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Impact of microcystin contaminated water on quality of carrots (*Daucuscarota*)

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INTRODUCTION:

Cyanobacteria blooms are often found in freshwaters and may reflect the increased eutrophication of these environments and because of this many water resources worldwide may have a limited utilization. The presence of these microorganisms may pose a serious threat to water quality because many of them produce a large diversity of toxins that can be harmful to human health (Figueiredo *et a*l., 2004). On the other hand contaminated waters used to agricultural purposes may pose additional concerns to food safety. The absorption of toxins by plants may induce morphological and physiological changes that can lead to a loss of productivity as well as toxin bioaccumulation in edible tissues. However, the impact of cyanotoxins on plants and its ability to enter the food chain via this pathway is not fully understood (Kitler*et al.*, 2012).

Microcystin (MC) is the cyanotoxin most frequently present in eutrophic freshwaters causing serious problems to human health, being the liver the main target. These toxins are potent and specific inhibitors of protein phosphatases PP1 and PP2Ain both animals and higher plants (Figueiredo et al., 2004). It is known that MC affect a number of physiological processes in plants (Corbel *et al.*, 2013).

The plant root system is usually more exposed, via soil irrigation, and therefore root-vegetables more prone to contamination. Carrots (*Daucuscarota*) are root-vegetables with great importance for human nourishment and economy, with extensive use all over the world (Singh *et al.*, 2012).

This work aims to evaluate the effects of the use of water containing MC in the growth and production of this specific horticultural crop as well as toxin accumulation.

MATERIALS AND METHODS:

Young carrots (˜ 1 month old) were grown in soil during 1 month in greenhouse conditions. Three groups were performed with plants being irrigated twice a week with non-contaminated water (control group) or with a crude *Microcystis aeruginosa* extract containing respectively 10 and 50 µg/L MC.

Fresh weight of plants was determined 3 times (0, 15 and 30 days), weighing leaves and roots (carrot) and dry weight was estimated in lyophilized leaves and roots.

Chlorophyll fluorescence was accessed through pulse amplitude modulation (PAM) fluorometry following the method described by Maxwell and Johnson (noninvasive method)(Maxwell & Johnson., 2000). Plants were adapted to darkness for at least 30 minutes and then leaves were illuminated with a pulse of saturating light and the fluorescence emitted was measured using PAM 2000 (Walz, Effeltrich, Germany).

The accumulation of toxin on soil and in carrots was determined using the MicroCystest which is based on the phosphatase activity inhibition by MC.

RESULTS AND DISCUSSION:

No significant variations (P<0.05) in fresh and dry weight of leaves and carrots were observed at any concentration of toxin, suggesting that the plant exposure to a *M. aeruginosa* toxic extract containing concentrations of MC between 10 and 50 µg/L does not impair plant growth. The results showed that both short and prolonged exposure to MC concentrations does not seem to be a stress factor for plants leading, inclusively, to a stimulation of photosynthesis. The results of MicroCystest showed a significant accumulation in the soil (13,225µg MC /g soil), however accumulation of MC in carrots is below the limit of detection of the method.

CONCLUSION:

According to our knowledge this is the first work reporting the effects of MC on carrots, in which growth, photosynthesis and accumulation were investigated. Exposure of carrots to these concentrations of MC did not seems to have adversely affected any of the parameters evaluated. However we hypothesize that other physiological and metabolic processes (synthesis of vitamins and nutrient accumulation) should be also studied in the future.

Our future work will focus on the evaluation of the toxin accumulation with more sensitive techniques (liquid chromatography and mass spectrometry)and the nutritional value of carrots (nutrients and vitamins).

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