# Dynamics of Change in the Elemental Composition of Technical Hemp Varieties in the Soil-Plant System, Grown in the Conditions of the Syrdarya Region

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## Abstract

The results of studying the macro and microelement composition in the soil of the Syrdarya region are presented. The content of the elements and their forms have been studied. The paper presents the results of atomic emission spectrometry in order to determine the forms of compounds and their significance for the plant organism. The chemical composition of three varieties of industrial hemp and soil has been studied. Shown intervarietal differences in technical hemp in the ability to assimilate elements. It has been established that the qualitative and quantitative elemental composition of plants of a given culture can change under the influence of biologically active substances by means of activation of adaptation to the intake of chemical elements from the soil solution.

As a result of the analysis, the content of the following macro- and microelements was established in all samplesLi, B, Na,Mg, Al, P, S, K, Ca, V, Cr, Mn, Fe, Co, Ni, Cu, Zn, As, Se, Sn, Sb, Hg, Pb, Mo, Ag, Cdand Ba is within acceptable limits.

**Keywords:**industrial hemp, macro and microelements, ICP - OES (Inductively Coupled Plasma Optical Emission Spectroscopy). microwave decomposition system, biological active substances, sodium, potassium, honey, calcium, etc.

**Introduced.** Industrial hemp (Cannabis sativa L) - includes a variety of Cannabis sativa L. varieties for agricultural and industrial applications [1]. In March 2020, the President of the Republic of Uzbekistan Shavkat Mirziyoyev Miromonovich signed a law authorizing the commercial cultivation of cannabis containing up to 0.2% THC "for industrial purposes not related to the production or manufacture of narcotic drugs and psychotropic substances" (such activities are still illegal).Currently, despite the great progress in the synthesis of new biologically active substances, the range and prospects for the use of herbal medicines are expanding. Plants are good natural sources of vital chemical elements [2-4]. The mineral composition of plant raw materials makes it possible to determine its therapeutic significance, to evaluate the area of growth of plant raw materials for further use in order to develop new drugs. In addition, plants are indicators that indicate the degree of pollution of their growing area. Therefore, the task of determining the content of macro-microelements, heavy and toxic elements in plant samples is urgent [5-11].

**Objective:** study of changes in the macro- and microelement composition of varieties of industrial hemp (Cannabis sativa L) grown in the conditions of the Syrdarya region.

## Materials and methods

Research on the change in the elemental composition in the plant Cannabis sativa L was carried out in the periods 2020 -2021 in the conditions of the Syrdarya region. Soils of the Syrdarya region and cultivated varieties of industrial hemp were selected as objects of research. For sample preparation, all samples were dried to constant weight at a temperature of 105 ° C for three hours, after which they were ground to a homogeneous powder and sieved through a sieve with a diameter of 1 mm. The soil samples of the Syrdarya region are interesting in that they represented different soil conditions, and also have a high salt content, which is usually available in many countries. The extraction method was chosen for the preparation of soil samples as it represents the most commonly used method for analysis. A mixture of hydrochloric and nitric acid was used for extraction, and, as expected, each sample left an insoluble residue after decomposition. Before analysis, soil samples were prepared by microwave digestion in a closed vessel using a microwave digestion system (MILESTONE Ethos Easy, Italy). Все образцы были приготовлены методом микроволнового разложения с использованием системы микроволнового разложения (MILESTONE Ethos Easy, Италия). 200 mg of sample was added to each vessel, followed by 6 ml of concentrated nitric acid ($HNO_3$) and 2 ml of hydrogen peroxide ($H_2O_2$). After that, the vessels were closed and the device was placed at 180 ° C for 20 minutes for heating and dissolution. After the decomposition was complete, the samples were transferred into 25 ml volumetric flasks and diluted to 25 ml with deionized water. We will check this solution using the Avio 200 ICP - OES (Inductively Coupled Plasma Optical Emission Spectroscopy).

## Results and discussion

As a result of optical emission spectroscopy with inductively coupled plasma, the content was determined and the change in the elemental composition was studied. 3 macroelements, 21 microelements and 3 toxic elements were determined in soil samples, plants during the growing season 2020-2021, and the change in the elemental composition was studied. The content of macro and microelements in the studied objects does not exceed the maximum permissible norms [11]. However, it can also be seen that plants of these varieties of industrial hemp extract from the soil only those elements that they need for life and for the production of the most important groups of biologically active substances (polyphenolic compounds, vitamins, coenzymes).

**table 1.**

**Content of macro and microelements in soil and plant samples**

| 2020 year autumn | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| № | Element / Wavelength (nm) | Content mg / l | | | № | Element / Wavelength (nm ) | Content mg / l | | | № | Element / Wavelength (nm) | Content mg / l | | |
| | | The soil | Root | Aboveground part | | | The soil | Root | Aboveground part | | | The soil | Root | Aboveground part |
| **1** | Li 670.784 | 6.005 | 0.012 | 0.004 | **10** | V 292.464 | 0.962 | 0.01 | 0.004 | **19** | Se 196.026 | 0 | 0.0103 | 0 |
| **2** | B 249.72 | 60.8 | 0.067 | 0 | **11** | Cr 267.716 | 2.259 | 0.011 | 0 | **20** | Sn 189.927 | 2.827 | 0.025 | 0.001 |
| **3** | Na 589.592 | 422.3 | 8.374 | 25.475 | **12** | Mn 257.610 | 88.096 | 0.106 | 0.001 | **21** | Sb 206.836 | 0 | 0 | 0 |
| **4** | Mg 279.077 | 809.1 | 11.81 | 6.914 | **13** | Fe 238.204 | 71.18 | 3.264 | 0 | **22** | Hg 253.652 | 0 | 0.002 | 0 |
| **5** | Al 396.153 | 605.292 | 3.455 | 0 | **14** | Co 228.616 | 0.217 | 0.002 | 0 | **23** | Pb 220.353 | 1.973 | 0.002 | 0 |
| **6** | P 214.914 | 47.83 | 10.55 | 0.008 | **15** | Ni 231.604 | 3.151 | 0.004 | 0 | **24** | Mo 202.031 | 1.487 | 0.004 | 0.006 |
| **7** | S 181.975 | 0 | 0 | 0 | **16** | Cu 327.393 | 27.149 | 0.037 | 0 | **25** | Ag 328.068 | 1.521 | 0.004 | 0.013 |
| **8** | K 766.490 | 170.74 | 49.67 | 3.382 | **17** | Zn 206.200 | 89.92 | 0.104 | 0.012 | **26** | Cd 214.440 | 0.297 | 0.0004 | 0 |
| **9** | Ca 315.887 | 254.51 | 27.2 | 43.641 | **18** | As 193.696 | 0 | 0.203 | 0 | **27** | Ba 455.403 | 8.42 | 0.049 | 0.001 |

table 2.

**Content of macro and microelements in soil and plant samples**

| 2021 year autumn | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| № | Element/ wavelength (nm) | Content mg / l | | | № | Element/ wavelength (nm) | Content mg / l | | | № | Element / Wavelength (nm) | Content mg / l | | |
| | | The soil | Root | Aboveground part | | | The soil | Root | Aboveground part | | | The soil | Root | Aboveground part |
| **1** | Li 670.784 | 4.48 | 0.08 | 0.004 | **10** | V 292.464 | 4.257 | 0.06 | 0.007 | **19** | Se 196.026 | 0 | 0.001 | 0 |
| **2** | B 249.72 | 60.7 | 0.06 | 0 | **11** | Cr 267.716 | 3.924 | 0.007 | 0 | **20** | Sn 189.927 | 3.496 | 0.008 | 0.001 |
| **3** | Na 589.592 | 1539.8 | 7.95 | 29.736 | **12** | Mn 257.610 | 219.966 | 0.08 | 0 | **21** | Sb 206.836 | 0 | 0 | 0 |
| **4** | Mg 279.077 | 722 | 10.9 | 7.103 | **13** | Fe 238.204 | 199.33 | 2.35 | 0.001 | **22** | Hg 253.652 | 0 | 0.001 | 0 |
| **5** | Al 396.153 | 1818.11 | 2.72 | 0 | **14** | Co 228.616 | 0.989 | 0.001 | 0 | **23** | Pb 220.353 | 3.256 | 0.001 | 0 |
| **6** | P 214.914 | 103.25 | 8.66 | 0.007 | **15** | Ni 231.604 | 5.466 | 0.002 | 0 | **24** | Mo 202.031 | 1.717 | 0.0015 | 0.011 |
| **7** | S 181.975 | 0 | 0 | 0 | **16** | Cu 327.393 | 23.458 | 0.01 | 0 | **25** | Ag 328.068 | 0.174 | 0.003 | 0.011 |
| **8** | K 766.490 | 258.82 | 35.6 | 5.027 | **17** | Zn 206.200 | 67.871 | 0.045 | 0.029 | **26** | Cd 214.440 | 0.292 | 0.005 | 0 |
| **9** | Ca 315.887 | 265.1 | 20.6 | 45.532 | **18** | As 193.696 | 0 | 0.2 | 0 | **27** | Ba 455.403 | 21.369 | | 0.001 |

| 2021 year spring | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| № | Element / Wavelength (nm ) | Content mg / l | | | № | Element / Wavelength (nm) | Content mg / l | | | № | Element / Wavelength (nm) | Content mg / l | | |
| | | The soil | Root | Aboveground part | | | The soil | Root | Aboveground part | | | The soil | Root | Aboveground part |
| **1** | Li 670.784 | 2.05 | 0.006 | 0.003 | **10** | V 292.464 | 1.854 | 0.007 | 0.004 | **19** | Se 196.026 | 0 | 0 | 0 |
| **2** | B 249.72 | 103.86 | 0.012 | 0 | **11** | Cr 267.716 | 2.55 | 0.008 | 0 | **20** | Sn 189.927 | 2.951 | 0.009 | 0.001 |
| **3** | Na 589.592 | 368.5 | 6.699 | 29.102 | **12** | Mn 257.610 | 74.329 | 0.09 | 0 | **21** | Sb 206.836 | 0 | 0 | 0 |
| **4** | Mg 279.077 | 797.0 | 10.58 | 5.761 | **13** | Fe 238.204 | 101.7 | 2.137 | 0 | **22** | Hg 253.652 | 0 | 0.001 | 0 |
| **5** | Al 396.153 | 952.942 | 2.011 | 0 | **14** | Co 228.616 | 0.106 | 0.001 | 0 | **23** | Pb 220.353 | 0.592 | 0 | 0 |

| | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **6** | P 214.914 | 40.98 | 7.81 | 0.007 | **15** | Ni 231.604 | 2.554 | 0 | 0 | **24** | Mo 202.031 | 1.235 | 0.002 | 0.008 |
| **7** | S 181.975 | 0 | 0 | 0 | **16** | Cu 327.393 | 17.218 | 0.02 | 0 | **25** | Ag 328.068 | 0.369 | 0 | 0.017 |
| **8** | K 766.490 | 159.68 | 28.901 | 3.134 | **17** | Zn 206.200 | 76.213 | 0.06 | 0.011 | **26** | Cd 214.440 | 0.224 | 0.007 | 0 |
| **9** | Ca 315.887 | 297.6 | 18.5 | 36.544 | **18** | As 193.696 | 0 | 0.262 | 0 | **27** | Ba 455.403 | 11.846 | | 0.001 |

**table 3.**
**Content of macro and microelements in soil and plant samples**

When studying the macro- and microelement composition of several varieties of industrial hemp (Cannabis sativa L) presented in the table, the following was revealed: the largest amount of individual microelements by weight was found in the roots of the 1st variety, the smallest - in the 2nd and 3rd varieties. In addition, the differences in the content of the elements are obvious (indicated by dots).

Copper demonstrates the phenomenon of bioconcentration, which is due to the peculiarities of the metabolism of industrial hemp. It is known that copper is a part of polyphenol oxidase, an activator in the biogenesis of phenolic compounds [3,4]. Copper deficiency negatively affects the production of phenolic compounds, as well as pigments, anthocyanins, some vitamins, auxins, proteins. Saponin-containing and alkaloid-bearing plants are also characterized by a higher copper content[6]. Plastocyanins, which contain blue proteins, take part in the process of photosynthesis, being natural antioxidants. Dark green enzyme of fatty acid oxidation in plants, butyryl-CoA dehydratase and ascorbate oxidase contain copper ions in the active center.The copper content changes in the soil: 1> 3> 2. Copper content not determined in plants.

Zinc takes an active part in the physiological processes of plants, as it is part of the active center of a number of enzymes, including those involved in the biosynthesis of polyphenolic compounds. According to some data, zinc increases plant resistance to drought and hyperthermia [6]. The critical concentration of zinc in plants is 300 mg / kg. The mobility and bioavailability of zinc is increased in acidic light soils. The zinc content changes in the soil: 1> 2> 3. On the roots: 1> 2> 3. And in plants 3> 1> 2.

The quantitative content of manganese changes in the soil: 3> 1> 2, On the roots: 1> 2> 3. And in plants of the 1st cultivar it was determined 0.001 mg / l and for the 2nd and 3rd cultivars it was not determined, this indicates the existence of a physiological barrier that prevents the accumulation of manganese in the assimilating and generative organs of Cannabis sativa L. to phototoxic concentrations. It is part of many metal flavoproteins.

participating in redox processes in plant cells [4, 6]. This element activates enzymes involved in the synthesis of monosaccharides. Derivatives of cyclopentanopergid rofenantrene. tannins, alkaloids, vitamin B12. The quantitative content of tannides correlates with the accumulation of manganese in plants. Its phytotoxicity increases in acidic conditions and it appears to be a copper antagonist.

Nickel (soil 3> 1> 2, roots 1> 3> 2 and not found in plants) has a nonspecific effect on a number of enzyme complexes, participating in many biochemical reactions, including the synthesis of biologically active compounds. Nickel is a stabilizing factor for anthocyanin pigments and its significant amounts are found in flowers of flavonoid-containing plants [4].

It should be noted that the studied pharmacopoeial species of mountaineers also contain elements such as lead and cadmium, which are considered to be toxic. However, there are no toxic and non-toxic chemical elements in nature, there are toxic and non-toxic concentrations. The concentrations of these microelements are rather low in all organs of the studied plants, which is an indicator of the purity of the soils in the place of their growth. Potassium, sodium, calcium and magnesium dominate in all, however, the individual set of elements in each species is specific and associated with the dominant groups of biologically active substances in these species.

## Conclusion

Macro and microelement compositions of plant raw materials are an important commodity indicator of plant raw materials. Ash is an indicator of the quality of the harvested raw materials, and the determination of the elemental composition of the ash residue of plant origin allows you to obtain information about the place of growth and the possibility of constant collection of medicinal raw materials.Thus, as a result of the work carried out, the following 27 macro- and microelements were determinedLi, B, Na, Mg, Al, P, S, K, Ca, V, Cr, Mn, Fe, Co, Ni, Cu, Zn, As, Se, Sn, Sb, Hg, Pb, Mo, Ag, Cdand Ba soil and in this place the ingrowing plants Cannabis sativa L. We have investigated the elementary composition of technical hemp (see tables 1, 2, 3).

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