THE INFLUENCE OF LIGHT ON MORPHOLOGICAL CHANGES OF BLUE-GREEN ALGAE *NOSTOC GELATINOSUM* (SCHOUSB) ELENKAND *CYLINDROSPERMUM LICHENIFORME* (BORY) KÜTZ. (CYANOPHYTA)

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Abstract. The light influences the morphological aspects of algae Nostoc gelatinosum (Schousb) Elenk. and Cylindrospermum licheniforme (Bory) Kutz.. The dark regime generates the dimensional reducing of vegetative cells and heterocysts leading to the alteration of biomass, but spores do not suffer significant changes. Cultivating these algae to favorable conditions of natural and artificial light (continuous), results with launching the process of self-regulating dimensional of cells. The most beneficial sources of ilumination are natural and artificial light.

Key words. algae, light, morphological changes,continuous light, dark,

Introduction

Environmental factors act directly on algae development and especially the morphological aspects of algal cells. Morphological changes of algal cells allow to determining the physiological status and using the algae as bioindicators [4]. In this regard, Л. Х. Абузарова, Л. А. Гайсина, Л. М. Сафиуллина, Г. Р. Бакиева [3] have demonstrated that as the result of administration of urea and potassium chloride in a growing medium for alga *Cylindrospermum michailovsckoënse*, take place essential morphological changes of vegetative cells and heterocysts, but spores are more resistant and does not suffer important changes. These researches indicate that algae in response to changes of environmental factors, are changing their dimensional aspect.

Light is one of the abiotic limiting factor, that fulfills and energy function to algae. Light regime, in turn, influences the photosynthesis and nycthemeral alternation of cell division to algae, which in turn, are reflected quantitatively on the biomass [1].

Cylindrospermum licheniforme and *Nostoc gelatinosum* shows a great interest in research, because they have a high content of biologically active substances in cells, and can be widely used as biofertilizers [2]. Therefore it is important to study the morphological changes of these algae under the influence of different

illumination, to determine the optimal light intensity that would not cause essential morphological changes in algal cells, and will allow for obtaining significant quantities of biomass.

Materials and Methods

In experiments were used the blue-green algae *Nostoc gelatinosum* (Schousb) Elenk. and *Cylindrospermum licheniforme* (Bory) Kutz. selected in pure culture from soil collected in the southern districts of the Republic of Moldova. Nowadays they are part of collection from laboratory of ,,Algology,,Moldova State University.

Conditions for carrying out of experiments. The experiments was carried out in the laboratory at 24-26^{o}C, for a period of 12 days. Varied conditions of lighting was obtained by cultivating at daylight (natural light) of the window of the laboratory (summer June 2014), continuous light to 3 fluorescent lamps (120W/0,64 m^2 – yellow light spectrum), in the dark – in thermostat with adjustable temperature model TC-80 MC-2.

Algae cultivation. The algae *Nostoc gelatinosum* and *Cylindrospermum licheniforme* were cultivated using the periodically method, on nutritive medium Drew [5] preventively sterilized to 160 t^{o}C for 45 minutes. The alga was inoculated in a dose of 0,4 g/l.

Study of morphological changes was carried out by samples analysis under the electronic microscope Optica Provision (x40 objective) equipped with a camera and measuring program size. Morphological aspects were analyzed by determining the length and width of vegetative cells, spores and heterocysts. The obtained results were statistically processed using the program "Microsoft Office 2013" determining the arithmetic mean – X and standard error – x.

Results and discussions

Ensuring the adequate ratio between light and dark can determine rhythmical coordination of vital processes for a population of algal cells into a larger extent than in natural growth conditions and light changes directly impacts to their dimensional appearance [1].

The obtained results show that the vegetative cells of *Nostoc gelatinosum* dimensional changes depending on the age of the culture and the light source. The total absence of light impacting on the length and width of the vegetative cells, contributing to the decrease of their size from the 6th day (2,5 to 0,18 μ). Daylight helps to increase the cell size of *Nostoc gelatinosum* within admissible limits. The cells exposed to continuous and natural light have a tendency of increasing followed by decreasing and reverse (tab. 1).

The morphological changes of vegetative cells of alga *Cylindrospermum licheniforme* have the same dimensional decreasing trend to the long exposure in

the dark. Cultivation the alga in daylight, the cells are slightly larger. The natural and continuous light contribute to increasing the size of the cells, after that, the cells decreased and reverse.

Table 1.

The morphological changes of vegetative cells in alga *Nostoc gelatinosum*

Days of analysis	Type of light					
	Continuous, $X \pm x$		Daylight, $X \pm x$		Dark, $X \pm x$	
	Cell length, μ	Cell width, μ	Cell length, μ	Cell width, μ	Cell length, μ	Cell width, μ
1	7,37±0,38	5,20±0,23	7,37±0,38	5,20±0,23	7,37±0,38	5,20±0,23
3	7,12±0,34	6,72±0,18	9,91±0,54	7,19±0,21	8,86±0,52	7,71±0,21
6	8,8±0,61	7,32±0,5	10,73±0,61	7,94±0,49	10,21±0,99	8±0,22
9	8,84±0,45	6,99±0,19	8,25±0,54	7,41±0,33	6,31±0,39	6,69±0,17
12	7,78±0,49	7,07±0,19	8,27±0,78	7,71±0,37	7,6±0,63	6,5±0,22

Table 2.

The morphological changes of vegetative cells in alga *Cylindrospermum licheniforme*

Days of analysis	Type of light					
	Continuous, $X \pm x$		Daylight, $X \pm x$		Dark, $X \pm x$	
	Cell length, μ	Cell width, μ	Cell length, μ	Cell width, μ	Cell length, μ	Cell width, μ
1	4,5±0,71	4,5±0	4,5±0,71	4,5±0	4,5±0,71	4,5±0
2	5,4±0,15	5,15±0,19	4,71±0,16	4,66±0,15	4,26±0,14	4,56±0,08
6	5,84±0,31	5,8±0,24	8,96±0,73	7,36±0,27	4,49±0,49	4±6,3
9	6,14±0,25	5,95±0,27	6,24±0,27	6,10±0,22	4,89±0,19	5,43±0,21
12	6,15±0,28	6,07±0,19	6,19±0,21	5,99±0,17	was altered	was altered

The morphological changes of vegetative cells of algae *Nostoc gelatinosum* and *Cylindrospermum licheniforme* talks about the morphological self-regulating character of cell size.

The heterocysts of *Nostoc gelatinosum*, suffers the morphological changes depending on the light regime. Prolonged exposure the alga *Nostoc gelatinosum* in dark, notes with heterocysts decreasing of length and widh with 2,98 to 0,28 μ. Continuous light contributes to increase the length from 2,67 to 0,91 μ and width of 1,5 to 0,27 μ of heterocysts, compared with the *Nostoc gelatinosum* heterocysts exposed to daylight (tab. 3).

Table 3.

The morphological changes of heterocysts in alga *Nostoc gelatinosum*

Days of analysis	Type of light					
	Continuous, $X \pm x$		Daylight, $X \pm x$		Dark, $X \pm x$	
	Cell length, μ	Cell width, μ	Cell length, μ	Cell width, μ	Cell length, μ	Cell width, μ
1	8,25±0,47	6,18±0,38	8,25±0,47	6,18±0,38	8,25±0,47	6,18±0,38
3	9,15±0,75	6,91±0,36	9,95±0,47	9,26±0,49	10,89±0,75	10,02±0,75
6	12,08±0,2	9,37±0,95	11,4±0,59	8,28±0,58	9,45±0,44	9,43±0,19
9	10,76±0,69	8,93±0,39	8,09±0,29	7,43±0,25	7,78±0,55	7,15±0,39
12	11±0,63	7,31±0,34	10,09±0,5	7,04±0,4	10,25±1,4	8,38±0,8

The morphological aspect of heterocystes in *Cylindrospermum licheniforme* cultivated in dark suffers dimensional changes by decreasing the cells size, from the 6th day of cultivation. In general, the heterocystes of alga *Cylindrospermum licheniforme* did not suffer obvious dimensional changes at the continuous light and daylight (tab. 4).

Table 4.

The morphological changes of heterocysts in alga *Cylindrospermum licheniforme*

Days of analysis	Type of light					
	Continuous, $X \pm x$		Daylight, $X \pm x$		Dark, $X \pm x$	
	Cell length, μ	Cell width, μ	Cell length, μ	Cell width, μ	Cell length, μ	Cell width, μ
1	8,62±0,37	5,02±0,32	8,62±0,37	5,02±0,32	8,62±0,37	5,02±0,32
2	8,57±0,54	6,47±0,57	8,82±0,36	6,12±0,44	9,68±0,54	6,64±0,29
6	10,51±0,6	7,39±0,66	11,36±1,42	7,58±0,58	7,37±0,54	5,01±0,27
9	8,09±0,35	6,24±0,3	7,98±0,21	6,30±0,32	7,93±0,44	5,9±0,26
12	8,46±0,47	6,25±0,14	7,92±0,61	6,35±0,30	was altered	was altered

Both length and width of heterocysts have increasing trends followed by decreasing. What tells us, about the self-regulating dimensional character of heterocysts in algae *Nostoc gelatinosum* and *Cylindrospermum licheniforme.*

The exposure of algae *Cylindrospermum licheniforme* and *Nostoc gelatinosum* in dark produces no essential dimensional changes of algal spores, compared to exposed variants to continuous and natural light. The morphological changes of spores in *Nostoc gelatinosum* and *Cylindrospermum licheniforme* have the same tendency ofincreasing followed by decreasing and reverse, which indicates that the spores are dimensional self-regulating.

Conclusions

Prolonged exposure of algae *Cylindrospermum licheniforme* and *Nostoc gelatinosum* in dark contributes to dimensional reduction of vegetative cells and heterocystes. Daylight stimulates the dimensional increasing of vegetative cells and partially of algae spores, but continuous lighting generates the dimensional increasing of heterocysts. As a result of research it has been found, that the exposure of algae *Nostoc gelatinosum* and *Cylindrospermum licheniforme* under favorable conditions of natural and artificial light (continuous), results with launching the process of dimensional self-regulating of algal cells. Thus, for cultivation of these algae can be used both source of natural and artificial light.

References

1. Cărăuş I. Cultura algelor pentru biomasa şi principii active, Note de curs lucrări de laborator. Bacău: Universitate din Bacău, 2007. 99 p.
2. Trofim A.A., Zosim L.S., Dobrojan S.N., Donţu N.R., Stratulat I.I., Semeniuc E.N. Importance and biochemical characteristics of some soil bluegreen algae from Republic of Moldova. Physiology and biotehnology of oxygenic phototrophic microorganisms looking into the future, 2014, p. 18-19.
3. Абузарова Л.Х., Гайсина Л.А., Сафиуллина Л.М., Бакиева Г.Р. Изменение морфологии *Cylindrospermum michailovsckoënse (Cyanoprocaryota)* при воздействии минеральных удобрений. Вестник ОНУ, том 13, вып. 4, 2008, 55-60 с.
4. ВассерС. П., Кондратьева Н. В., Масюк Н. П. и др. Водоросли. Справочник. Киев: Наукова думка, 1989. 605 с.
5. Гайсина Л.А., Фазлутдинова А.И., Кабиров Р.Р. Современные методы выделения и культивированияводорослей. Учебное пособие. Изд-во БГПУ. Уфа, 2008. 152 с.