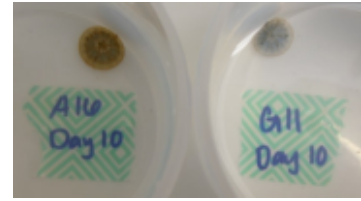


Effects of herbicide exposure on growth and photosynthetic efficiency of the upside-down jellyfish *Cassiopea marmetens* (NESP TWQ 3.1.5, AIMS and JCU)


[Metadata](#) | [Metadata \(XML\)](#)

Title	Effects of herbicide exposure on growth and photosynthetic efficiency of the upside-down jellyfish <i>Cassiopea marmetens</i> (NESP TWQ 3.1.5, AIMS and JCU)
Date	2020-03-06
Date type	Creation
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Abstract

This dataset shows the effects of hexazinone (detected in the Great Barrier Reef catchments) on growth (as bell surface area), photosynthesis (effective quantum yield), zooxanthellae density (cells mm⁻²) and statolith number on the upside-down jellyfish *Cassiopea marmetens* during laboratory experiments conducted in 2017.

The aims of this project were to develop and apply standard ecotoxicology protocols to determine the effects of the Photosystem II (PSII) herbicide hexazinone on the host jellyfish (growth) and endosymbiont photosynthetic efficiency (effective quantum yield and zooxanthellae density) and statolith number. A bioassay was performed over an exposure period of 14 days using hexazinone, a herbicide that has been detected in the Great Barrier Reef catchment area (O'Brien et al. 2016). The toxicity data will enable improved assessment of the risks posed by hexazinone to cnidarians and their symbionts for both regulatory purposes and for comparison with other taxa.

Methods:

Cassiopea marmetens were sourced from Lake Magellan, Sunshine Coast, Queensland. Jellyfish were held in 10-20 L plastic tanks partially filled with natural 0.5 µm-filtered seawater in the Marine and Aquaculture Research Facilities Unit (MARFU) at James Cook University, Townsville, Queensland.

Herbicide stock solutions (100 mg L⁻¹) were prepared using PESTANAL (Sigma-Aldrich) analytical grade hexazinone (CAS 51235-04-2). Hexazinone was dissolved in the carrier solvent acetone (final concentration 0.01% v/v), and the stock solution was prepared in Milli-Q® water. A control (no herbicide) and solvent control treatments were added to support the validity of the test protocols and to monitor continued performance of the assay. Herbicide analysis was performed by The University of Queensland, Queensland Alliance for Environmental Health Sciences (QAEHS), Woolloongabba, 4102, Australia.

Individual *C. marmetens* medusae of similar size were placed in 250 mL plastic tanks and subjected to designated control/exposure treatments for 14 days. The treatments included two control treatments and five herbicide exposure treatments. Individuals were maintained at 25 ± 1 °C media temperature on a 12:12 h light:dark cycle under light intensity of 146 ± 15 µmol m⁻² s⁻¹. Medusae were fed 24-hr old *Artemia nauplii* every other day with complete solution replacement 2-5 hrs after feeding.

Bell surface area (mm²) was determined using photographs taken every five days and analysed using the software ImageJ (Reuden et al.2017).

Zooxanthellae density was performed following an adapted protocol of tissue digestion used in Zamoum and Furla (2012) to extract the zooxanthellae. Immediately following zooxanthellae extraction, zooxanthellae counts were conducted per individual using a Neubauer Improved

haemocytometer. Zooxanthellae density (cells mm⁻²) was standardized to the bell surface area (mm²) of digested tissue volume.

Effects of hexazinone on the photosynthetic efficiency of *C. maremetens* was measured by chlorophyll fluorescence as the effective quantum yield (Delta F/Fm') using pulse amplitude modulation fluorometry (mini-PAM, Walz, Germany). Light adapted minimum fluorescence (F) and maximum fluorescence (Fm') were determined and effective quantum yield was calculated for each treatment as per equation (1)(Schreiber et al. 2002).

$$\text{Delta F/Fm}' = \text{Fm}' - \text{F/Fm}'$$

Statoliths were extracted and counted following the Hopf and Kingsford (2013) protocol.

Mean percent inhibition in bell surface area, Delta F/Fm' and statolith count of each treatment relative to the control treatment was calculated as per equation (2)(OECD 2011), where Xcontrol is the average bell surface area, Delta F/Fm' or statolith count of control and Xtreatment is the average bell surface area, Delta F/Fm' or statolith count of single treatments.

$$\% \text{ Inhibition} = [(X_{\text{control}} - X_{\text{treatment}}) / X_{\text{control}}] \times 100$$

Effect concentrations, EC10 and EC50, for the bell surface area, photosynthetic efficiency Delta F/Fm', and statolith count were obtained relative to the control treatment.

Format:

Cassiopea maremetens herbicide toxicity data_eAtlas.xlsx

Data Dictionary:

There are five tabs for hexazinone in the spreadsheet. The first tab corresponds to the bell surface area data; the second tab is the pulse amplitude modulation (PAM) fluorometry data; the third tab is the zooxanthellae density data; the fourth tab is the statolith data; and the fifth tab shows the measured water quality (WQ) parameters (pH, salinity, and temperature) of the test.

For each Hex_ 'XXX' tab:

Nominal (µg/L) = nominal herbicide concentrations used in the bioassays; SC denotes solvent control which is no herbicide and contains less than 0.01% v/v solvent carrier

Measured (µg/L) = measured concentrations analysed by The University of Queensland

Rep = Replicate: for Bell and Zoox, notation is 1-5; for PAM and Stat data, notation is A, B, C, etc.

Hex – Hexazinone

- = no data

For the 'Hex_Bell' tab: (includes information for each Hex_ 'XXX' tab as well as...)

T14_SA (mm²) = Bell Surface Area at Day 14 (mm²)

For the 'Hex_PAM' tab: (includes information for each Hex_ 'XXX' tab as well as...)

PAM = pulse amplitude modulation fluorometry to calculate effective quantum yield (light adapted)

No = number of measurements taken per individual *Cassiopea maremetens*.

Delta F/Fm' = effective quantum (light adapted) yield measured by a Pulse Amplitude Modulation (PAM) fluorometer

For the 'Hex_Zoox' tab: (includes information for each Hex_ 'XXX' tab as well as...)

T14_CellsPer_mm2 = zooxanthellae density at day 14 (cells per mm²)

For the 'Hex_Stat' tab: (includes information for each Hex_ 'XXX' tab as well as...)

No = number of measurements taken per individual *C. maremetens*.

T14_StatolithsperStatocyst = number of statoliths contained within a statocyst

References:

Hopf, J.K., Kingsford, M.J., 2013. The utility of statoliths and bell size to elucidate age and condition of a scyphomedusa (*Cassiopea* sp.). *Marine Biology* 160, 951-960

O'Brien, D., Lewis, S., Davis, A., Gallen, C., Smith, R., Turner, R., Warne, M., Turner, S., Caswell, S. and Mueller, J.F. (2016) Spatial and temporal variability in pesticide exposure downstream of a heavily irrigated cropping area: application of different monitoring techniques. *Journal of Agricultural and Food Chemistry* 64(20), 3975-3989.

OECD (2011) OECD guidelines for the testing of chemicals: freshwater alga and cyanobacteria, growth inhibition test, Test No. 201. <https://search.oecd.org/env/test-no-201-alga-growth-inhibition-test-9789264069923-en.htm>

Rueden, C. T.; Schindelin, J. & Hiner, M. C. et al. (2017), "ImageJ2: ImageJ for the next generation of scientific image data", *BMC Bioinformatics* 18:529, PMID 29187165, doi:10.1186/s12859-017-1934-z

Schreiber, U., Müller, J.F., Haugg, A. and Gademann, R. (2002) New type of dual-channel PAM chlorophyll fluorometer for highly sensitive water toxicity biotests. *Photosynthesis Research* 74(3), 317-330.

Zamoum, T., Furla, P., 2012. Symbiodinium isolation by NaOH treatment. *J Exp Biol* 215, 3875-3880.

Data Location:

This dataset is filed in the eAtlas enduring data repository at: [data\nesp3\3.1.5_Pesticide-guidelines-GBR](#)

Metadata language	eng
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Character set	UTF8
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Hierarchy level	Dataset
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OnLine resource

Linkage	https://eatlas.org.au/data/uuid/3c716ba9-42b3-4736-8521-479d17e9b99e
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Protocol	WWW:LINK-1.0-http--metadata-URL
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Linkage	https://nesptropical.edu.au/index.php/round-3-projects/project-3-1-5/
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Protocol	WWW:LINK-1.0-http--related
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Linkage	https://eatlas.org.au/data/uuid/71127e4d-9f14-4c57-9845-1dce0b541d8d
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Protocol	WWW:LINK-1.0-http--related
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Linkage	https://eatlas.org.au/nesp-twq-3/pesticide-guidelines-gbr-3-1-5
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Protocol	WWW:LINK-1.0-http--related
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Linkage	https://eatlas.org.au/pydio/public/au-nesp-twq-3-1-5-aims-pesticide-guidelines-gbr-cassiopea-maremetens-2020-03-06
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Protocol	WWW:LINK-1.0-http--downloaddata
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Point of contact

Individual name	Templeman, Michelle (Shelley)
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Organisation name	James Cook University
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Role	Point of contact
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Topic category	Biota
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Extent

Description	Great Barrier Reef, Australia
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File identifier	3c716ba9-42b3-4736-8521-479d17e9b99e
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Metadata language	eng
Character set	UTF8

Metadata author

Individual name	eAtlas Data Manager
Organisation name	Australian Institute of Marine Science (AIMS)
Role	metadataContact
Date stamp	2020-11-18T04:31:23