

Multiple stressor effects of ionising (gamma) radiation and non-ionising (UV) radiation in duckweed (*Lemna minor*)

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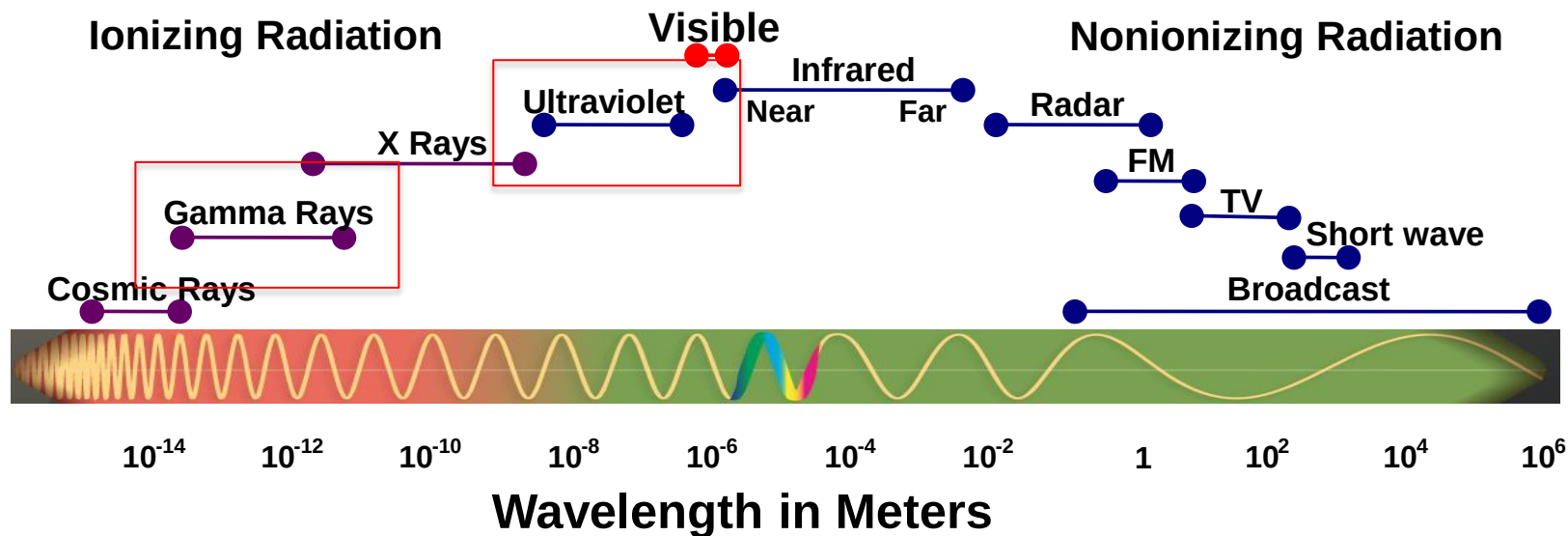
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Ionizing and Non-Ionizing radiation



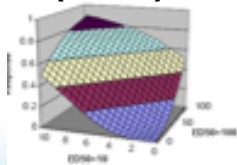
The challenge



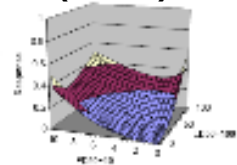
What will happen in
the aquatic ecosystem?



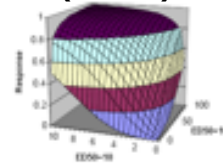
Additivity
(1+1=2)



Antagonism
(1+1<2)



Synergy
(1+1>2)



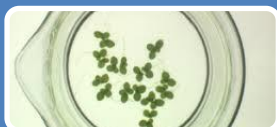
Duckweeds (*Lemna minor*)



Central function in aquatic ecosystems



Easily cultured in controlled laboratory conditions



✧ Standardised protocols available for regulatory testing



Rapid reproduction capacity

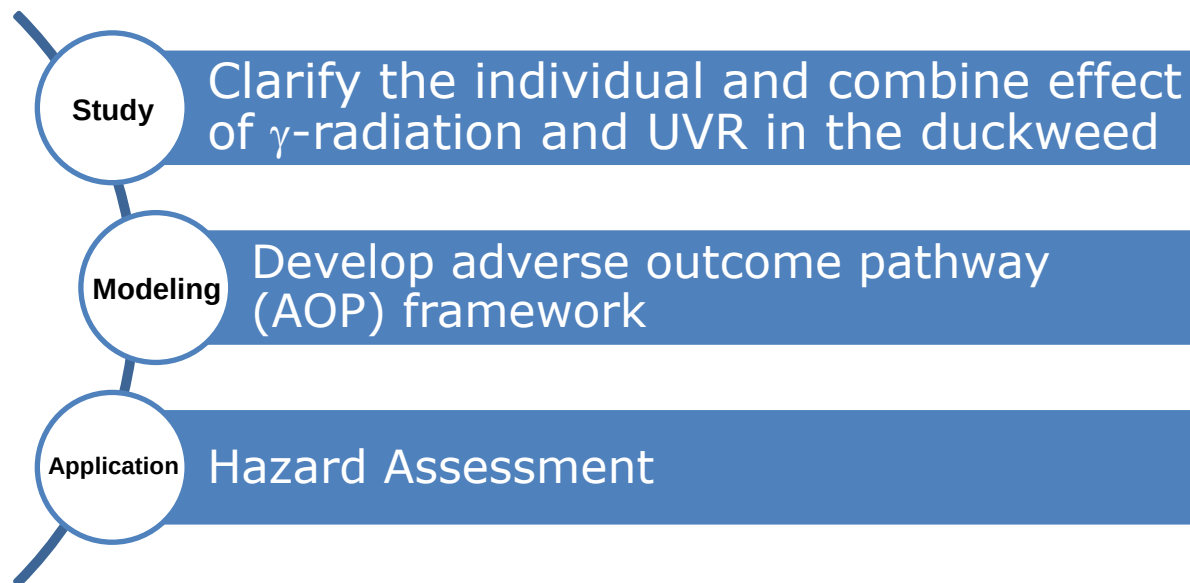


✧ Highly sensitive to contaminants



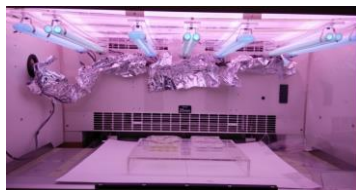
✧ Genome partly sequenced, molecular tools partly available

Objective

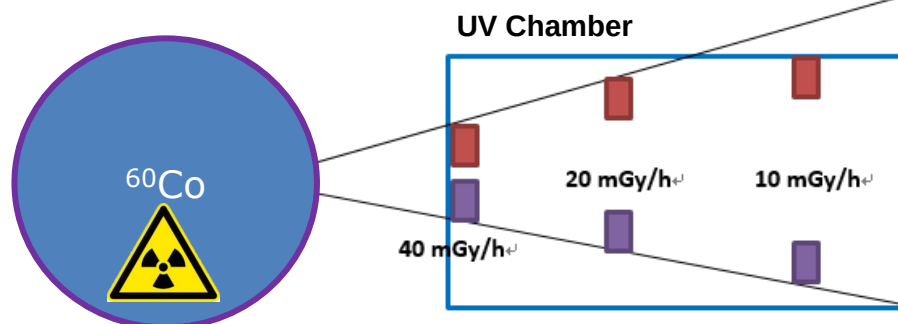
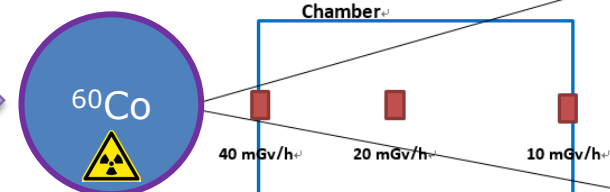


Approach

Study 1: UV radiation effects



Study 2: Gamma radiation effects



Study 3: UV and gamma radiation combined effects



Endpoints:

Growth
ROS formation
Lipid peroxidation
OXPHOS
PSII efficiency
Pigments
DNA damage
Gene expression

Gamma dose rate D_{Water} (mGy/h)*	Gamma total dose D_{Water} (mGy)	UV Dose rate (W/m ²)
13.2	2195	0.5±0.03
20.3	3375	
47.1	7831	

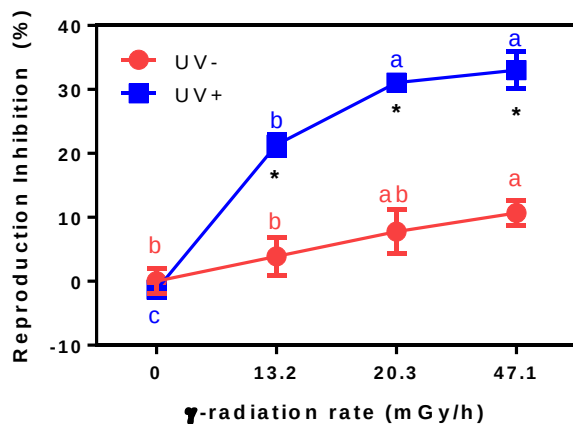
Statistics

Two-way ANOVA

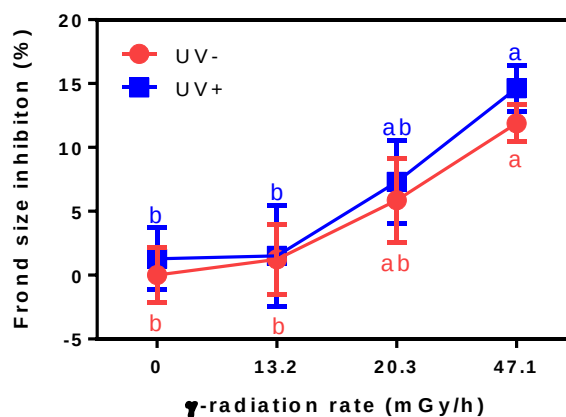
Growth



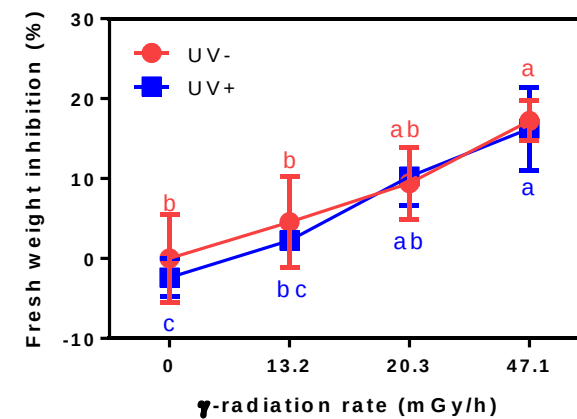
Reproduction



Frond size

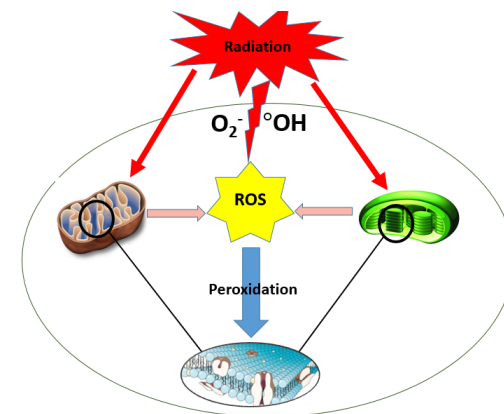


Frond weight

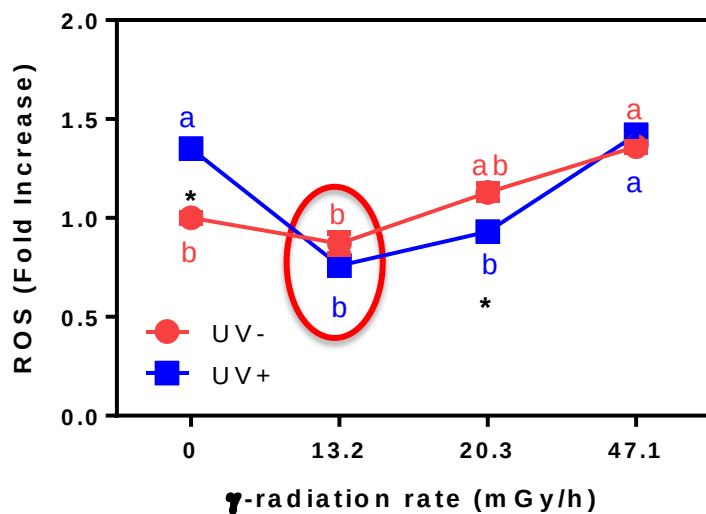


UV did not interrupt gamma radiation effects on frond size and weight but reproduction rate.

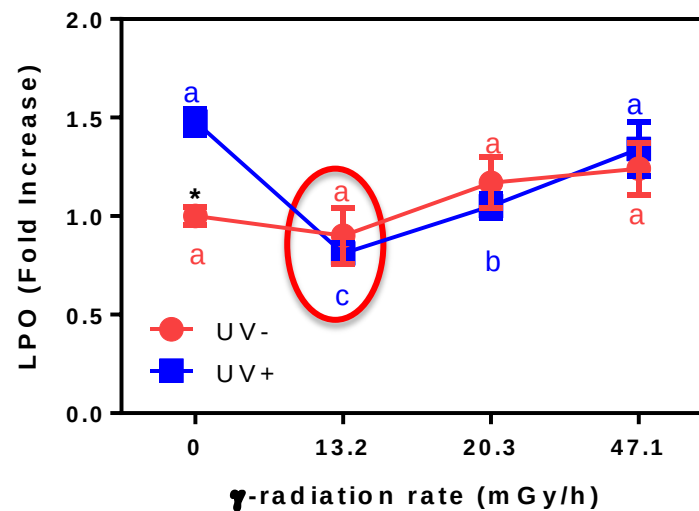
Oxidative stress



ROS formation

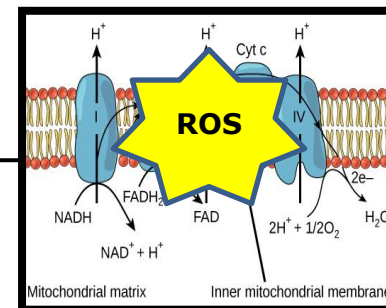


Lipid peroxidation

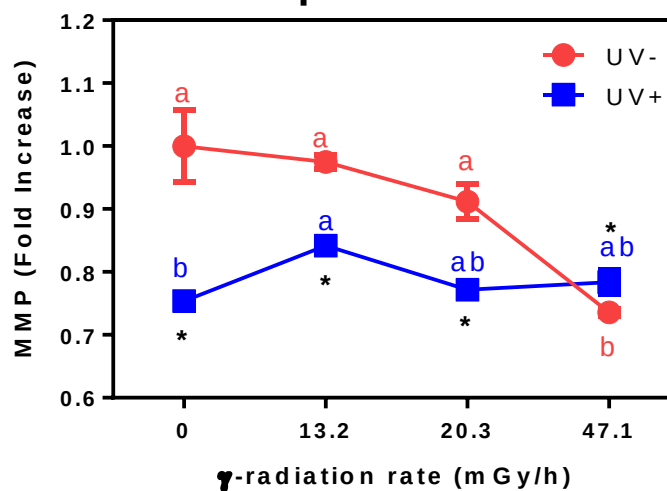


**Activation
antioxidant
defense system**

Oxidative phosphorylation

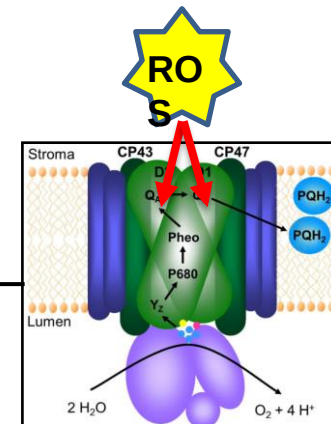


Mitochondrial membrane potential

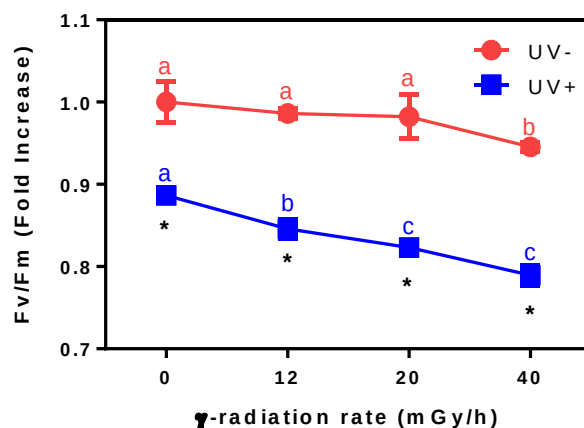


UVR reduced MMP and interfere gamma radiation effect

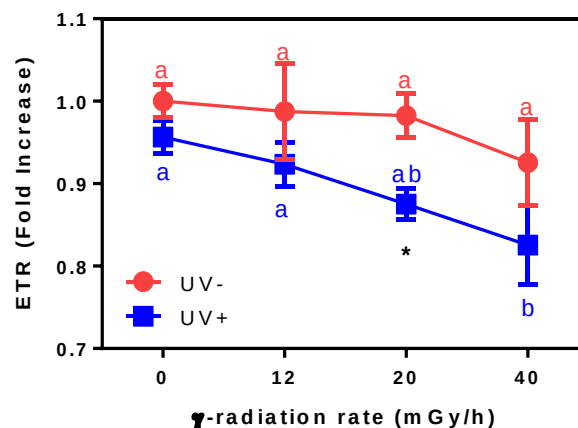
PS II inhibition



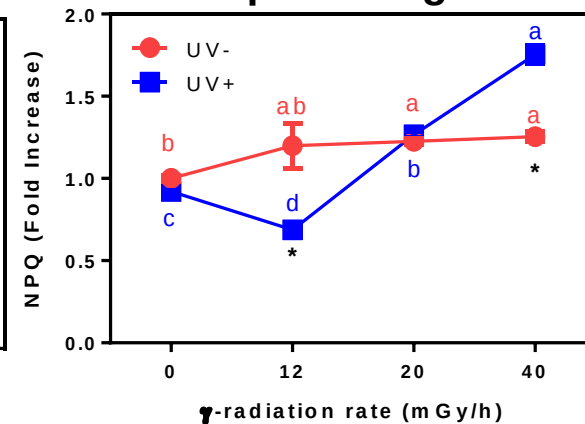
Maximal PS II efficiency



Electron transport rate

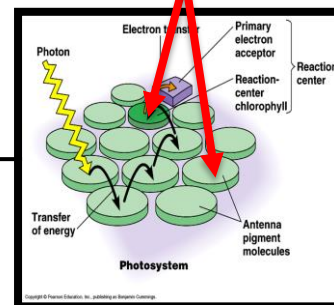
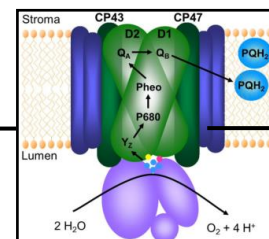
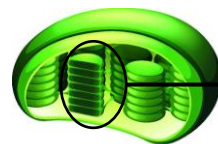


Non-photochemical quenching

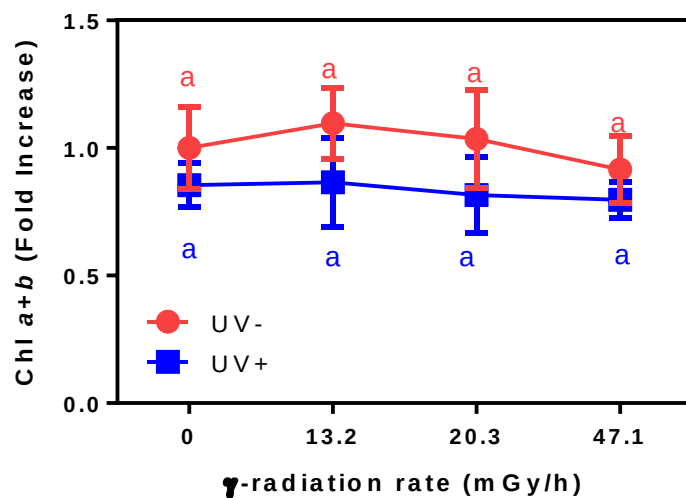


In combined exposure, γ -radiation and UV had additive effects on Fv/Fm

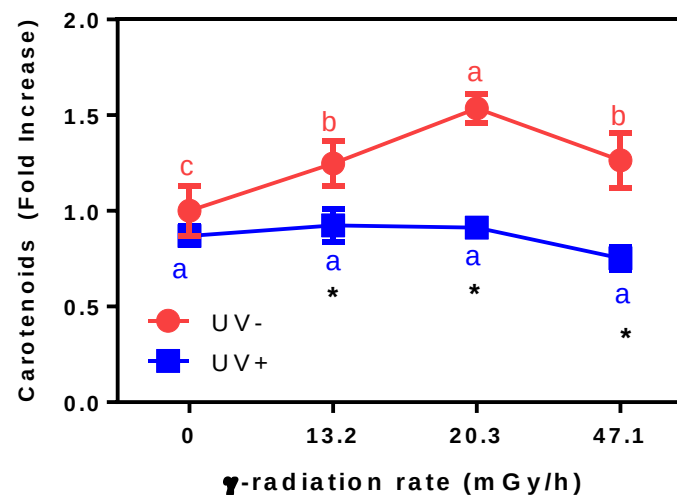
Pigment content



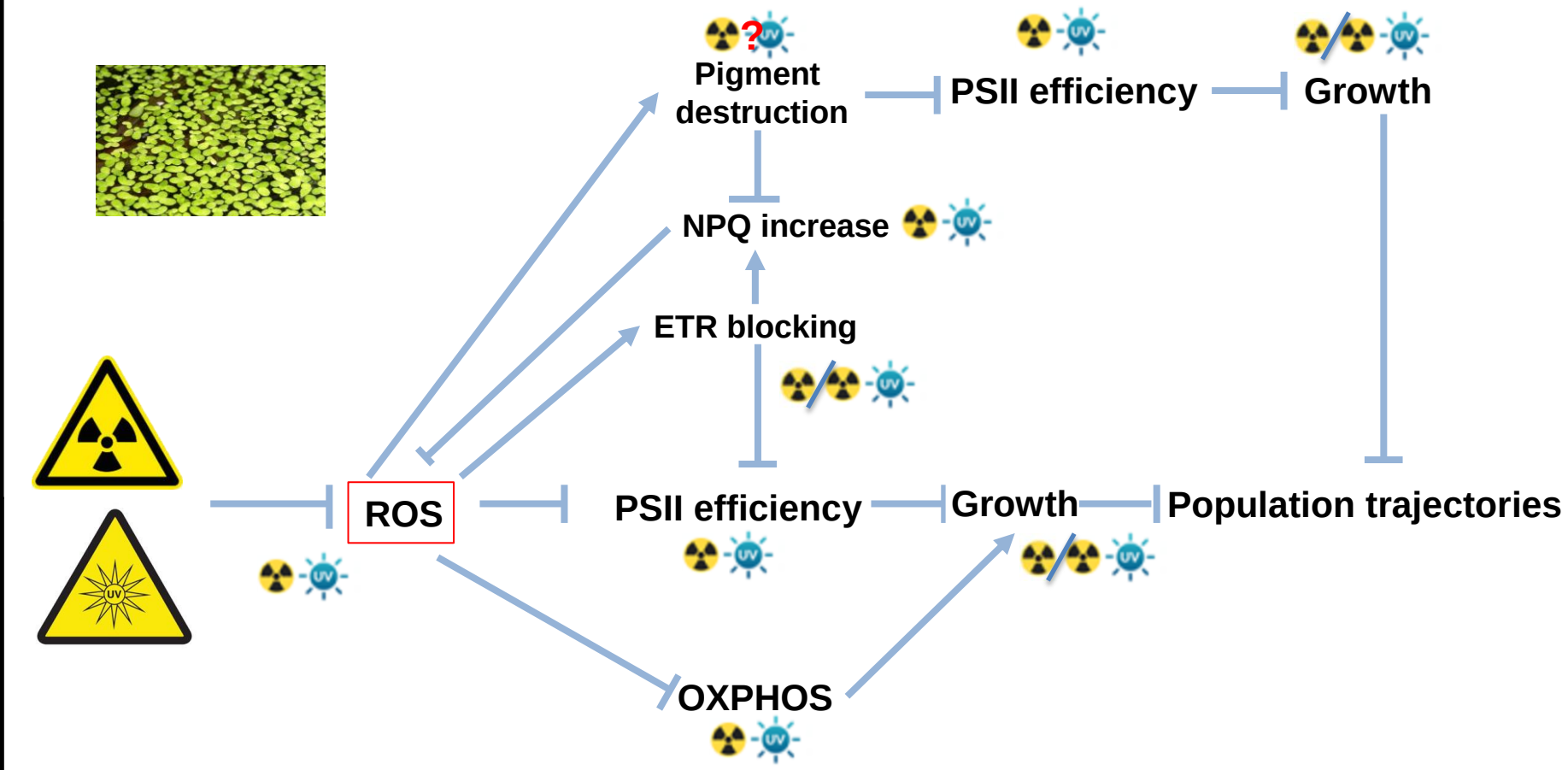
Total chlorophyll



Total carotenoids



Carotenoids are also antioxidants to quenching ROS in plant



Tânia Gomes
You Song

Dag Brede
Dag Wenner
Hans Christian Teien
Yetneberk Ayalew Kassaye

Terje Christensen



THANK YOU!

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QUESTIONS
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