

Original Article

Two algal species of *Volvox* L. with their taxonomy and ecology from West Bengal, India

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Abstract

The present paper was communicated with the taxonomic description and ecology of two species of the genus *Volvox* L. viz. *Volvox aureus* Ehr. and *Volvox globator* L. under the order Volvocales of class Chlorophyceae. They are freshwater and planktonic phycoflora. The colony of former species was comparatively smaller (340 µm) than the later (480 µm) whereas, somatic cells were found slightly larger in the former species in comparison to later species. Both were colonial, multicellular, greenish and formed dots like appearances in the water bodies and, exhibited phototactic movements. These two species were being reported first time from Hooghly of West Bengal, India. The ecological study showed that they preferred to grow in alkaline water (pH 7.3-7.5) with slight high organic nutrient contents ($\text{NO}_3\text{-N}$: PO_4^{3-} ratios: 0.25-0.35: 0.30-0.32 mg/l). This study also revealed that higher total alkalinity values (174.0-184.0 mg/l) were favorable for their developments and their maximum growth noticed in summer in aquatic ecosystems.

Keywords: taxonomy, ecology, *Volvox* L., Hooghly, West Bengal, India

1. Introduction

Volvoclean green algae comprise a monophyletic assemblage of lineages indicating varying degrees of complexities in terms of colony size, structure, and cell specializations (Kirk, 1998; Solari *et al.*, 2008). The genus *Volvox* L. includes about 20 species (Shelton *et al.*, 2012). It is a colonial, photosynthetic and planktonic green alga (Yamano *et al.*, 2011). They are free-swimming and show phototactic movements in the presence of sunlight which is due to behavioral changes of the flagella on the illuminated and shaded sides of colony (Solari, 2011). The colony is known as 'coenobium' and consists of a definite number of ovoid cells which are arranged in a particular fashion. It is a flagellate genus of green algae that forms hollow and spherical colonies up to 1 mm in diameter and made up of approximately 500 to several thousands of cells (Beardall *et al.*, 2009). The somatic

cells are connected by delicate cytoplasmic bridges. A small numbers of asexual reproductive cells called 'gonidia' are formed within the interior of the mother colony (Hoops *et al.*, 2000). Its sexual reproduction is oogamous. A perusal of literature survey showed that a few taxonomic investigations on *Volvox* L. species were carried out from India. In this field, some important contributors were those of Iyenger (1933), Apte (1936), Dixit (1937), Rao (1948), Das and Srivastava (1955), Kamat (1962), Patel (1967, 1978), Manohar and Patel (1985), Sau and Gupta (2005), and Halder and Sinha (2016). Besides these, Iyenger and Desikachary (1981) published an excellent monograph on the colonial Volvocales algae named as 'Volvocales' and had given an account of *Volvox* L. species in India. There had been no comprehensive taxonomic and ecological reports on these species from this area of West Bengal, India. Hence, this work had been undertaken.

The aims and objectives of the present study were the exploration and documentation of the Volvocales members in order to make floristic accounts of Chlorophycean algae from this district. Taxonomic descriptions of any new species or taxa are needed to know their morphological characteristics

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and structural peculiarities, for documentations and to know the diversification of the taxa in a particular habitat or ecotype whereas, ecological study is necessary to assess chemical parameters of water and to check the water quality status whether it is polluted or not or may be used for drinking purposes or not as well as to evaluate the role of a particular aquatic organism or taxon to sustain ecosystem healthy. The present ecological study showed that the species of *Volvox* L. preferred to grow in freshwater ecosystems, low turbid, and nutrient rich water with higher total alkalinity values, and summer was the ideal season for their profuse growth because at that time water temperature was found quite high within bracket (28°C - 30°C).

2. Materials and Methods

Algal samples were collected in plastic and glass containers from fresh water habitats at Madhusudanpur (23.01°N; 88.40°E) and Behula (23.18°N; 88.42°E) of Hooghly district (20°30'32" - 23°1'20"N; 87°30'20" - 80°30'15"E), West Bengal, India during the period of 2009 to 2010 in summer season. Detailed taxonomic study was made by examining the specimens under Olympus microscope (Model-CH20i) for descriptions of these species. The samples were preserved in 4% formalin solution and the voucher specimens were deposited in the Departmental Herbarium of R.P.M. College, Uttarpara, Hooghly, West Bengal. Identifications of the taxa were accomplished with the help of authentic literatures and monographs such as Smith (1950), Iyenger and Desikachary (1981), Anand (1998) and Celekli *et al.* (2007). The pH and temperatures of waters were determined immediately after collections with the help of portable pH meter (Model PP9046 Philips, India) and Zeal's mercury thermometers (UK). The other limnological parameters such as nitrate-nitrogen ($\text{NO}_3\text{-N}$), phosphate (PO_4^{3-}), dissolved oxygen (DO), biochemical oxygen demand (BOD), turbidity and total alkalinity of waters were estimated by UV-VIS Spectrophotometry (CECIL CE- 7200) following the standard method (APHA, 2005). All physico-chemical parameters in ecological notes are expressed in mg/l except the pH and temperatures.

3. Results and Discussion

A total number of two planktonic green algal taxa viz. *Volvox aureus* Ehr. and *Volvox globator* L. of the genus *Volvox* L. included to the order Volvocales of the class Chlorophyceae were recorded and described for the first time from two different aquatic ecosystems in Hooghly district of West Bengal, India. Each currently accepted name has been provided with its author (s) name. Their taxonomical descriptions had been provided below:

KEY TO THE SPECIES

1a. Colony 340 µm broad; cells 5.5 µm broad – *Volvox aureus* Ehr.

1b. Colony 480 µm in diameter; cells 4.5 µm broad – *V. globator* L.

Order: Volvocales

Family: Volvocaceae

Genus: *Volvox* L.

1. *Volvox aureus* Ehr. in Abh. Königl. Akad. Wiss. Berlin 1831, Phys. K., 77, 1832; Smith, Fresh Water Algae of the United States 105, fig. 48, 1950; Iyenger and Desikachary, Volvocales 468, figs. 24:1-12, 274, 1981; Anand, Indian Fresh-water Microalgae 25, fig. 69, 1998 (Figure 1A).

Description: Coenobium dioecious, rarely monoecious; colony spherical to sub-spherical and hollow; 340 µm broad; cells 1,500-3,000 in each colony and ovoid; 5.5 µm broad; internal portion of colony filled with homogeneous gelatinous mass; sheath confluent; cells uninucleate; flagella two of equal lengths; two contractile vacuoles present at anterior end of somatic cells; several daughter colonies present within mother colony; sexual reproduction oogamous; oospore rounded; 64.0 µm broad with smooth wall.

Habitat: Moat water (a deep and wide ditch which is smaller than pond in size and water dry up at the late summer) at Madhusudanpur, Hooghly, West Bengal, India

Collection no.: Voucher specimen no. NH 648; dated: 18.04.2010

Ecological notes: Madhusudanpur, water temperature: 30°C; pH: 7.5; $\text{NO}_3\text{-N}$: 0.25; PO_4^{3-} : 0.32; DO: 6.2; BOD: 4.0; turbidity: 14.2; total alkalinity: 174.0

Significance: Primary producer and component of aquatic food chain in freshwater ecosystems.

Remarks: Collected from water in a moat during summer. This species is being reported for the first time from Hooghly, West Bengal, India

Species occurrence: Sporadic

2. *Volvox globator* L. in Syst. Nat. ed. 10, 1: 820, 1758; Celekli, Albay and Dugel in Turk. J. Bot. 31: 59, figs. 6c-e, 2007 (Figure 1B).

Description: Coenobium monoecious, spherical and multicellular; 480 µm broad; cells 800-4,000 in each colony and ovoid or pear-shaped; 4.5 µm broad; cells uninucleate; several daughter colonies formed within the mother colony; sexual reproduction oogamous; oospore spherical with rough cell wall; 55.0 µm broad.

Habitat: Pond water at Behula, Hooghly, West Bengal, India

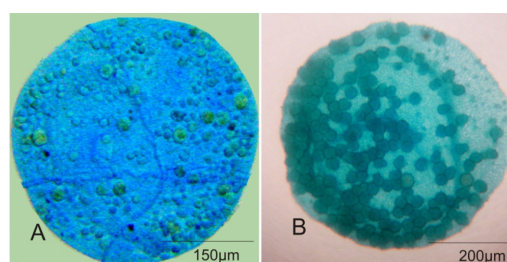


Figure 1. A-B: A. *Volvox aureus* Ehr.; B. *Volvox globator* L.

Collection no.: Voucher specimen no. NH 639; dated: 21.03.2010

Ecological notes: Behula, water temperature: 28°C; pH: 7.3; NO₃-N: 0.35; PO₄³⁻: 0.30; DO: 6.6; BOD: 4.4; turbidity: 15.2; total alkalinity: 184.0

Significance: Primary producer and component of aquatic food chain in freshwater ecosystems.

Remarks: Collected from stagnant water in a pond during summer season. This species is being reported for the first time from Hooghly, West Bengal, India

Species occurrence: Sparsely present

Taxonomic notes: One can easily identify the species of *Volvox* L. from freshwater ecosystems as it is seen in naked eyes as green dots like appearances on the surface of water bodies and they are movable in the presence of light due to having flagella in their somatic cells. In the present study, some distinguishing morphological features had been noticed between these two species. Colony size was observed smaller in *Volvox aureus* Ehr., whereas it was greater in *Volvox globator* L. On the other hand, vegetative cells were found larger in the former species while they were smaller in the later species. Therefore, taxonomic study is prerequisite to identify and classify any algal species or genera found a particular habitat or ecosystem.

4. Conclusions

The current investigation showed that these two species were new taxonomic reports from Hooghly district of West Bengal, India. In addition to that water bodies where these algal species had been grown were less polluted. Perhaps, higher temperature and total alkalinity along with alkaline pH and low turbidity rendering these algal species to grow rapidly in those studied sites.

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