STUDY OF THE ABUNDANCE INDEX OF *PHYSCIA AIPOLIA* AND *XANTHORIA PARIETINA* IN CORRELATION WITH THE CONCENTRATION OF ENVIRONMENTAL PB AND ZN

STUDIUL INDICELUI DE ABUNDENȚĂ AL SPECIILOR DE LICHENI *PHYSCIA AIPOLIA* ŞI *XANTHORIA PARIETINA* ÎN CORELAȚIE CU CONCENTRAȚIA DE PB ŞI ZN DIN MEDIU

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Abstract: In a period of 12 weeks, samples of white poplar bark (Populus alba), naturally covered with lichens of the Xanthoria parietina and Physcia aipolia species, and were polluted under lab conditions with different levels of Zn and Pb. The pollution was done through the watering and nourishing solutions and the level of the two pollutants varied between 20 – 240 mg Zn/L and 10-120 mg Pb/L. The reaction and adaptation mode of the two lichen species was assessed through the phytomass abundance study, evaluated according to the bark surface covering degree. The watering performed to pollute and nourish was done twice a week. Measuring the surface covering degree was done through planimetry at 3, 6, 9, and 12 weeks. Our results evidenced great sensitivity of the Physcia aipolia species to high pollution levels of Pb and ZN. The covering degree is reduced after 3 weeks to 60%, to 95% after 6 weeks, and at 9 weeks, this species completely disappeared. After an accommodation period of about 3-4 weeks, when the covered area remained the same, the covering degree of the surface by the Xanthoria parietina species increases by 10% at 6 weeks, reaching 15% at 12 weeks. These results lead to the idea that the careful study of the lichen abundance may offer in an easy way signal-news about the gaseous pollution level of the environment.

Rezumat: Într-o perioadă de 12 săptămâni, ramuri de plop alb (Populus alba), care conţineau în mediul natural licheni din speciile Physcia aipolia şi Xanthoria parietina, au fost poluate în condiţii de laborator cu diferite nivele de Zn şi Pb. Poluarea s-a realizat prin intermediul soluţiei de udare şi hrănire, de două ori pe săptămână, iar nivelul celor doi poluanţi a variat între 20—240 mg Zn/l şi 10-120 mg Pb/l soluţie. Modul de reacţie şi de adaptare a celor două specii de licheni s-a evaluat prin studiul abundenţei de fitomasă, evaluată după gradul de acoperire a suprafeţei cuticulare prin planimetrie la 3, 6, 9 şi 12 săptămâni. Rezultatele au evidenţiat o mare sensibilitate a speciei Physcia aipolia la toate nivelurile de poluare cu Pb şi Zn. Gradul de acoperire cu licheni se reduce într-o relaţie foarte directă cu cantitatea de poluanţi încât la 6 săptămâni, cu excepţia variantelor E1 şi E2, lichenii din specia Physcia aipolia au dispărut complet de pe ramurile de plop. După o perioadă de acomodare de cca. 3-4 săptămâni, când suprafaţa ocupată a rămas aceeaşi, gradul de acoperire a suprafeţei de către specia Xanthoria parietina creşte la 9 săptămâni cu 12,7% la varianta martor şi cu 6 până la cca. 10% la variantele E_1, E_2 şi E_3. În cazul variantelor cu nivel foarte ridicat de poluare (E_4, E_5, E_6) lichenii din specia Xanthoria parietina au o dezvoltare încetinită. La 12 săptămâni indicele de abundenţă al acestei specii este pozitiv la toate variantele, comparativ cu valorile de la începutul experimentului. Aceste rezultate conduc la ideea că studiul atent al abundenţei lichenicole poate oferi în mod facil ştiri-semnal despre nivelul de poluare gazoasă a mediului.

***Key words**: corticolous lichens, high levels of Pb and Zn, lichen abundance, monitoring*
***Cuvinte cheie**: licheni corticoli, nivele ridicate de Pb şi Zn, abundenţă lichenicolă, monitorizare*

INTRODUCTION

Heavy metals, like lead and zinc, resulted especially from industrial activities and road transport can migrate in shape of vapours at variable distances from the pollution sources contributing to environment degradation. [1, 2, 3, 6, 7]

Due to a shortage protection system, some gases, solutions, or particles in suspension from air can easily penetrate the lichens tissues where they accumulate and produce counter effects that negatively influencing their development and abundance on surfaces. The delayer effect of this pollutants leads in time to the narrowing of the occupied surface climaxing with the completely disappearance of the talophytes from the ligneous cuticle. [3, 5, 7, 8]

The assessment and evaluation of dependency relation between the environment pollution level, bioaccumulation in tissues and the abundance of covering surface of lichens on trees, stones, walls, or rocks admits the selection of some species that can be used as instrument – organism in the monitoring of environmental quality.

On this experiment, we study the effects of some high doses of Zn and Pb pollution on *Physcia aipolia* and *Xanthoria parietina* lichens species.

MATERIALS AND METHODS

The study on *Physcia aipolia* and *Xanthoria parietina* lichens species was done in lab on white poplar branches (*Populus alba*). The lichens samples was allotted in seven pots with dimensions of 28 x 18 x 4.5 cm, exposed on north natural light and 24-25^{0}C temperature.

After studying the dispersion way of talophytes biomass was chosen the experimental locations. They were individualized for every experimental versions and corticolous lichen specie. Each version had three experimental locations.

The samples were weekly watered with a nourishing solution of macro elements (N, P, and K) and microelements (Ca, Mg, Fe, Cu, Mn, Mo). Next to a control sample was formed six experimental samples (E_1-E_6). The pollution was done through the watering and nourishing solutions as follows: 20 mg Zn / l + 10 mg Pb / l (E_1), 60 mg Zn / l + 30 mg Pb / l (E_2), 100 mg Zn / l + 50 mg Pb / l (E_3), 140 mg Zn / l + 70 mg Pb / l (E_4), 180 mg Zn / l + 90 mg Pb / l (E_5) şi 240 mg Zn / l + 120 mg Pb / l (E_6). The study lasted twelve weeks during the period 23.02. – 23. 05. 2006.

Measuring the surface covering degree was done by copying on transparent paper of the lichens talomass ambit at 3, 6, 9 and 12 weeks. Was resulted a map whose surface was calculated through planimetry using REISS – 3005 polar planimeter.

RESULTS AND DISCUSSIONS

The obtained dates after measuring the surfaces from experimental locations established for every version are presented in table 1.

The pollution level was the same for both lichens species, increasing gradually from 20 mg Zn / l and 10 mg Pb / l in E_1 sample to 240 mg Zn / l and 120 mg Pb / l on E_6 sample.

After three pollution weeks, in the entire experimental version existed the thalophytes mass on both lichens species. The surfaces covering degree was fluctuant, in general down on both species. The highest decreasing is observed on *Physcia aipolia* specie on all versions. Besides, the abundance of this specie decrease closely correlated with the polluted quantity. Therefore, when on both metals the polluted level increase five times (E_3), the thalophyte mass is reducing for almost three times compared to the beginning of the experiment. On the versions with higher pollution degree, E_5 and E_6, is observed a severe involution of over seven times (E_5) to fifteen times (E_6) of thalophyte mass.

Table 1

The corticolous occupied surface by of *Physcia aipolia* and *Xanthoria parietina* lichens species during the experimental period (mm^2)

Version	Ensured level		*Physcia aipolia*					Xanthoria parietina				
	Zn (mg/l)	Pb (mg/l)	Beginning of the experiment	3 weeks	6 weeks	9 weeks	12 weeks	Beginning of the experiment.	3 weeks	6 weeks	9 weeks	12 weeks
M	-	-	131.2	142.1	135.3	156.4	172.1	77.1	85.3	96.7	98.2	106.1
E_1	20	10	332.0	290.4	72.4	-	-	92.6	97.9	98.8	98.2	102.1
E_2	60	30	723.1	341.2	166.6	-	-	63.4	66.5	71.2	70.2	74.6
E_3	100	50	423.4	146.3	-	-	-	56.3	57.5	59.0	59.7	66.2
E_4	140	70	298.9	29.7	-	-	-	81.6	72.3	73.6	76.7	88.9
E_5	180	90	497.7	72.1	-	-	-	90.1	81.2	72.3	77.8	82.0
E_6	240	120	96.2	6.4	-	-	--	112.4	94.2	90.3	88.6	96.7

In case of *Xanthoria parietina* specie is registering a reduction of occupied surface on high pollution versions (E_4, E_5, and E6), while on the incipit three versions with low pollution levels the effects are weaker making so that occupied surface degree to be almost the same or easily raised.

During the 3rd and 6th week period, the effect of Zn and Pb pollution, especially on high pollution level versions is dramatically felt by lichens of *Physcia aipolia* specie. The thalophyte mass from E_3, E_4, E_5, and E_6 versions has completely vanished from all experimental locations, remaining a amount of 4-4.5 or lower only on E_1 and E_2 versions. During time, the noxious effect of Zn and Pb pollution is destroying the corticolous locations of these versions.

In conclusion, lichens of *Physcia aipolia* specie have a high sensitivity on Zn and Pb air pollution, so that even on the lower pollution level of 10 mg Pb / l and 20 mg Zn / l are completely vanishing after about six weeks. Based on this dates, lichens of this specie can represent a very important monitoring instrument of air pollution with heavy metals level.

After three pollution weeks, lichens of *Xanthoria parietina* specie are occupying almost the same surface in experimental locations as the begging of experiment excepting the last three versions where the abundance is reducing with 10-12%. Follow up, the lichens of this specie are accommodating with the administrated pollutants, still being on a low proportion on whole versions. At nine weeks, the first three lichens versions polluted with low levels of Pb and Zn, are presenting abundance higher with about 6-11% to the one from the begging of experiment, and in case of last three versions the abundance is still lower. At the end of experiment, excepting E_5 and E_6, all the versions has made a thalomass quantity higher to the one from the begging of the experiment, which prove that lichens of *Xanthoria parietina* specie are having high accommodation capacity and resistance even on high pollution levels.

CONCLUSIONS

1. Lichens of *Physcia aipolia* specie are presenting a high sensitivity on high air pollution levels of 10 mg Pb / l and 20 mg Zn / l, and on levels of five or ten times higher are completely vanishing from the corticolous locations in five to six weeks.

2. The high Zn and Pb air pollution degree are partially inhibiting the growing and development of lichens of *Xanthoria parietina* specie, and after three to five weeks accommodation the abundance is recovering, more obvious on polluted versions with low Zn and Pb quantities.

3. The analyze of abundance and presence of lichens of *Physcia aipolia* specie on deciduous trees can be used as instrument on monitoring activity of Pb and Zn air pollution level.

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