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Phaeodactylum tricornutum : new source of eliciting molecules for plant defense and plant health

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Introduction

Stimulator of plant defense : an alternative to chemical treatments

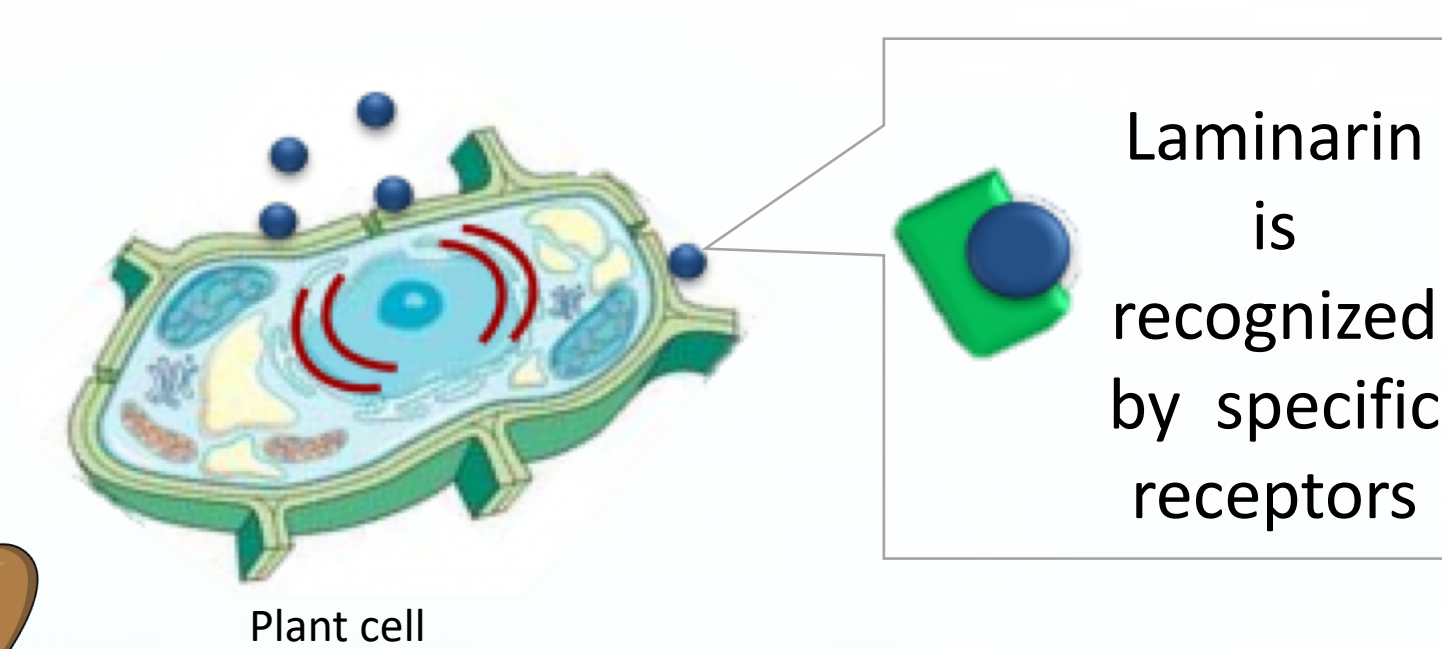
Microalgae as a new source of SDP



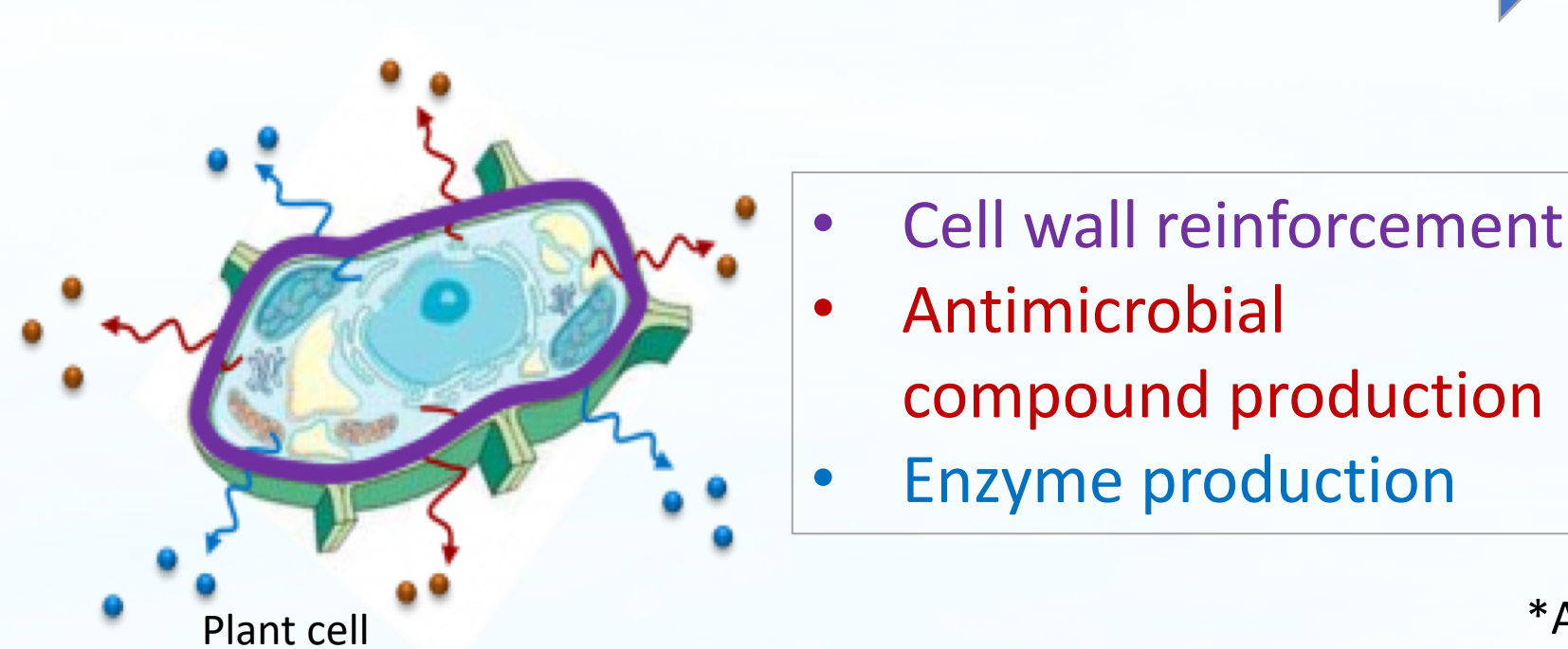
Recently, the use of effective and eco-friendly substitutes to traditional agrochemicals has aroused great interest in agriculture. The development of these new products is based on studies on eliciting molecules, also called elicitors or stimulator of plant defense (SDP), that mimic pathogen aggression to trigger plant defense. Different storage and parietal polysaccharides such as β -glucan, chitin and chitosan oligomers, oligogalacturonides have been reported to induce plant immunity¹. Among β -glucans, Laminarin extracted from the brown macroalga *Laminaria digitata* is a well-known elicitor of plant defense².

Laminarin is extracted from *Laminaria digitata*

1. Laminarin mimic pathogen aggression to trigger plant defense

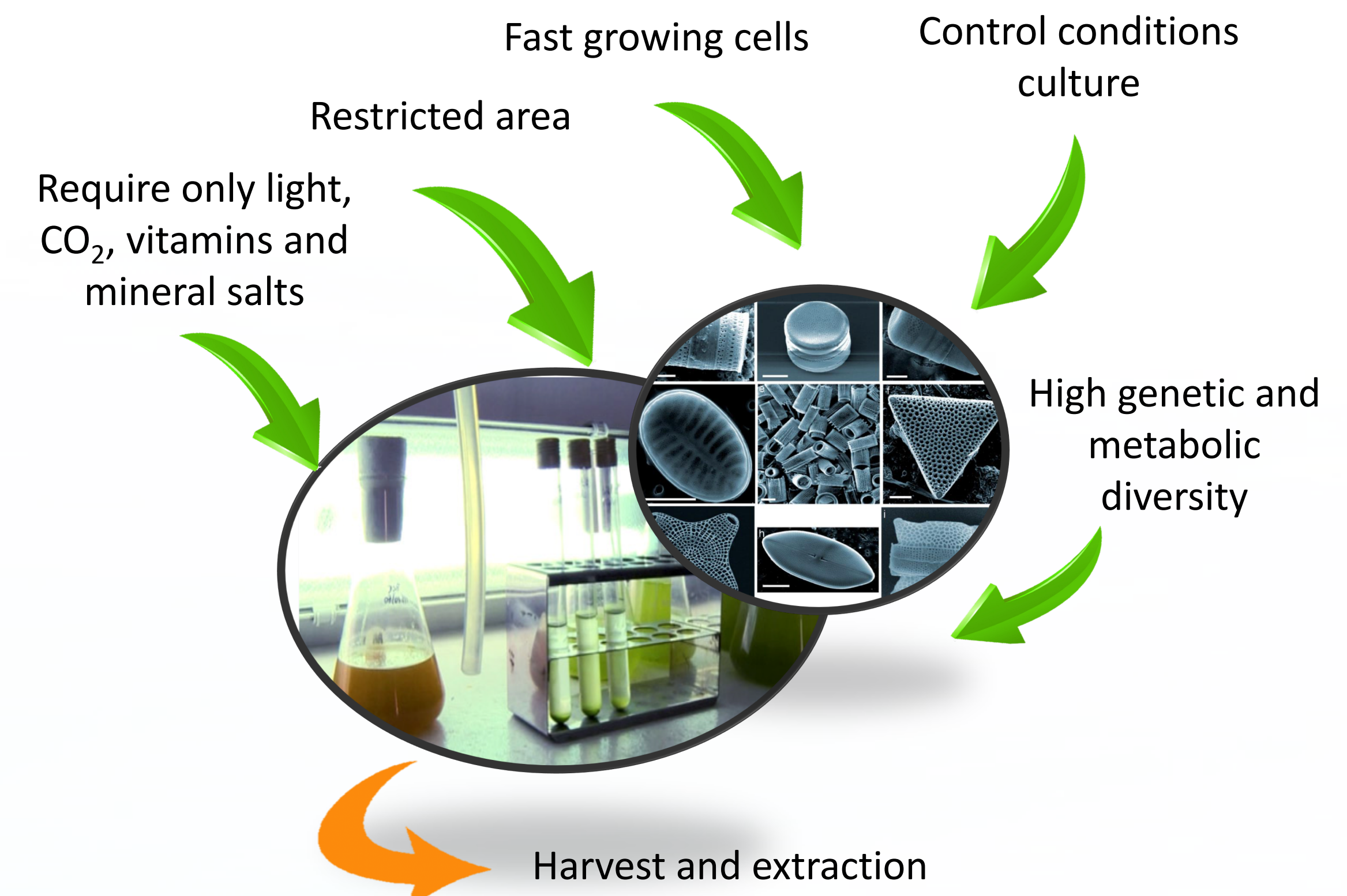


2. Activation of defense mechanisms



3. Plant is protected against future aggression

*Adapted from Goemar Etraining-Vacciplant⁴

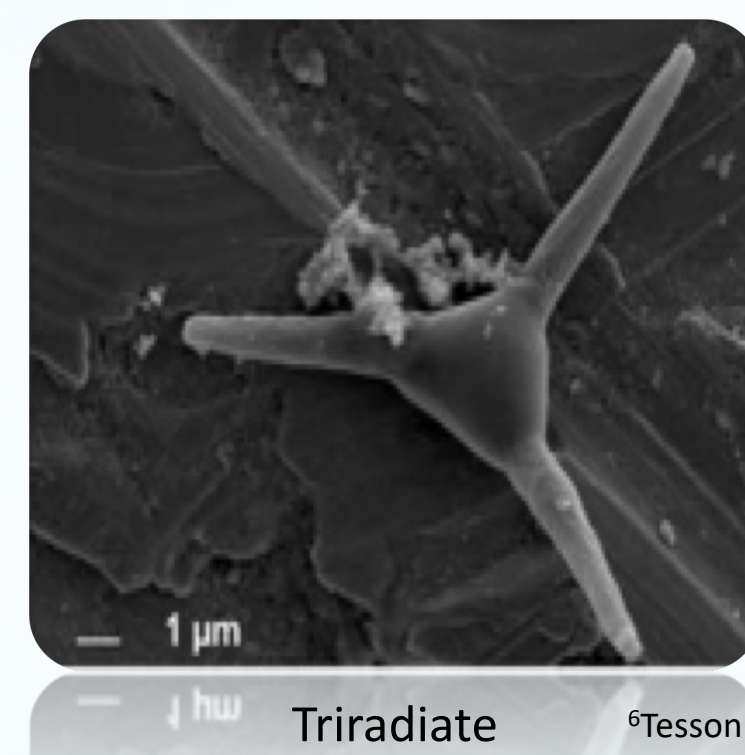
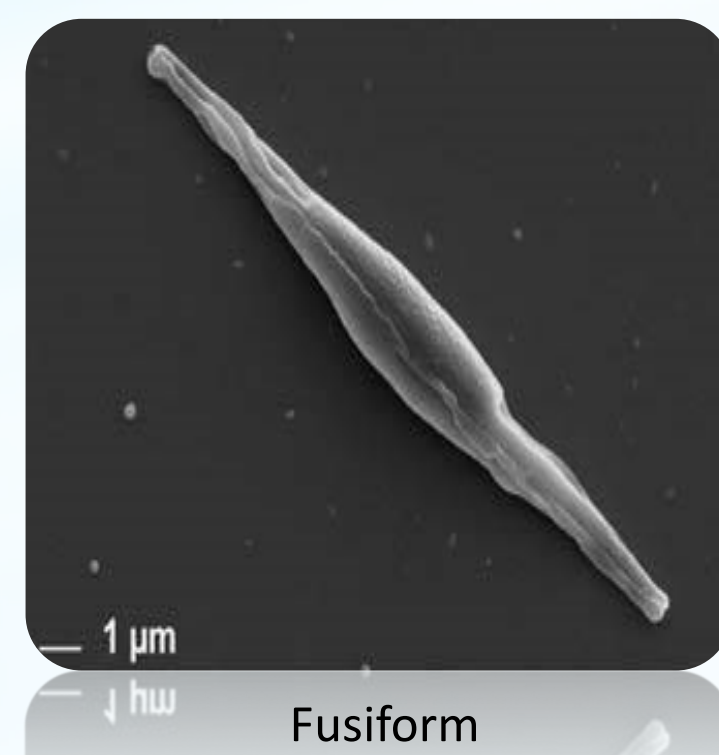
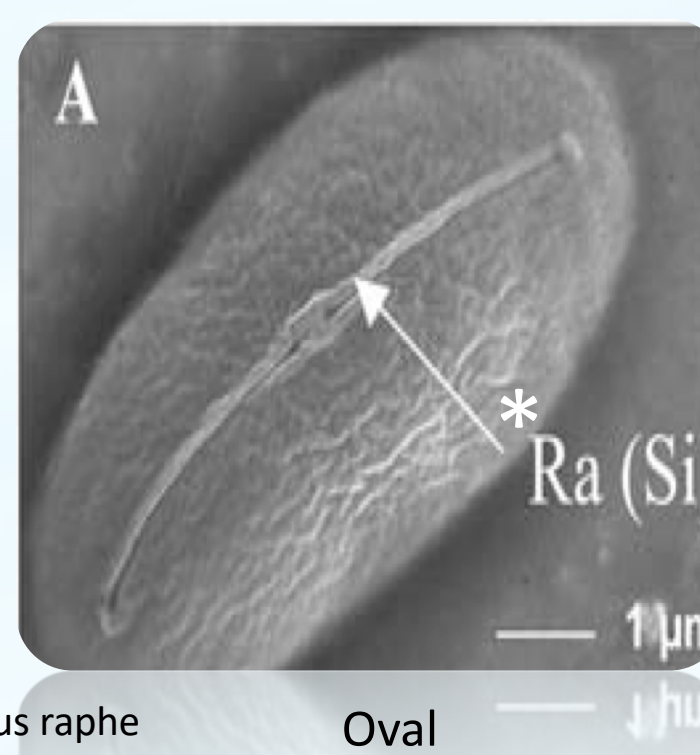


By contrast to macroalgae that require large natural culture areas and take a long time to develop, microalgae grow fast and in controlled restricted areas. They represent a highly diverse group with a wide range of metabolites which represents potential source of eliciting molecules.

Image source : Dudek 2016⁵

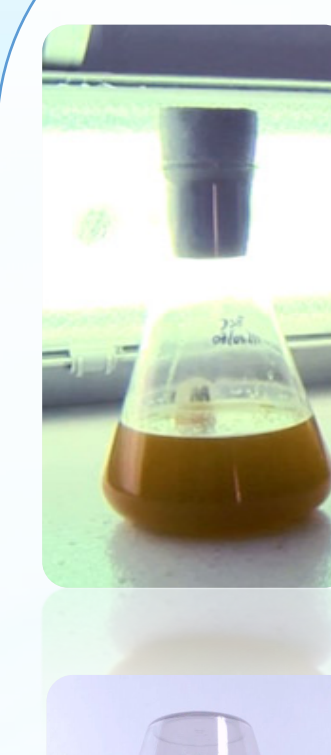
Phaeodactylum tricornutum as a model of microalgae

Arabidopsis root elicitation with *P.tricornutum* crude cell homogenate



- Sequenced genome
- Easy and cheap** culture conditions
- Pleiomorphic cells** depending on environmental conditions⁷.
- Production of **allelopathic compounds**⁸⁻⁹
- Storage polysaccharide (chrysolaminarin¹⁰) whose structure is related to laminarin¹¹

Promising candidate to identify new elicitor



P.tricornutum was grown in water complemented with seasalt (33g.L⁻¹), Conway medium (1mL.L⁻¹) and silicate (2mL.L⁻¹). Culture were placed in 16-h-day/8-h-night cycles (50 μ E m⁻² s⁻¹, 19°C).



P.Tricornutum cells were harvested after 10 days of growth and ground via theFastPrep-24TMSystem (MP Biomedicals) (6x 6,5msx30s)

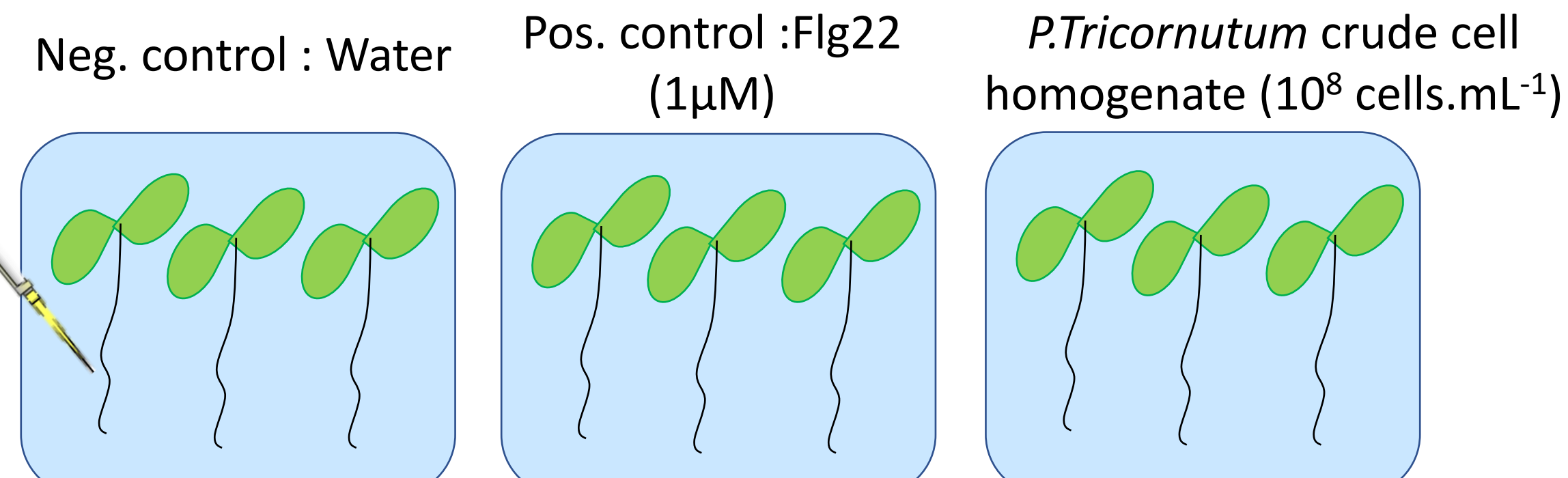
P.Tricornutum crude cell homogenate



- Neg. control : Water
- Pos. control : Flg22
- Crude cell homogenate

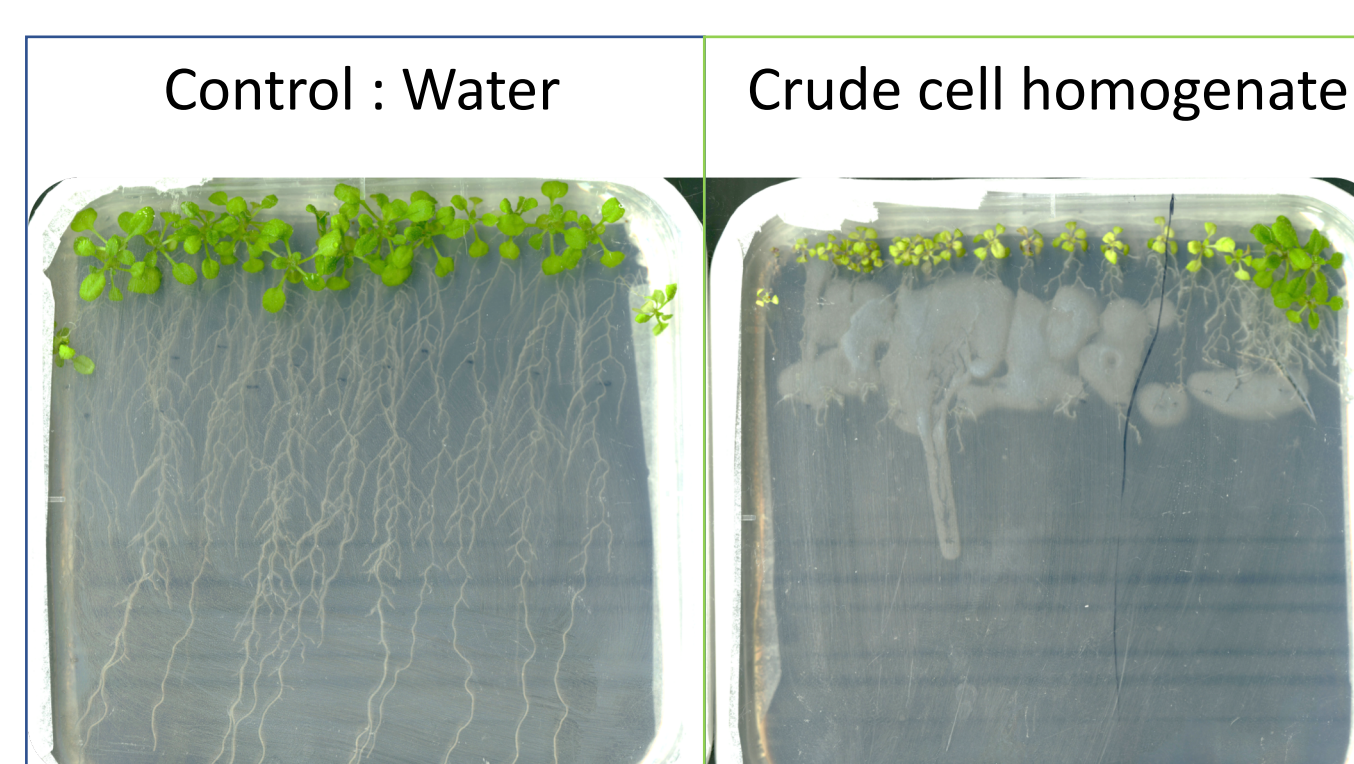
Sterilized *Arabidopsis thaliana* ecotype Columbia seeds are sown onto Murashige and Skoog medium containing 1% (w/v) Bacto Agar (Durand et al., 2009). Plant were grown in 16-h-day/8-h-night cycles (120 μ E m⁻² s⁻¹, 21°C).

Method to evaluate the potential elicitor effect of *P.tricornutum* extract

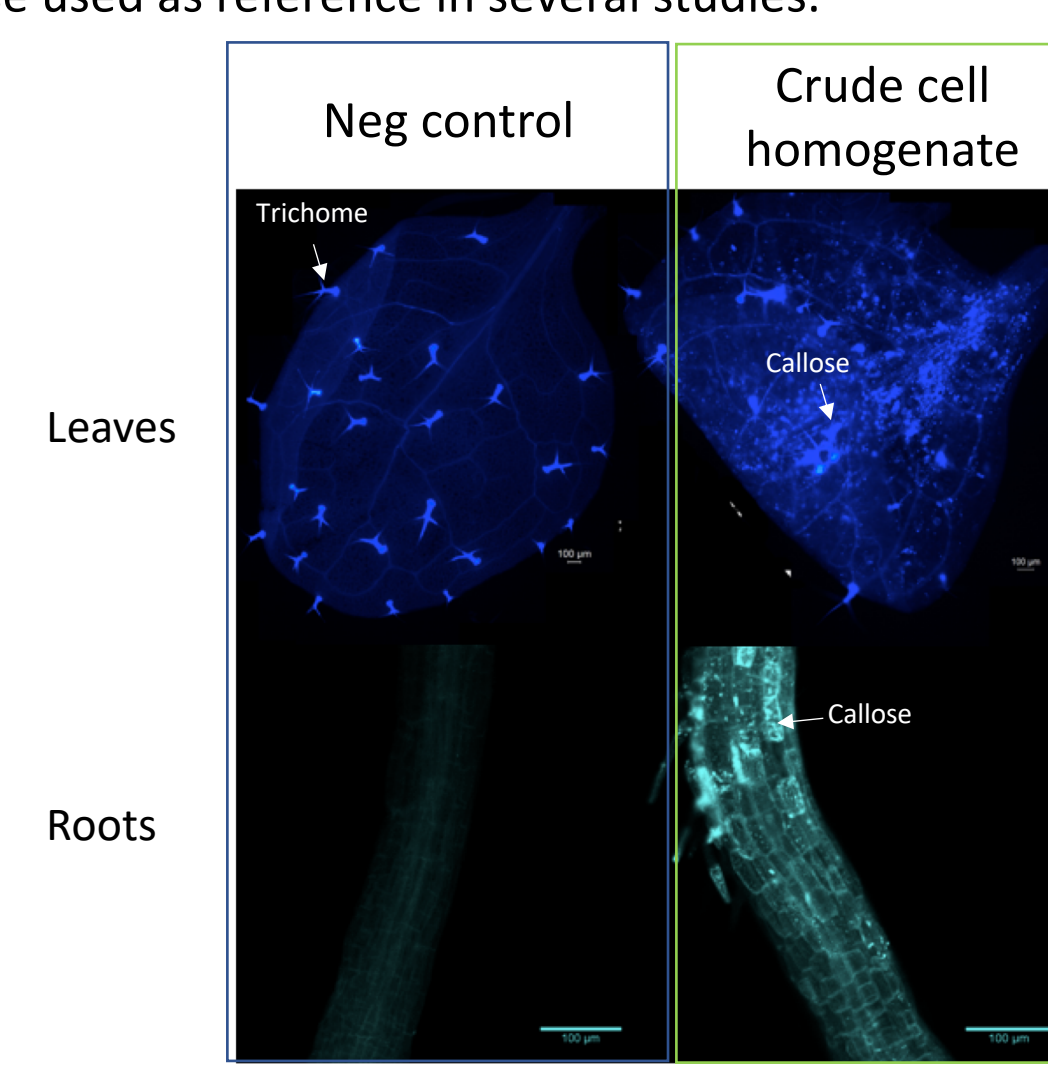


Eliciting treatment was performed on 7 days-old seedlings. Arabidopsis root treated with crude cell homogenate are harvested after different time according to the technique evaluated. Two control were used to evaluated the capacity of crude cell homogenate to induce plant defense. *Flg22 is a famous elicitor of plant defense used as reference in several studies.

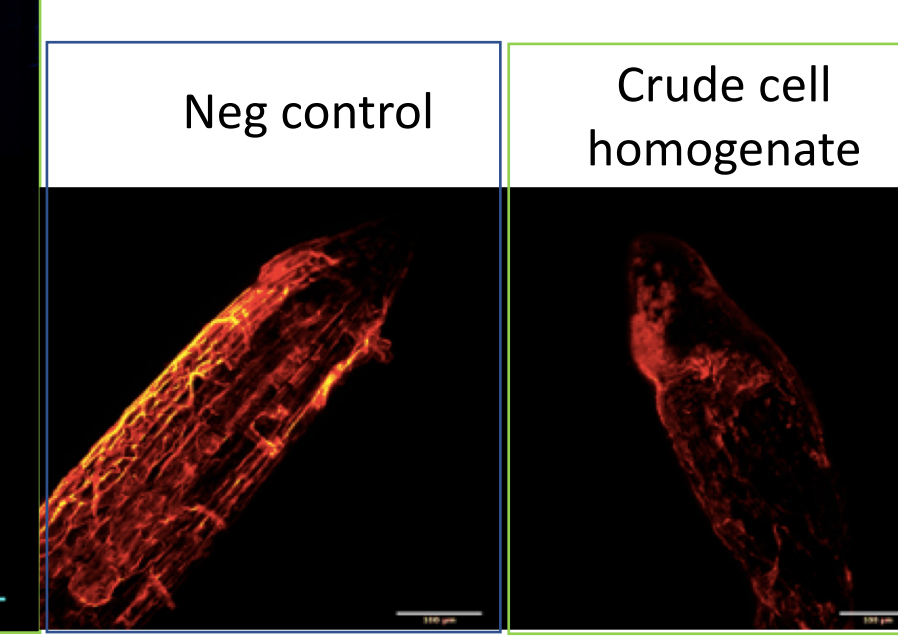
Some results illustrated



Effect on plant vigour :
Root growth was inhibited after microalgae crude cell homogenate for 2 days application on Arabidopsis roots.



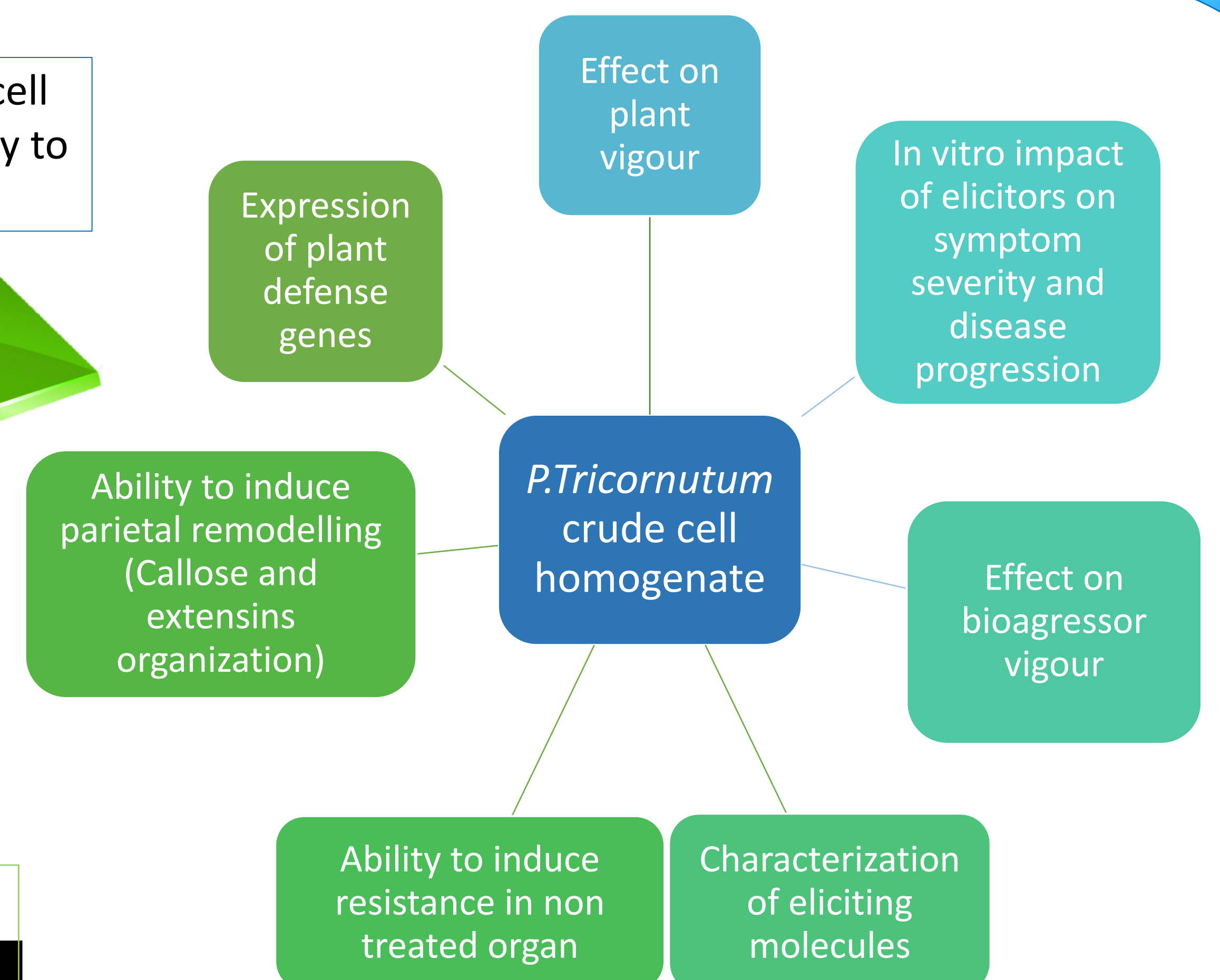
Effect on callose deposition in roots and in leaves :
Aniline blue staining showed callose deposition (white arrows) after microalgae crude cell homogenate application for two days.



Effect on parietal remodelling :
Immunolabelling of extensins with LM1 antibody showed a different distribution of labelling when microalgae crude cell homogenate was applied for two days on Arabidopsis roots.

Ability to induce parietal remodelling

Evaluation of crude cell homogenate efficiency to protect plant



Conclusion

Actual results have shown that the crude cell homogenate from *P.tricornutum* induce parietal remodeling and root growth inhibition. However, we need to further investigate the immune response triggered by *Phaeodactylum tricornutum*. To this end, we will study the impact of the elicitor on specific defense markers genes of root defense. Furthermore, a fine structural analysis of the active compound will be performed.

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References:

1. Trouvelot, S. et al. *Frontiers in Plant Science* 5, (2014).
2. Klarzynski, O. et al. *Plant Physiol.* 124, 1027–1038 (2000).
3. Norwegian seaweeds (consulted in 2017) : <http://seaweeds.uib.no/?art=196>
4. Goemar Etraining-Vacciplant (consulted in 2018) : <http://etraining.vacciplant.fr/3>
5. Dudek 2016, Aberystwyth university, 237p
6. Tesson et al. (2009) *Botanica Marina*. Special issue, *Algae Cell Biology*, 52, 2, 104-116.
7. De Martino, A. et al. *Protist* 162, 462–481 (2011).
8. Wang, J. et al. *Scientific Reports* 6, 37263 (2016).
9. Prestegard, S. et al. (2015) *Marine Drugs* 14, 9
10. Gugi, B. et al. (2015) *Marine Drugs* 13, 5993–6018
11. Caballero, M. A. et al. *Algal Research* 20, 180–188 (2016).

