ISSN NO: 2771-8840
December 2024

The importance of bentonite clays in the cultivation of agricultural crops

Karshi engineering-economics institute, doctoral student
D. N. Kuziyev
"TIIAME" MTU Karshi institution of Irrigation and agrotechnology, Associate Professor, candidate of Agricultural sciences
A.A.Abdiyev

Abstract. The article highlights the use of bentonite clays, which are one of the non-traditional agricultural ores, as fertilizers and obtaining high and high-quality crop yields, as well as a positive effect on changing the mechanical composition of the soil, which is one of the important factors in increasing soil fertility.
Key words: Unconventional agrominerals, alkaline bentonite, normal adsorption, glauconite, diatomite, tripoli, zeolite, bentonite, montmorillonite, microporosity
Annotatsiya. Maqolada noan'anaviy agrorudalardan biri hisoblangan bentonit gillarini o'g'itlar sifatida qo'llash hamda qishloq xo'jaligi ekinlaridan yuqori va sifatli hosil olish hamda tuproq unumdorligini oshirishning muhim omillaridan, tuppoq mexanik tarkibining o'zgarishiga ijobiy ta'siri yoritilgan.
Kalit so'zlar: Noan'anaviy agrorudalardan, ishqoriy bentonit, normal adsorbsiya, glaukonitlar, diatomitlar, tripoli, seolit, bentonit, montmorillonit, mikro g'ovaklilik xususiyati.
Аннотация. В статье освещается применение бентонитовых глин, являющихся одной из нетрадиционных агроруд, в качестве удобрений и получение высоких и качественных урожаев сельскохозяйственных культур, а также положительное влияние на изменение механического состава почвы, являющееся одним из важных факторов повышения плодородия почвы.
Ключевые слова: Нетрадиционные агроминералы, щелочной бентонит, нормальная адсорбция, глауконит, диатомит, трепел, цеолит, бентонит, монтмориллонит, микропористость.

It is well-known that one of the crucial factors in obtaining high-quality yields from agricultural crops and increasing soil fertility is the combined application of local and mineral fertilizers in scientifically determined ratios. However, there is currently a shortage of both local and mineral fertilizers. To address this deficiency, it is advisable to use non-traditional agro-ores as supplementary nutrients to maintain and enhance soil fertility. Increasing the efficiency of using bentonite clays as fertilizers, which are considered one of the non-traditional agro-minerals in agriculture, increases the level of provision of macro and microelements in the soil in optimal proportions. In exchange for microelements, the metabolism of substances in the plant improves, contributes to the optimal course of physiological and biochemical processes, has a positive effect on the process of chlorophyll synthesis, and increases the intensity of photosynthesis. Under their influence, plants increase their resistance to fungal and bacterial diseases, to adverse environmental conditions such as moisture deficiency, and temperature increase or decrease.

Bentonite Extensive experience has been accumulated in the use of clay in agriculture. Abroad, bentonites and preparations made from them are used in agriculture: as pesticides in the fight against pests of agricultural plants; as additives to improve the agrochemical properties of sandy and other infertile soils; as diluents and accumulators of mineral fertilizers - reducing their harmful effects on soil biocenoses, preventing leaching of fertilizers from the soil and, as a result, preventing pollution of groundwater with mineral salts; as suspending and stabilizing agents, widely used in the production of liquid complex fertilizers.

Bentonite (from the Benton deposit, USA) is a sedimentary fine-dispersed clay comprising 60-70% montmorillonite group minerals. They have high binding capacity, adsorption and catalytic activity. In addition to montmorillonite, bentonite often contains hydromica, mixed-layer minerals, kaolinite, zeolites and other minerals. All large deposits of bentonite clays were formed as a result of underwater decomposition of volcanic ash and tuff. Alkaline bentonites are characterized by high plasticity and swelling properties [75; 105-108-p.] .

Bentonite clays are named after the port of Benton, Wyoming, USA, where the first industrial extraction of bentonite began in the late 19th century. In the following period, interest in bentonite clays increased significantly, and their deposits began to be found on almost all continents of the planet [57; pp. 91-94].

ISSN NO: 2771-8840
December 2024

Bentonite clays were first discovered in 1888 in the Benton area of Wyoming, USA. Bentonite also refers to simple clayey materials from deposits formed from volcanic potash rocks, consisting of at least 60-70% montmorillonite group minerals with high complex binding capacity, normal adsorption and catalytic growth capacity [58; 9-12-p., 120; 98-p., 72; 36-42-p.].

Bentonite (named after a mine near Fort Benton, USA) is a compound with high binding capacity, adsorption, and catalytic activity. All large deposits of bentonite clays are formed as a result of underwater decomposition of volcanic ash and rocks. Alkaline bentonite has high plasticity and swelling properties [34; p. 454].

Currently, bentonite clays contain 60-70% or more of the smectite group minerals (montmorillonite, nontronite, beidellite, etc.). The general formula of bentonite clays is "$Al_2O_3 \cdot 4SiO_2 \cdot nH_2O$". Montmorillonite in bentonite is often considered a rock-forming component in bentonite clays, which determines the properties (structural and physicochemical) that distinguish bentonite clays from other clay minerals [66; p. 148].

Bentonites are natural clay minerals with a high content of montmorillonite. Bentonites contain up to 14% or more of aluminum oxide, up to 56% or more of silicon oxide, up to 4% or more of iron oxide, and more than 30 different trace elements and oxides of other metals. The chemical composition of bentonites includes a large number of macro- and microelements.

A.N. Sikalov's research indicates that the most effective rates of application of bentonites in combination with mineral fertilizers in sunflower cultivation are bentonite 7; 10 and 15 t/ha and mineral fertilizers $N_{90}P_{60}K_{60}$ kg/ha [94; pp. 40-46].

The Russian Federation is rich in various natural resources, of which the country's reserves of phosphorites are 22 million tons, bentonites 13 billion tons, zeolites 2.7 billion tons, glauconites 36 billion tons, and sapropel 100 billion tons. In the Republic of Tatarstan, the reserves of zeolites are 300 million tons, bentonites 120 million tons, phosphorites 6 million tons, glauconites 65 million tons, and sapropel 100 million tons. [32; p. 2, 18; p. 272].

D. Tungushova, L. Slesaryov, Ye. Belousov, about 200 deposits and occurrences of bentonite clays with estimated reserves of more than 2 billion tons have been identified in Uzbekistan [85; p. 23].

Geologists have identified more than 200 types of bentonite and bentonite-like clays in Uzbekistan, and their exploratory reserves, according to preliminary data, are estimated to be more than 2 billion tons. Massive formations of high-quality clay structures occurred in the Jurassic, Cretaceous, and Paleogene periods. To date, only the deposits of "Navbahor", "Azkamar", "Kattakurgan", "Lagon", and "Shorsu" are being developed on an industrial scale. The total amount of bentonite clays extracted and processed from these deposits still amounts to 30-40 thousand tons per year.

World experience in the use of non-traditional agro minerals shows that their use provides a 10-15% higher yield of agricultural crops, improves the quality of the product, and purifies the soil from contamination with heavy metals, toxic substances, and radioactive elements. They are also used to eliminate the negative effects of toxic salts, replenish the deficiency of microelements in the soil, as feed additives for livestock, and to improve the composition and quality of manure and silage.

Natural compounds used in agro-industrial production as fertilizers, ameliorants, fillers, biostimulants and feed additives are considered agro-ores. Agricultural ores are divided into traditionally used (phosphorus and potash) fertilizer mixtures and non-traditional types of mineral raw materials. These include minerals and rocks that increase the efficiency of chemicals in the agro-industrial complex. This non-traditional group includes bentonites, glauconites, diatomites, tripolites, etc.

Bentonite has a high capacity of exchangeable bases, sorption and catalytic activity. Bentonite can be used for structure formation, liming and fertilization of fields, pectins, adsorption of harmful substances (heavy metals, radionuclides) from the soil , and regulation of water exchange in the soil.

Bentonite clays consist of minerals of the montmorillonite group. Bentonite may contain hydromica, kaolinite, palygorskite, cristobalite, zeolites, and other minerals dispersed in water to a colloidal state. Bentonite is a natural hydrated aluminum silicate with the general formula $Al_2O_3 \cdot 4(SiO_2) \cdot H_2O$.

In the studies of AV Kraves, VAVinnikova, it was found that an aqueous extract of bentonite at a concentration of 0.5% increased the germination of oat seeds by up to 10%. It was also observed that the mass of seedlings increased by 24% and the mass of roots by 33% [45; pp. 149-152].

ISSN NO: 2771-8840
December 2024

Using bentonite increases plants' resistance to fungal and viral diseases, reduces the susceptibility of cotton to wilt, and increases the yield of vegetable crops, potatoes, sugar beets, wheat, and cotton. At the same time, when using bentonite clays, the greatest effect is manifested at low rates of traditional mineral fertilizers (up to 0.5 of the recommended rate for this crop, i.e., 0.5 parts of the usual rate are sufficient) [57; pp. 91-94].

In Iran, the application of bentonite to soil in the form of natural minerals is popular. This is because it is a natural supersorbent and a conglomerate of clay minerals, which are minerals, and provides high productivity due to its ability to absorb and retain water and nutrients, as well as its active participation in high cation exchange processes [110; p. 4].

In recent years, interest in the use of natural aluminosilicates (bentonite) in agriculture has been growing. A number of studies have shown that the unique physical and chemical properties of natural aluminosilicates make them particularly suitable for use in agriculture. In particular, bentonite is a natural structure with the ability to retain moisture necessary for plants, and has a high cation exchange and ion adsorption capacity [112; p. 12].

Bentonite has a high cation exchange capacity, prolonging the effect of mineral fertilizers in the soil. Bentonite contains a large number of micro and macro elements, such as zinc, magnesium, calcium, potassium, etc. , the introduction of which into the soil allows to significantly improve the agrochemical and agrophysical properties of the soil and increase its fertility [56; p. 4].

The interest in natural minerals (zeolite, bentonite, montmorillonite, etc.) is explained by their unique skeleton and structural structure, as well as the content of a large number of mineral nutrients in them. Due to their microporous nature, they have the ability to retain a large amount of water and then gradually release it. This property has a positive effect on the effective use of moisture by soil and plants [24; 452-454-p., 33; 72-p.].

List of used literature

1. Roshchupkina Yu.S., Bobreshov E.Yu., Tsykalov A.N. Sposoby introduction of bentonites and glauconites under sugar beets. Molodejnyy vector development of agricultural science. Materialy 63-y nauchnoy studencheskoy conference. Chast III. Voronezh. 2012. – S. 105-108.
2. Makhkamova D.N., Sodikova Sh.A., Usmonova Z.T. Bentonite clay, its physical and chemical characteristics and application in national economy // Universum: Technical science: electronic. nauchn. journal. 2019. No. 6(63) -S. 91-94 . URL: http://7universum.com/ru/tech/archive/item/7515
3. Merabishvili, M.S. Stabilization sypuchesti granulirovannogo carbamide bentonite / M.S. Merabishvili, L.E. Ayzikovich, A.G. Kozmanishvili // Khranenie i pererabotka zerna. - 1972. - No. 2. - S. 9–12.
4. Grim R.E. Clay mineralogy / R.E. Grim; per. English - Moscow: Izd-vo inostrannoy literature , 1956. - 454 p.
5. Mostalygina L.V., Elizarova S.N., Kostin A.V. Bentonite clay Zauralya: Ecology and healthy people. Monograph.– Kurgan: Izd-vo Kurganskogo gosudarstvennogo universiteta, 2010. – 148 p.
6. Tsykalov A.N. Influence of introduction of bentonites and mineral fertilizers on the yield and quality of sunflower seeds and the conditions of the steppe zone of the central black earth. Journal of Voronezh State Agrarian University. 40 – 2016. – No. 3 (50). 40-46 p.
7. Gosudarstvennyy doklad "O sostoyanii i ispolzovanii mineralno-syrevykh resursov Rossiyskoy Federatsii v 2011 godu". - Electronic . from – 2011. – URL: http://www.mnr.gov.ru/regulatory/list.php?part=1450. (15.07.2003).
8. Tungushova D., Slesaryov L., Belousov E. Primenenie netraditsionnyx agrorud // Selskoe hozyaystvo Uzbe-kistana . - Tashkent, 2004. - #3. - S.23.
9. Kravets A.V., Vinnikova V.A. VLIYANIE VODNYX VYTYAJEK IZ GLINISTYX MINERALOV NA POSEVNYE KACHESTVA SEMYAN OVSA // Mejdunarodnyi zurnal prikladnyx i fundamentalnyx issledovaniy. – 2018. – No. 1. – S. 149-152; URL: https://applied-research.ru/ru/article/view?id=12083 (data processing : 19.01.2022).
10. Kabiri , K., 2005 Superabsorbent Hydrogel: Introduction and Applications. In: Proceedings of 3rd specific symposium on application of super absorbent polymer hydro gels in agriculture. Petrochemistry and Polymer Research Center Iran. Karaj. (In Farsi).

ISSN NO: 2771-8840
December 2024

11. Kojic , D.; S. Pajević ; A. Jovanović- Galović ; J. Purać , E. Pamer ; S. Škondrić ; S. Milovac ; Ž. Popović and G. Grubor-Lajšić (2012). Efficacy of natural aluminosilicates in moderating drought effects on the morphological and physiological parameters of maize plants (Zea mays L.) J. Soil Sci. Plant Nutr . 12 (1). Temuco 2012.