УДК 574.3:582.29

ХОЗЯЕВА ИЛИ ПАРАЗИТЫ? ПАРАЗИТИЧЕСКИЕ ОБРАЗОВАНИЯ ЛИШАЙНИКОВ НА СУХИХ СКАЛАХ КАК ЭФФЕКТИВНЫЙ СПОСОБ ЛИХЕНИЗАЦИИ МОЛОДЫХ МИКОБИОНТОВ

HOSTS OR PARASITES? NON-SPECIFIC LICHENICOLOUS GROWTH OF LICHENS IN DRY ROCK COMMUNITIES AS AN EFFECTIVE TOOL FOR LICHENIZATION OF YOUNG MYCOBIONTS

Я. Вондрак[1], О. Пекса[2], О. Вондракова[3]

J. Vondrák[1], O. Peksa[2], O. Vondráková[3]

[1] Институт Ботаники ЧАН, (Замок-1, 25243, Пругонице, Чешская Республика) и Университет Южной Богемии, отделение ботаники факультета биологических наук (Бранишовска 31, 370 05, Ческе Будеёвице, Чешская Республика)
[2] Западночешский Плзеньский музей (Сады Копецкего 2, 30100, Плзень. Чешская Республика)
[3] Федеральное государственное бюджетное учреждение науки Институт степи Уральского отделения Российской академии наук (460000 Россия, Оренбург, ул.Пионерская, 11)

[1] Institute of Botany, Academy of Sciences, (Zámek 1, CZ–252 43 Průhonice, Czech Republic) & Department of Botany, Faculty of Biological Sciences, University of South Bohemia, (Branišovská 31, 370 05, České Budějovice, Czech Republic)
e-mail: j.vondrak@seznam.cz
[2] Západočeské muzeum v Plzni (Kopeckého sady 2, CZ-30100, Plzeň, Czech Republic)
e-mail: opeksa@zcm.cz
[3] Institute of Steppe of the Ural Brunch of the Russian academy of Sciences (460000, Russia, Pionerskaya str, 11)
e-mail: mer.os@mail.ru

Эпилитные лишайники в аридных условиях часто образуют очень богатые сообщества, где неспецифично нарастают друг на друге. Интересным является то, что первоначально лишайники ведущие себя как паразиты, вскоре сами становятся хозяевами для других лишайников. Изучение этого явления представляет большой интерес, поскольку оно может показать, каким образом начинается процесс первичной лихенизации (поиска водоросли грибом) в аридных условиях.

In dry conditions, epilithic lichens often form abundant populations and individuals of various lichens overgrow each others. The fascinating fact is that lichens starting as parasites become hosts for other starting lichens in later stages. A question for the future research is: Why these «*parasite becomes host*" *cycles* are pronounced especially in arid regions?

Lichens are basically dual organisms [5] containing fungus (*mycobiont*) and alga / cyanobacterium (*photobiont*). This makes understanding their biology fairly difficult and many questions are still unsufficiently answered. For instance, we still know a little about the establishment of a new thallus.

In vegetatively reproducing lichens, where both partners are distributed together in large multi-cellular diaspores (e.g. *soredia* = globose units of several tens of micrometers in diameter containing colony of photobiont cells intermixed and coated by cells of mycobiont), establishment of the new lichen is no mystery. Quick mobilization of both lichen partners will result in the new thallus. Nevertheless, situation is not always so straightforward - algal population, which was transferring with the mycobiont in the soredium, may be replaced by the local population of a new photobiont [8].

Many lichens are known to reproduce exclusively by small fungal diaspores: by sexual *ascospores* and asexual *conidia*. Whether mycobiont in such lichens may be easily dispersed, the algal partner does not produce and diaspores for effective dispersal. Its mobility is thus restricted, although algal cells or colonies of cells may be removed from thalli and distributed by themselves.

The green algae from the genus *Trebouxia* represent frequently detected photobionts. Although *Trebouxia* has been found in a free-living state [e.g. 1, 4], these findings are rather rare. It is almost certain, that *Trebouxia* algae do not form larger and permanent free-living colonies. They are predominantly found in lichens, in their vegetative diaspores (mainly soredia) or in decaying lichen thalli.

Restricted source of available photobionts must often cause obstacles in lichenization of germinating fungal ascospores / conidia. Selectivity of mycobionts for only particular *Trebouxia* lineages [2] makes their situation even worse. Germinating mycobionts may solve this problem by taking photobiont from foreign soredia [3]. It is suggested that detached soredia of various lichens are abundant in most lichen-inhabited habitats and they may densely covered substrata colonized by young mycobiont mycelia.

Another possibility for the young mycelium to obtain the photobiont is starting on other lichen. Lichenicolous growth is not considered as the main way to obtain the photobiont partner in most habitats; lichenicolous lichens are in low minority, when taken data from e.g. the main European lichen floras [6, 7]. Nevertheless, "cryptic" lichenicolous growth in early stages of lichens, which are soon free-living, is very probable. The well known example is a lichen *Xanthoria parietina* which obtains its photobiont by invading soredia, pre-thalli or thalli of *Physcia* species [3].

In steppes of southern Russia, we have found lots of lichen communities on limestone rocks, where lichenicolous growth is strongly pronounced in most of lichen species (Tab. 1).

Each species often behave as lichenicolous lichens at the beginning but later becomes the host for other starting lichen mycobionts. The obviously big frequency of these «*parasite becomes host*» *cycles* in very dry continental areas is probably not random. We have no doubts that photobionts are transferred in these cycles from hosts to young thalli, but why is this strategy enormously developed in the dry areas?

Tab. 1.

Host and lichenicolous lichens on dry limestone rocks in continental localities in southern Russia. Obligatory lichenicolous lichens, which do not act as hosts, are in bold.

	Hosts																				
Lichenicolous lichens	Aspicilia calcarea	Aspicilia contorta	Aspicilia desertorum	Caloplaca biatorina	Caloplaca bullata	Caloplaca decipiens	Caloplaca inconnexa	Caloplaca polycarpa	Candelariella oleifera	Lecania sp.	Phaeophyscia orbicularis	Physcia caesia	Rinodina lecanorina	Staurothele sp.	Toninia cinereovirens	Verrucaria calciseda	Verrucaria marmorea	Verrucaria sp. (grey species)	Verrucaria sp. (brown species)	Xanthoria papillifera	Xanthoria sorediata
Aspicilia calcarea	•																				
Aspicilia desertorum	•	•			•																
Aspicilia sp. (lichenicolous)		•																			
Caloplaca biatorina			•			•															
Caloplaca bullata	•	•	•														•				
Caloplaca decipiens	•	•	•		•				•				•			•	•		•		
Caloplaca inconnexa					•														•		
Caloplaca polycarpa	•		•													•					
Caloplaca sororicida					•																
Caloplaca sp. (lichenicolous)				•		•															
Diplotomma sp.																•					
Candelariella oleifera	•	•	•	•	•	•	•	•		•	•	•		•	•			•	•		•
Lecanora invadens		•			•		•			•					•				•		
Lobothallia sp.	•																				
Phaeophyscia nigricans															•				•		
Phaeophyscia orbicularis										•									•		
Physcia caesia					•					•									•		
Rinodina lecanorina	•																				
Staurothele sp.		•							•									•			
Toninia cinereovirens					•																
Verrucaria calciseda																•					
Verrucaria marmorea																	•?				
Verrucaria subfuscella																			•		
Verrucaria sp. (grey species)				•		•			•					•	•				•		
Verrucaria sp. (brown species)	•	•	•		•		•	•		•					•		•	•			
Xanthoria papillifera		•	•		•				•											•	
Xanthoria sorediata																					•

Hypotheses for future investigations

(1) Non-specific lichenicolous growth of lichens increases towards dry habitats.

(2) Biodiversity of photobionts decreases towards dry habitats.

(3) Lichen mycobiont diversity decreases towards dry habitats.

(4) Biodiversity and abundance of vegetatively distributed species decreases towards dry habitats.

(5) Surviving of detached vegetative diaspores is limited in dry habitats.

(6) "*parasite becomes host*" *cycles* exist in various habitats with high frequencies. They are more obvious in dry areas, because of slow growth and long life of lichens in dry habitats.

Our research was supported by the Visegrad Fund (51100753) and Institute of Botany AS ČR (AV0Z60050516).

REFERENCES:

1. Bubrick P., Galun M. & Frensdorff A. (1984): Observations on free-living *Trebouxia* de Puymaly and *Pseudotrebouxia* Archibald, and evidence that both symbionts from *Xanthoria parietina* (L) Th. Fr. can be found free-living in nature. New Phytologist 97: 455–462.
2. Nyati S. (2007): Photobiont diversity in Teloschistaceae (Lecanoromycetes). Dissertation, Universitдt Zьrich, Switzerland.
3. Ott S. (1987): Reproductive strategies in lichens. Bibliotheca Lichenologica 25: 81-93.
4. Sanders W. B. (2005): Observing microscopic phases of lichen life cycles on transparent substrata placed in situ. Lichenologist 37: 373–382.
5. Schwendener S. 1867. Ьber die wahre Natur der Flechtengonidien. Verh. Schweiz. Naturforsch. Ges. 9–11.
6. Smith C. W., Aptroot A., Coppins B. J., Fletcher A., Gilbert O. L., James P. W. & Wolseley P. A. (eds) (2009): The Lichens of Great Britain and Ireland. British Lichen Society. London.
7. Wirth V. (1995): Die Flechten Baden-Wurttembergs, Teil 1 & 2. Eugen Ulmer, Stuttgart.
8. Wornik S. & Grube M. (2010): Joint Dispersal Does Not Imply Maintenance of Partnerships in Lichen Symbioses. Microbial Ecology 59: 150–157.

УДК 911.2 (571.51)

ГИДРОТЕРМИЧЕСКИЕ УСЛОВИЯ И ОРГАНИЧЕСКОЕ ВЕЩЕСТВО ПОЧВ ГЕОСИСТЕМ КОНТАКТА СТЕПИ И ТАЙГИ

THE HYDROTHERMAL CONDITIONS AND ORGANIC MATTER SOILS OF GEOSYSTEMS CONTACT STEPPES AND TAIGA

И.Б. Воробьева
I.B. Vorobyeva

Институт географии им. В.Б.Сочавы СО РАН
(Россия, 664033, Иркутск,
ул. Улан-Баторская, 1)

V.B.Sochava Institute of Geography SB RAS
(Russia, 664033, Irkutsk, Ulan-Bator st., 1)
e-mail: Irene@irigs.irk.ru

Выявлено, что в почвах на глубине 20 см на склоне северо-западной экспозиции в зимний период холоднее, чем в почве на склоне юго-восточной экспозиции, а в летний период почва прогревается сильнее и на более длительное время на склоне юго-восточной экспозиции. Установлено увеличение количества водорастворимого органического вещества во всех почвах. Исследования многолетний динамики водорастворимых форм органического углерода и содержание влаги обнаружило, что наибольшие содержания органического углерода фиксируются в следующие за годами, с аномальными гидротермическими условиями

It was revealed that the soil at a depth of 20 cm on the slope of the north-western exposure in the winter is colder than the soil on the slope of the south-eastern exposure, and in summer the soil warms up more and more time on the slopes of the south-eastern exposure. The increase in the number of water-soluble organic matter in all soils is established. Investigations of long-term dynamics of water-soluble forms of organic carbon and moisture content revealed that the highest content of organic carbon fixed in the next for years, with anomalous hydrothermal conditions

Геосистемы контакта степи и тайги выступают как зоны соприкосновения, взаимопроникновения и взаимодействия степных и лесных типов природной среды. На территории Средней Сибири степь вступает в контакт с тайгой — иным типом природной среды, а степи, с которыми соприкасается тайга, отличаются от европейских. Эти различия объясняются высокой степенью континентальности климата (годовая сумма осадков ниже потенциальной величины суммарного испарения, не только в степи, но и в значительной части ареалов тайги), преобладанием горного рельефа: котловины и крутые южные склоны способствуют продвижению