the offspring. This ultimately determines the characteristics of the development of halophytes and their active ecological and biological reactions to soil salinity conditions, due to which and a change in heredity, soil salinity from a negative factor becomes a positive one, ensuring high salt tolerance of plants and their ability to regulate metabolism in the presence of the amount required by the plant in the substrate absorption of ions by the root system, their transport, metabolization of used mineral elements from the body [4].

During individual development, profound qualitative changes occur in halophytic plants to conditions of varying salinity, but the difference in the influence of types of soil salinity, which is significant for most glycophytes, is smoothed out.

Cultivated plants grown on non-saline soils have a relatively limited ability to adapt to salinity and do not have the characteristic morphological and anatomical features characteristic of halophytes, since the conditions of their existence in the process of long evolution were not favorable for the emergence of this property [5]. Deviations of environmental conditions to extreme values under the influence of natural factors and negative anthropogenic influences lead to a sharp decrease in yield, loss and death of agricultural crops. According to G.V. Udovenko and E.A. Goncharova [6-7], extreme factors of different nature (salinity, drought, etc.) have the same effect on the structure of the yield of cultivated plants. Therefore, in recent years, agriculture has dictated the need to study, develop and implement in the fields effective methods of targeted anthropogenic impact on both low-productive soil and the plant itself, which contributes to the reproduction of its artificial fertility, which materializes in the harvest of zoned varieties of cultivated plants, creating effective soil fertility.

The problem of increasing the productivity of agrocenoses and soil fertility is based on the well-known laws of agro-soil science formulated by V.R. Williams, as well as the use of the biological characteristics of those crops that are supposed to be grown on reclaimed lands.

The level of increase in soil fertility depends on its initial state and the interconnected system of factors that regulate the expanded reproduction of fertility and exclude the occurrence of undesirable consequences of economic activity on the natural environment when carrying out various types of reclamation, which are divided by content by V.V. Egorov [9] into two groups. The author includes in the first group all types of reclamation that improve only the condition of soils, and the second - reclamation that not only transforms low-productive soils, but simultaneously contributes to changing the state of one or more soil-forming factors.

Gypsum is considered one of the well-known effective chemical ameliorants. Over the past time, a wealth of experience has been accumulated in the reclamation of solonetz soils with gypsum under rainfed and irrigated farming conditions [10]. An analysis of the literature shows that, depending on regional conditions, the use of gypsum has a positive effect on the improvement of solonetzic soils of neutral salinity and is noticeably reduced during the reclamation of alkaline soils. The best results in rainfed conditions are achieved by combining the use of gypsum with physical and biological methods of reclamation. The average duration of the reclamation period varies within a fairly wide range of 5-7 years or more.

Irrigated agriculture differs from rainfed agriculture in the more intensive use of agricultural land. It makes significant changes to the natural soil-forming process and the structure of the soil cover [11].

Irrigation has a multifaceted effect on soils, causing changes in the mineral part of the soil, the structure, quantity and composition of humus, morphological structure, microbiological, biochemical and nutritional regimes, water-physical properties [12], and in general on the ecological environment. The nature and speed of changes are determined by the soil and climatic characteristics of the region, the culture of irrigated agriculture, the level of zonal agricultural technology and the land reclamation methods used. To increase the fertility of alkaline solonetz soils under irrigation conditions, it is important to properly use irrigation water and organize the necessary system of agrotechnical, hydraulic and other measures, taking into account the dynamics of soil processes. Otherwise, irrigation can quickly lead not to soil cultivation, but to secondary salinization.

Along with gypsum, other calcium salts are increasingly being used, which in their effect are often superior to the classic ameliorant. Thus, the development of soda-sulfite solonetzes in the Voronezh region revealed the exceptional reclamation value of chalk [25], and the saline soils of the Kuban revealed the positive effect of fluff lime , the effectiveness of which increased with the joint application of fourfold doses of ammonium sulfate [13].

Among local raw materials, industrial waste is used to improve solonetz soils, in particular, cement dust, gypsum waste from a tartaric acid production plant, alabaster, synthetic gypsum, calcium metasilicate, soot, calcium chloride, defecate and phosphogypsum [14] .

Due to low reclamation efficiency, many of these substances are not justified or are of local importance . The most widely used are calcium chloride and phosphogypsum.

Some studies show that the use of sulfur-containing calcium substances (especially gypsum) is not always effective [15], and on saline soils of rice plantations it is even negative, as it is associated with the process of sulfate reduction . Most calcium salts are either very poorly soluble, or contain various toxic elements, or do not effectively regulate the alkaline reaction of the environment. Therefore, in some regions of the former Soviet Union, methods of activating calcium-containing substances with acidic chemical reagents are widely practiced [33,34]. By their nature, acidic reagents are divided into acids (sulfuric, sulfurous, hydrochloric, nitric, etc.) and salt hydrates (FeSO4 x 7H20, Fe 2 (SO4)3, (NH4)2 SO4, etc.).

The use of acidic chemical reagents for the reclamation of alkaline solonetzic soils began in Kazakhstan relatively recently and in the initial period was associated mainly with sulfuric acid and iron sulfate. Large-scale pilot production work on the use of sulfuric acid and iron sulfate for the development of lands with soda salinity was carried out by the Research Institute of Soil Science and Agrochemistry of Armenia [16].

The experience of Armenian researchers in the use of acidic chemical reagents was a prerequisite for their widespread use in other regions with saline soils [17].

From the laboratory and field experiments with acidic chemical reagents described in the literature, it is impossible to draw clear conclusions regarding the most appropriate form of a particular ameliorant, since their choice may be influenced by local factors.

According to T.N. Voinova and R.Sh. Turdiev [18], the introduction of iron sulfate into takyr-like alkaline soils of the Akdala massif not only increased the removal of salts from the meter layer, but also had a stimulating effect on the growth and development of rice in ontogenesis. However, the use of various concentrations of sulfuric acid for the reclamation of these soils, despite a significant improvement in their water-physical and chemical properties, caused inhibition of plant growth in the tillering phase. By the end of the growing season, the height of the rice was 30-40 cm and no harvest was obtained. The authors associate this phenomenon with the process of sulfate reduction.

The most important indicator of the potential fertility of cultivated soil is organic matter. The additional use of various types of organic and mineral fertilizers serves as a kind of reserve of nutrients necessary for agricultural crops, is an energy and nutritional source for the life of microorganisms, an additional source of carbon dioxide for plants, a radical means of improving water-physical, chemical properties and targeted regulation of effective soil fertility. The effectiveness of fertilizers increases provided that differentiated agricultural technology is followed, which allows for the most rational use of irrigation water and protects the soil from secondary salinization against the background of various drainage systems. Of the organic fertilizers in crop production, the most promising are manure, straw and various types of composts. The fertilizing and ameliorating value of manure has been known for a long time and enjoys universal recognition both in Kazakhstan and abroad. However, its reserves in most regions are limited and do not satisfy the ever-increasing demand of crop production. Therefore, along with manure, in many soil-climatic zones, crushed straw is increasingly used as a fertilizing and reclamation fertilizer - as a new form of providing low-productive soils with organic matter and increasing agricultural yields [42]. According to V.D. Pannikov and V.G. Mineev [19], when harvesting grain crops using combine harvesters with straw collectors, the cost of straw harvesting is approximately twice as high as the cost of grain harvesting. Due to overloaded equipment and lack of labor, straw harvesting is delayed for a long period, which makes it difficult to carry out timely and high-quality autumn tillage. Therefore, leaving straw in the field is an important organizational and economic measure that speeds up and reduces the cost of harvesting.

On black and chestnut soils of rice fields, autumn surface (0-6, 0-10 cm) plowing of straw is preferable at least 1-1.5 months before sowing cultivated plants, which contributes to less accumulation of toxic compounds formed during decomposition in the arable layer straw. On soils depleted of organic matter in the south of Kazakhstan, spring surface incorporation of straw at a dose of 6.5 t/ha with a production dose of mineral fertilizers is most effective [46]. The ameliorative and fertilizing effect of straw on alkaline saline soils is enhanced when it is used together with chemical ameliorants (gypsum, polyacrylonitriles K-4, K-9), polyphosphate fertilizers, zinc and nickel salts and preliminary inoculation with cultures of lactic acid bacteria [20].

The unfavorable agrophysical properties of alkaline solonetzic soils are due to the presence of an illuvial horizon enriched with peptized highly dispersed particles. When dry, this horizon becomes compacted and breaks up with cracks into blocky, columnar or nutty sections, and when moistened, it floats and turns into a continuous sticky, smearing mass, which sharply reduces the water permeability of soils and is one of the reasons for the long-term preservation of their negative properties, which are difficult to improve by leaching using high-volume calcium-containing substances, acidic chemicals, reagents, as well as waste from industrial and agricultural production and requiring special structure-forming preparations.

A significant role in structuring and increasing the effective fertility of saline soils belongs to polymers and surfactants.

V.P. Batyuk [21] subdivides all polymers used for soil structure formation into three types: horse polymers (salts of acrylic and methacrylic acid, sulfo derivatives of polystyrene); nonionic polymers (polyvinyl alcohol); copolymers of acrylonitrile, acrylamide, vinyl acetate, raspberry anhydride with acrylic, methacrylic malic acids.

Over the past 30 years, systematic experiments have been carried out to determine the effectiveness of reclamation of saline soils with various polymer substances in various soil and climatic conditions. The most widely used in reclamation practice are industrially developed and economically available preparations made from hydrolyzed polyacrylonitrile (K-4, K-9) and polyacrylamide (PAA), which have structure-forming ability and are good nitrogen fertilizers [22]. In field and laboratory studies N.D. Gradoboeva, R.P. Alekseeva, L.V. Berezina, carried out on non-irrigated solonetzic soils of the Omsk region, it was found that the effect of adding polyacrylamide is more significant on low-sodium solonetz and extremely weak on polysodium solonetz. According to R.P. Aleseyeva [23], the reason for the unequal action of PAA lies in the different microaggregation of low- and high-sodium solonetzes and the ability of the polymer to impart good water resistance only to existing aggregates.

According to V.A. Vinogradov [24], the effectiveness of polymers on saline soils is associated with the establishment of their doses and methods of application. Under irrigation conditions, the action of polymer substances is more effective. Moreover, preparations that provide high water resistance of the structure, as a rule, also provide the greatest filtration capacity of soils, and this creates favorable conditions for rational leaching of saline soils [25].

Analyzing the available data on the effect of polymer substances on desalinization and desalinization of soils, it can be stated that the use of polymers improves the physicochemical properties of low-productive soils and contributes to the maximum reduction of the reclamation period at relatively low costs, since the rate of their consumption per unit area is insignificant, the effectiveness of polymers depends on the soil and climatic conditions of the region, and also on the dose and method of introducing their composition.

Polymer surfactants can be structure formers, nutrition sources, plant growth stimulants or regulators of water-salt regime, physicochemical properties of saline soils, and each of them has a specific function.

Employees of the Department of Chemistry of Macromolecular Compounds of the Kazakh National University. Al-Farabi developed methods for the synthesis of new soluble polymeric substances (polyampholytes, RPA) - which simultaneously serve as an acidic chemical reagent, a humic-like organo-mineral fertilizer, a structure former, a regulator of alkali processes in soil and irrigation water, a growth stimulant and a means for increasing the salt tolerance of rice seeds [26] . Due to the high cost of this drug, its production was discontinued at the stage of vegetation and field experiments.

Thus, to date, a large amount of experimental material has been accumulated in Kazakhstan and abroad on the reclamation of saline soils using classical methods. However, recommendations for obtaining the maximum yield of any crop, compiled on the basis of numerous experiments on the studied massifs, are usually far from optimal for other developed areas with different climatic and reclamation conditions. This explains the organization of a large number of experimental stations and research institutes that are developing optimal reclamation methods for the development and exploitation of saline soils in various regions.

The high cost and long-term development of reclamation recommendations are due to the empirical approach to solving the problems of reclamation of each isolated massif. At the same time, necessary environmental protection measures are often violated. For example, to flush saline soils and maintain design reclamation conditions in developed areas, a large amount (from 5 to 40 thousand m3 per 1 ha) of fresh water is consumed. Drainage salt water is usually discharged into river beds or onto territories adjacent to developed areas, turning them into "dead" ecological zones in a few years.

Reclamation resuscitation of such zones against the background of drainage systems necessitates an ever-increasing increase in water consumption for flushing, which leads to negative environmental consequences in large areas of the delta plains of southern Kazakhstan, which received comprehensive coverage in the works of V.M. Borovsky [27] and M. A. Orlova [28].

Indicative in this regard are the large-scale reclamation activities in the desert zone of Kazakhstan, which over the past 40 years have led to the Aral environmental tragedy and the Ili-Balkhash problem.

It should be emphasized that on the soils of the saline range of the arid zone of Kazakhstan, the amount of crop yield depends on many factors, but primarily on the degree and chemistry of soil salinity, alkalinity of soil solutions, meteorological conditions of individual years, the effectiveness of reclamation measures, the quality of seeds and the level of agricultural technology, as well as the environmental sustainability of the plants themselves.

Thanks to many years of experimental research by A.A. Shakhov, B.P. Stroganov, L.A. Boyko, G.V. Udovenko, M. Ya. Shkolnika [29] and others. By now, the physiological basis that determines the salt tolerance of many agricultural crops in a wide range of soil salinity is well known, which served as a theoretical basis for the development of diagnostic methods and special agricultural techniques for increasing plant resistance to unfavorable conditions. environmental factors of great practical importance in the development of saline lands.

Therefore, over the past 70 years, along with the search for effective traditional reclamation methods for increasing the fertility of saline soils, agronomic practices are increasingly being introduced into agronomic practices for actively influencing the physiological processes occurring in cultivated plants in extreme environmental conditions, using electrophysical factors , salt solutions , microelements, extracts of halophytic plants, as well as environmentally friendly, physiologically active sodium humates obtained from brown coal [30]. Due to the low energy intensity of technological processes and the high return on material and labor costs, the widespread introduction of these agricultural practices is relevant under certain soil reclamation conditions, as it is associated with a sharp reduction in the overall energy intensity and cost of agricultural products.

To increase the effective fertility of saline soils in various regions of Kazakhstan, the most promising is the use in crop production of special physiologically active humic preparations enriched with macro-, microelements and extracts of wild plants.

The direction proposed by T.A. Kukharenko, L.L. Khristeva, I.I. Yarchuk and others: [31] provides for the widespread use of humic fertilizers obtained from coal to increase the productivity of agricultural crops. Humic fertilizers are generally considered to be those fertilizers that contain water-soluble humic acids (humophos, humcophos, sodium, ammonium, potassium humates, etc.). The most widely used in agriculture are humates, which are a product of the interaction of brown coal with an aqueous solution of alkali (KOH, NH, OH, NOH).

Numerous studies conducted in laboratories in Ukraine, Belarus, Czechoslovakia, Hungary, Kazakhstan, Kyrgyzstan, Italy) have shown that water-soluble salts of humic acids have high bioactivity.

They enhance the supply of nutrients to plants, activate soil microflora, the synthesis of proteins, carbohydrates, increase the resistance of plants to low and high temperatures, to the action of increased doses of mineral fertilizers and pesticides, activate plant growth, help increase yield and improve its quality.

In addition, it is known to use sodium humate as a biologically active feed additive for cattle, pigs and poultry in order to increase weight gain and enhance the general non-specific resistance of the body .

Research by Professor I. Yarchuk [32], who studied the effectiveness of humates, showed that the yield of corn on sandy soils in the south of Ukraine increased by 30.3%, while the application of organomineral fertilizers in the form of a mixture: peat + superphosphate + ammonium sulfate led to an increase in yield by only 23.5%. Corn plants fertilized with humophos were almost twice as heavy as the control plants and contained more nutrients valuable for silage. In addition, the use of humophos reduced the gap between the flowering of male and female flowers, which created optimal conditions for more complete pollination. Humophos increases wheat yield on chestnut soils in southern Ukraine by 35%.

Summarizing the results of experimental tests, G.V. Kukharevsky concludes that 1 ton of humophos is equivalent in efficiency to 6-8 tons of humus or 10 tons of peat mixed with mineral fertilizers.

The positive effect of nitrogen and sodium humate, used in liquid form during vegetation irrigation, as well as when applying 1 liter of a 0.001% aqueous solution under potatoes at the time of planting, accelerates the emergence of seedlings and increases the yield by 8%. Adding the same amount of sodium humate to the budding phase increased the yield by 15%. And the addition of sodium humate both during planting and during the flowering period resulted in a 48% increase in yield.

Agrobiological studies of various humates have shown that sodium and ammonium humates have the most effective effect. Less effective are humates of potassium, calcium, and iron.

Analysis of the results obtained allows us to conclude that humates are easily soluble in water, form highly dispersed and true solutions, ensure high digestibility by plants and, as a result, have a strong stimulating effect, but not all types of plants respond unambiguously to these preparations.

According to L.L. Khristeva et al. [33], potatoes, tomatoes and sugar beets give the highest yield increases, and wheat, winter and spring, barley, oats, millet, corn, rice, wheatgrass, alfalfa react somewhat worse; peas and beans give a slight increase in yield, while sunflower, pumpkin and a number of cotton varieties do not respond to the presence of humates.

The widespread use of brown and oxidized coals mixed with organic and mineral fertilizers in a number of European countries, as well as in Ukraine and Belarus, has shown their promise [69,72-75,80,90].

The advantage of this fertilizer compared to humates is that not only humic acids are used, but also residual organic matter and mineral components rich in micro- and macroelements. In addition, having a high adsorption capacity, brown coals attract individual scattered soil particles, improving its structure.

The combined application of these coals with mineral fertilizers protects soils from diversion erosion, ensures better growth and development of plants and, ultimately, increases the yield and its quality.

In world practice, the results of these studies are used quite widely. Thus, in Czechoslovakia, carbon dioxide is fruitfully used - a mixture of fossil coals (brown, lignites, etc.) with mineral fertilizers, and in Germany - brown coal waste with slurry.

Biomineral fertilizers are a mixture of brown coal with various bottom sediments, inoculated with special soil bacteria grown on waste water from sugar production.

Bacteria contribute to the development of the process, deamination (formation of an assimilable form of nitrogen) and the production of compounds necessary for plant growth, etc.). The use of these fertilizers is based on their properties to form soil sorbents - organomineral colloids that serve as absorbers of elements necessary for plants. The use of these fertilizers helps to increase the yield of cultivated plants and improve the quality of agricultural products. Studies on the production of composts and organomineral mixtures from oxidized brown coals and manure have shown that when these components are mixed in various ratios, the content of components vital for plants, namely nitrogen, phosphorus, and potassium, increases [34].

The results obtained indicate that, under conditions of microbiological life, brown coals absorb ammonia nitrogen compounds, as a result, the quality of manure is significantly improved and the effectiveness of its impact on the yield of grain potatoes, flax, sugar beets and oats increases. This composting technique increases the efficiency of not only manure, but also mineral fertilizers.

Brown coals formed in Meso-Cenozoic swamps are based on humic acids, similar to the organic matter of modern peats, as well as macro- and microelements: calcium, magnesium, iron, aluminum, sulfur, phosphorus, manganese, copper, molybdenum, vanadium , nickel, scandium, beryllium, etc.).

Analysis of the composition of fossil fuels shows that they contain trace elements in large quantities compared to soils.

Studies on the effect of brown coals on plant growth when added to the soil in their natural state have shown an increase in the height and weight of plants, grain yield and the amount of chlorophyll in the leaves [35].

During the experiments, brown coals from the Alexandria deposit of Ukraine were used, containing total nitrogen - 0.53 -1.15%; phosphorus slots - 0.39; K20 - 0.67%; traces of Mg, Na and trace elements.

No less convincing results were obtained when testing sugar beet crops. If mineral fertilizers alone increased the sugar beet yield by 10.5 c/ha, the amount of sugar by 2.9 c/ha, then when adding 20-30 kg/ha of brown coal, the yield increased by 20.5-56.1 c/ha. ha, sugar content - by 0.2-1.0% and the amount of sugar by 5-6 c/ha.

In the Donbass, waste from coal preparation plants, containing 6-17% organic matter, was used as organic fertilizer in doses of 10,15,20 t/ha on eroded chernozems. The increase in grain yield ranged from 1 to 5.2 c/ha.

In addition, there was an increase in the activity of the humification process in the arable layer. In slightly acidic chernozems formed on loess-like loams, with the addition of these wastes, the content of humic acids increased almost 1.5 times.

Float tailings from coke production were also used as organic fertilizers on sandy loam chernozem at a dose of 5 t/ha, which showed a positive effect on increasing productivity.

Along with brown coals, L.A. Khristeva [36] tested shale at a dose of 2-4 t/ha, which showed positive results.

From the above data it follows that raw-milled oxidized coals in their natural form and in a mixture with various substances effectively increase yield and product quality, improve humus content and soil structure.

The physiological effect of humates, according to L.A. Khristeva [37], is more effective when there are adverse external influences on plants or their habitat (excess or lack of moisture, light, heat, nutrients).

Increased resistance of plants in the presence of humates to high doses of mineral fertilizers, as well as when they are exposed to increased doses of radiation and pesticides, has been revealed. According to the author, humic preparations relieve allelopathic tension of substrates or soil fatigue. The action of humic preparations is especially effective during the initial period of plant development under extreme environmental conditions.

2.2 Marketing research

An analysis of patent and scientific and technical literature has shown that currently in many countries of the world, namely in the USA, Canada, Germany, Great Britain, Japan, Italy, Spain, India, Bulgaria, Russia, Belarus, Ukraine, Uzbekistan, Turkmenistan, work is underway on the creation of technology for the industrial production of humic preparations from brown coals and their use. At the moment, in a number of countries there are pilot industrial installations with a small capacity of up to tens of tons per year, and the use of humates has not yet expanded beyond experimental stations and individual farms. In Kazakhstan, research on the development of technology for the production of humic preparations is in its infancy.

According to static data, in the gross agricultural output of Kazakhstan, agriculture accounts for 47.3%, and livestock farming accounts for 52.7%; the total sown area of agricultural crops is 25991.4 thousand hectares.

68.4% of the total area is occupied by grain crops (including 60.7% by wheat), 0.6% by industrial crops, 1% by potatoes and vegetables and melons, and 30% by forage crops.

When using a humic preparation as a growth stimulator for agricultural plants, both pre-sowing seed treatment and 2-fold treatment of plants during the growing season are carried out.

In addition, when treating mineral fertilizers (nitrogen, phosphorus and potassium) with humic preparations, it is possible to reduce the consumption rates of these fertilizers

Thus, the estimated need of Kazakhstan for the production of humic preparations for growing only wheat, corn for green mass, raw cotton, potatoes and vegetables is about 3000 tons (in terms of dry powder). More accurate data will be obtained after 2-3 years of testing a humic preparation obtained from brown coals of the Kiyakty deposit in various climatic zones of Kazakhstan on different agricultural crops [38].

The need to use humic fertilizers is dictated by the following factors:

1. The high cost of industrial mineral fertilizers - 180-200 US dollars per 1 ton, which is unaffordable for economically weak rural producers.
2. A sharp decrease in the volume of fertilizer applied to fields;
3. Depletion of land, reduction in productivity;
4. Deterioration of the economic situation of rural producers;
5. At a consumption rate of 8-10 centners of industrial mineral fertilizers per 1 hectare of sown area, the costs are 12-13 thousand tenge; at a consumption rate of humic fertilizers of 5 t/1 ha, the costs are 3-4 thousand tenge, i.e. 3-4 times less, and industrial fertilizers only improve plant nutrition, and humic fertilizers increase the humus content in the soil;
6. No special capital storage facilities are required for storing humic fertilizers and preparations. They are non-toxic, do not cake and do not deteriorate when stored in open areas.

Until recently, this drug was imported in small quantities from neighboring Uzbekistan; there were small pilot plants in the Turkestan, Pavlodar and Almaty regions. However, due to disorganization and poor work among agricultural producers and agricultural authorities, the use of humates has not been established.

2.3 Economic efficiency of using humic preparations

The technology for producing humic preparations is characterized by low energy and material consumption. Therefore, the cost of producing a unit of product is relatively small, but it is consumed in small doses. Consequently, transport costs are insignificant.

All this predetermines the low cost of work associated with its production, application and use over large areas. Approximate calculations show that when treated with humate, 345.5 thousand hectares (seeds treated with the drug are recalculated per area based on the seeding rate). The costs of this work will amount to 41.9 million tenge, and the increase in production from the action of the drug will be received by 1.52 billion tenge, i.e., the net profit will be 1.48 billion tenge. All this will certainly affect the economy of rural producers.

The Republic of Kazakhstan has quite significant reserves of B3 brown coal, the largest of which are the following deposits: Alakol - 7.6 million tons; Maikuben - 104.6 million tons; Oy-Karagay - 8.0 million tons; Kiyakty - 130 million tons.

The integrated use of these reserves opens up wide opportunities for providing both the republic and neighboring countries with highly effective fertilizers and physiologically active preparations that increase the productivity of plants on saline soils [39-40].

As a result of the work performed, the effectiveness of the drug obtained using the developed technology on low-productive soils with a salinity level of 0.8-2.2% was established. At the same time, the increase in the yield of grain crops reached 24.2-42.1%, rice 76.2-78.6%, and soybeans - 34.8% (see Table 1).

Table 1

Optimal concentrations of aqueous solutions of humic preparation

Culture	Variety, hybrid	Sodium humate, %	
Rice	Sunny,Солнечный, Kuban 3, Ushtobinsk	1,0-3,5	2,5-3,0
Wheat	Saratovsk 29, Karlygash Kazakhstan10	1,0-2,5	2,0-2,5
Barley	Chernogovsk 5	0,5-3,5	2,5-3,0
Soybeans	Arna	0,005-0,05	0,02-0,04
Sorghum	Eureka	1,0-2,0	1,0-1,5
Corn	Venichnoe 623	0,6-1,5	0,6-1,0

Humic compounds are part of brown coals and are substances of non-synthetic origin, non-toxic to humans and the ecosystem as a whole, which is a positive aspect of their use for various needs.

To solve pressing problems of modern industry and agriculture, new types of composite materials are needed. These materials include modified humic preparations. The complexity of the structure and the presence of different functional groups, amino acids, polysaccharides, etc. in the composition of humus determine their functions such as accumulative, transport, regulatory, protective, physiological, etc [41-42].

Humate-containing compounds have unique properties, which allows expanding their areas of application:

- The country's electrical industry needs humic composite materials, which are used as extenders and corrosion inhibitors for batteries. For these purposes, domestic enterprises use expensive and toxic products imported from abroad: BNF tanning agent, boric acid, λ-hydroxynaphthoic acid. This leads to high costs for their acquisition, transportation, etc.;
- in the metallurgical industry, modified humic compounds are used to increase the strength of pellets and reduce granulation time. They can also act as biologically active substances, sorbents of heavy metals, radioactive elements and toxic organic compounds, i.e. they can incorporate some pesticides, hydrocarbons. These compositions are also used for the purification of natural and wastewater, for the reclamation of degraded and contaminated soils.

2.4 Experience in biological remediation of tailings dumps

Over 55 billion tons of waste from mining enterprises are stored in Kazakhstan, which pollutes the atmosphere with various toxic gases and dust. The average residence time of non-settling dust (light) is about 2 years. Coal mining enterprises and coal preparation plants emit up to 2 million tons of dust into the atmosphere per year.

All this indicates the need to develop a strategy for ensuring the environmental safety of subsoil development, increasing the efficiency of use and reproduction of georesource potential. The solution to this problem lies in the creation of effective synthesized technologies for the extraction and processing of coal, the development of a systematic approach for specific conditions, and the study of an individual object from the perspective of a more general system of which it is a part.

Analyzing the results of laboratory studies, it can be assumed that the tested agricultural techniques can become the basis for a new technology of biological reclamation by growing green mass on the surface of tailings to reduce dust formation [43-44].

It is almost impossible to completely eliminate dust in all tailings dumps with modern mining technology, but it is possible and necessary to reduce the dust content in mine air to such limits that the possibility of occupational diseases can be reduced.

The fact is that mine dust is heterogeneous in mineralogical composition, since the products of grinding various rocks, especially quartz minerals, enter the air. Also most dangerous in relation to silicosis is the content of free silicon dioxide in dust. The higher this content, the more dangerous the mine dust. Quartz is a widespread mineral in the earth's crust, representing an essential component of many igneous and metamorphic rocks - granites, porphyries, hornfels, gneisses, etc., forming an independent rock - quartzite, which is often found in the form of veins in igneous rocks and constitutes the main mass of sandstones. Almost all mines in Kazakhstan have high levels of silicon dioxide.

The amount of silicon dioxide in rocks and in the air, as a rule, is not the same. For example, in the rocks of the Maslosko-zavodskaya formation the SiO2 content averaged 70%, and in dust 54%; The Zhezdinsky mine has SiO2 in rocks of 30%, in dust 30%; East Konuradsky mine - 78% in rocks, 70% in dust.

Mine dust usually has a complex mineralogical composition. So, for example, according to chemical analysis, the rocks that make up the Maslosko-Zavodskaya suite contain: SiO2 -48-73%, Al2O3 -3.2-25.1%, FeO -2.7-4.1%, MgO - 0.3-9.6%, CaO -0.2-4.6%, K2O -0.5-6%. The average particle diameter for three groups of observations was determined to be 0.72-0.75 μm.

In accordance with the considered strategy for rational environmental management, an option was chosen based on the targeted impact on the biocenosis of the technogenic landscape, namely waste storage facilities for processing asbestos-containing and manganese-containing tailings with the aim of forming a biologically active environment using biotechnological, agrotechnical and chemical methods.

The results of the research made it possible to determine the optimal modes for preparing seeds of wild plants for experimental tests.

The objects of research were the tailing dump of JSC "Kostanay Minerals", located in the city of Zhitikara, Kostanay region, the tailings dump of the Zhezdinsky processing plant, which is located in the Ulytau district of the Ulytau region (Kazakhstan).

These wastes occupy large areas, for example, the experimental site located on the territory of the Zhezdinsky enrichment plant is 25 hectares. From an economic point of view, a technology for dust removal using green spaces using adaptogen drugs has been proposed [45-46].

To carry out experimental tests on dust suppression, seeds of wormwood Zhungarskaya, Kellera, wormwood white earth and wheatgrass varieties Sharapat were used. The chemical composition of pollen and wheatgrass is given in Table 2.

Table 2

Content of basic nutrients in plants

Plant	Season	N	P	K	Ca	N:P:K	protein	fat	sugar	fiber	ash
Wormwood Belozemelnaya	Весна	1,85	0,17	2,20	0,63		11,56	4,40	6,00	13,40	5,10
	Лето	1,51	0,12	1,30	0,80		9,14	3,40	6,20	23,40	4,70
	В среднем	1,68	0,14	1,75	0,71	12:1:12	10,35	3,90	6,10	18,40	4,90
Wormwood Zhungarskaya	Весна	1,78	0,19	1,55	0,72		11,2	7,60	3,80	17,20	10,60
	Лето	1,48	0,15	1,37	0,85		9,25	8,50	3,80	22,0	10,10
	В среднем	1,63	0,17	1,46	0,78	9:1:8	10,18	8,05	3,80	19,60	1,35
Zhitnyak	Весна	1,05	0,18	1,20	0,18		6,56	2,20	11,20	23,40	5,40
	Лето	0,78	0,16	1,52	0,16		4,94	2,40	12,50	27,40	5,50
	В среднем	0,91	0,17	1,36	0,17	5:1:8	5,75	2,30	11,85	25,40	5,45

The technology for planting green mass on dusty surfaces is as follows: seeds of wild plants growing around the tailings pond, selected for testing, were soaked in 0.1; 0.2; 0.3; 0.4; 0.5; 0.6; 0.7; 0.8 and 0.9% aqueous solutions of humic preparation for 60 minutes. After the processing time of the test seeds had expired, they were removed from the working solutions and dried at a temperature of 20-40°C to an air-dry state. The treated seed material was sown in 0.5 L test beakers without drainage with the studied phytotoxic enrichment tail. The substrate humidity was maintained at 65-70% of its total moisture capacity. Exposure of the experiment - 15 days.

According to the research results, it is clear that among the tested wormwood species, the most promising for the biological reclamation of phytotoxic enrichment tailings is white earth wormwood. The effectiveness of working solutions for wormwood seeds increases in the concentration range of 0.3-0.7%, and when they increase, it noticeably decreases. Lower concentrations of the humic preparation do not have a significant effect on the sowing quality of seeds and are not effective enough in increasing the salt tolerance of plants.

Tailings samples from the surface of the tailings dump were taken from a depth of 20 cm, and similarly samples were taken from the surface and from a depth of 20 cm of adjacent natural soil. The samples were subjected to chemical and granulometric analysis. The results of the analysis are shown in Table 3.

Table 3

Results of analysis of samples from the tailings dump

Sample name	Granulometer. composition, %			Chemical composition, %							
	0+2	-2+10	-10+15	SiO_2	Fe_2O_3	Al_2O_3	MgO	CaO	FeO	K_2O Na_2O	Heavy metals
Tails from the surface	5	10	5	37,0	1,9	0,8	39,1	1,09	0,9	0,32	0,3
From a depth of 20 cm	85	10	5	40,9	5,4	1,4	41,6	1,6	2,7	0,3	0,32

As can be seen from the results given in the tables, the tailings material is represented by SiO2 - 37.0-40.9%, MgO - 39.1-41.6% in the form of fine material of class O+2, accounting for 85%.

The content of ammonium, iron, calcium does not exceed 1.6-5.45%, and heavy metals (manganese, chromium, nickel, cobalt) reaches 0.3-0.32%.

Analysis of soils adjacent to the tailings dump showed that the content of heavy metals varies widely and differs from the depth of sampling (in the surface layer (5 cm) or at a depth of 20 cm). The highest level of pollution is observed on the border of the sanitary protection zone (C33) to the west of the asbestos quarry and for most pollutants their content on the soil surface exceeds the content in the soil, except for copper and vanadium, for which they are almost the same.

A high level of pollution is also observed on the soil surface at a distance of 300 m from the tailings dump, where the concentration of nickel is 5.7 times higher than the maximum permissible concentration, copper - 2.3, chromium - 2.3.

The high biotesting ability of barley for the phytotoxicity of the studied breed made it possible to determine the most promising methods for its detoxification. The greatest stimulating effect on seed germination and germination was observed in the presence of derecato in an amount from 10 to 30% of the mass of the main enrichment substrate; the results of the experiment are shown in Table 4.

Table 4

Promising methods for detoxification of rock from the tailings dump of Kostanay Minerals OJSC

Option	Seed germination, %	Average plant height on the 17th day, cm	igns of inhibition of plant growth and development
1. Breed + humic preparation at a dose of 5% by weight of the breed	20	1,8	Complete death in the 1st leaf phase
2. Breed + defect – 10% of the mass of the breed	44	6,8	Complete death in the 2nd leaf phase
3. Breed + defect – 20% of the mass of the breed	64	7,8	Complete death in the phase of 2-3 leaves
4. Breed + defect – 30% of the mass of the breed	80	6,3	Complete death in the phase of 2-3 leaves

As can be seen from the test results, the most promising detoxicant is defecate. Taking into account the fact that the Republic:

Kazakhstan has 8 sugar factories, and waste is generated in quite large quantities, and taking into account the dumps that have been equipped since the 1940-1950s when these factories began operating, we can focus on the huge quantities of this waste, estimated in millions of tons.

The study, development and testing of agro-reclamation methods for pre-sowing treatment of seeds of wild plants were carried out through laboratory, field, stationary and production experiments.

All this indicates the need to develop a strategy for ensuring the environmental safety of subsoil development, increasing the efficiency of use and reproduction of georesource potential. The solution to this problem is facilitated by the creation of effective technologies for coal mining and processing.

Laboratory studies were carried out on the substrate of the tailings of the Zhezdinsky processing plant using seeds of plants growing in this region - black wormwood, wheatgrass, parsnip, alabote, etc. The seeds were soaked in aqueous solutions of a humic preparation with a concentration of 0.1÷0.9% for 60 minutes, then dried at a temperature of 20÷40°C to an air-dry state for 2÷3 hours and sown in prepared sand in the tailings substrate. During the observation, it was found that among the tested plants, the most promising for the biological reclamation of enrichment tailings are wormwood, wheatgrass and alabote (Table 5).

Table 5

Effect of pre-sowing treatment on seed germination

Plant variety	Seed germination, %	Average
Wormwood – control	24	3
Processed wormwood	90	4
Zhitnyak - control	16	-
Processed wheatgrass	34	14
Alabota - control	26	5
Alabbota processed	91	6

The experimental testing scheme included the following conditions: soil preparation, i.e. cultural and technical photography; seeding rate for wormwood at the rate of 4 kg/ha, for wheatgrass - 15 kg/ha; seeding depth of wheatgrass is 2-3 cm, wormwood – without seeding; method of sowing wormwood and wheatgrass in rows with a row spacing of 15 cm. Based on the results of laboratory studies, the consumption rate of wormwood and alabote seeds was established, which is 4 kg/ha. The observation results showed that in control plots sown with wormwood seeds not treated with the drug, germination was 18÷21%, and in experimental plots using the drug - 87%.

The drug obtained using the developed technology will be competitive in the domestic and foreign markets due to its low price, environmental friendliness, availability and effectiveness. In addition, when obtaining a humic preparation, cheap local raw materials and available reagents are used, and it is produced using standard equipment. The possibilities for export and import substitution of this drug are high, because the Republic is currently purchasing similar products abroad. Establishing production using technology, which was developed on the basis of the presented research, will not only replace analogues imported to Kazakhstan, but also export the humic preparation, since imported analogues are inferior in properties and price. The technology for its production and implementation in production is aimed at increasing the complexity of the use of Kazakhstan's raw materials [47].

And so the scientific significance of the work being carried out lies in the development of the concept of biotechnical reclamation of man-made objects using biologically active preparations-humates, ensuring the growth of plants in extreme conditions, and the applied significance is in the development of technologies for growing vegetation on man-made formations in conditions of high salinity and aridity.

Patent and licensing search conducted for the period 2018-2023. showed the prospects of the developed area, since the proposed technology will allow the reclamation of man-made formations within 2-3 years. Sowing seeds treated with physiologically active humic preparations and introducing a surface layer of man-made formations promotes the growth of herbaceous plants characteristic of a given region.

Known technologies make it possible to reclaim technogenic formations only within 4-12 years, even with the introduction of active soil microflora into the soil surface. It should be noted that these technologies require significant capital investment.

As a biotest culture, we used barley seeds of the Arna variety, which were germinated in a thermostat in triplicate on the test substrates in accordance with the requirements of GOST (GOST 12038-66, GOST 12040-66).

The humidity of the substrates was maintained by weight in the morning and evening at a level of 90% of their lowest moisture capacity. Exposure of the experiment - 19 days.

One of the main reasons for the decrease in the amounts of HMs transferred from soil to plants is their participation in complexation reactions with HA, leading to the formation of stable chelate compounds, which are then fixed on the surface of bentonite clays due to adsorption. On the other hand, the fixation of HM ions is due to the ability of clay minerals to ion exchange due to the presence, along with a positive charge, of a large negative charge on their surface.

Since bentonite clay and soil humic acids have cation exchange centers and a total amount of large negative charge, the positively charged particles of HM ions are adsorbed more firmly and, accordingly, due to such accumulation in the soil environment, the translocation process into plants is sharply reduced.

By comparing the experimental data obtained by introducing bentonite clay and its mixture with HA into the soil system, the independence of the process of cadmium translocation into plants from the presence of HA was established. The amount of cadmium in plants was almost the same both in the presence of HA and without it, which can be explained by the absence of chemical interaction between cadmium and humic acid with the formation of complex compounds [48] .

The addition of bentonite and its mixture with humic acid has a different quantitative effect on the supply of the studied elements, for lead and cadmium, where the effect is higher than for zinc. Under the same conditions, the supply of Pb to tomatoes is reduced by 78-83%, Zn by 30-45%, Cd by 80-86%; in clover, respectively, P - by 85-97%, Zn - by 23-48%, Cd - by 97-98%.

The research results indicate that bentonite clay used as an ameliorant and its mixture with HA have a great influence on the mobility of lead and cadmium than zinc, which is obviously explained by differences in the chemical properties of these elements.

Thus, the introduction of bentonite clays, as well as their mixtures with humic acids and other organic substances, into soils contaminated with lead, cadmium and zinc makes it possible to eliminate the undesirable effects of heavy metals on cultivated plants and obtain environmentally friendly products.

Experimental studies also confirmed that the most effective method for improving the hygienic quality of plant products and restoring the productive properties of soils contaminated with heavy metals adjacent to agricultural roads is clay-sorption detoxification.

The main factors regulating the behavior of heavy metals in the soil-plant system include the reaction of the environment and redox conditions, the granulometric, mineralogical and chemical composition of the mineral part of the soil, the group composition of humic substances and the biological characteristics of plants and the specifics of their cultivation.

An alternative to existing soil restoration methods. This is especially important for mountainous areas poor in vegetation, as this improves the landscape.

Vegetation reduces the spread of heavy metals due to wind erosion, stormwater runoff, and infiltration. The grown plants can be processed using conventional methods or placed in small volumes.

In this regard, the experience of foreign countries whose soil conditions and climate are similar to Kazakhstan is interesting.

Results from field studies on metal-bearing tailings from lead and zinc mines located in semi-arid and saline areas of Central Iraq showed that while the average concentrations of lead, zinc and cadmium in soils were 4431, 4920 and 37 mg/kg, respectively, the concentrations in plant samples were relatively high. Thus, Chenopodium album L., growing under natural conditions, accumulated lead up to 557 mg/kg in dry stems. Planted Atriplex leucoceada contained the highest amounts of zinc and cadmium - 3165 14 mg/kg dry stems, respectively.

The possibility of using genetic engineering to dramatically increase the amount of arsenic extracted from soil is currently being explored.

A team of US researchers has developed the first transgenic system for removing arsenic from soil by growing genetically modified plants on it. Transgenic plants extract arsenic from the soil and accumulate it in the leaves in a form that is easier to remove and destroy.

Conclusion

Low-productive saline-alkaline soils of the arid zone of Kazakhstan create extremely unfavorable conditions for the growth, development and yield of cultivated plants, which is a serious obstacle to their intensive use in agricultural production.

Reclamation of such soils using classical methods, in conditions of acute shortage of irrigation water, poor natural drainage of territories, and the absence of special drainage systems, is not effective enough and is accompanied by significant difficulties arising from the progressive secondary salinization of soils and deterioration of environmental conditions. In this regard, there is a need for widespread use in plant growing of physiologically active drugs with multifunctional properties that increase the environmental resistance of cultivated plants to extreme environmental factors. The solution to this problem requires not only purely scientific interest, but also life itself, since with the transition to market relations, the growth of land productivity in the republic largely depends on the effectiveness of the agricultural technologies used. The use of agro-reclamation methods in crop production to increase the environmental resistance of plants to salinity and other unfavorable environmental factors ensures the sustainability of agricultural production and allows minimizing its dependence on natural and climatic conditions.

For the harsh soil and climatic conditions of Kazakhstan, the most promising is an environmentally friendly, physiologically active humic preparation from brown coals, enriched with macro- and microelements and wormwood extract.

The balance of the ingredient composition in this preparation in relation to the low-productive soils of the desert zone of Kazakhstan suggests its widespread use in the cultivation of agricultural crops and in other soil-climatic zones with more favorable hydrothermal conditions.

Kazakhstan has significant reserves of brown coal, which is the raw material for obtaining these materials. However, despite the presence of large brown coal deposits in the Republic and a sufficiently developed infrastructure for the production of such products, their production has not been established. Therefore, the development and industrial implementation of technology for producing modified humic preparations from natural hydrocarbon raw materials is an urgent task, and the creation and production of such materials contributes to expanding the export potential of the Republic and import substitution. At the same time, not only economic problems are solved, but also social problems, which consist in creating additional work, developing the infrastructure of the regions, increasing the well-being of the population, etc.

The effectiveness and feasibility of investing in the proposed work is ensured by reducing dust, restoring the biological balance of the region by fixing dusty particles of man-made objects with vegetation, the formation of biota, moderating the climate of the region, reducing the morbidity of the population and budget expenses for treating the population.

Conclusions.

1. As a result of research carried out in 2018, the following work was completed: a cartogram of the Kiyaktinsky coal mine was compiled, showing the spatial location of brown coal varieties suitable for obtaining humic preparations;

2. An optimal technology for producing experimental humic preparations enriched with macro- and microelements and wormwood extracts has been developed;

3. The resulting preparation was analyzed by gel chromatography and thermography, and it was found that the preparation is represented by sodium humates and consists of aromatic compounds and various functional groups;

4. The maximum effect of salt tolerance was obtained in variants with pre-sowing seed treatment, %: wheat 1.0-2.5%, barley - 0.5-3.0%, rice - 1.0-3.0%, soybean -0.005 -0.04% solution of the drug. In this case, the optimal time regimes for pre-sowing seed treatment are 30-120, 30-240, 30-120, 5-10 minutes, respectively.

5. Increases germination energy and seed germination; promotes enhanced growth of roots and above-ground parts of plants; improves the mineral nutrition of plants on irrigated soils in the arid

zone of Kazakhstan by an average of 25-30%; accelerates the ripening of grains, legumes, fodder, oilseeds, industrial, melons, fruits and berries, vegetable crops in open and protected ground, as well as potatoes for 7-12 days; reduces the nitrate content in agricultural products by 25-40% and the negative effect of pesticides applied to the soil; contribute to an increase in the size of inflorescences; increases the yield of agricultural plants by an average of 25-30%.

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