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TREATMENT OF WASTEWATER USING AQUATIC PLANTS AND THEIR USE FOR IRRIGATION

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Abstract: In recent years, major changes have been taking place in our Republic. Although Uzbekistan has long been considered an agrarian country, during the Soviet period mainly cotton and grain were cultivated on its territory. Today, not only a wide range of fruits and vegetables, cotton, grain, legumes, meat, silk, and leather products are produced, but the country has also gained a well-deserved place in the global market. The yield obtained from irrigated lands accounts for 95% of the total agricultural production. About 55–60% of irrigated lands are saline and waterlogged, 50% are subject to erosion, and 10–12% consist of gypsum and carbonate soils. In addition, low-productivity sandy, sandy-loam, stony and gravel soils are also found among irrigated lands. The development of the active soil layer is strongly influenced by its mechanical composition, porosity, quality, structure, moisture, temperature, and mineral content. The soil contains such chemical elements as calcium (Ca), magnesium (Mg), chlorine (Cl), sodium (Na), sulfate (SO_4), and carbonate (HCO_3).
Keywords: irrigated lands, azolla, eichhornia, pistia, agriculture, soil, plant, mechanical composition.

ОЧИСТКА СТОЧНЫХ ВОД С ПОМОЩЬЮ ВОДНЫХ РАСТЕНИЙ И ИХ ИСПОЛЬЗОВАНИЕ ДЛЯ ОРОШЕНИЯ.

Аннотация: В последние годы в нашей Республике происходят большие изменения. Хотя Узбекистан издавна считается аграрной страной, в период Советского Союза на его территории в основном выращивались хлопок и зерно. В настоящее время не только производится широкий спектр фруктов и овощей, хлопка, зерна, зернобобовых, мясной, шелковой и кожевенной продукции, но и занимает достойное место на мировом рынке. Урожай, получаемый с орошаемых земель, составляет 95% общего объёма продукции сельского хозяйства. 55–60% орошаемых земель засолены и заболочены, 50% подвержены эрозии, 10–12% состоят из гипсовых и карбонатных почв. Кроме того, в составе орошаемых земель встречаются малопродуктивные песчаные, супесчаные, каменистые и гравийные почвы. В развитии активного слоя почвы важную роль играют её механический состав, пористость, качество, структура, влажность, температура и содержание минералов. В составе почвы присутствуют такие химические элементы, как кальций (Ca), магний (Mg), хлор (Cl), натрий (Na), сульфат (SO_4), карбонат (HCO_3).
Ключевые слова: орошаемые земли, азолла, эхорния, пистия, сельское хозяйство, почва, растение, механический состав.

СУВ ЎСИМЛИКЛАРИ ЁРДАМИДА ОҚОВА СУВЛАРИНИ ТОЗАЛАШ ВА УНДАН СУҒОРИШДА ФОЙДАЛАНИШ.

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Аннотация: Сўнгги йилларда Республикамизда катта ўзгаришлар рўй бермоқда. Ўзбекистон азалдан аграр мамлакат ҳисобланиб келган бўлса-да, Совет Иттифоқи даврида ҳудудда асосан пахта ва ғалла етиштирилган. Ҳозирги кунда эса нафақат мевалар ва сабзавотлар, пахта, ғалла, донэкинлари, гўшт, ипак ва чарм маҳсулотлари кенг миқёсда ишлаб чиқарилмоқда, балки жаҳон бозорида муносиб ўринни эгаллаб келмоқда. Суғориладиган ерлардан олинадиган ҳосил қишлоқ хўжалиги маҳсулотларининг умумий ҳажмининг 95% ни ташкил этади. Суғориладиган ерларнинг 55–60% шўрланган ва ботқоқланган, 50% эрозияга учраган, 10–12% эса гипсли ва карбонатли тупроқлардан иборат. Шунингдек, суғориладиган ерлар таркибида унумдорлиги паст бўлган қумли, қумлоқ, тошли ва шағалли тупроқлар ҳам учрайди. Тупроқнинг фаол қатламининг ривожланишида унинг механик таркиби, ғоваклиги, сифати, структураси, намлиги, ҳарорати ва минерал моддалар миқдори муҳим аҳамиятга эга. Тупроқ таркибида кальций (Ca), магний (Mg), хлор (Cl), натрий (Na), сулфат (SO_4), карбонат (HCO_3) каби кимёвий элементлар мавжуд.
Калит сўзлар: суғориладиган ерлар, азолла, эихорния, пистия, қишлоқ хўжалиги, тупроқ, ўсимлик, механик таркиб.

Introduction. In recent years, major changes have been taking place in our Republic. Although Uzbekistan has long been regarded as an agrarian country, during the Soviet era mainly cotton and grain were cultivated in its territory. Today, thanks to ongoing reforms, various types of fruits and vegetables, cotton, grain, legumes, meat, silk, and leather products are produced, which occupy high positions in the global market. To promote entrepreneurship and increase crop yields, special attention must be paid to the land reclamation status of agricultural areas. As our ancestors used to say: *"If you take care of the land, the land will take care of you."* Irrigated lands constitute only 9.3% of the total area of the Republic, yet they account for 95% of agricultural output. Of these lands, 55–60% are saline and waterlogged, 50% are affected by erosion, and 10–12% consist of gypsum and carbonate soils. Moreover, low-productivity sandy, sandy-loam, stony and gravel soils are also widespread. According to reclamation tasks, reclamation is divided into four types: irrigation, drainage, desalination, and erosion control. Depending on the nature of the work, it includes agrotechnical, hydraulic, biological, forest, chemical, cultural-technical, thermal, and water reclamation measures. Each type of reclamation is used according to its purpose.Biological reclamation is used to improve soil conditions and to treat wastewater. It is carried out by growing natural plants on the soil, introducing biological aquatic plants into irrigation water, and treating wastewater and drainage water.

The development of the active soil layer is influenced by its mechanical composition, porosity, quality, structure, moisture, temperature, and mineral content. Excessive salt concentration in the soil leads to salinization. To reduce the amount of salts in saline soils, salt-tolerant crops such as alfalfa, corn, wheat, sorghum, pumpkin, barley, and millet are cultivated. Adding blue-green algae (chlorella), azolla, eichhornia, and pistia to irrigation water yields good results. In water-short regions, it is advisable to treat wastewater using biological plants. For this purpose, natural aquatic plants such as duckweed (*Lemna minor*), pistia (*Pistia stratiotes*), azolla (*Azolla caroliniana*), eichhornia (*Eichhornia crassipes*), and the green alga *Chlorella* are introduced into wastewater, sewage, and drainage water. After purification, this water can be used for irrigation.

Pistia (*Pistia stratiotes*). Pistia is a free-floating aquatic plant with a short stem and paddle-shaped leaves. Under introduction conditions, its height reaches 20–40 cm. The leaves form a dense rosette; the upper surface is green with longitudinal grooves. Due to its well-developed aerenchyma, the plant remains afloat. The root system is fibrous, 50–60 cm long, densely covered with root hairs.

Azolla (*Azolla caroliniana*). Azolla floats on the water surface, with a length of 0.7–1.8 cm. The upper part of the sporophyte consists of two rows of small overlapping leaves, while the lower part has a root 2.0–2.5 cm long. The leaf consists of two segments: the upper green segment located above the water surface, and the lower immersed segment absorbing dissolved substances.

The optimal period for mass reproduction of azolla is July–September; it produces 250–300 g/m² of biomass per day. In wastewater, 1 hectare of surface can produce 1500–2000 kg of wet azolla biomass; pistia and eichhornia — 1800–2700 kg of wet biomass or 90–135 kg of absolutely dry biomass (June–October). The biomass can be used in biological ponds at treatment facilities or processed thermally (AVM-0.65, AVM-1.5) to produce vitamin meal, which serves as a protein-vitamin supplement for livestock and poultry.

Eichhornia (*Eichhornia crassipes*). Eichhornia is a floating plant 30–40 cm tall. The leaves are smooth, shiny, oval, with clearly pronounced veins. At the base of the petiole is an air chamber that provides buoyancy. The root system is fibrous and highly branched.

Chlorella. Preparations based on the green alga *Chlorella vulgaris* are widely used in fish farming, animal husbandry, poultry farming, and crop production as an organic fertilizer and biostimulator, as well as in medicine. The biomass of *Chlorella vulgaris* contains 62% protein, 30% carbohydrates, 5% fat, numerous mineral salts, and vitamins. In fish farms, chlorella suspension enhances the feed base, reduces bacterial contamination of water, accelerates zooplankton development, and promotes healthy fish growth. When added to livestock feed, it increases meat quality in bulls, improves weight gain, and increases milk productivity in cows. In crop production, chlorella is used as a biological fertilizer for seed soaking, root application, and foliar treatment. Plants become more stress-resistant and develop a strong root system, which increases yield.

Conclusion. All the aquatic plants discussed above are widely used for wastewater treatment and for reducing the mineralization of collector-drainage waters. Their additional advantage is their ability to retain moisture in the soil when used in irrigation water, improving its composition and serving as a natural fertilizer. To improve the reclamation status of lands, additional measures are required, especially on highly saline areas — proper selection of crops, timely irrigation, and application of organic and mineral fertilizers. The use of bioremediation plants makes it possible to use water efficiently not for discharge, but directly for irrigating agricultural crops.

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