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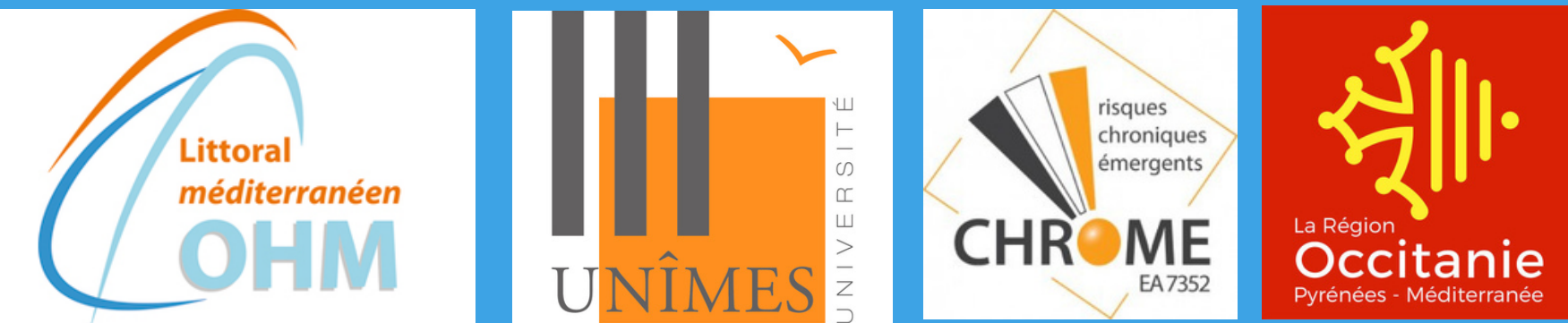
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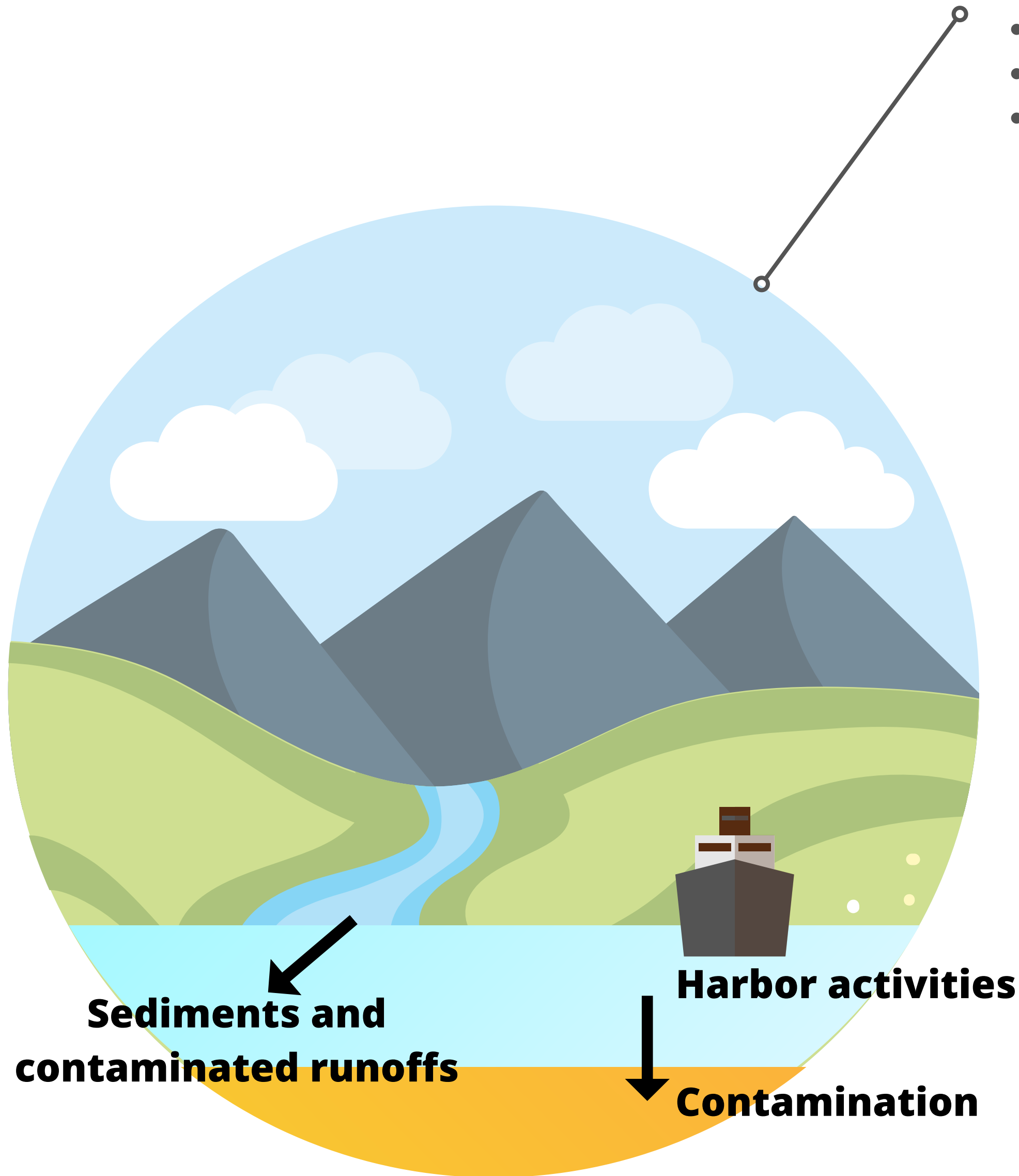
Salinity problems in dredged sediments treated by phytoremediation

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Context



Sediments and contaminants accumulate in the harbor. They both come from :

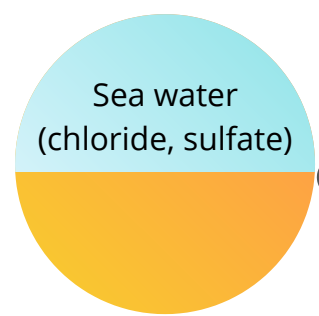
- Geological background
- Agriculture
- Industry
- Harbor activities
- Waste water

- Sediments need to be **dredged** to maintain touristic and economic activities.
- Level of heavy metals, PBC, HAP and TBT determine if dredged sediments should be **brought back inland, instead of released offshore**.
- Dredged sediments management face environmental, juridic and economic issues. Nearly one quarter of them are brought to land where they must be treated as waste. Regulation calls for a strict limitation of the offshore dumping.

Inland sediment treatment
Dredging

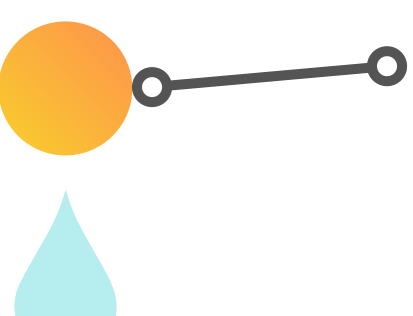
Drainage

Phyto-remediation
(Experimental)



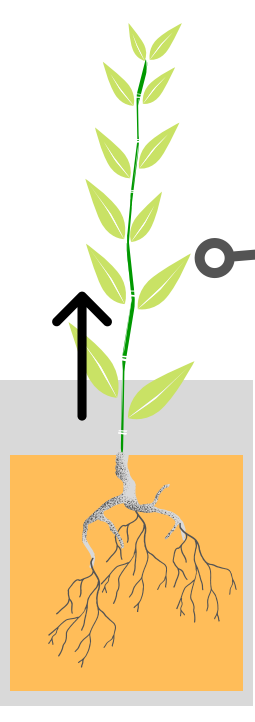
Salt contamination

Dredged sediments are naturally rich in different salts (Sea water chloride mean concentration: $[Cl] = 20g/L$).



Decrease of soluble contamination

Sediments drainage are usually observed (various drainage methods). After this treatment step, chloride sediments concentration usually qualify them as **non hazardous and non inert waste french category** ($[Cl] = 0.8-15 g/kg$).



Decrease of chloride

Phytoremediation can be a solution to reduce chloride sediment concentration. Cl⁻ can be uptaken by some plants and accumulate in shoots:

- Expected to decrease chloride concentration to an **inert waste level** in a reasonable amount of time ($[Cl] < 0.8 mg/kg$).
- Energetic valorisation of the plants by-products.

Metallic and organic contamination

Occitanie dredging projects

Occitanie plan to dredge **5.8 millions m³** of sediments in the next **10 years**.

26% of french dredged sediments are brought back inland and therefore are considered as waste.

64% of these sediments are **silt or clay**.

-> **Chloride tend to accumulate** in fine granulometry (Hu et al. 2013)



Occitanie Region (CC BY-SA 4.0)

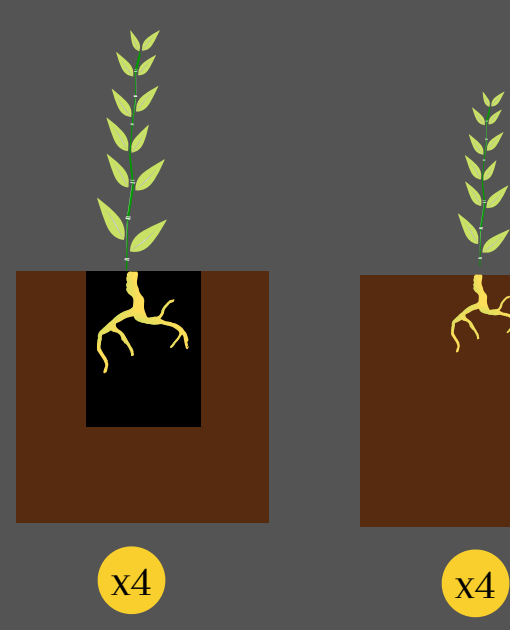
Material and method

- 3 sites were studied : Pérois (65%<63µm, 5 months drainage), Port Camargue (58%<63µm, 2 month drainage) and le Grau du Roi (70%<63µm, totally drained).
- *Arundo Donax* plants were selected

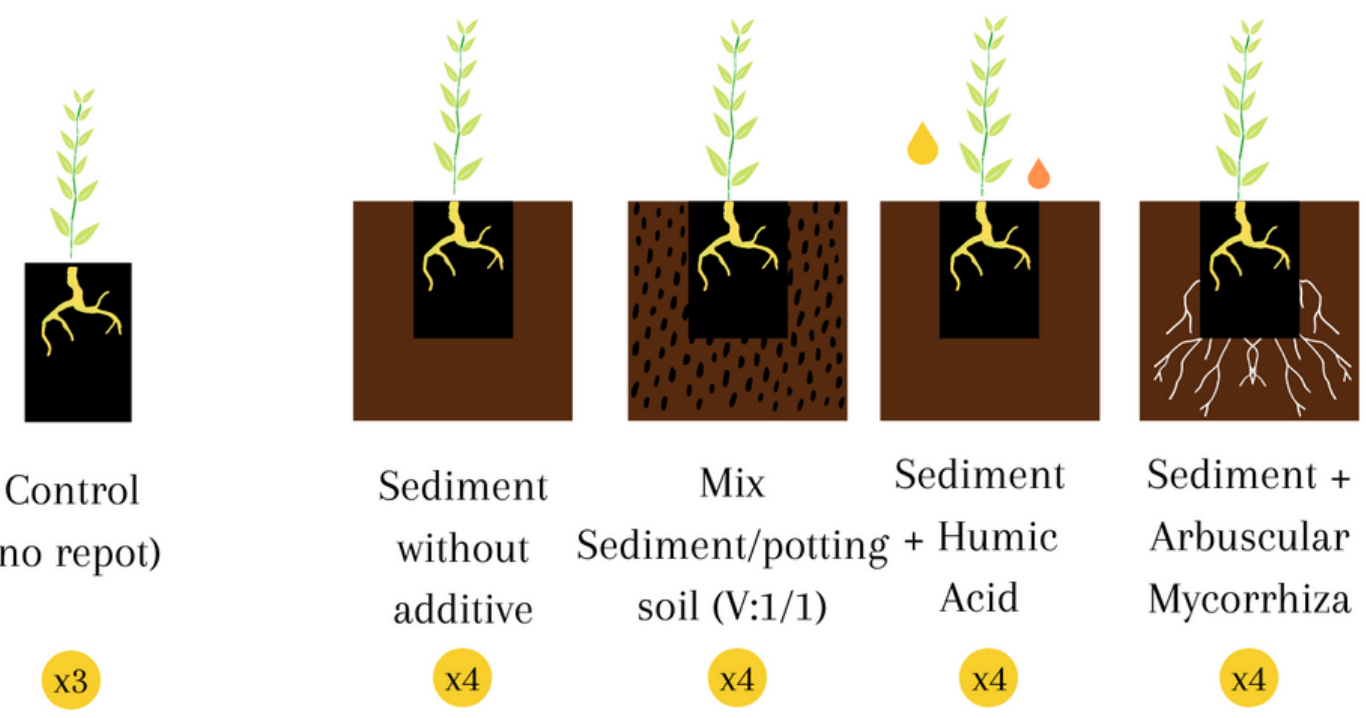


Drainage in geotubes - Pérois (Sordes 2020)

Preliminar Survival test for *Arundo donax* in similar sediments regarding the granulometry. Sediments comes from Le Grau du Roi ($[Cl] = 2.4 g/kg$) :
Repoting vs planting from cutting.

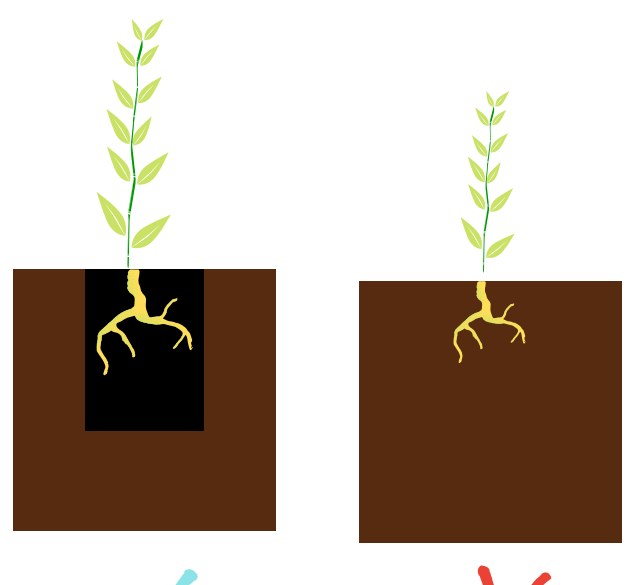


Experimental cultures were realised in Le Grau du Roi sediments (**potting soil, Humic Acid, Arbuscular Mycorrhiza**)

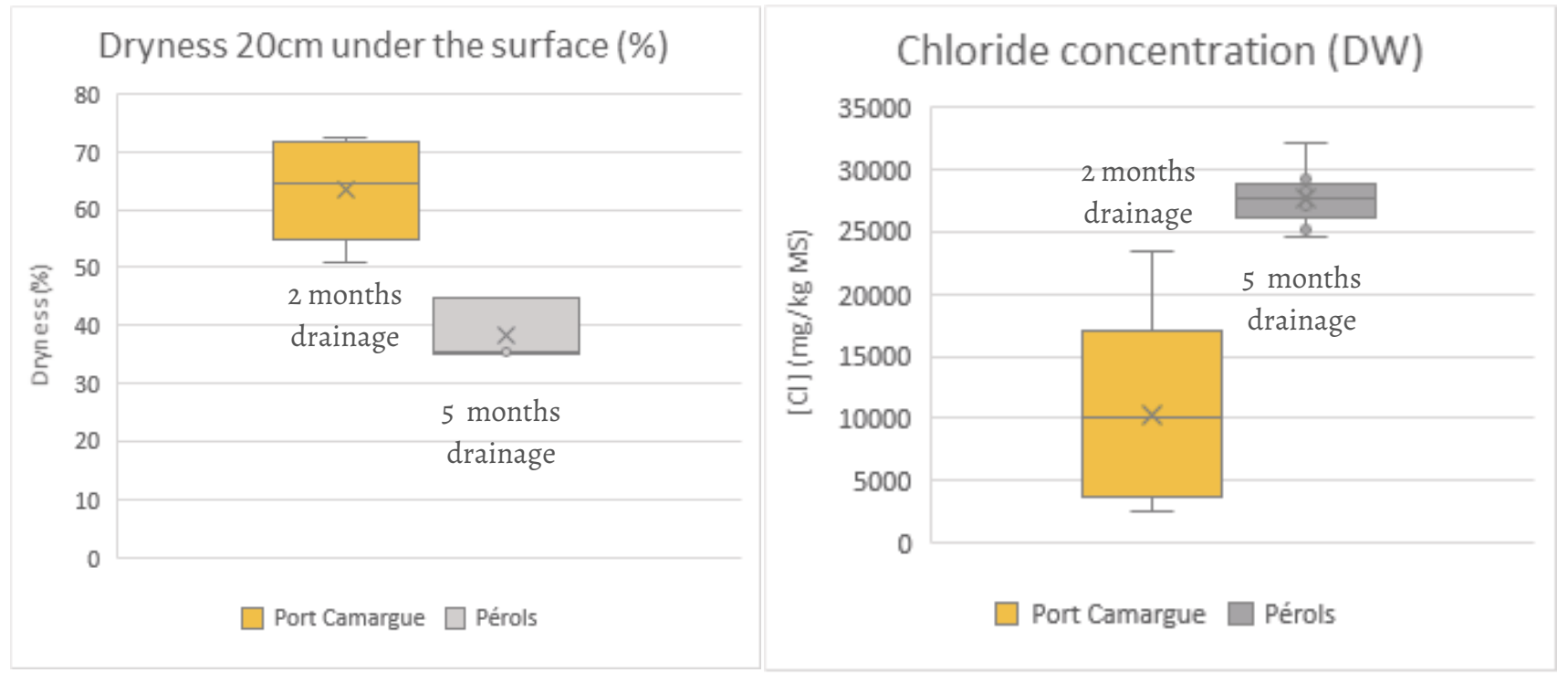


- 2.5L repot into 7L of sediments
- Grow box (10 hour of light per day, 20°C, 0.5L water/pot/week)
- Harvest after 2 weeks and 4 months

Results



100% survival 0% survival



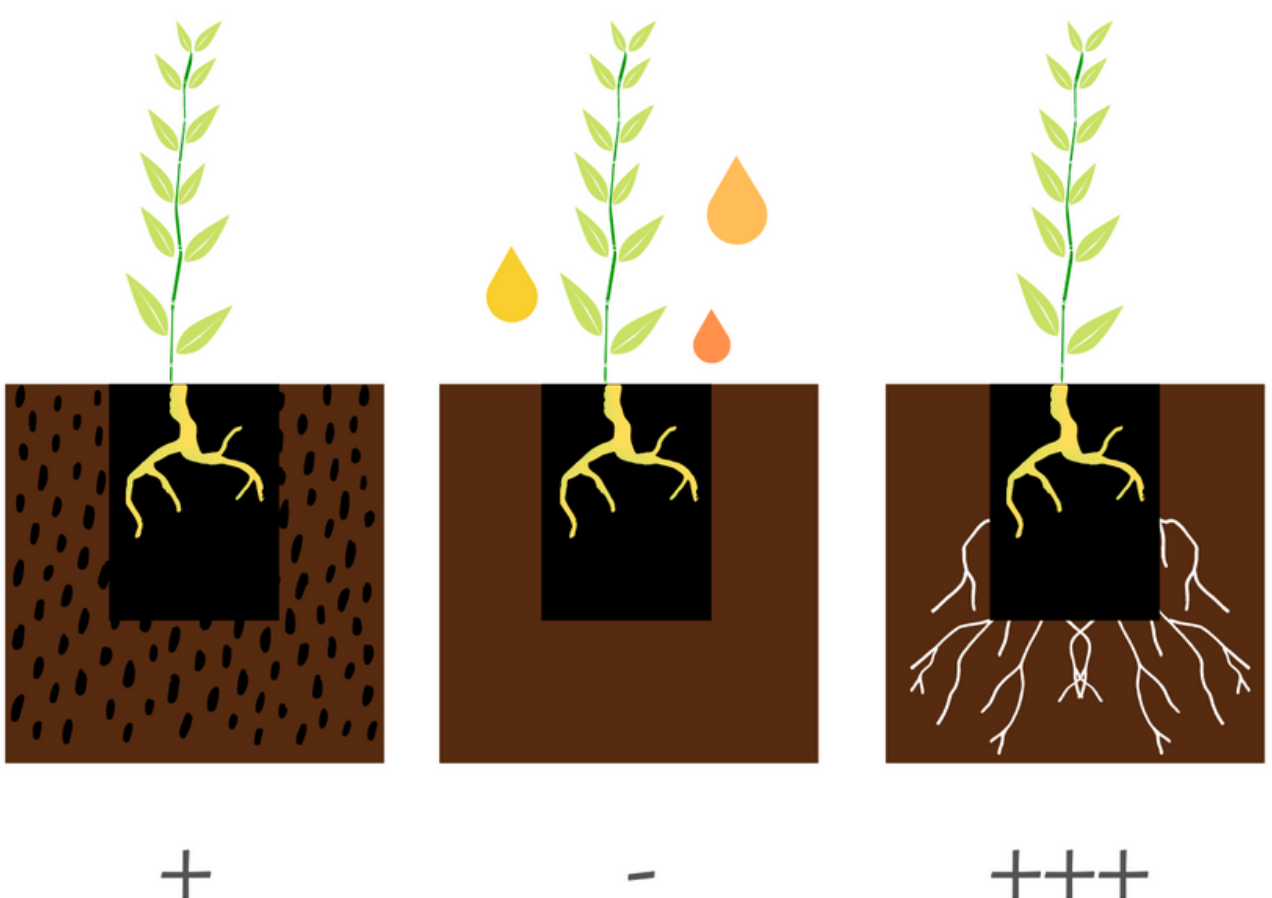
Sediments are in hazardous waste category ($[Cl] > 15 g/kg$) which make it difficult to eliminate.

Conclusion

- Longer drainage should improve chloride elimination. Phytoremediation seems a good complementary technique.

- Tests realised with *Arundo donax* commonly used for energetic valorisation show good results in terms of uptake of chloride. Even with smaller bioaccumulation than other species, this specie have more interesting biomass production and economic valorization.

- Repot and Arbuscular Mycorrhiza show the best result in term of Cl⁻ extraction and bioaccumulation.



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References

- Al Hassan, M., del Pilar Lopez-Gresa, M., Boscaiu, M., & Vicente, O. (2016). Stress tolerance mechanisms in *Juncus*: responses to salinity and drought in three *Juncus* species adapted to different natural environments. *Functional Plant Biology*, 43(10), 949-960.
- Hasanuzzaman, M., Nahar, K., Alam, M., Bhowmik, P. C., Hossain, M., Rahman, M. M., ... & Fujita, M. (2014). Potential use of halophytes to remediate saline soils. *BioMed research international*, 2014.
- Hu, Y., Zhang, C., Wang, D. Z., Wen, J. Y., Chen, M. H., & Li, Y. (2013). Chloride ion transport and fate in oilfield wastewater reuse by interval dynamic multimedia equivalence model. *Water science and technology*, 67(3), 628-634.
- McSorley, K., Rutter, A., Cumming, R., & Zeeb, B. A. (2016). Phytoremediation of chloride from a cement kiln dust (CKD) contaminated landfill with *Phragmites australis*. *Waste management*, 51, 111-118.
- Morteau, B., Triffault-Bouchet, G., Galvez, R., Martel, L., & Leroueil, S. (2010). Treatment of salted road runoffs using *Typha latifolia*, *Spartina patula*, and *Arundo donax*: a comparison of their salt removal potential. In *Contaminated Sediments: Sustainable Management and Remediation*. ASTM International.
- Rozema, E. R., Gordon, R. J., & Zheng, Y. (2014). Plant species for the removal of Na⁺ and Cl⁻ from Greenhouse Nutrient Solution. *HortScience*, 49(8), 1071-1075.
- Ariela Eau et Environnement. 2018. MARCHE SUBSEQUENT N° 2018-SDAP-JL01 AU LOT 2 DE L'ACCORD-CADRE N°16P00165 Caractériser les possibilités d'évacuation d'un dépôt terrestre de sédiments de dragage
- Région Occitanie, Parlement de la mer. 2015. Schéma régional des dragages en occitanie. Phase 1.