Генофонд и ценофонд дикорастущих миндалей Армении нуждается в неотложной охране. В последние 10 лет, в период общего энергетического кризиса в Армении, природные заросли миндальников подвергались безжалостному уничтожению и выкорчевыванию в качестве топлива.

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S.H. AREVSHATYAN

ON THE PROBLEM OF USING THE LICHENS IN MAN-MADE ENVIRONMENTAL POLLUTION BIOMONITORING

Possibilities of using vegetation, particularly cryptogams, in bioindication and biomonitoring of environmental pollution are discussed. Findings on accumulative properties of lichens as the bioindicators of atmospheric heavy metal pollution are provided.

Արեւշատյան Ս.Հ. Շրջակա միջավայրի տեխնածին աղտոտման կենսամոնիթորինգում քարաքոսների օգտագործման հարցի շուրջ: Քննարկվում է բույսերի՝ մասնավորապես կրիպտոգամների օգտագործման հնարավորությունը շրջակա միջավայրի աղտոտման կենսաինդիկացիայում եւ կենսամոնիթորինգում: Բերվում են նյութեր քարաքոսների կուտակիչ հատկությունների վերաբերյալ՝ որպես մթնոլորտի ծանր մետաղներով աղտոտման կենսանշանացույցներ:

Аревшатян С.Г. К вопросу об использовании лишайников в биомониторинге техногенного загрязнения окружающей среды. Рассматривается возможность использования растений, в частности криптогамов, в биоиндикации и биомониторинге загрязнения окружающей среды. Приводятся материалы исследований по накопительным свойствам лишайников как биоиндикаторов загрязнения атмосферы тяжелыми металлами.

Rapid development of modern technologies and urbanization cause the environmental degradation and intensive dispersion of chemical elements over the planet. This underlies the increased concentrations of rare chemical elements, particularly heavy metals (HMs) which often being typomorphic and biophilic often act as pollutants and toxicants. In this connection it is very urgent to revise the information on the current state of ecosystems and their parts, as well as to determine the basic trends. Studies on the response of biological objects to different impacts and changes of their state include monitoring of functional and structural parameters (Izrael, 1980; Callweit, 1987). Biomonitoring of different man-made trends, especially pollution, has successfully been carried out through using widely recognized and effective methodologies. However, not a single type of industrial pollution can be quickly identified by adequate responses of indicator organisms. Under the chronic pollutant, especially HM, loads the only available and effective way is a set of biogeochemical methods of biomonitoring, directed towards determination of pollutant levels in biological components. Academician V.I. Vernadsky's concept of accumulative properties of the living matter has been a principal aspect (Vernadsky, 1980).

In this context, the primary problem is to find an appropriate optimal bioindicators. Plant organisms can play this role, because being the key linking element of biogeochemical cycles in ecosystems they accumulate HMs unlimitedly. This is caused by the very nature of the plants: fixed spatial position, high biomass (with higher coverage area) etc. But the use of a certain plant species as an optimal bioindicator should meet a number of requirements: widespread distribution in studied area, high accumulative properties for different HMs and adequate accumulation in the biomass. For representative indication of HMs in the environment, the most suitable are just cryptogamic plants of which highest metal accumulating properties are found in lichens. Concentrations of HMs in lichens have more adequately been reflecting the distribution of these elements in different points of surface atmospheric layers than those in vascular plants (even such conifers as *Picea*, *Abies* and *Pinus*). Unlike the laboratory methods, lichen indication (LI) has a number of advantages: 1) lichens being a universal accumulating substrate interact with the environment by whole thallome all the year round; 2) they adsorb tiny amounts of aqueous pollutant aerosols immediately; 3) they accumulate HMs adequately to the pollutant's average gross concentration around in relatively short terms (~15 months) (thallomes function in a passive role of cation exchanger); 4) they have high sensitivity, low physiological rates and other properties.

LI methodology is widely applicable for all the types of man-made pollution in different climatic zones, but principally for habitats with plain relief. For mountaineous regions the relevant literature is scarce (Aivazian, 1974; Petrushina, 1987). In Armenia pilot experiments on using the methodology were first implemented by us for the oldest industrial center of the country - the city of Yerevan (Arevshatyan, 1996). As the research on distribution of lichen species has shown, in most places LI seems to be inapplicable as even in the background highland areas majority of ubiquitous species has the disjunctive distribution area. Moreover, lichen flora and nature of its representatives is studied very weakly and unequally (Abramian, 1984). That is why we use biogeochemical aspect of LI.

During the geobotanical path surveys by transects through the Yerevan lowland it was revealed that the territory's basic part (altitudes 1250-1300 m) is deprived of lichen cover, and only lime, cement and other substrates with pH≥7 are patchily inhabited with crustose lichen *Prosa* sp. (Razdan bank ravine). Similar areas belong to the so called "lichen deserts" followed by Kanaker slopes enriched with common acidophilic epiphites (*Xanthoria parietina* (L.) Beltz., *Physcia pulverulenta* (Schreb.) Hampl.) and epilites (*Parmelia saxatilis* (L.) Ach., etc.). In comparison with background regions, urban lichens have frequent morphological and anatomic abnormalities: decreased number of soredia and isidia, deformation and sterilization of apothecia and lobes, chlorosis and necrosis of algal layer. Most often such events are recorded within the central part of Yerevan that makes the identification of most species harder. Only 3 poleotolerant (PT) species (Trass, 1985) are widely distributed in the Yerevan lowlands: epiphites - *Ph. pulverulenta* (PT=7) and *X. parietina* (PT=9) and tupha epilite *P. saxatilis* (PT=5). Besides the wide distribution, frequency of observation and tolerantce the choice of these species is caused by that epiphites and epilites accumulate HMs more intensively than epigeinic lichens (Lounamaa, 1965; Pilegaard, 1978).

As results of the research show, all 3 species growing in Yerevan have increased bioactivity to the HM row Ag, Mo, Sn, Cr, Ni, Pb, Cu and V compared with the background areas (Aragats mountain, Ankavan, Dilijan). At the same time, individual selectivity to HMs is noted in the lichen species that enables them to be used in indication of environental pollution with these elements and their complexes: *Ph. pulverulenta* - Ag and Sn; *X. parietina* - Cu; in relation to Mo, Cr, Ni and Pb - all 3 species, and for V - *Ph. pulverulenta* and *X. parietina*. Given the gerenalized data, the HM rows are composed for separate lichen species:

Ag > Sn > Mo > Pb > Cu > Cr > Ni > V - *Ph. pulverulenta*

Mo > Ag > Cu > Pb > Sn > Cr > Ni > V - *X. parietina*

Mo > Ag > Pb > Cu > Cr > Ni > V > Sn - *P. saxatilis*

General row has the following structure:

Mo > Ag > Pb > Cu > Cr > Ni > V, while for Sn the individual selectivity is found.

Lichens, being one of the first links in biogeochemical chains in ecosystems have adequately been reflecting the processes of element migrations. For example, general HM row in lichens is transitory between the rows of HM pollution geochemical flows in the atmosphere:

Mo > Cu, Ni > Cr > Pb > Co > Zn (1991) and

Ag > Pb > Cu, Ni > Mo > Zn > Co, Cr (1995).

The investigations have come to the following conclusions:

– lichens may act as the selective indicators of HMs and their complexes pollution;

– biogeochemical LI may be a representative assessment method that adequately reflects a level of HM pollution in urban areas.

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