



International Congress on Biological, Physical And Chemical Studies

International Congress on Biological, Physical And Chemical Studies - is an international conference platform under open access policy. The conference is led by international expert members who take an objective approach to peer review, ensuring each research paper is reviewed, edited by authors and evaluated on its own scholarly merits and research integration. Publishing and joining on the proceeding of the International Congress on Biological, Physical And Chemical Studies will ensure publishing experience and indexing possibilities on various global indexing.

Effect of Heavy Metals on Soil Humus Status and Nutrient Element Levels

Karimov Khusniddin Nagimovich

Senior researcher, Scientific-research institute of horticulture, viticulture and winemaking named after Academician M.Mirzaev

Ermatova Munajat Kosimovna

Senior researcher, SDMCHBUTF university

Shukrullaeva Munisa Shavkatovna, Nigmanova Layla Alisherovna

Independent researcher, Laboratory of agrochemical analysis center of Tashkent region

ABSTRACT

Heavy metal ions in the soil are difficult for plants to absorb due to the damage they cause to soil composition and their impact on humus and nutrients, putting the soil under stress. Releasing it from this state of stress, i.e., removing metal ions using the phytoremediation method, leads to soil regeneration.

KEYWORDS: soil, heavy metal, humus, nutrients.

Introduction: Contamination of soil with heavy metal ions is now considered part of the set of invisible toxicants in agriculture. An increase beyond the specified norm affects the agrochemical condition of the soil and travels through the trophic chain - soil, water, plants, animals, and humans.

Today, toxic elements negatively impact the environment on a global scale, leading to the contamination of agricultural products. Therefore, it is essential to identify agricultural lands with poor ecological conditions within widely used areas across all regions of our republic. Ecological maps should be created for areas contaminated with toxicants, and efforts must be made to grow ecologically clean products, restore soil fertility, and improve the overall ecological condition of agricultural lands. Additionally, it is important to develop measures aimed at ensuring the purity and ecological cleanliness of agricultural products.

Review of literature. In terrestrial biogeocenosis, the biological circulation of chemical elements is observed in the processes of mass exchange in the ocean and troposphere. According to V.V. Dobrovolsky's data, over the course of one year on islands in the Indian Ocean, iron accumulates at 10-15 mg/m², copper at 1 mg/m², and manganese, lead, and nickel at 0.1 mg/m² from fine dust

particles falling from the atmosphere. In addition, nickel accumulates at 1.5-4.5 kg/km² with rain, and 0.1-0.2 kg/km² from dry air [3].

The priorities for providing the population with environmentally friendly products are to clean the soil and increase both the yield and quality of agricultural crops [6].

Anthropogenic changes in developed countries have affected almost all ecosystems of the planet..

Today, 11% of the Earth's surface, or 14.5 million km², is considered suitable for production. Due to anthropogenic activity, up to 500 million tons of various substances are released into the environment [8]. Kh.N.Karimov believes that metals in the form of compounds are absorbed by plants as ions from the soil solution.

Academician A.A. Juchenko notes that "In the context of environmental and food pollution, a decrease in biodiversity, and an increase in the genetic vulnerability of ecosystems, a recession occurs. The sustainable development of a long-term civilization cannot be imagined without understanding the inevitability of a paradigm shift in environmental management" [5].

B.G. Rozanov estimated that throughout the entire history of humankind, the total area of destroyed and degraded soils has reached 20 million km², exceeding the total cultivated area of the modern world, which is 15 million km² [2].

In terms of pollution levels and their effects on biological organisms, heavy metals hold a particularly significant level of toxicity among pollutants [2].

The term "heavy metals" was first used in 1817 by the German chemist Leopold Gmelin, who classified the chemical elements known at the time into three groups: non-metallic, light metals, and heavy metals. Heavy metals included 25 elements with densities ranging from 5.31 to 22.00 g/cm³. According to N.Reymers, elements with densities greater than 8 g/cm³ should be considered heavy metals, including Pb, Cu, Zn, Ni, Cd, Co, Sb, Sn, Hg, and others [9].

Heavy metals are one of the priority groups of pollutants that contribute to environmental degradation. This group includes more than 40 elements with atomic masses exceeding 50. Many of these elements play an important enzymatic role in biological processes. When present in natural concentrations, they are referred to as "microelements" [1].

The study examined the industrial impact in the regions of Kashkadarya, Samarkand, and Tashkent, focusing on how the levels of toxicants in the soils of fields near old agricultural airfields affect humus and nutrient availability.

The typical irrigated grey soils of the Pastdargom district, which are five times contaminated with copper, did not show a stressed state of humus compared to the control, with humus levels found to be 0.066% higher than the control. In the May analysis, minimal stress from copper was observed in 12 samples that were five times contaminated. Additionally, 18 samples that were ten times contaminated with copper showed a humus increase of 0.184% compared to the control. Furthermore, the release of Cr, Ni, Cd, Cu, and Pb ions from heavy metals in soils that are ten times contaminated with respect to the maximum permissible concentration (MPC) suggests that the sorption of metals by microorganism strains plays a significant role.

It has been found that the level of exposure to humus is high in grassland soils brought from Ghuzor district that are contaminated ten times with selected heavy metals in grey soils, in the following order: Co → Ni → Cr → Cd → Cu.

Soils brought from the potash plant's garden in Dekhkanabad district have a high potassium content of 400 mg/kg, but they are classified as very low-income groups based on their nutrient supply levels.

The mobile forms of potassium have been observed in irrigated soils from Pastdargom district, with a concentration of 249 mg/kg in control soils, which are classified as moderately supplied (200-300 mg/kg). Control soils contain 788 mg/kg, while variants treated with microorganism

strains have been found to contain 919 mg/kg of mobile potassium. Additionally, the 3.5 to 10-fold contaminated variants of copper, relative to the maximum permissible concentration (MPC), showed a reduction in potassium levels compared to the control. Specifically, the 10-fold contaminated variant exhibited a reduction of 254 mg/kg compared to the control.

Subsequent analyses revealed strong effects of lead and cobalt on the mobile form of potassium. In grazed soils, 5- and 10-fold contamination with Pb ions reduced potassium levels from 621 to 384 mg/kg, while cobalt-contaminated variants showed a decrease from 461 to 402 mg/kg. These conditions have been linked to the reduction of potassium levels in typical grey soils.

Irrigated soils from the Pastergorn district exhibit high levels of mobile forms of phosphorus, exceeding 60 mg/kg, with control soils measuring 62 mg/kg. In comparison, soils from the Dekhkanabad and Ghuzor districts also show high levels, at 53 mg/kg (within the range of 45-60 mg/kg), while grassland grey soils contain 47 mg/kg.

In variants contaminated with Cr, Cd, and Cu ions at three times the MPC compared to control soils, all five times polluted variants caused a decrease in phosphorus levels in irrigated typical grey soils. In contrast, soils from the Pastergorn and Ghuzor districts, which have low humus content, experienced a sharp decrease in phosphorus levels in variants contaminated with heavy metals at ten times the MPC.

In the ten-fold contaminated variants of lead and cobalt, decreases of 29 mg/kg and 23 mg/kg, respectively, have been observed. Grassland grey soils showed a decrease of 18-24 mg/kg, indicating that phosphorus levels of 15-30 mg/kg fall within the grouping sequence. The highest stress state was noted in the ten-fold contaminated variant of chromium, which exhibited a decrease of 31 mg/kg compared to the control.

Subsequent observations indicate that phosphorus regeneration occurs through the sorption of ions by microbial strains. In the control variants of the experimental soils, nitrogen is present in moderate levels (30-50 mg/kg) and low levels (20-30 mg/kg). The effects of toxicants have also been shown to reduce the N-NO₃ nutrient element, contributing to a state of stress.

Nitrogen levels in controlled soils from the potash plant garden of the Dekhkanabad district were found to be 34 mg/kg, while grassland grey soils from the Ghuzor district contained 27 mg/kg. In introduced control variants, microbial strains in soils from the Pastergorn district increased from 31 mg/kg to 37 mg/kg.

The stress state of nitrogen in toxic environments is significantly higher in variants contaminated with heavy metals at more than ten times the maximum permissible concentration (MPC). The highest incidence was observed in cobalt-contaminated environments, with decreases of 8 mg/kg and 10 mg/kg in irrigated typical grey soils, and 8 mg/kg in grassland grey soils. The recovery of nutrient elements is facilitated through the accumulation or purification processes of plants that remove toxicants from the soil.

In conclusion, heavy metal ions can interact differently with nutrient elements and the amount of humus present in the soil. Each heavy metal ion exerts an effect that leads to a stress state by interacting with ions from other complex elements. To mitigate the stress on nutrient elements and humus, the toxic ions can either be reduced within the soil composition or removed by breaking double bonds, or they can be returned to a less harmful state through phytoremediation methods.

Used literature

1. Алексеев Ю.В. Тяжелые металлы в почвах и растениях.- Л.: Агропромиздат. Ленингр. отд-ние, 1987. - 142 с.
2. Черников В.А., Алексахин Р.М., Голубев А.В. и др. Агрэкология / Под ред. В.А.Черникова, А.И.Чекереса. - М.: Колос, 2000, -536 с.
3. Добровольский В. В. Глобальные циклы миграции и особенности биологического

- круговорота тяжелых металлов на океанических островах // Почвоведение. – 1988. – №. 7. – С. 102.
4. Nabashi F. Gmelin and his Handbuch // Bulletin for the History of Chemistry. – 2009. – Т. 34. – №. 2. – С. 30.
 5. Жученко А. А. Проблемы адаптации в сельском хозяйстве XXI века // Вестник аграрной науки. – 2006. – №. 2-3 (2-3). – С. 4-6.
 6. Каримов Х. Н. Антропогенно измененные орошаемые почвы и пути повышения их плодородия // ХН Каримов. International Book Market Service Ltd., member of OmniScriptum Publishing Group. BeauBassin. – 2018. – С. 256.
 7. Титов А.Ф., Казнина Н.М., Таланова В.В. Тяжелые металлы и растения. Петрозаводск: Карельский научный центр РАН, 2014. 194 с.
 8. <http://www.ipe.org.cn>
 9. <https://geoecology.nethouse.ru/page/147831>