The Accumulation of Heavy Metals in Leaves of Woody and Vegetable Plants

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Abstract **- It is shown that the improvement of the environment can be achieved by using the adsorption properties of leaves of woody plants, which are able to absorb the exhaust gases from vehicles, industrial plants, dust and vapors from air. The number of toxic influence of heavy metals on vegetable plants was established with good indicative properties: Cd > Ni >Pb. Accumulation of heavy metals, leaves of the juniper have any symptoms of poisoning, inhibition of root growth, formation of necrosis, dwarfism, wilting, dropping foliage, etc, especially in leaves exposed to cadmium. Different kinds of heavy metals have their own specifics, which defining the maximum level of exposure in the investigated samples. Virtually all heavy metal compounds are toxic and have carcinogenic effect.It should be noted that the main source of it are the smokestacks of factories, the industrial enterprises and exhaust gases from vehicles. If there is an excess of heavy metals, occur symptoms on plants - growth noticeably slows, getting a dwarf form.Thus, on the basis of obtained date, we get conclusion, that the accumulation of heavy metals by leaves of woody plants, in our casejuniper and oak, is due to the passage of the adsorption process of toxic metals contained in the air basin.**

Key words **- adsorption, air, toxic heavy metals, leaves, woody plants.**

I. INTRODUCTION

In recent years, the issue of conservation is an important issue. Negative impacts on the environment provide industrial emissions, containing a number of heavy metals and various oxides, which destroy vegetation and contribute to the morbidity people. Almost all heavy metal compounds have toxic and carcinogenic effect. The main sources of heavy metals in soil are mainly industrial enterprises, thermal power stations and road transport. A special category of pollutants are exhaust fumes and heavy metals from combustion of liquid fuels. In the human body heavy metals do with water and plant food, and the contamination of the latter in turn by the migration of heavy metals from the soil [1].

Currently even the newest traps toxic substances in the atmosphere are not able to completely rid the environment from pollution. Unfortunately, absolute waste disposal the majority of enterprises are unprofitable.

It is our deep conviction to one of the most appropriate techniques of improving the atmosphere can be attributed to the purification of the city through green spaces, capable of absorbing gases, dust and vapors from the air, along with sanitary methods for cleaning the environment. It is known that plants such as pine, arborvitae and cypress trees absorb from the environment of harmful substances and at the same time in a large number of produce useful.

The adsorption properties of leaves of woody plants can contribute to improving the state of the atmosphere of the metropolis. At the same time, changes in the anatomy of their leaves, associated with the negative impact of exhaust gases, causing various diseases.

According to employees of the Tashkent Botanical garden environmental pollution with heavy metals in most cases leads to excessively increased accumulation in their leaves by the end of the growing season. Of the three species they studied woody plants; the highest amounts of zinc were accumulated in the leaves of maple and oak. The authors came to the "conclusion that the accumulation of heavy metals by plants has a negative impact on the environment and on human activity"[1,2]. However, we believe that in this case special attention must be paid to the process of adsorption of heavy metals by leaves, which can facilitate the purification of the air basin.

To identify the effects of toxic heavy metals on the leaves of woody plants it is necessary to conduct comprehensive studies, allowing establishing the changes in anatomy and morphology.

In addition necessary recommendations focused use of woody plants adapted to these conditions and are able to maintain a healthier environment by using the adsorption properties of their leaves to absorb the exhaust fumes from vehicles, industrial manufacturing gases, dust and vapors from the air. In this regard, the study of accumulation of heavy metals by different plants is an important issue and is essential in solving environmental problems.

Therefore, in the future, we envisaged the study of the adsorption properties of plants to clean the air basin from exhaust emissions of vehicles, emissions of toxic substances by industry and CHP.

II. RESEARCH METHODS

Preparation for planting of seeds of oak, Archie (juniper), cherry tomatoes and cucumbers - gherkins in the

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laboratory. For these purposes, the prepared plastic cups, pre-punctured with a thick needle and then were placed in a whole in which the glasses were planted 2-3 pieces of seed samples to the depth of the soil at 3-4 cm [4-8]. For comparison, 4 samples of oak, juniper and vegetables were selected as background samples. The remaining seedlings were prepared for treatment with solutions of heavy metals. Seedlings were watered with salt solutions and water 2 times a week.

Solutions of heavy metals - Pb $(NO_3)_2$, $6H_2O$ "ch.p.", Cd $(NO_3)_2$, $46H_2O$ "ch.p:" Ni $(NO_3)_2$ "ch. p." - were prepared by using known techniques.

After emergence of seeds of wood plants and vegetables they have been subjected to impact vey heavy metals, and then the leaves of these plants were subjected to fixation in a solution containing an equivalent amount of alcohol, glycerin and water. In Fig. 1, 2 are shown samples of oak leaves and juniper, placed in fixing solutions.

There were prepared medicines from the leaves of trees and vegetable plants to conduct anatomical studies. There were made longitudinal sections of leaf thickness 0.01 mm with subsequent analysis at 140 times magnification with a microscope and the captured image a digital camera.

III. THE RESULTS WERE OBTAINED AND DISCUSSED

Our studies started with vegetable plants, which are a kind of indicators of such processes, since they are more sensitive to such effects.

Assessing the impact of a number of heavy metals to vegetable plants conducted on tomatoes varieties of tomatoes and cucumbers varieties of cucumbers. The negative impact of heavy metals on vegetable plants was established in the process of growth after irrigation with solutions of salts of lead, Nickel and cadmium. After planting of seed samples in the soil and obtain good seedlings of cherry tomatoes and cucumbers - gherkins at the stage of flowering is exposed to salt solutions of heavy metals.

Certainly, heavy metals, entering from soil to plants, are not evenly distributed in organs and tissues. For example, the root system often contains more zinc compared to aboveground, and zinc accumulates only in old leaves [3-6]. Leafy vegetables contain more of it than those that form fruits and roots; in carrot the amount of heavy metals (except iron) decreases from bottom to top and the iron is evenly distributed along the roots. Zinc and lead accumulated in the middle part, and copper, manganese, cadmium in the root.

We have grown vegetables without the impact of heavy metals for comparative analysis (Fig. 1).

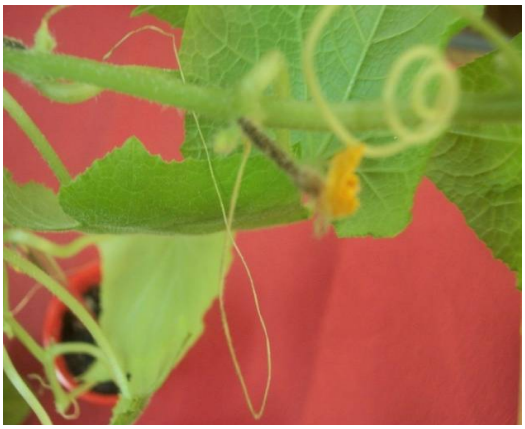




Fig. 1. Type of gherkins and cherry tomatoes in background conditions

It was found that after irrigation with solutions of lead salts for 3 weeks, the fruits of gherkins at an early stage blackened and the leaves remained unchanged (Fig. 2).

With regard to the impact of cadmium for this period at the flowering stage gherkins were killed, this suggests that cadmium is the most toxic metal (Fig. 3).



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Fig. 2. The influence of lead salts on the fruits of growth gherkins and cherry tomatoes





Fig. 4. Influence of cadmium salts on growth of gherkins and cherry tomatoes.

As the third heavy metal were used solutions of salts of Nickel. The effect of this metal can be considered intermediate between cadmium and lead, unnecessarily, as can be seen from figure 4, reflect the gradual impact of Nickel on the condition of the leaves and flowers of cucumbers during the period of time, and the strong stems.





Fig. 5. Effect of Nickel salts on the growth of cucumbers and cherry tomatoes

The conducted researches allow to draw a conclusion about the negative effects of heavy metals on the growth of cucumbers and cherry tomatoes [7,8].

The number of toxic influence of heavy metals on vegetable plants was established with good indicative properties: Cd > Ni >Pb.

It should be noted that there isn't information about the impact of heavy metals on the anatomical structure of the leaves of woody plants.

The determine the degree of impact of heavy metals, which were introduced in irrigation water, with subsequent study of their metal accumulating abilities on the example of juniper and oakwas conducted in this regard [9].

The leaves of these plants were collected in the month of November, when the environmental pollution with heavy metals in most cases leads to increased accumulation to the end of the growing season.The main part of heavy metals appears in the atmosphere from the combustion of petroleum products and activity of enterprises of non-ferrous metallurgy[10].

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As can you see from Fig. 1, there are changes in interveinal areas of the Archie leaves collected in late autumn.





Fig. 6.Juniper, grown in environmentally friendly conditions

After reaching a certain phase of growth for 4 months, which consists in the processing of batches of seedlings with solutions of heavy metals such as Pb, Ni and Cd, there were carried out the research of influence of mixtures of heavy metals on the leaves of juniper and oak.

After generous treatment of the samples with solutions of salts of lead, Nickel and cadmium in the leaves of the juniper have put on preservation for subsequent anatomical research in 160 times magnification, and capture images through the microscope on the camera.

The results are shown in Fig. 7-9.

As can you see from Fig. 7, lead severely affects young leaves of the juniper, causing loss of turgor by the cells of plants, causing the leaves become flaccid.

Based on our own experimental date, we see that different kinds of heavy metals have their own specifics, which defining the maximum level of exposure in the investigated samples.



Fig. 7. Sheets of juniper subjected to a 0.01 M solution of Pb (NO3)2

As can you see from Fig. 7, it is an anatomical structure of the leaf of juniper, there is the impact of Nickel on its leaves, but to a greater extent than lead.

As a result of excessive accumulation of heavy metals, leaves of the juniper have any symptoms of poisoning, inhibition of root growth, formation of necrosis, dwarfism, wilting, dropping foliage, etc, especially in leaves exposed to cadmium.

As you can see in Fig. 8, there is a distortion of the anatomical structure of the leaf of juniper after treatment with 0.01 m solution of $Cd(NO_3)_2$.



Fig. 8. The leaves of juniper, watered with a solution of 0.01 M Ni(NO3)2.

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Fig. 9. The leaves of juniper, watered with a solution of 0.01 m Cd (NO3)2.

IV. CONCLUSION

In our opinion, virtually all heavy metal compounds are toxic and have carcinogenic effect.It should be noted that the main source of it are the smokestacks of factories, the industrial enterprises and exhaust gases from vehicles. If there is an excess of heavy metals, occur symptoms on plants - growth noticeably slows, getting a dwarf form.Thus, on the basis of obtained date, we can conclude, that the accumulation of heavy metals by leaves of woody plants, in our casejuniper and oak, is due to the passage of the adsorption process of toxic metals contained in the air basin [11]. These studies will allow us to recommend specific types of woody plants
for use as adsorbents for purification of the air basin of large cities on the example of Almaty from the exhaust.

Due to the passage of the adsorption process of heavy metals by leaves of woody plants is the improvement of the environment, i.e. a kind of self-purification of the biosphere.

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