Content of certain mineral components in the thallus of lichens and the bark of roadside trees

STANISŁAWA KUZIEL

Department of Evolutionism, Institute of Botany and Zoology, University of Łódź

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Abstract

The total N, P, Mg, Ca, K and Na contents were investigated in the thalli of several lichen species occurring on various trees, and in the bark and bark extracts from these trees. pH of the bark extracts was also determined.

Wide differences were found in the content of the elements in point in the thalli of various lichen species on *Acer platanoides* and on the thalli of the same species on other trees. No relation was detected between the chemical composition of the bark and that of the lichen thalli occurring on it.

INTRODUCTION

Investigations undertaken up to date for elucidation of the causes of occurrence of particular species of associations of lichens on the given sites are mainly based on physiographic and morphological data. It results from them that the state of the lichen flora on the trees depends on many factors, and among them on the tree species (Culberson, 1955; Barkman, 1968; Kuziel, 1964; Fabiszewski, 1968; Rydzak, 1964). On various tree species growing in the vicinity of this state may be different in spite of apparently similar environmental conditions (Rydzak, 1970).

One of the numerous important ecological factors deciding on the distribution of certain vegetation types on the continents is the chemical composition of the substrate. Chemical analyses of the ash of various plant species from various sites demonstrated that certain taxonomic groups or ecological types are characterized by a higher or lower content of mineral components. Quantitatively the ash composition shows rather wide variations depending on the species. In spite of an identical composition of the substrate, the content of the particular mineral components in the plant species occurring on it is not the same. On the other hand, it is known that the composition of the substrate exerts an influence on the mineral components content in all plants. Analysis of ash from plants of the same species collected on

various sites shows a different quantitative composition as regards to the particular elements.

The aim of the present study was to examine the content of certain mineral components in the thalli of several lichen species occurring on the same or on different trees. The bark from the trees on which the lichens were collected was also analysed.

Analyses were performed in 3 groups:

- 1) thalli of several lichens growing on the same tree species;
- 2) thalli of chosen lichen species occurring on different species of trees;
- 3) bark from trees on which the lichens were collected and extracts from it in 1 per cent citric acid.

The pH of bark extracts was also measured.

MATERIAL AND METHODS

The material investigated were thalli of lichens growing on roadside trees. Such trees grow in specific ecological conditions. This appears in the state of their lichen flora which is different than that of trees growing in small groups or close to woods (Rydzak, 1970).

The following species were investigated: *Parmelia physodes* (L.) Ach., *P. sulcata* Taylor., *P. furfuracea* (L.) Ach., *Ramalina fastigiata* (Liljebl.) Ach., *R. fraxinea* (L.) Ach., *Evernia prunastri* Ach. and the bark of trees from which they were collected: *Acer platanoides* L., *Betula verrucosa* Ehrh., *Fraxinus excelsior* L., *Populus alba* L., *Sorbus aucuparia* L., *Salix* sp., *Tilia* sp. These trees grew along roads in the environs of Giżycko, Mikołajki, Kętrzyn and Węgorzewo in the Mazurian Lakeland.

The trees from which lichen thalli and bark were taken were about 40—50 years old and exhibited a richly developed lichen flora with a large proportion of foliaceous and fruticose forms. The trees grew on the roadside of asphalt roads in open country in the neighbourhood of meadows and cultivated fields. Both the lichen thalli and the bark were collected at a height of 1 to 2 m above ground.

The total N, P, Mg, Ca, K and Na contents were determined in the bark of the above named trees, in bark extracts in 1 per cent citric acid (it was assumed after Mitscherlich that the mineral components extractable with 1 per cent citric acid are assimilable for plants) and in lichen thalli.

Bark samples thoroughly washed with distilled water were dried and ground to powder in a mill. Another lot of bark from the same trees was first powdered and then infused with 1 per cent citric acid for 3 days. The filtered extract was evaporated to dryness. The lichen thalli were dried and powdered.

The above mentioned chemical components were determined by the following methods: total N by Kjeldahl's method modified by Schillak, (Collective work — Methods of chemical analysis of organic soils and plant material, IMUZ, 1967), P — by the method of Snell (1959) Mg — after H. J. G. Challi and D. F. Wood, K, Ca and Na with the use of a flame photometer. The analyses were carried out in the

chemical laboratory of the Institute of Soil Science, Cultivation and Fertilization in Gorzów Wielkopolski.

pH of the water extracts of powdered bark was read on a LBS-66 potentiometer. Bark samples after a monthly period of drying at room temperature were ground and 2-g samples were infused with 20 ml of distilled water. After 24 h pH was determined in the filtrate. For each tree 5–10 replications were made that is about 400 measurements. The results giving the percentual values of the elements under examination are shown in the table and figures.

Table 1
Content of mineral components in tree bark (%) and bark pH

		Total N	P	K	Mg	Ca	Na	pH
<i>Acer plan-</i> <i>tanoides</i>	K	0.929	0.116	0.281	0.101	3.294	0.114	5.4–6.1
	W	0.353	0.274	1.170	0.191	3.978	0.128	
<i>Fraxinus ex-</i> <i>celsior</i>	K	0.787	0.051	0.889	0.120	3.688	0.086	4.7–5.1
	W	0.341	0.090	1.737	0.155	2.943	0.104	
<i>Sorbus aucu-</i> <i>paria</i>	K	0.852	0.108	0.317	0.125	3.531	0.049	6.0–6.2
	W	0.349	0.296	0.876	0.210	5.004	0.064	
<i>Populus alba</i>	K	0.952	0.047	0.247	0.072	2.869	0.034	4.5–5.1
	W	0.423	0.082	1.056	0.160	3.122	0.088	
<i>Tilia</i> sp.	K	0.793	0.050	0.156	0.062	3.123	0.057	4.2–4.7
	W	0.288	0.096	0.553	0.164	4.415	0.094	
<i>Salix</i> sp.	K	0.686	0.046	0.537	0.163	3.768	0.070	5.6–6.4
	W	0.192	0.053	1.282	0.234	3.582	0.089	
<i>Betula ver-</i> <i>rucosa</i>	K	0.575	0.035	0.178	0.055	0.469	0.036	4.2–4.6
	W	0.199	0.054	0.405	0.092	2.378	0.068	

K — bark; W — bark extract

The numerical data are means from 15–30 replications.

RESULTS AND DISCUSSION

As seen from fig. 1 there are wide differences in the content of the particular mineral components between the lichen species examined. It is striking that species of the genus *Parmelia* which adhere loosely to the bark with their whole lower foliaceous thallus surface show a higher phosphorus magnesium, calcium and potassium level than the species of the genus *Ramalina*. The latter contact the substrate only at one point where the thallus is attached (fruticose thalli).

In experiments in which the content of mineral components was determined in one species from various trees, the thalli of *Ramalina fraxinea* were chosen as representative of fruticose lichens and *Parmelia physodes* as an example of foliaceous thalii.

Fig. 1. Mineral components content in thalli of lichens from *Acer platanoides*:

a — *Parmelia furfuracea*, b — *Parmelia sulcata*, c — *Parmelia physodes*, d — *Ramalina fastigata*, e — *Ramalina fraxinea*, f — *Evernia prunastri*

Fig. 2. Mineral components content in thalli of *Ramalina fraxinea* collected from various trees:

a — *Acer platanoides*, b — *Salix* sp., c — *Sorbus aucuparia*, d — *Tilia* sp., e — *Populus alba*, f — *Fraxinus excelsior*

Fig. 3. Mineral components content in thalli of *Parmelia physodes* collected from:

a — *Acer platanoides* and b — *Betula verrucosa*

As seen from figs 1 and 2 there are wide differences between thalli of the same species collected from various trees.

Another aim in view was to verify whether there is a relation between the chemical composition of the bark and that of the lichen thalli occurring on it.

It proved necessary in these investigations to measure the bark pH. It is namely, known that one of the important factors in assimilation of mineral components from the substrate is the pH. It decides, on the one hand, of the solubility, and thus the assimilability of the particular components, and on the other hand, it is a factor regulating the permeability of cytoplasmic membranes. In this connection roadside trees are a very specific and probably variable environment. From the data in the table it results that often the mineral components content in the bark extract greatly exceeds their content in the bark.

Analysis of the results concerning the chemical composition of the bark and its extracts and of the lichen thalli occurring on it does not, however, allow to establish any regularities or conclusions in this respect. As far as bark pH is concerned, changes in it are due to windblown dust. It results from the investigations of numerous authors and of the present one that the pH of bark of roadside trees is different (less acid) than that of the bark of the same tree species growing in the forest.

Hence the conclusion may be advanced that the factor favouring the occurrence of certain lichens on roadside trees may be an appropriate pH of the bark, beside other factors such as light and water (dew, mist).

The same is also true as regards to the mineral components which are more abundant in the bark of roadside trees.

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Author's address
Dr Stanisława Kuziel
Institute of Botany and Zoology
University of Łódź
90-327 Łódź, Poland

Zawartość niektórych składników mineralnych w plechach porostów oraz w korze drzew przydrożnych

Streszczenie

Przebadano zawartość N-ogólnego, P, Mg, Ca, K, i Na w plechach kilku gatunków porostów występujących na różnych drzewach, oraz w korze drzew i w wyciągach z tej kory. Oznaczono również pH wyciągów tej kory.

Stwierdzono znaczne różnice w zawartości badanych pierwiastków w plechach różnych gatunków porostów występujących na *Acer platanoides*, oraz w plechach tych samych gatunków występujących na różnych drzewach. Nie znaleziono zależności pomiędzy składem chemicznym kory i plech porostowych na niej występujących.