



**HAL**  
open science

# Phytotoxic effects of microcystins on tomato seedlings (*Solanum lycopersicum* var. MicroTom) and soil microbial communities

Sylvain Corbel, Nouredine Bouaicha, Christian Mougin

► **To cite this version:**

Sylvain Corbel, Nouredine Bouaicha, Christian Mougin. Phytotoxic effects of microcystins on tomato seedlings (*Solanum lycopersicum* var. MicroTom) and soil microbial communities. Journées de l'Ecole Doctorale ABIES " De l'usage des ressources naturelles aux défis du changement global ", Feb 2013, Paris, France. 2013. hal-02803313

**HAL Id: hal-02803313**

**<https://hal.inrae.fr/hal-02803313v1>**

Submitted on 2 Apr 2023

**HAL** is a multi-disciplinary open access archive for the deposit and dissemination of scientific research documents, whether they are published or not. The documents may come from teaching and research institutions in France or abroad, or from public or private research centers.

L'archive ouverte pluridisciplinaire **HAL**, est destinée au dépôt et à la diffusion de documents scientifiques de niveau recherche, publiés ou non, émanant des établissements d'enseignement et de recherche français ou étrangers, des laboratoires publics ou privés.

# Phytotoxic effects of microcystins on tomatoe seedlings (*Solanum lycopersicum* var. MicroTom) and soil microbial communities

Sylvain Corbel<sup>1</sup>, Nouredine Bouaïcha<sup>2</sup>, Christian Mougin<sup>1</sup>

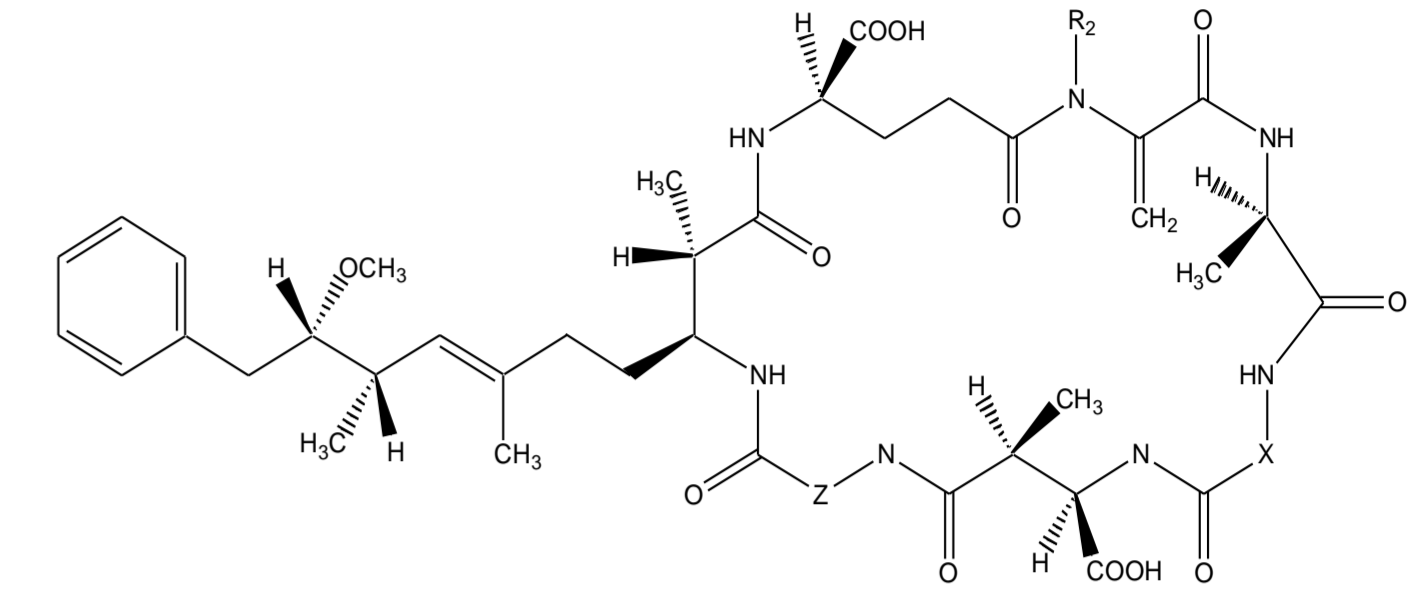
<sup>1</sup> INRA, UR 251, PESSAC, F-78026 Versailles, France; <sup>2</sup> Université Paris-Sud / CNRS / AgroParisTech, UMR 8079, ESE, F- 91405 Orsay, France

## Introduction

The occurrence of harmful cyanobacterial blooms in surface waters is often accompanied by the release of cyanotoxins known as neurotoxins, dermatotoxins, and hepatotoxins. The presence of hepatotoxins of the microcystin type (MC), commonly found in surface waters, can induce adverse effects on aquatic ecosystems, human health, as well as socioeconomic disturbances. By contrast, little is known to date on the possible adverse effects of microcystins on terrestrial ecosystems. The main objective of this study deals with the study of toxic effects of microcystins on tomatoes seedlings (*Solanum lycopersicum* var. MicroTom) and on microbial communities of the soil. Toxins are provided to the soil by irrigation with contaminated water.



Cyanobacterial bloom

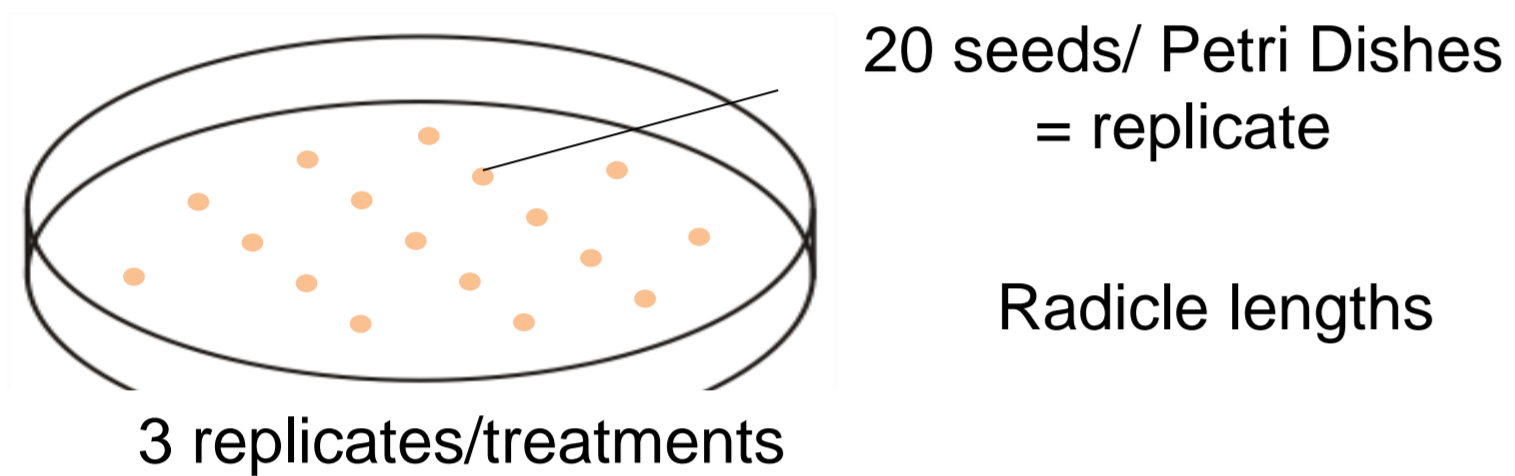


Structure of MCs

## Materials and Methods

Microcystins (MCs) obtained from cultures of *Microcystis aeruginosa* (PCC7820, Pasteur Institute) amount to 6.78 mg equi MC-LR / g DW of cyanobacteria

Germination essays with toxic concentrations (0-20 mg equi MC-LR/L)



350 g of dry sandy soil (2 mm)



3 replicates/treatments

Plantation

10 seeds/replicate

Exposition

Control  
5 µg/L  
20 µg/L  
50 µg/L  
100 µg/L

Harvesting of Plants  
Dry weight

Harvesting of Soil  
Potential nitrification  
DNA quantification  
(Bacteria and Fungi)

Exposure

Moistened the soil

Daily Exposure

J30

## Résultats and Discussion

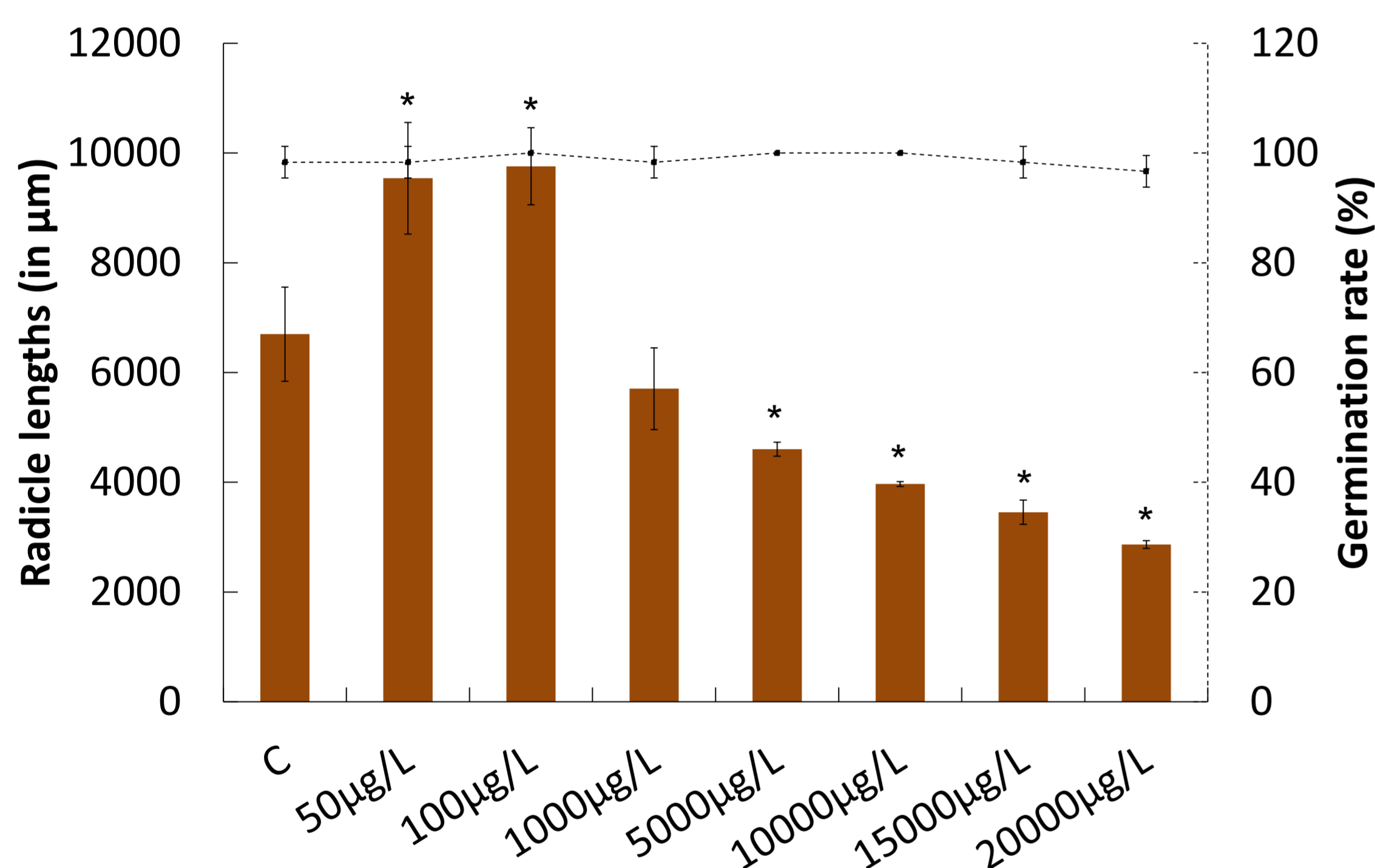


Fig. 1. Germination rate of *S. lycopersicum* seeds and inhibition growth of radicles after exposure to various concentrations of MCs

The exposure of the seeds of *Solanum lycopersicum* var. MicroTom to irrigation water containing different concentrations of microcystins (0-20 mg eq. MC-LR/L) did not decrease its germination rate (Fig. 1).

Growth of radicles (Fig. 1) was significantly increased at low concentrations of microcystins (50 and 100 µg eq. MC-LR/L) and significantly inhibited at higher concentrations (>100 µg eq. MC-LR/L).

Microcystins are strong inhibitors of protein phosphatases in higher plant cells. They can disrupt at low concentrations absorption and transfer of nutrients or root phloem function, thus simulating additional root growth to compensate impaired root function.

Irrigation of the seedlings of *S. lycopersicum* by water containing different concentrations of microcystins (0-100 µg eq. MC-LR/L) showed no effects on root development, but dry biomass of aerial parts increased significantly (Fig. 2).

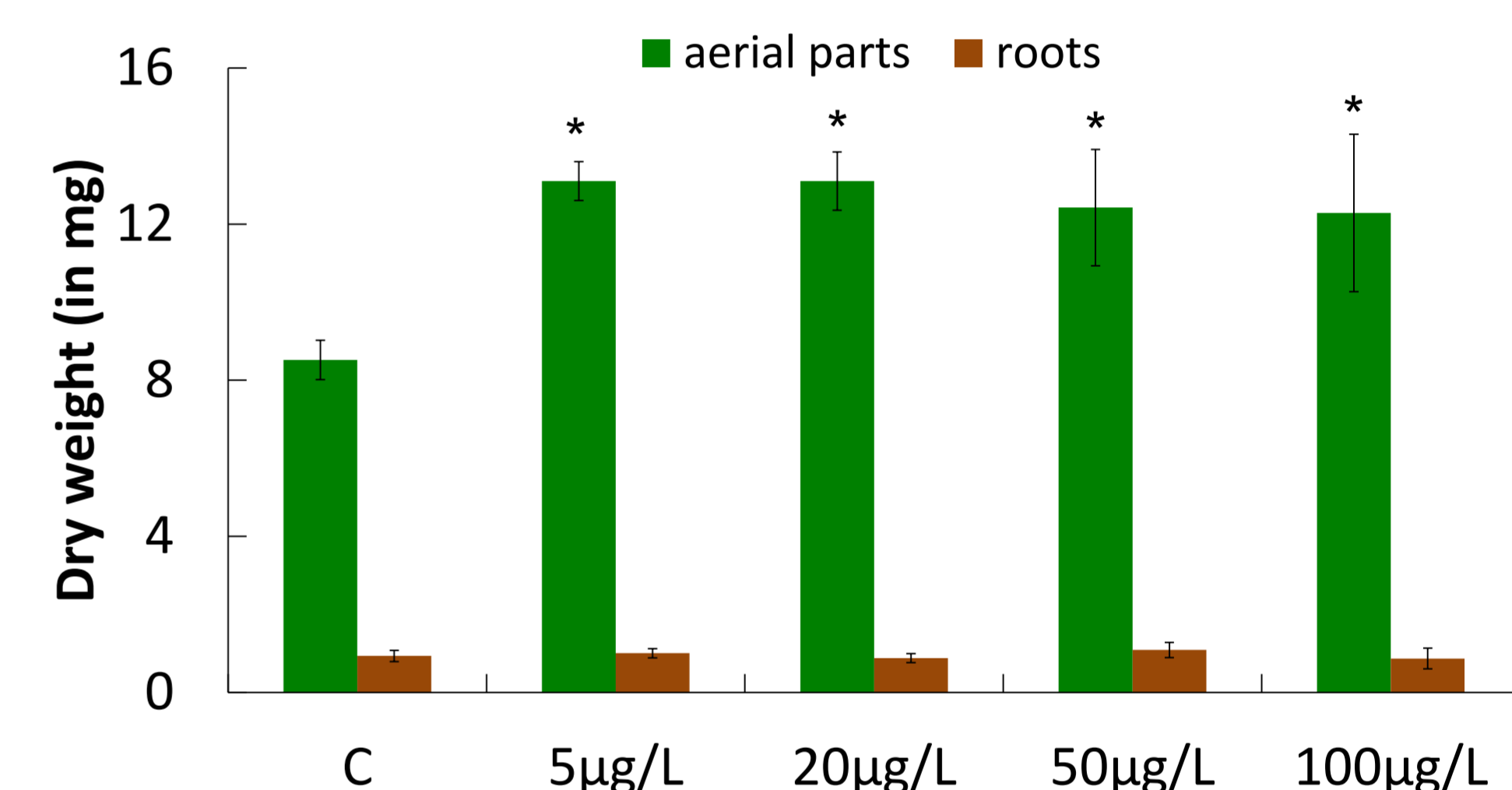


Fig. 2. Dry weight of aerial parts and roots of *S. lycopersicum* seedlings after 15 days of exposure to various environmental concentrations of MCs

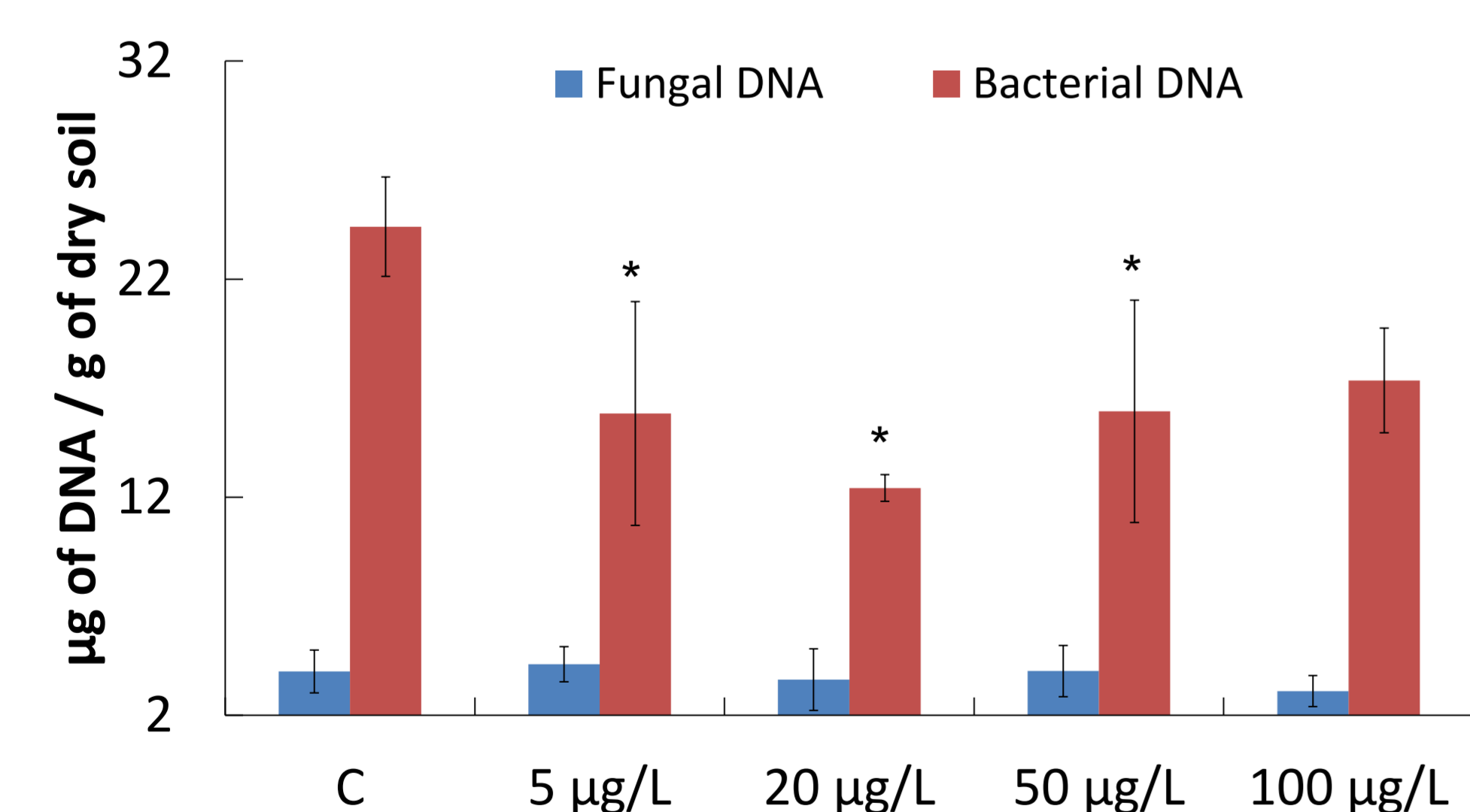


Fig. 3. Quantification of fungal and bacterial DNA in soils after 15 days of exposure to various environmental concentrations of MCs

Bacterial DNA amount was significantly decreased in the irrigated soil, but no effect was observed on fungal DNA level (Fig. 3), suggesting that only soil bacterial population seemed affected by MCs.

However, soil biological activity, such as nitrification was enhanced by microcystins at concentrations ranging from 5 to 50 µg/L. At the highest concentration (100 µg/L), no significant increase of nitrification was observed (Fig. 4).

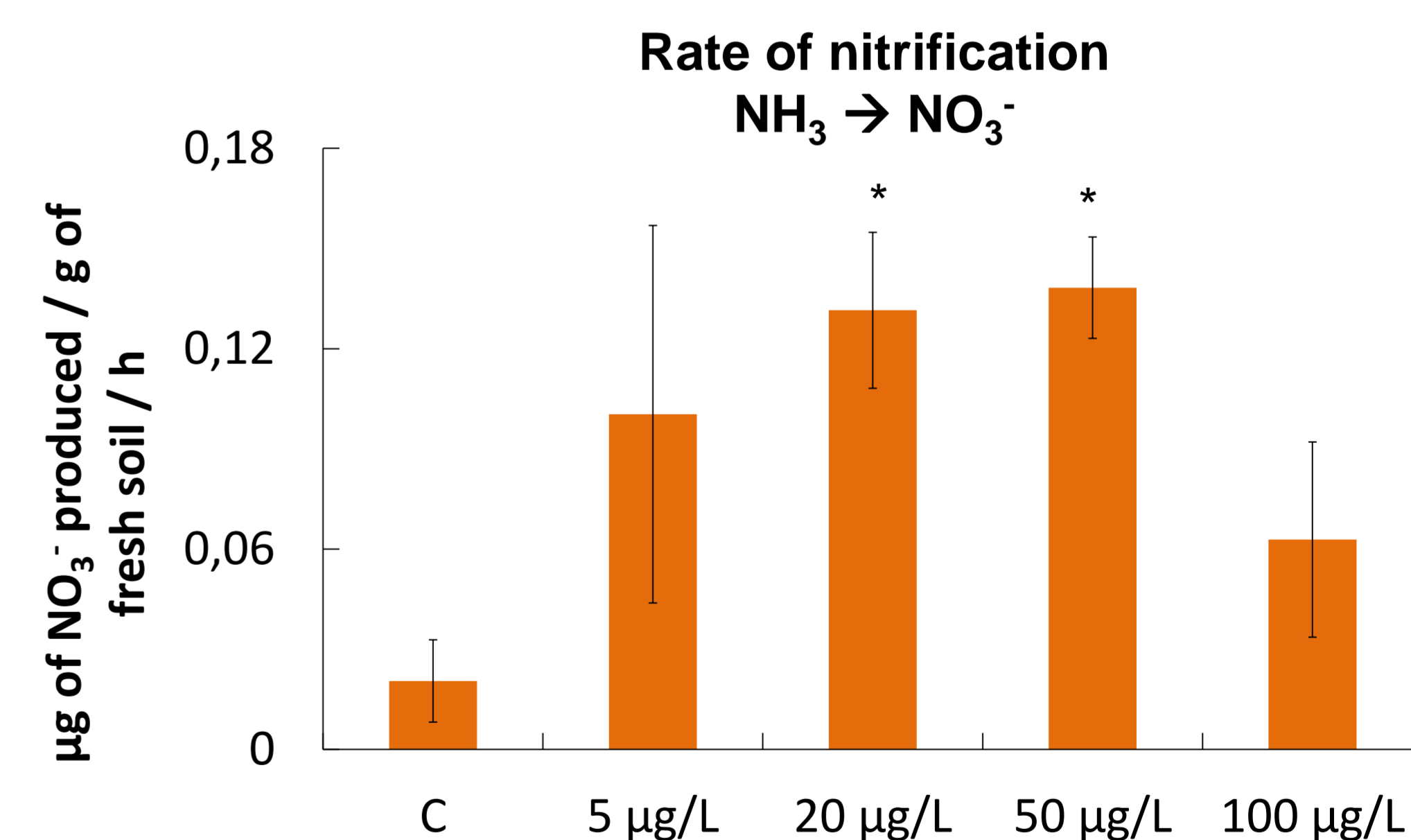


Fig. 4. Rate of nitrification in soil after 15 days of exposure to various environmental concentrations of MCs

## Conclusions

Microcystins are known to affect many processes in plants. In the present study, we evidenced their effects on growth of radicles and seedlings of *Solanum lycopersicum* in soils irrigated with water contaminated with environmental concentrations of MCs. In addition, microcystins affect soil microbial communities by decreasing the size of bacterial populations and increasing the nitrification activities.

## Acknowledgements

Sylvain Corbel thanks the Région Ile-de-France and the Dim Astrea program for supporting his doctoral grant. He is grateful to Virginie Grondin, Christelle Marrault and Olivier Crouzet for their technical assistance during the experiments.