

Cyanotoxin uptake by food crops – what's the risk? Souther

Peter Hobson

Howard Fallowfield, Sandra Henville, Shayne Faulkner, Paul Canala, Martin Faulkner, Suzanne Froscio













September 2023













Introduction

- Cyanotoxin uptake by food crops has been on the radar for several decades
- Increase use of recycled wastewater has heightened awareness
- Does it pose a health risk to consumers?
- Initial discussions between SA Health and SA Water with subsequent interest from the wider water industry through Water RA resulted in:

Cyanotoxin Risk in Recycled Water Used for Food Crop Irrigation – Water RA Project Number: #3049 (2022 – 2026)



Cyanotoxin risk in recycled water used for food crop irrigation - Water RA #3049

- 1. Literature Review: Conduct comprehensive review of scientific literature to determine current understanding of the issue. Shayne Faulkner
- 2. SA Water, Investigation: Review the extent of recycled water use on crops and pasture in Australia, and Worldwide. Martin Faulkner
- 3. Flinders Uni, Honours Project: Biodegradation of microcystin within soils. Paul Canala
- 4. SA Water/Interstate Authorities: Test for cyanotoxins in South Australia and Interstate food crops. Peter Hobson
- 5. Flinders Uni, PhD Project: Investigate the fate of cyanobacterial toxin in the journey from recycled wastewater through to uptake by irrigated crops. Shayne Faulkner





Fate of Toxins Following Irrigation

Source

- Surface Water
- Recycled Wastewater

Groundwater Hydroponics Fertiliser Drip



- Intracellular
- Extracellular







Contamination:

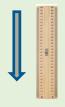
- Internal
- External

Consumption Risk assessment



Partitioning

- Shoots/leaves/fruits
- Roots



Penetration depth





Soil type / Chemistry Adsorption/Desorption



Biodegradation

Plant uptake

Paul Canala and Prof. Howard Fallowfield 2023





Preliminary Risk Assessment

- Three values were used to assess risk to consumers
 - 1. ABS median daily consumption of fruit and vegetables 2011/2012
 - 2. Toxin levels measured in edible food crops from literature
 - 3. Tolerable daily intakes (TDI) for chronic exposure to cyanotoxins
 - Microcystin 0.04 ug/kg body weight/day (WHO guideline based on Fawell et al., 1999)
 - Cylindrospermopsin 0.03 ug/kg body weight/day (WHO guideline based on Humpage and Falconer 2003)
- TDI if food is sole source of toxin for a 70kg adult
 - Microcystin 2800 ng/day
 - Cylindrospermopsin 2100 ng/day





Preliminary Risk Assessment

Maximum concentration of toxin allowed in food crop (ng/g) before reaching tolerable daily intake if sole source of toxin for 70kg person

Food Crop	Microcystin (ng/g)	Cylindrospermopsin (ng/g)
Leaf and Stalk	114	85
Root Vegetables	75	57
Tomato	74	55
Rice	17	13



Preliminary Risk Assessment

Summary of literature results - edible components only

3011111ary of illerature results - earbie components offig						
Experiment Type	No. of Papers	Plant type Tested	Toxin Source	Toxins Tested Microcystin (MIC) Cylindrospermopsin (CYP)	Plant showing exceedance of TDI	
Field	4	Root Veg., Leafy Greens, Rice, Fruiting Veg.	1 x ground water3 x bloom	MIC	All 4 papers - cabbage, dill, lettuce, parsley, spinach, rice	
Laboratory Hydroponics	3	Leafy Greens	2 x cyano extract1 x pure toxin	MIC, CYP	1 paper, MIC, lettuce	
Laboratory, soil, water at base	10	Leafy Greens, Fruiting Veg., Root Veg., Rice, Tomato	5 x pure toxin5 x cyano extract4 x bloom	MIC	4 papers, MIC, root veg, rice	
Laboratory, soil, water over whole plant	7	Leafy Greens, Root Veg.	3 x pure toxin3 x cyano extract	MIC, CYP	4 paper, MIC, lettuce	
Soil Conditioner	1	Leafy Greens	Cyanobacteria biomass	MIC		





Summary

- Initial review of scientific literature suggests a potential for food crops irrigated with cyanotoxin to pose a health risk to consumers
- More information needed:
 - Are toxin levels in literature representative of those found in irrigation waters
 - Are irrigation methods used in the literature comparable to real practices
 - What happens to toxins from point of irrigation to presence in food crop
 - Extent of recycled water use on food crops in Australia
- Cyanotoxin risk in recycled water used for food crop irrigation Water RA #3049 will provide this information
- Outcomes from this project can be used by health regulators and the agricultural industry to guide future policies and guidelines on cyanotoxins in irrigation water and food crops.







Thankyou

Peter Hobson, Howard Fallowfield, Sandra Henville, Shayne Faulkner, Paul Canala, Martin Faulkner, Suzanne Froscio















September 2023











