J. Indian bot. Soc. 64:51-54, 1985.

EFFECTS OF THREE METABOLIC INHIBITORS ON COSMARIUM AND CLOSTERIUM SPP.¹

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ABSTRACT

In the present communication, effects of three metabolic inhibitors namely, sodium azide, sodium arsenate and cadmium chloride on the growth of two species each of the genera Cosmarium (Cosmarium laevz, G. obtusatum) and Closterium (Cl. moniliferum and Cl. lanceolatum are described.

INTRODUCTION

A number of studies have been directed towards the discovery of the mical agents potentially useful for the effective control of algae in natural waters and also to dtermine concentrations which might be safely employed for eliminating contaminants in the purification of algal cultures. Among the more extensive earlier studies on potential inhibitors of algal growth, especially in fresh water, were those of Fitzgerald *et al.*, (1952-57), Palmer and Maloney (1955). Jacob and Nisbet (1955) and Galloway and Krauss (1959 a, b). given treatments of sodium azide (2 and $8 \mu g/ml$). Sodium arsenate (5, 10 and 20 $\mu g/ml$) and cadmium chloride (0.025, 0.05 and 0.25 $\mu g/ml$) in separate experiments. Growth was determined in terms of cell counts representing number of cells/ml. with the help of a haemocytometer. Average of at least ten separate counts was taken for the purpose of assessment of growth. Lethal concentrations of the three chemicals were also determined for all the taxa.

MATERIALS AND METHODS

Actively growing cultures of the algae (Cosmarium laeve, C. obtusatum, Closterium moniliferum and Cl. lanceolatum) were maintained at $21 \pm 1^{\circ}$ C at c2000 lux light intensity. The source of inocula was a washed suspension of exponentially growing cells of an axenic clonal population. The cultures were diluted and the initial population density was adjusted to

RESULTS

From a comparative assessment of the degree of inhibition of growth by the metabolic inhibitors used during present study, the following conclusions emerge. (a) Out of the three inhibitors used cadmium chloride proved to be most toxic to the growth of all the four species of desmids, both in terms of lethality and percentage inhibition (Table I).

(b) A generic level *Closterium* species proved to be more sensitive to the toxicity of all the three inhibitors as

about $150-170 \times 10^4$ cells/ml for each set of experiments. Culture materials were

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1. Accepted for publication on October 15, 1984.

compared to Cosmarium species. At specific level, Cosmarium laeve showed

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PERCENTAGE INHIBITION OF GROWTH ON 21ST DAY						
Name of the species	Sodium azide 8 µg/ml	Sodium arsenate 20 µg/ml	Cadmi- um chlo- ride 0.25 µg/ ml			
Cosmarium laeve	41.78	75.00	75.6			
Cosmarium obtusatum	35.60	67.75	74.4			
Closterium moniliferum	34.40	50.00	86.1			
Closterium lanceolatun	n 33.30	54.15	77.6			

more resistance than Cosmarium obtusatum, whereas Closterium lanceolatum showed more resistance than



- Closterum moniliferum (Graphs 1-6). (c) Low concentrations scuh as 2 μ g/ml and 5 μ g/ml., respectively of sodium azide and sodium arsenate brought about slight stimulation in growth which was more in case of both the species of Cosmarium (Graph 1 and 3).
- (d) The most common morphological change observed in *Cosmarium* species at the subinhibitory concentrations of these three chemicals was the presence of elongated isthmus between the two semicells with no septa in between. This effect was more common in the populations treated with sodium arsenate and sodium azide.
- (e) Cadmium chloride had more pronounced effect on lengthening the period of lag in all the four species of desmids (Graph 5, 6).
- (f) Lethal levels of the three chemicals to these desmid species were esta-



..... C. obtusatum

Fig. 2. Growth curves of two spp. of Closterium in the presence of various conc. of sodium

blished as follows : (i) Sodium azide—6500 μ g/ml proved lethal after 24 hours to all the four species. azide. ------ Cl. moniliferum $\cdots \cdots \cdots Cl. lanceolation$ OO Control $\Delta\Delta \ 8 \ \mu$ g/ml

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Fig. 3. Growth curves of two spp. of Cosmarium ... the presence of various conc. of sodium arsen-317.

--- C. iaeve C. obtusatum

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Fig. 4. Growth curves of two spp. of Closte-



Fig. 5. Growth curves of two spp. of Cosmarium in the presence of various conc. of cadmium chloride.

- G. laeve C. obtusatum

Fig. 6. Growth curves of two spp. of Closte-

rease in the presence of various cone, of sodium ----- L. maniliferum

and a second s **Gontrol** -2 -5 μ g al

 $\Theta O = 10 \ \mu g \ ml$

▲▲ —ij #g·ml

rium in the presence of various conc. of cadm.um chloride.

------ Cl. lanceolatum Cl. moniliferum **Control** $\Delta \Delta = 0.025 \ \mu \text{g/m}$ $OO = 0.05 \ \mu g/ml$ ▲ ▲ ---0.25 µg/ml

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- (ii) Sodium arsenate-20,000 μ g/ml proved to be lethal after 4 and 2 days to *Cosmarium* and *Closterium* spp. respectively.
- (iii) Cadmium chloride—5,000 μ g/ml proved lethal after 24 hrs to both the species of Cosmarium, whereas 2,500 μ g/ml conc. proved lethal to Closterium spp. after 24 hrs.

DISCUSSION

Both arsenate and azide have been shown to affect phosphate transfer in various cellular systems (James, 1953). Both these chemicals also inhibited cellulose wall synthesis by effecting various enzymatic reactions (cf. Baker and Roy, 1965; Bahal, 1969; Losada and Arnon, 1963). Heavy metals are often introduced excessively into aquatic ecosystems as by-products of industrial processes and acid mine drainage residues. Bringmann and Kuhn (1959a, b) reported that cadmium proved toxic to Scenedesmus. Hutchinson and Czyrska (1972) estblished the comparative toxicity of cadmium and zinc to floating aquaitc plants. Say and Whitton (1977) observed that cadmium was highly toxic either alone or in combination with zinc to Hormidium rivulare. In the present study also, growth of the four desmid species was effected by various concentrations of the azide, arsenate and cadmium. Effects of these chemicals at enzymatic level were not investigated. Inhibition of cellulose wall sanythesis by arsenate and azide was also observed in Cosmarium and Closterium species.

ging effects of the metabolic inhibitors employed in the present ssdy.

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Lethal levels determined for these four species are very high as compared to blue-green algae, which points to the fact that these desmids seem to be comparatively more resistant to the dama-

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