BIOMONITORING AS DIAGNOSTICS OF QUALITY OF AN ENVIRONMENT

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Diagnostics of a condition of an environment at the present stage of development of a technosphere is obligatory element of designing, creation and operation of any natural-technical complexes. Duly reception of results of diagnostics does possible prevention of negative influence, decrease in scales of damage and operative restoration of quality of an environment.

In connection with that in territory of the Udmurt Republic the factory on destruction of the chemical weapon, including arsenic-organic substances (lewisite) is located, the problem of monitoring of environmental contamination is rather actual. For chemically dangerous objects to which the given factory concerns, the basic kind of danger is outflow of the harmful substance, capable time for the small period to cause the big damage to the population and environment. Therefore the basic influences on components of natural ecosystems in a zone of influence of this object, will be connected with possible receipt of chemical compounds containing arsenic in environment at a stage of operation of object in a regular mode, and also in case of emergencies.

Quality monitoring of pollution existing now do not give an exact and fast estimation of a condition of an environment even within the limits of a sanitary-protective zone, not speaking already about all territory of influence of object. As consequence, the mistake in the forecast of development of this or that situation is possible.

The most widespread are **tool methods** (the equipment, gauges of industrial inspection) which are expensive, have the certain threshold of sensitivity, do not consider behavior of substances from structure of emissions in an environment, their distributions

and transformation to a natural landscape, reaction of biosystems (including the human) and the remote consequences.

Classical ecological monitoring consists of two parts: *geoecological* (consisting sampling and the analysis of environments on the maintenance of any polluting substances), and *bioecological* (using methods of population ecology). This approach demands gathering of the big file of various data, it has high expenses under the finance and time. Besides the collected data also do not consider the remote consequences of influence of small pollutant dozes, have no amendments on adaptive and compensatory mechanisms of bioobjects.

At the classical approach to biomonitoring of chemically dangerous objects, time and economic expenses sharply increase, reliability of monitoring researches results decreases at presence of large-scale area or mosaic zones of influence. As a result, obtained data cannot be used for diagnostics of quality of an environment and preparation of forecasts for decision-making at suddenly arising problems, for example, at threat or occurrence of extreme situations.

Unlike the classical approach to biomonitoring, concerning monitoring of chemically dangerous object, it is necessary to allocate its two versions:

1. Diagnostic monitoring, spent for a long time influences of object. For diagnostic monitoring it is necessary to choose the biological systems capable to the integrated answer to complex influences and showing cumulative effect.

At a choice of objects for bioindication it is necessary to observe the following requirements shown to them:

(1) broad natural habitat;

(2) everytopness;

(3) settled way of life;

(4) antisynanthropness;

(5) indicator plasticity;

(6) simplicity of extraction (account);

(7) level of scrutiny of species and intraspecific taxons.

2. Operative monitoring, which would allow to estimate quickly quality of environment at any supernumerary situation on object, excepting necessity of the detailed analysis of biological objects in all territory. This version of monitoring should consider

amendments on an opportunity of the adaptation of biological objects to technogenic influence with increase of intensity of action in time, and also suppose an opportunity of test check of anthropogenous influence and the response of biological objects to the given influence.

The basic requirement to the analyzed biological parameters used in monitoring of fast reaction are low thresholds and insignificant delay of response.

Basis of complex ecological monitoring of objects of destruction of the chemical weapon, and biomonitoring in particular, should become expert analytical system which problem is the multifactorial analysis of the physical and chemical, biological and sanitary-and-hygienic information, revealing of interrelation of acting data of primary monitoring and an establishment of the factors allowing objectively to estimate a situation in a zone of influence of object. Integral part of system should be the ecological range, allowing to model various scripts of development of a situation on object in a mode most approached to real with definition of dependences "doze-effect" and "time-reaction".

The ecological range allows to study experimentally features and details of transformation of natural objects and biological systems under influence concrete pollutants and products of their transformations into the same landscape, climatic, lithologic, edaphic conditions in which there is a object and the greatest part of a zone of its influence. On such range there is possible a studying of reaction on certain pollutants of ecosystems as a whole; revealing and an estimation of efficiency of organisms - indicators, accumulators and destructors. Thus diagnostics and monitoring of influence of small dozes in a range of values from background up to PMC that is seldom considered at the classical approach are extremely important.

Nevertheless, influence of super-ecotoxicant at a level of maximum concentration limit is traced in one of our experiments in 1-1,5 years after its entering into ground. For example, concerning quality of seeds of a ordinary pine (see fig. 1): obvious stimulation of formation of defective seeds is available at concentration of arsenic in ground on which the tree grows, at a level 1 PMC.

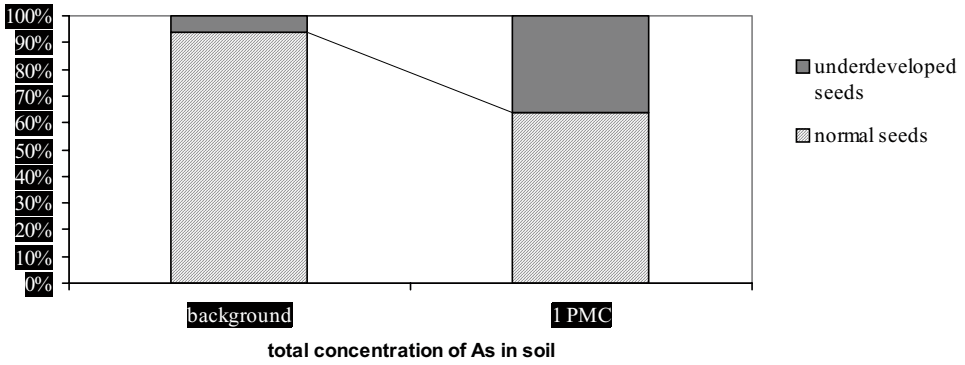

Fig. 1. Share of seeds with a pathology of development in a pine of age of 20-25 years

For the express train-diagnostics of arsenious pollution the small-leaved linden, widespread enough in a zone of influence of object can serve, for example: on speed of shrinkage kidneys on branches, yellowing of leaves, reddening of a bark of branches (see fig. 2, 3, 4).

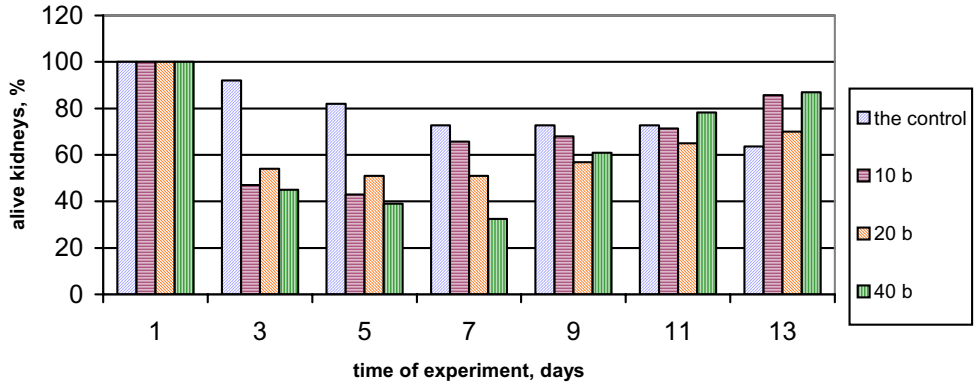

Fig. 2. Dynamics of kidneys shrinkage, percent from total

Designations: the control - entering of arsenic at a level of a background, 10b - tenfold increase of a background, 20b - twentyfold increase of a background, 40b - fortyfold increase of a background.

The diagram (fig. 2) shows dependence toxic effect from a doze of arsenic in the paradoxical (bi-phase) form within the first 7 day, further gradually vegetative organism leaves a condition of a sharp toxic shock, and dependence gets a normal form: the quantity of alive kidneys decreases with increase in a doze of arsenic.

Concerning other parameters the specified dynamics is kept (see fig. 3,4)

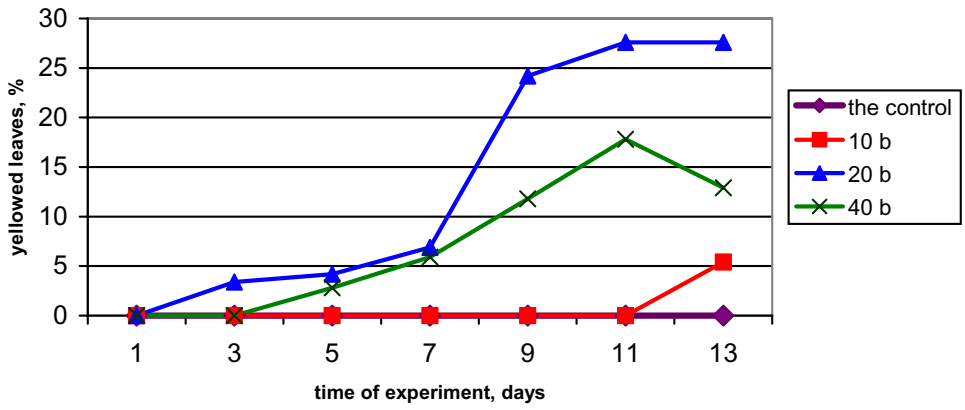

Fig. 3. Occurrence of yellow leaves on branches, percent from total

Designations: the control - entering of arsenic at a level of a background, 10b - tenfold increase of a background, 20b - twentyfold increase of a background, 40b - fortyfold increase of a background.

The Fig. 3 shows preservation of two-phasal nature of dependence "doze-effect" on speed and quantity of leaves yellowing on branches during experiment. It is connected with irreversibility of the given reaction (chlorosis of a sheet plate), and also with speed of its occurrence - within day from the beginning of influence of this pollutant.

Occurrence of a reddened trunk (fig. 4), on the contrary, concerns to late reactions that is connected with slower metabolism of a wood plant trunk in comparison with green weight of leaves. At the best branches of a linden show transition to normal dependence "doze-effect" in a week of carrying out of experiment, i.e., upon termination of the period of the general toxic stress when at a plant compensatory and regenerative mechanisms are started.

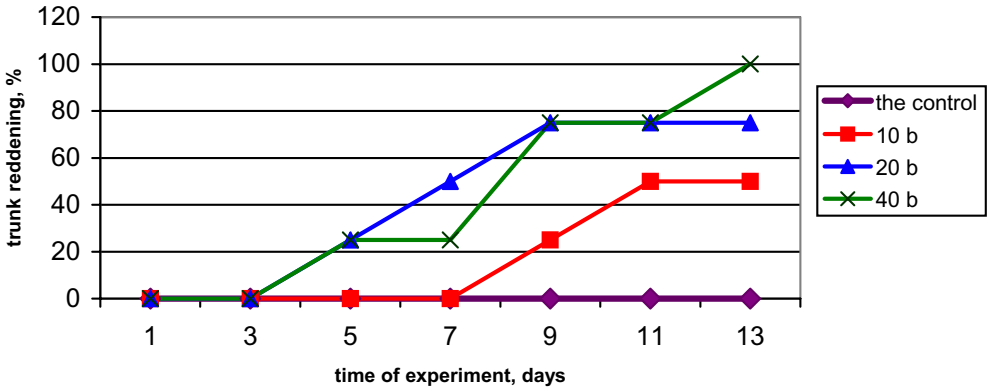

Fig. 4. Occurrence of a reddened trunk on branches, percent from total

Designations: the control - entering of arsenic at a level of a background, 10b - tenfold increase of a background, 20b - twentyfold increase of a background, 40b - fortyfold increase of a background.

Thus, as the express train-indicator (within first seven day) arsenious pollution of the environment can be recommended an estimation of a share of dry kidneys and leaves with chlorosis on branches of a linden in a zone of influence of object. As the indicator of later pollution (i.e., longer influence of arsenic) change painting (reddening) of a bark branches can serve.

Obtained data allow to speak about necessity to use results of expert and analytical system, and range in particular, for the operative and effective decision of problems on protection and restoration of quality of an environment.