Volume 3, Issue 9, September - 2025
ISSN (E): 2938-3781

Web of Agriculture: Journal of Agriculture and Biological Sciences
webofjournals.com/index.php/8

MOUNTAINOUS BROWN SOILS AND SEVERSOV PINE (FRITILLARIA SEWERZOWII REGEL.) IN MICROELEMENTS BIOGEOCHEMICAL MONITORING

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Abstract
This scientific article is aimed at studying the distribution and biological assimilation of microelements Fe, Mn, Zn, Mo, Co in mountain brown soils and the wild plant Fritillaria sewerzowii Regel. The average concentration of microelements in the soil and plant organs was determined and compared with the soil clarke values. The results showed moderately high Fe content and significant accumulation in the organs of the onion and roots. The concentration of Mn and Zn is high in the roots and seeds, and low in the leaves. Mo and Co are mainly found in the organs of the root and bulb, which affect the biological activity and medicinal properties of plants. It has been established that the distribution of microelements is closely related to the mechanical composition of the soil, the amount of humus, genetic horizons, and agroecological conditions. In addition, the coefficients of biological absorption of soil and plants were calculated. The results of this study will create a scientific basis for assessing the nutritional potential, biological assimilation mechanism, and medicinal value of the Seversov onion plant (Fritillaria sewerzowii Regel.) in mountain brown soils and will serve the development of ecological monitoring and agricultural practices in the future.

Keywords: Fritillaria sewerzowii, mountain brown soils, microelements, biological absorption coefficient, nutritional potential, medicinal plant, soil-plant relationship.

Introduction

Today, ensuring food security on Earth and the sustainable development of agricultural production are closely linked to the chemical composition of soil resources formed in different regions, in particular the presence or presence of microelements. In particular, microelements such as Fe, Mn, Zn, B, and Cu perform crucial biological functions in the soil-plant-human-animal chain, ensuring not only the photosynthesis, enzymatic processes, and growth of plants but also the healthy functioning of animals and the human body [1,2]. It has been repeatedly emphasized that their deficiency leads to a sharp decrease in crop yields, a decrease in food quality, and, as a consequence, the emergence of various deficiencies in the population's nutrition [6]. Therefore, a deep study of the distribution of microelements, the influence of soil, vegetation, and anthropogenic factors is relevant from a scientific and practical point of view.

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The presence of microelements in soils is determined not only by the total amount but also by pH, organic matter, adsorption surfaces, and rhizosphere conditions [3,4]. For example, Zn and Cu, complicated by organic substances, can have both beneficial and toxic effects on plants [4]. Therefore, it is important to assess the forms and bioassimilation of microelements through biogeochemical monitoring [10].

Studies conducted in recent years have shown that agricultural techniques, fertilization, and the use of land resources have a significant impact on the distribution of microelements. For example, in South Ethiopia, it has been noted that different types of land use directly affect the amount of trace elements, pH, and organic matter in the soil [7]. In Java's saline soils, Fe and Zn deficiencies are observed, and special attention should be paid to microelements in fertilization programs [8]. Similar results were recorded in the Nigerian savannas, where the amount of Cu and Zn varies depending on the type of land use [9].

Research aimed at studying the effectiveness of nanofertilizers deserves special attention. For example, it has been noted that TiO2 and ZnO nanoparticles significantly increase the concentrations of Fe, Zn, Mn, and Cu in plants [12]. Similarly, the use of nanofertilizers in calcium carbonate soils increased nutrient absorption and corn yield [14]. The effectiveness of foliar fertilization in improving yield and grain quality has also been scientifically substantiated [15].

Scientific research shows that anthropogenic factors are also significant. In the soils of the Kashmir Valley, along with a deficiency of Cu, Ni, and Zn, the presence of toxic elements such as As, Pb, and Cr has been identified [17]. In the Amazon region of Brazil, microelements and pollutants in pasture soils have been observed entering the food chain through herbs, supplementary feed, and livestock products [13].

In general, monitoring the distribution, biogeochemical behavior, and bioassimilation of trace elements, especially Fe, Mn, Zn, B, and Cu, serves as an important scientific basis for ensuring agricultural productivity and food security.

RESEARCH OBJECT AND METHODS

Microelements (Fe, Mn, Zn, B, Cu) in the surface layers of mountain brown soils formed in the mountainous regions of the Pap district of the Namangan region were selected as the object of research. Morphogenetic and cross-sectional methods of V.V. Dokuchaev were used as the main research method, chemical analysis of the obtained soil samples was carried out using the manual "Guide to Chemical Analysis of Soils".

Morphogenetic, physicochemical, and neutron activation methods were chosen as the main methods for studying soils, and standard methods and techniques generally accepted in soil science were also widely used today. Elemental analysis of soil and plants was carried out by the neutron activation method in the Laboratory of Ecology and Biotechnology of the Institute of Nuclear Physics of the Academy of Sciences of the Republic of Uzbekistan. In this case, the samples were irradiated with a neutron flux of 5*1013 neutrons/cm^2 sec. in an atomic reactor, and their quantities were determined based on the half-lives of the chemical elements.

Research Results

The need for microelements by agricultural crops of our republic and natural wild plants distributed in the soil conditions of different regions is directly related to the presence of these

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elements in the soil layers and is one of the main factors determining the level of yield and ecological stability of product quality [18,19,20,21].

Nevertheless, to date, the need for microelements in various soil types and subtypes, as well as their interaction with certain crop varieties, has not been fully studied. However, some trace elements - in particular, copper (Cu), zinc (Zn), manganese (Mn), boron (B), molybdenum (Mo), and others - have been found to have significant properties for a number of agricultural plants.

It has been established that the total and mobile quantities of these microelements in soils change not only depending on the type and subtype of the soil, but also in close connection with their mechanical composition, humus content, the location of genetic horizons, and other agroecological factors. The total and mobile quantities of these microelements Fe, Mn, Zn, B, Cu in soils differ significantly under the influence of agroecological factors such as soil type and subtype, mechanical composition, humus content, and the location of genetic horizons.

Mountain brown soils are of particular importance as one of the main factors forming the biogeochemical state of microelements in elementary landscapes. The determination of the composition and quantity of microelements in these soils, as well as in Seversov's onion (Fritillaria sewerzowii Regel.), growing in natural conditions, creates a scientific basis for studying the mechanisms of adaptation of plants to various soil and climatic conditions, the possibilities of their effective use, and their medicinal properties.

As established within the framework of the study, the distribution of microelements in mountain brown soils and in some organs of the Severtsov onion *(Fritillaria sewerzowii)* directly influences the biological, biogeochemical, morpho-anatomical, and physiological processes occurring in plant tissues. These processes, naturally, are closely related to the characteristics of the soil in which the plant grows and are dynamically changing.

As a result of the conducted observations, different levels of microelement accumulation were noted in mountain brown soils and in the organs of Severtsov's onion. The detailed distribution of these indicators is presented in tables, which allow for a deeper understanding of biogeochemical interactions in the soil-vegetation system.

Table 1 Medium concentration of microelements in mountain brown soils and the plant Seversov onion (Fritillaria sewerzowii Regel.), mg/kg

Element symbol	**Soil clarke**	**Soil**	***Fritillaria sewerzowii* Regel.**			
		0-20 cm	**Root**	**Leaf**	**Seed**	**Onion**
Fe	35,000	32400	3250	299.	140.	1250
Mn	600	1070.	90.4	28.2	22.	45.6
Zn	70.	181.	26.2	10.6	35.6	28.4
Mo	1.	1.18	1.31	<0.01	0.28	0.73
Co	8.	15.6	1.91	0.13	0.088	0.57

The presence of such trace elements as Fe, Mn, Zn, Mo, and Co in mountain brown soils is a key factor in the growth, development, and biological assimilation of the Seversov onion plant (Fritillaria sewerzowii Regel). The data in the table show the average concentration (mg/kg) of these microelements in the soil and plant organs. The amount of Fe in the soil was 32400 mg/kg,

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ISSN (E): 2938-3781

and in the plant organs it was 3250 mg/kg in the roots, 299 mg/kg in the leaves, 140 mg/kg in the seeds, and 1250 mg/kg in the bulbs. This confirms the bioavailability of Fe from the soil to the plant; its high accumulation, especially in the bulb and root organs, is associated with plant metabolism and storage processes. The amount of Mn in the soil is 1070 mg/kg, in the roots - 90.4 mg/kg, in the leaves - 28.2 mg/kg, in the seeds - 22 mg/kg, and in the onions - 45.6 mg/kg. This distribution shows that Mn plays an important role in photosynthesis and enzymatic processes, especially in the organs of the root and bulb. Zn in the soil is 181 mg/kg, and in plant organs - 26.2 mg/kg in the roots, 10.6 mg/kg in the leaves, 35.6 mg/kg in the seeds, and 28.4 mg/kg in the bulbs. High concentrations of Zn in the organs of seeds and bulbs indicate their direct influence on reproductive and storage functions. Mo is 1.18 mg/kg in the soil, 1.31 mg/kg in the roots, <0.01 mg/kg in the leaves, 0.28 mg/kg in the seeds, and 0.73 mg/kg in the onions. The minimal amount of Mo in the leaf indicates that it is mainly fixed in the roots and bulbs, which reflects the plant's functions in nitrate reductase and nitrogen metabolism. If the amount of Co in the soil is 15.6 mg/kg, then in the plant organs it is 1.91 mg/kg in the roots, 0.13 mg/kg in the leaves, 0.088 mg/kg in the seeds, and 0.57 mg/kg in the bulbs. A low concentration of Co indicates that it has minimal biological requirements for the plant.

The results show that in mountain brown soils, the distribution of microelements in plant organs is organ-specific and depends on the metabolic activity and storage organs of the plant. Fe and Mn accumulate more in the roots and bulbs, while Zn accumulates more in the organs of the seeds and bulbs. Mo and Co are present in small quantities, which means they are only sufficient for the biologically necessary functions of the plant. At the same time, these results contribute to a deeper understanding of the mineral composition of the soil and the mechanism of biological assimilation. In mountain brown soils, Fe, Mn, and Zn exceed the soil clarke values and serve as a sufficient and sometimes high source of microelements for plants. The content of Mo and Co is close to the soil clarke value, indicating only minimal bioassimilation in the organs. These results are an important scientific basis for assessing the biological absorption of microelements from the soil, plant metabolism, and medicinal properties. Microelements Fe, Mn, Zn, Mo, and Co perform basic biological functions in the soil-plant system and directly affect the growth, development, and ecological quality of plants. Mountain brown soils and wild plants, including Fritillaria sewerzowii Regel., are important objects in the natural distribution and bioassimilation of microelements.

The results of the analysis show that the concentration of microelements in the soil and their distribution in plant organs are element-specific. For example, iron (Fe) accumulates in high amounts in the root and bulb organs of plants, while it is present in minimal amounts in leaves and seeds. Although manganese (Mn) and cobalt (Co) are abundant in the soil, their bioavailability in plant organs is limited and is mainly found in the roots. Zinc (Zn) is relatively evenly distributed in soil and plant organs and serves as a stable source for plants. Molybdenum (Mo) is present in sufficient quantities in the organs of the roots and bulbs and is characterized by minimal concentration in the leaves and seeds.

The biological absorption coefficient (BCP or Ah) of the necessary chemical elements in the Seversov onion ***(Fritillaria sewerzowii* Regel.)** plant is calculated. In the conditions of mountain brown soils, the microelements contained in Seversov's onion ***(Fritillaria sewerzowii* Regel.)** were determined based on the soil composition. The absorption of microelements is assessed as follows: if $\Delta h > 1$, it accumulates in the plant; if $\Delta h < 1$, it is considered to remain in the soil. [22].

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ISSN (E): 2938-3781

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Table 2 Biological absorption coefficient in mountain brown soils and the plant Seversov onion *(Fritillaria sewerzowii* Regel.) mg/kg

Element symbol	***Fritillaria sewerzowii* Regel.**			
	Root	**Leaf**	**Seed**	**Onion**
Fe	0.10	0.009	0.004	0.04
Mn	0.08	0.03	0.02	0.04
Zn	0.14	0.06	0.097	0.16
Mo	1.11.	0.008	0.24	0.62
Co	0.12	0.008	0.006	0.04

In Fritillaria sewerzowii Regel., growing on mountain brown soils, the coefficient of biological absorption of microelements Fe, Mn, Zn, Mo, and Co showed significant differences by organ. Fe has the highest absorption index in the root with 0.10 mg/kg, with minimal accumulation in the leaf organs - 0.009 mg/kg and in the seed organs - 0.004 mg/kg, and in the onion organ - 0.04 mg/kg. Mn shows a similar distribution pattern, amounting to 0.08 mg/kg in the roots, 0.03 and 0.02 mg/kg in leaves and seeds, and 0.04 mg/kg in onions, respectively. Zn is important in the plant's growth activity, it is absorbed to a relatively high degree in the organs of leaves - 0.06 mg/kg and seeds - 0.097 mg/kg, and in onions, a maximum accumulation of 0.16 mg/kg is observed. The highest indicator of biological absorption by organs is observed in the roots - 1.11 mg/kg, in the leaves - a minimum of 0.008 mg/kg, and in the organs of seeds and onions - 0.24 and 0.62 mg/kg, respectively. Co is most absorbed in the roots with a concentration of 0.12 mg/kg, and in the leaves and seeds it is minimal - 0.008 and 0.006 mg/kg, in onions - 0.04 mg/kg.
The results show that the degree of biological absorption of microelements depends on plant organs and their nutritional mechanisms, Fe and Mn are the most important for root activity, while Zn and Mo are the most important for the generative organs of the plant (seeds and onions). At the same time, Co significantly accumulates only in the organs of the root and bulb. This analysis creates a scientific basis for assessing the nutritional potential and medicinal properties of the Fritillaria sewerzowii plant in mountain brown soils.
Compared to the soil clarke values, it was found that the elemental composition of Fe, Mn, Zn, Mo, and Co in soils is concentrated at a slightly different level. Fe is close to the soil clarke, while Mn, Zn, and Co are present in quantities above the clarke. At the same time, plants unevenly distribute microelements throughout their organs, which indicates the elemental nature of their bioavailability mechanisms.

Conclusion

The concentration of microelements Fe, Mn, Zn, Mo, Co in mountain brown soils and the plant Seversov onion ***(Fritillaria sewerzowii* Regel.)** differed significantly compared to the soil clarke values. Fe accumulates at a high level mainly in the soil and onion organs, Mn and Zn are more concentrated in the roots and seeds, and are minimal in the leaves. Mo and Co are mainly present in the organs of the root and bulb, influencing the plant's nutritional mechanism and environmental adaptation. According to the coefficients of biological absorption Fe - 0.10-0.004, Mn - 0.08-0.02, Zn-0.14-0.097, Mo - 1.11-0.24 and Co - 0.12-0.006 differed by organs, reflecting the effective absorption of microelements by the plant and their distribution in various organs. The distribution of microelements is closely related to the mechanical composition, humus content, and genetic horizons of the soil. These results create a solid scientific basis for assessing the nutritional potential, medicinal value, and ecological adaptation of the Seversov onion plant ***(Fritillaria sewerzowii* Regel.)** in mountain brown soils.

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