

Oscillatoria simplicissima: An autecological study

A Venter*, S Janse van Vuuren and AJH Pieterse

School of Environmental Sciences and Development: Botany, PU for CHE, Potchefstroom 2520, South Africa.

Abstract

Oscillatoria simplicissima is a blue-green alga that was first observed in the Vaal River during 1984. It replaced *Microcystis aeruginosa* as the dominant blue-green algal species and became dominant after an increase in the organic phosphorus supply in the Loch Vaal catchment area to form algal blooms of great intensity. Although this blue-green alga is presumably non-toxic, a study over a seven-year period shows that it is one of the most important bloom-forming blue-green algal species in the Vaal River, interfering with recreational activities as well as water purification. During this study, environmental variables influencing the development of blue-green algae in a natural environment were studied in order to provide background information for growth studies of this group under controlled conditions. This paper gives an overview of an autecological study done on *O. simplicissima* in the Vaal River at Balkfontein, as well as the isolation and growth requirements of this blue-green alga under controlled conditions.

Introduction

Freshwater is South Africa's most valuable natural resource. Rivers in South Africa are under constant pressure of pollution from agricultural, mining, industrial and domestic uses. Pollution leads to the presence of high concentrations of organic and inorganic compounds, which enhance algal blooms and concomitantly decrease water quality.

The Vaal River is one of South Africa's largest rivers, supplying water to highly populated and industrialised areas. Demands on the Vaal River system for water are exceptionally high and the river and its tributaries are the only water bodies into which effluents from the Johannesburg, Vereeniging and Sasolburg regions can be discharged (Braune and Rogers, 1987). The Vaal River has been described as a nutrient enriched (eutrophic) river system (Pieterse, 1986a; Janse van Vuuren, 1996; 2001 and Roos, 1991). Eutrophication leads to changes in the phytoplankton composition, often shifting the dominance towards blue-green algae. Algal blooms occurring in the Vaal River result in the production of unpleasant odours and tastes and a general decline in water quality that can, in some cases, be aggravated by the production of toxins. These problems are costly to alleviate, may pose health risks to humans and animals alike and in some areas may contribute to the shortage of clean fresh water (Cooke and Carlson, 1989).

O. simplicissima Gomont was first identified in the Vaal River during 1984 (Pieterse and Steynberg, 1993). Since then extensive blooms of *O. simplicissima* were observed in the Loch Vaal (Pieterse and Steynberg, 1993), part of the Vaal River Barrage subcatchment area where self shading conditions may favour gas vacuolated blue-green algae such as *Microcystis aeruginosa* Kützting and *O. simplicissima* that are able to float to the upper, better-illuminated, part of the water column where they can utilise the available light. In the Loch Vaal catchment area, *O. simplicissima* replaced *Microcystis aeruginosa* as the dominant blue-green algal species after an increase in inorganic phosphorus supply, which indicates that growth of *O. simplicissima* had previously been limited by the available inorganic phosphorus concentration

(Pieterse and Steynberg, 1993). Swanepoel (1999) also found that during times of excess nitrogen, high concentrations of phosphorus induced algal blooms in the Loch Vaal.

Although *O. simplicissima* is presumably non-toxic, the magnitude of its blooms causes many problems in the Vaal River during summer seasons. The blooms are responsible for musty odours and colour changes in the water that discourage recreational activities, which have economic implications for the holiday resorts in the area. Soapy scums with methyl-isoborneol (MIB) that cause bad odours and tastes in final purified water as well as the clogging of filters in purification plants by *O. simplicissima* filaments, are impairing the utilisation of water from the river and adding to the high cost of water purification (Krüger, 1999).

With the estimated increase in South Africa's population, sustainable resource management is vital to enhanced economic stability in Southern Africa. In order to manage the Vaal River as a sustainable resource, it is essential to investigate the occurrence of, and factors leading to, blooms of nuisance species closely.

Due to the fairly recent appearance of *O. simplicissima* very little was known about the physiology and growth requirements of this blue-green alga. Because of its increasing disruptions of activities in the Vaal River, Pieterse and Steynberg (1993) recommended that *O. simplicissima* be isolated and cultured in an artificial growth medium and its growth requirements be determined under controlled conditions - hence the decision to do an autecological study on *O. simplicissima*.

The aims of this study were, therefore, to identify environmental variables influencing *O. simplicissima* in a natural (riverine) environment, to isolate *O. simplicissima* from samples taken from the Vaal River at Balkfontein and to investigate the growth requirements of this blue-green alga in controlled growth conditions.

Study area, material and methods

Study area

The study area falls within the middle Vaal River region (between the Vaal Barrage and Bloemhof Dam). A sampling locality was selected at Sedibeng Water at Balkfontein (± 20 km by road from Bothaville) because it is one of the important localities where water is withdrawn from the Vaal River for purification purposes. Massive

* To whom all correspondence should be addressed.

☎ 018 299 2517; fax 018 299 2503; e-mail: plbaav@puknet.puk.ac.za
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