



**Sori disinfection in cultivation of *Saccharina latissima*; evaluation of chemical treatments against diatom contamination**

Supervisors: Yngvar Olsen (NTNU)  
Kjell Inge Reitan (SINTEF)

Foto: Kaia Kjølbo Rød

# Diatom contamination

- Most threatening algae group in seaweed cultivation
- Compete for abiotic factors
- Epiphytic flora on sori



# Aim of the thesis

To find a disinfecting method that relieves sori from diatom contamination, without damaging the spores or affecting the early development of young sporophytes

# Experimental design

## 1. Chemical survey on diatoms in free suspension

- Acetic acid, Ethanol, Formaldehyde, Lugol's solution, Sodium hypochlorite (130 different trials)

## 2. Sori disinfection, evaluation of sporophyte development and diatom contamination

- Spore release
- Sporophyte density
- Pictures
- +/- diatoms

# 1. Results of the chemical survey

Positive growth when  $SGR > 0.05 \text{ day}^{-1}$

Chemical	Exposure time	Exposure temp: 10°C				Exposure temp: 15°C			
Acetic acid	<i>Concentration</i>	<b>1%</b>	<b>7%</b>	<b>35%</b>	<b>50%</b>	<b>1%</b>	<b>7%</b>	<b>35%</b>	<b>50%</b>
	2min	-	-	-	-	-	-	-	-
	4min	-	-	-	-	-	-	-	-
	10min	-	-	-	-	-	-	-	-
	30min	-	-	-	-	-	-	-	-
Ethanol	<i>Concentration</i>	<b>25%</b>	<b>50%</b>	<b>70%</b>		<b>25%</b>	<b>50%</b>	<b>70%</b>	
	2min	+	+	-		-	+	-	
	4min	+	-	-		-	-	-	
	10min	-	+	-		-	-	-	
	30min	-	-	-		-	-	+	
Formaldehyde	<i>Concentration</i>	<b>0.04%</b>	<b>0.4%</b>	<b>4%</b>		<b>0.04%</b>	<b>0.4%</b>	<b>4%</b>	
	2min	+	+	-		+	+	-	
	4min	+	-	-		+	+	-	
	10min	+	-	-		+	-	-	
	30min	+	-	-		+	-	-	



# 1. Results of the chemical survey

Positive growth when  $\text{SGR} \leq 0.05 \text{ day}^{-1}$

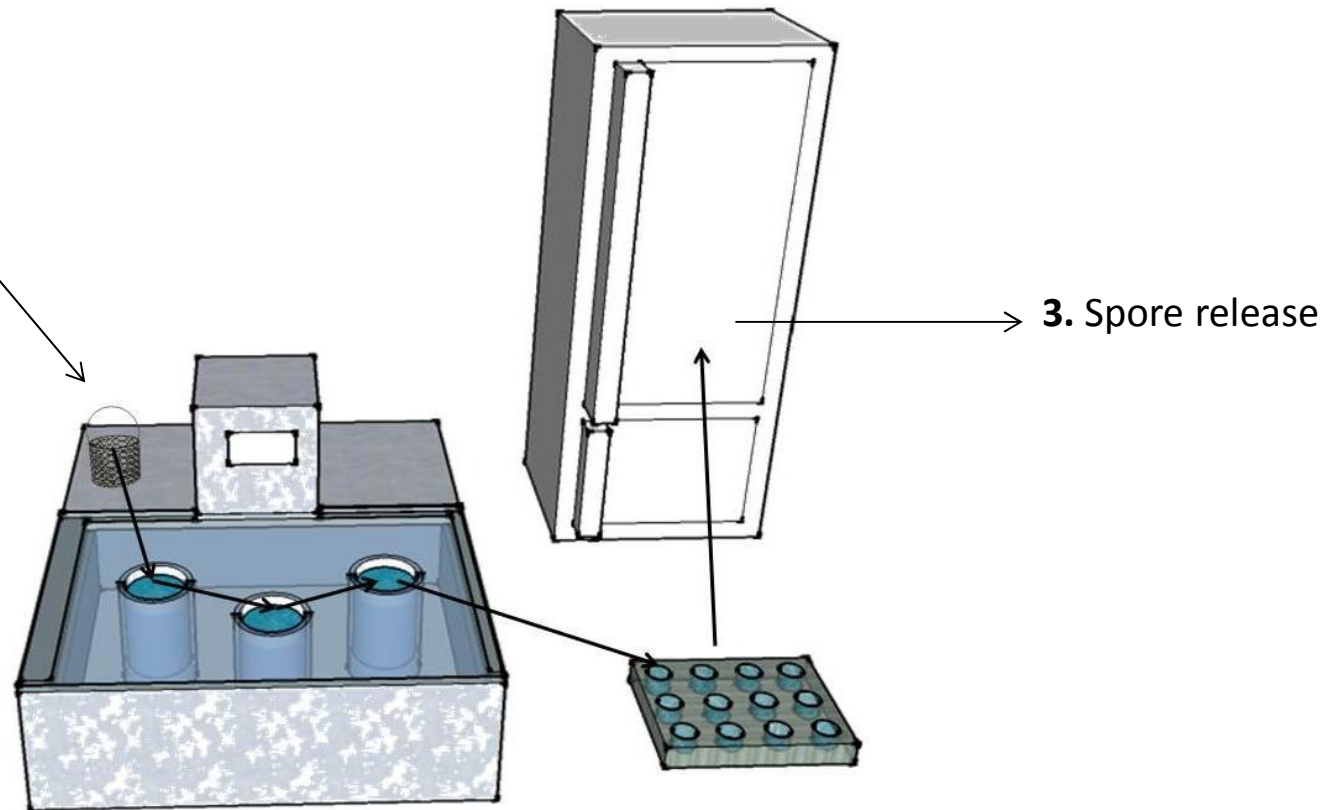
Chemical	Exposure time	Exposure temp: 10°C			Exposure temp: 15°C		
		<i>Concentration</i>	<i>0.02%</i>	<i>0.2%</i>	<i>2%</i>	<i>0.02%</i>	<i>0.2%</i>
Lugol's solution	2min	+	-	-	-	-	-
	4min	+	-	-	-	-	-
	10min	+	-	-	-	-	-
	30min	+	-	-	-	-	-
	<i>Concentration</i>	6ppm	60ppm	600ppm	6ppm	60ppm	600ppm
Sodium hypochlorite	2min	-	-	-	-	-	-
	4min	-	-	-	-	-	-
	10min	-	-	-	-	-	-
	30min	-	-	-	-	-	-
	<i>Concentration</i>	6ppm	60ppm	600ppm	6ppm	60ppm	600ppm

**Untreated sample (+ control):**  $\text{SGR} = 0.45 \pm 0.09 \text{ day}^{-1}$

**GeO<sub>2</sub> added to the growth medium (- control):** SGR significantly lower than the +control

## 2. Sori disinfection and sporophyte development

1. Disks of mature sori were punched out



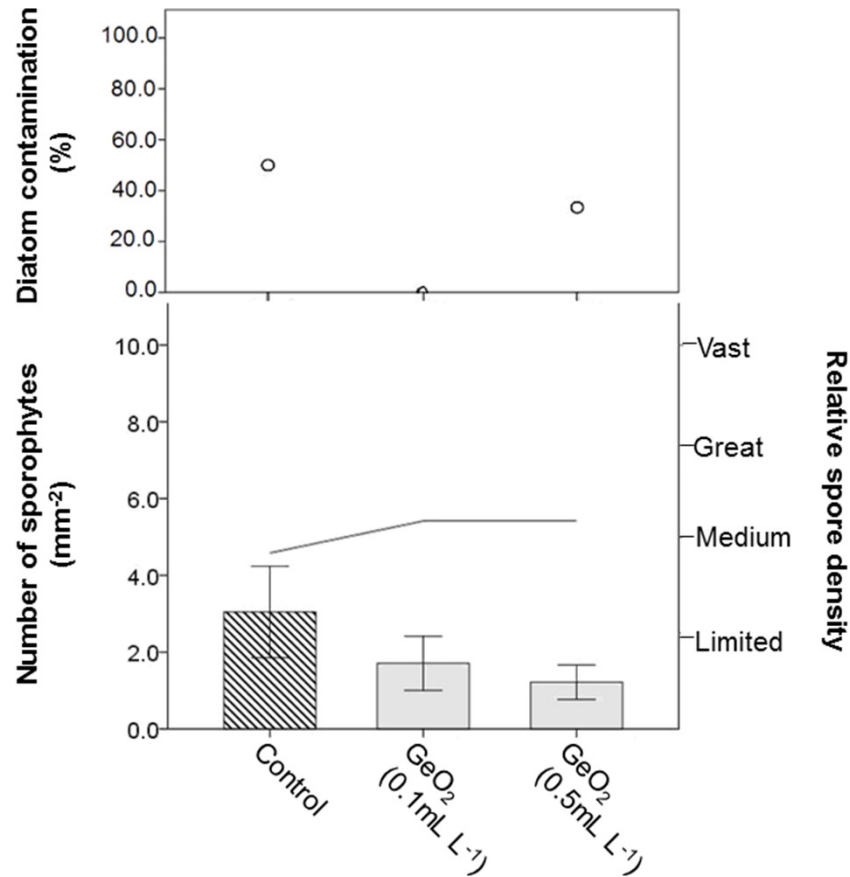
2. Sori were bathed in a disinfecting solution for a given exposure time, and rinsed twice in SSW for 30 seconds

# The disinfecting treatments

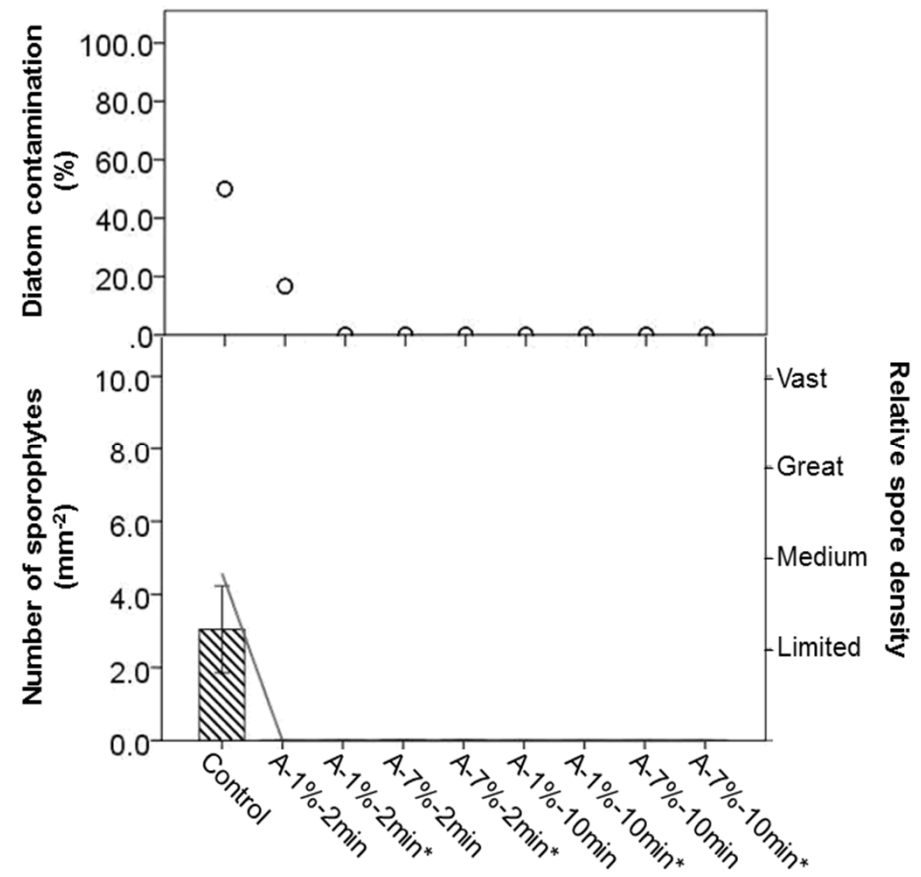
- Chemicals: Acetic acid, Lugol's solution, Sodium hypochlorite
- Exposure time: 2min, 10min
- Exposure temperature: 10°C



## Control treatments

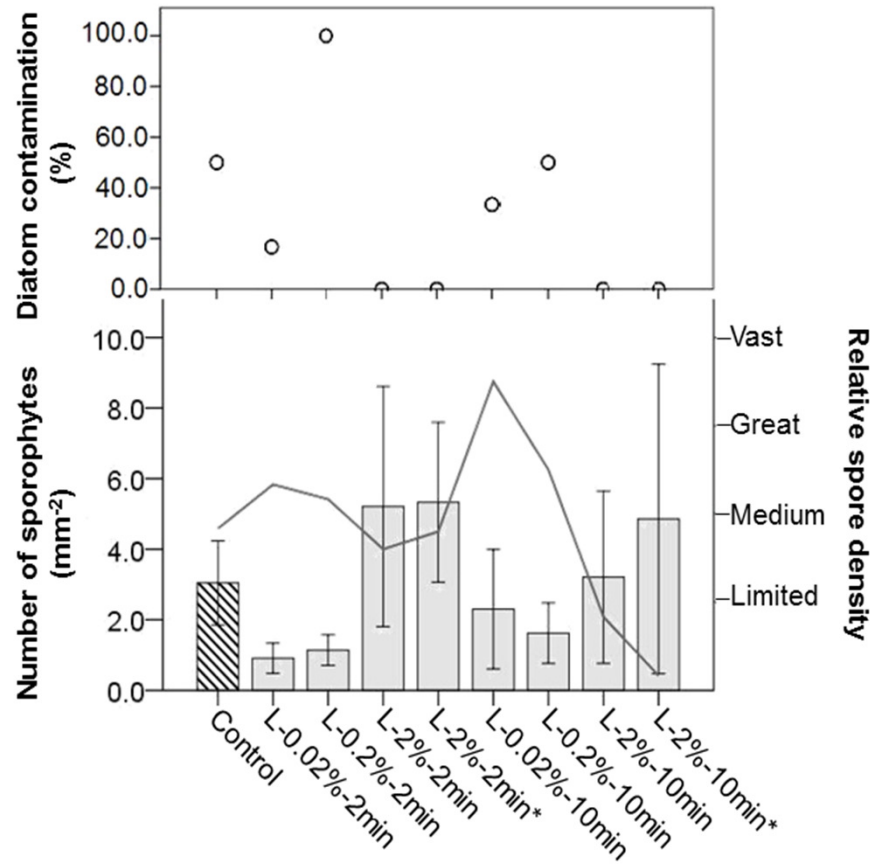


## Acetic acid

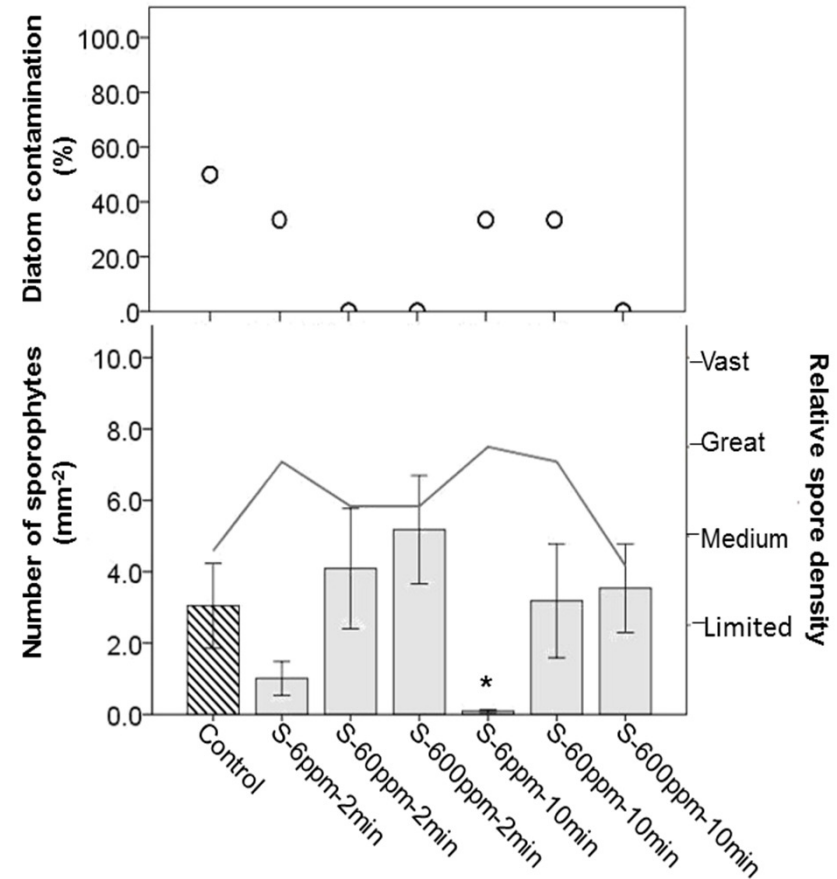


Bars indicate number of sporophytes (sporophytes mm<sup>-2</sup>) after four weeks of growth (mean values ± 1SE, n=6). Relative spore density is shown as a line and right y-axis (Vast, Great, Medium, Limited). Upper panel shows contamination of diatoms (% of replicates with diatom contamination after four weeks of growth). The x-axis gives the different treatments with sodium hypochlorite (first letter of the chemical - concentration - exposure time), \*= significantly lower sporophyte density than the control treatment.

## Lugol's solution



## Sodium hypochlorite



Bars indicate number of sporophytes (sporophytes mm<sup>-2</sup>) after four weeks of growth (mean values  $\pm$  1SE, n=6). Relative spore density is shown as a line and right y-axis (Vast, Great, Medium, Limited). Upper panel shows contamination of diatoms (% of replicates with diatom contamination after four weeks of growth). The x-axis gives the different treatments with sodium hypochlorite (first letter of the chemical - concentration - exposure time), \*= significantly lower sporophyte density than the control treatment.

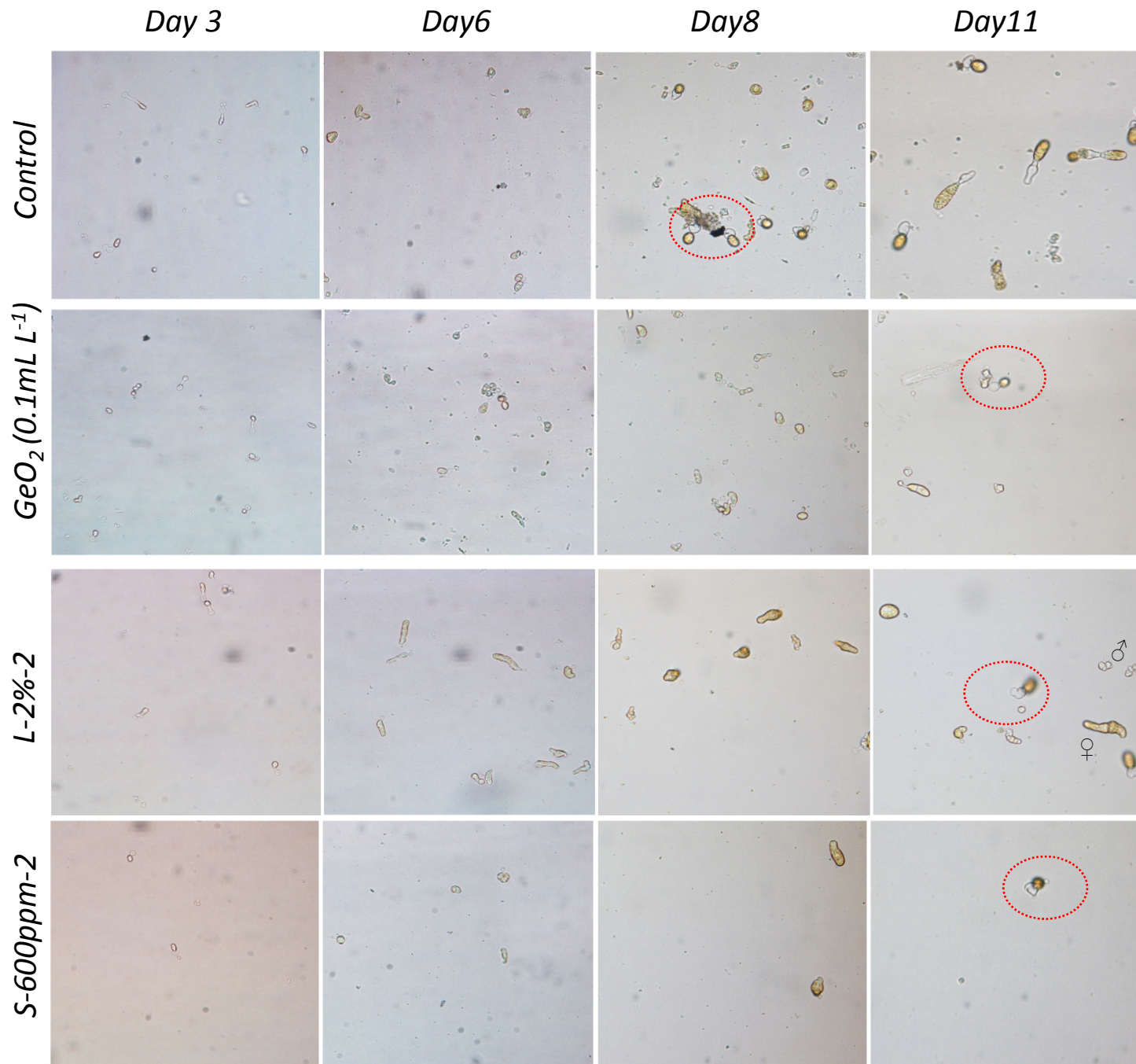


Foto: Kaia K. Rød



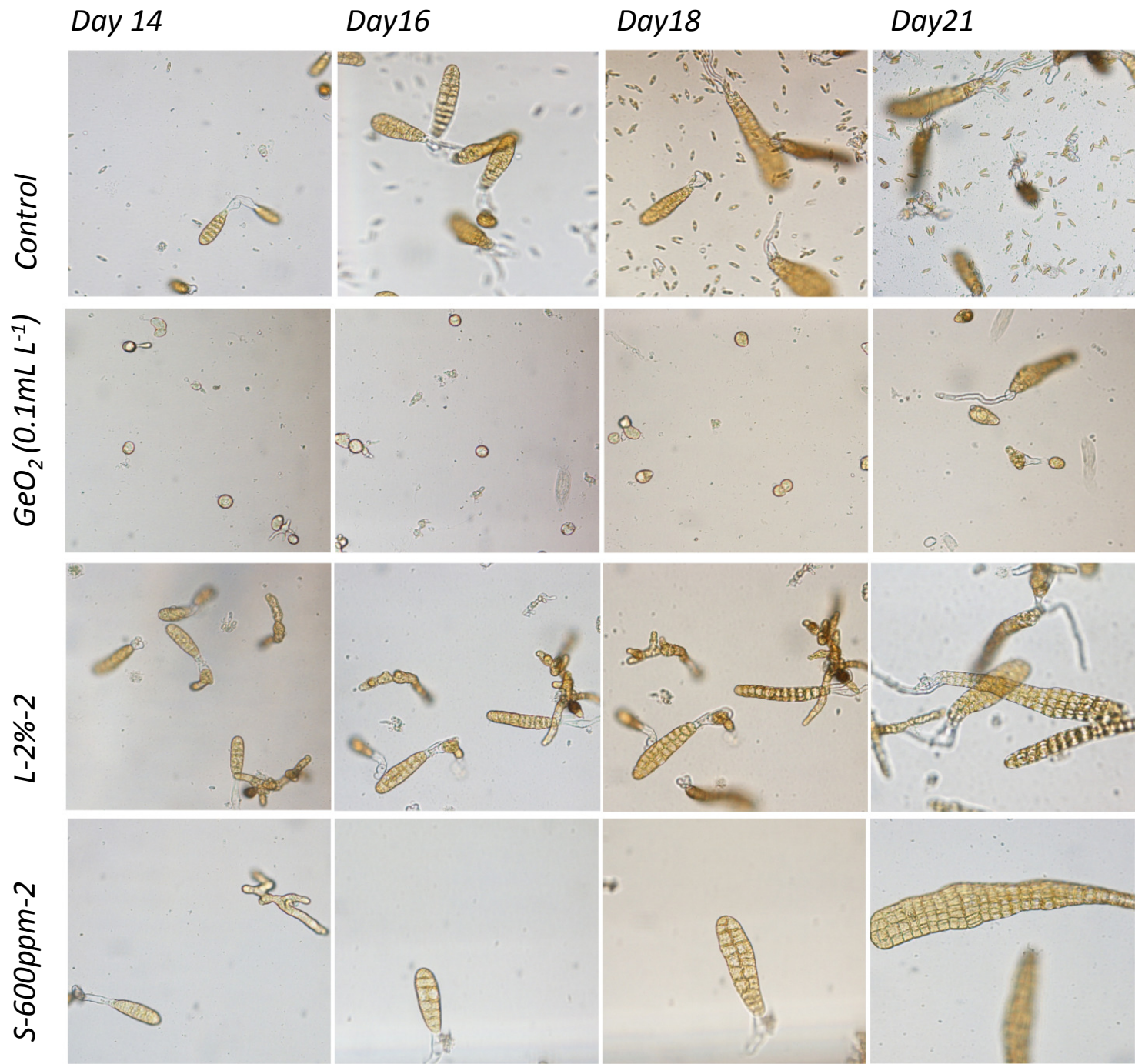


Foto: Kaia K. Rød

# Conclusions

- Sodium hypochlorite (600ppm) and Lugol's solution (2%), exposure time 2min and exposure temperature 10°C can be used to mitigate diatom contamination from *S. latissima* sori.
- Acetic acid: low pH (<2.8)
- Ethanol: dependent on the water content of the algae
- Formaldehyde: toxic

# Conclusions

- Mechanical disinfection can be avoided
- Concentration the decisive variable
- Higher disinfecting concentrations appears to be necessary to mitigate diatoms on sori compared to in free suspension
- Sodium hypochlorite, the better choice?



Disinfect sori in 600 ppm sodium hypochlorite for 2 min at 10°C, and two rinsing baths of SSW for 30 seconds

# Thank you!



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