International Scientific Conference „Natural Disasters in the 21st Century: Monitoring, Prevention, Mitigation“
Proceedings, ISBN 978-9941-491-52-8, Tbilisi, Georgia, December 20-22, 2021

IMPACT OF EXTREME NATURAL AND ANTHROPOGENIC FACTORS ON THE PHYTOCENOSES SUSTAINABILITY

[*]Gogebashvili M., [*]Ivanishvili N., [**]Salukvadze E., [*]Kontselidze A.

[*] *Laboratory of Radiation Safety Problems, I.Beritashvili Center of Experimental Biomedicine*
radiobiologia2020@gmail.com
[**]*Vakhushti Bagrationi Institute of Geography of Georgia State University of Ivane Javakhishvili*

Summary*: It was studied that defensive effects of an increasing number of radiated plants under high temperature conditions. The research revealed economical ground water consumption by radiated plants. However, the reduced transpiration rate at extreme temperatures does not provide effective surface protection in plant population and causes degradation of individual phytocenotic components. The article also discusses changes in stability parameters in various types of phytocoenosis and examines long-term forecast opportunities for successive processes.*

Keywords *– radiation, high temperature, phytocoenosis*

Introduction.

Phytocenoses of Georgia are featured by the structural characteristics. This, alongside the other factors, is conditioned by the vertical zonality of terrain, which, in turn, creates biodiversity in the composition of phytocenoses, even over small distances. The sustainability of any system, including the ecological system, is a significantly important parameter. The ability of the system to maintain stability during changes in environmental conditions is shaped by sustainability. In the aforementioned provision context, steadiness can be considered as a synonym of vitality. The numerous scientific articles report theoretical foundations of qualitative and quantitative evaluation of complex ecosystems sustainability [1,2,3,4]. Generally, it is shown that the vitality of the system is determined by the three groups of parameters – by volume (weight of system substances), productivity (the self-regeneration speed of system substances), and structural harmony. The parameters of the first two groups, in terms of ecological systems, are well-processed in classical biogeography, while the structural harmony of ecosystems and, in particular, the peculiarities of anthropogenic impact on it, are relatively less studied. The high-temperature potential of endemic ecosystems provides their maintenance of the initial state during the impact of extreme environmental conditions. Even if a significant portion of their area is lost, sustainable ecosystems continue to ensure that the natural cycle regime remains unchanged. This feature is related to the sustainability parameters that preserve many of the initial properties of ecosystems even after the anthropogenic transformation of their areas. The study of ecosystem stability parameters is important in order to predict the consequences of anthropogenic impact on phytocenosis sustainability, for the development of adequate methods. To solve this task, it is advisable to conduct model studies at the level of individual plant organisms, as well as to conduct monitoring observations on the whole landscape.

Research Object and Methods.

The study object was presented by the phytocenoses of the quarry area of Madneuli (Kazreti, Georgia). The choice was made considering the fact that, for obvious reasons, the phytocenoses present there are characterized by a pronounced anthropogenic load. The surface temperature of plants in phytocenosis was determined by remote laser scanning. Experimental plants grown in vegetation vessels were irradiated

with gamma radiation doses of 5, 10 and 20 Gy (irradiation source - ^{137}Cs). Temperature resistance of irradiated plants was determined by a standard method obtained in plant physiology [5].

Results and Discussion.

In our experiments, high temperature and ionizing radiation were used as extreme factors to determine the plant response parameters. The study aimed, on the one hand, to determine the radioresistance of specific plants and, on the other hand, to study the formation of radiobiological reactions under conditions of high temperature regime. Naturally, the focus was on the protective effects of plant organisms that contribute to the plant's resistance to high temperatures. The radioresistance of plant tissues directly to extreme conditions and their transpiration ability as a means of regulating the surface temperature of intact tissues were investigated. From the first picture it can be seen that plant tissues are characterized by a fairly high viability in relation to high temperatures.

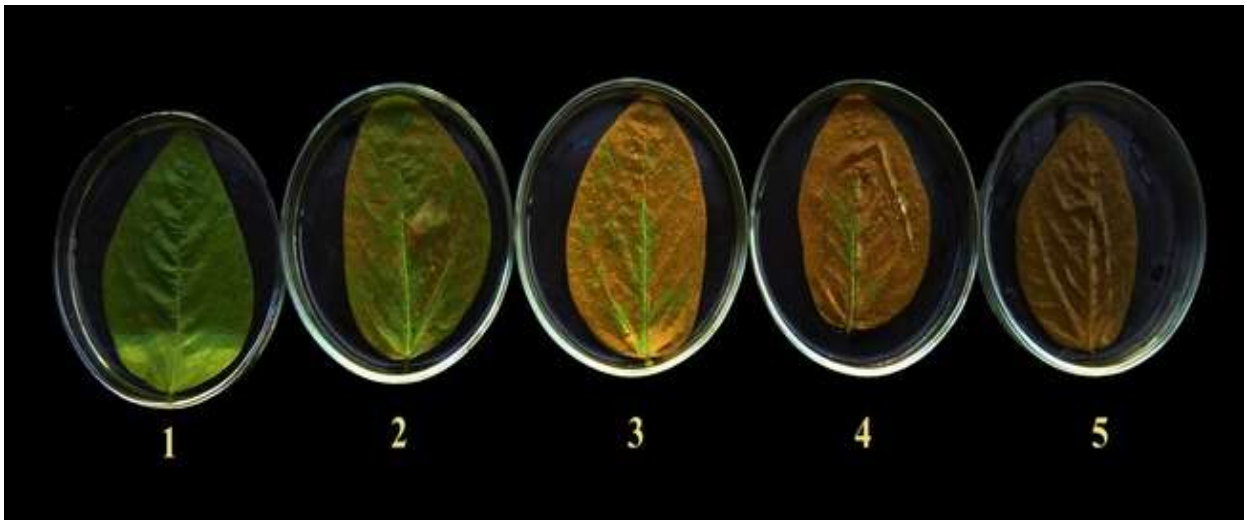

Fig. 1. Influence of high extreme temperatures
On the viability of leaf tissues
Up to: 1 - 30 °C; 2 - 40 °C; 3 - 50 °C; 4 - 60 °C; 5 - 70 °C

In these experiments, the study of the dependence of plant tissues on the temperature regime was carried out without water deficiency [5]; Subsequently the same experiments were performed on intact plants and as shown in Figure 2, changes in tissue transpiration intensity rates were observed.

In order to determine how the above effects are realized in the natural environment, we made observations in specific landscape conditions. The following pattern was observed here: the surface temperature of the leaves of the study plants increased due to the increase of the radiation dose (up to 20 Gy).

At the same time, experiments were carried out in vegetation vessels. Based on the obtained data, it was established that irradiated plants are characterized by economical consumption of soil water resources; However, reducing the level of transpiration under the influence of extreme temperatures does not provide an effective protection of the plant organism’s surface. A special danger of the latter effect occurs when the temperature threshold exceeds 40 °C. In the cultivation of irradiated plants under such extreme temperature conditions, irreversible processes take place and, in the case of prolonged exposure, end in lethal effects.

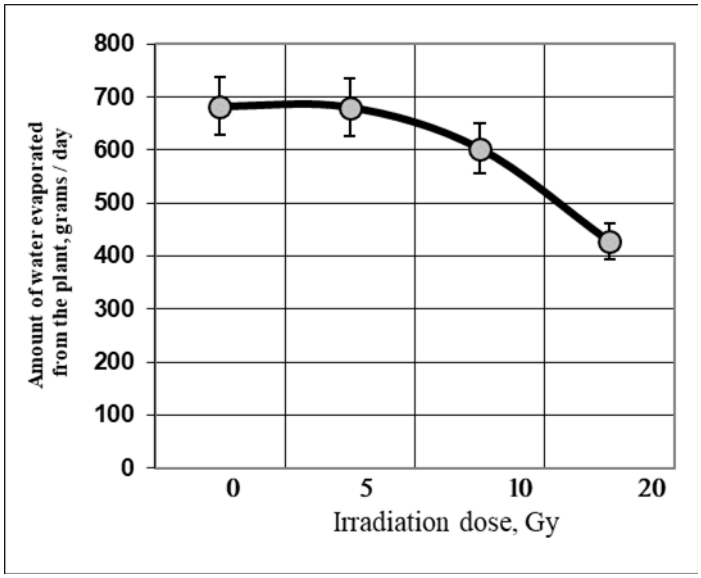

Fig. 2. Influence of gamma radiation on plant tissue transpiration intensity.

Experiments were performed at the landscape level to determine the sustainability parameters of phytocenoses under anthropogenic and climatogenic load conditions. The area adjacent to the Madneuli (Kazreti, Bolnisi district) quarry was selected as the study landscape. The choice was made due to the fact that the phytocenoses present in this area are distinctly different in anthropogenic load (Fig. 3).

Fig. 3. Location of study phytocenoses zones
(Camera height 14.21 km)

1-Minimum load zone; 2 - Highway and active cultivation zone of agricultural crops; 3 - Adjacent area of the ore quarry

According to the latter characteristic, phytocenoses were conventionally divided into three zones: the first zone was considered to be the minimum load zone (Fig.3-1); The second zone was the roadway and areas of active cultivation of agricultural crops (Fig. 3-2); And the third zone was considered to be the area directly adjacent to the ore quarry (Fig. 3-3). A comparative analysis of phytocenoses stability parameters

was performed in relation to the above zones. The criterion was to determine the surface temperature parameters of plant leaves united in phytocenoses, which was determined by the method of remote laser scanning. It was found that under the conditions of optimal temperature regime (up to 30 °C), this parameter had uniform character in all three study zones; During the extreme temperature regime (above 40 °C), the surface temperature varied according to the zones, namely: the surface temperature of plant leaves in the phytocenoses of the second and third zones was 3-6 °C higher than the same rate of plant leaves in the phytocenoses of the first zone, which indicates a decrease in the sustainability of phytocenoses in these zones.

Conclusion.

Based on the conducted experiment, it was established that any change, which is reflected in the stability parameters of phytocenoses, during long-term or permanent exposure is manifested in the form of changes in both quantitative and qualitative characteristics of successive processes. The effect we have described clearly indicates that during anthropogenic and global climate tension, the anthropogenic factor can be crucial to the viability of a particular ecosystem.

References

1. Chen Sh., Chen B., Brian D. Ecological risks assessment on the system scale: A review of state-of-the-art models and future perspectives. // Ecological Modelling,Volume 250,10b, 2013, pp. 25-33.
2. Perrodin Y,, Boillot C,, Angerville R,, Donguy G,, Emmanuel E. Ecological risk assessment of urban and industrial system: A review // Science of The Total Environment, Volume 409, Issue 24, 15, 2011,pp. 5162-5176.
3. Critto A., Torresan S., Semenzin E., Giove S., Mesman M., Schouten A.J., Rutgers M., Marcomini A. Development of a site-specific Ecological risk assessment for contaminated sites: Part I. A multi-criteria based system for the selection of ecotoxicological tests and Ecological observations.//Science of The Total Environment, Volume 379, Issue 1, 15,2007,pp. 16-33
4. Bruce K., Hope. An examination of Ecological risk assessment and management practices. // Environment International, Volume 32, Issue 8, 2006, pp. 983-995.
5. Третьяков Н.И. Практикум по физиологии растений. // Агропромиздат, М., 1990, 272с.