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The WALNUT project: Does cell wall pectic fraction modification influence plant nutrition and/or phytoremediation capacities ?

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Abstract

The project aims to increase the knowledge of the biological function of enzymes modifying the structure of pectins (or PRE for "Pectin Remodeling Enzymes") in the primary plant cell wall. Among these enzymes, Pectin MethylEsterases (PME, EC 3.1.1.11) catalyse the hydrolysis of C6 galacturonic acid methylester group present in newly synthesized homogalacturonans [1]. Analysis of recent bibliography indicates a potential role for the pectins demethylesterification in the plant response to nutritional (nitrogen, phosphorus) [2,3,4] or heavy metal (ex: cadmium) [5,6,7] stresses, evidenced by an increase/decrease of PME activity in such conditions.

Objective

Highlight and study the role of pectin methylesterification in the transport and apoplastic translocation of ions, both in root and aerial tissues

Strategy

Production of transgenic plants: Modified PME activity

Planned constructions:

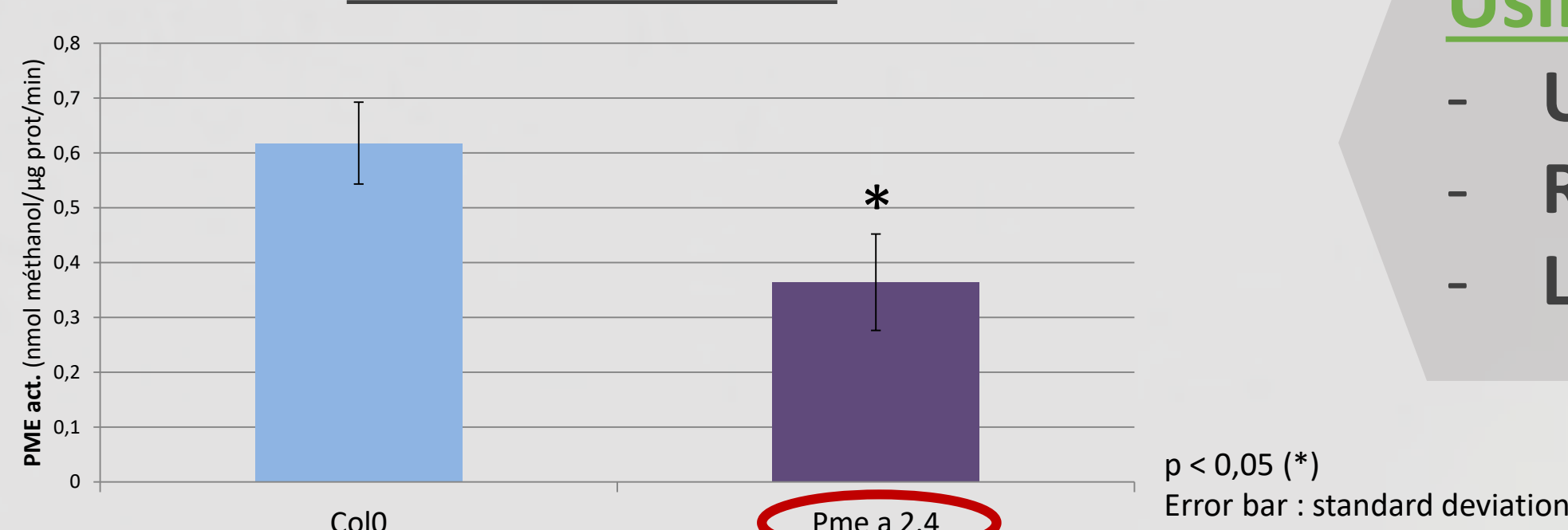
PME activity ↓

- Expression of PMEi5 (inhibitor of PME)

- RNAi construction
(→ targeting root specific PME genes)

Some RNAi lines have already shown a decrease in PME activity

PME activity of plantlets (cultivated in liquid medium for 7 days): RNAi line "Pme a 2.4" and its control Col 0



PME activity ↑

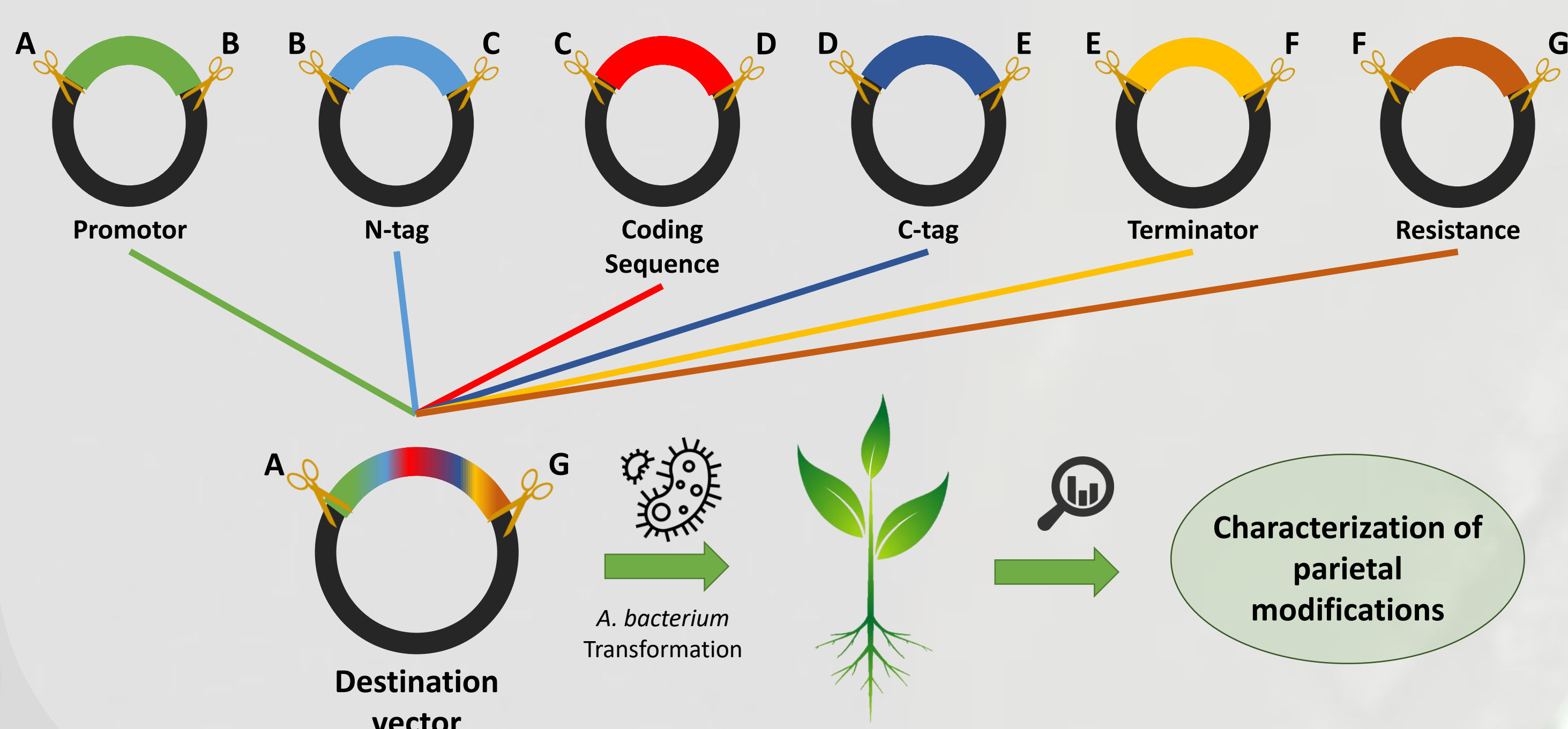
- Expression of VdPME (*Verticilium dahliae* PME)

Very strong PME activity [8]

Using Promoters :

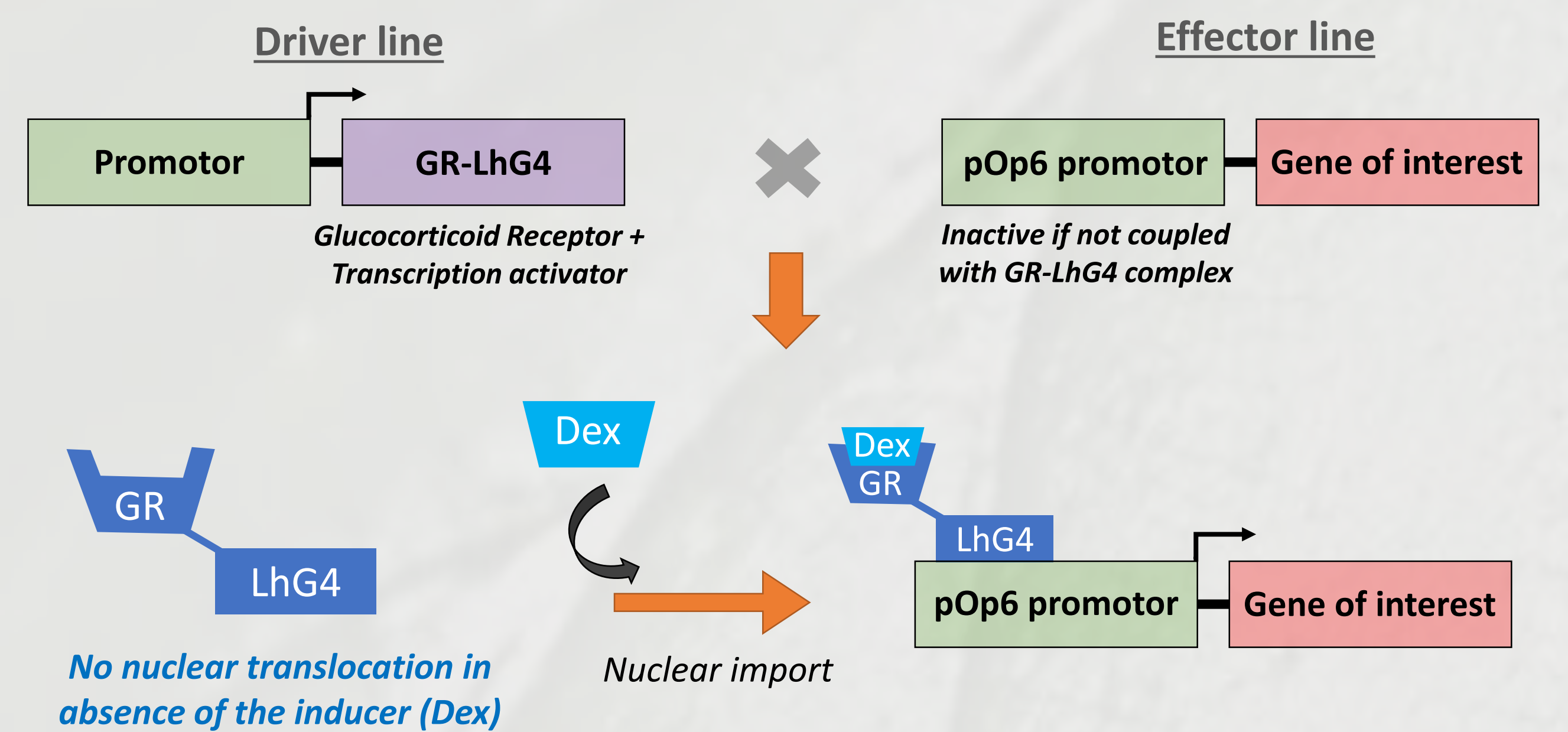
- Ubiquitin
- Root specific
- Leaf specific

GreenGate cloning method [9]:



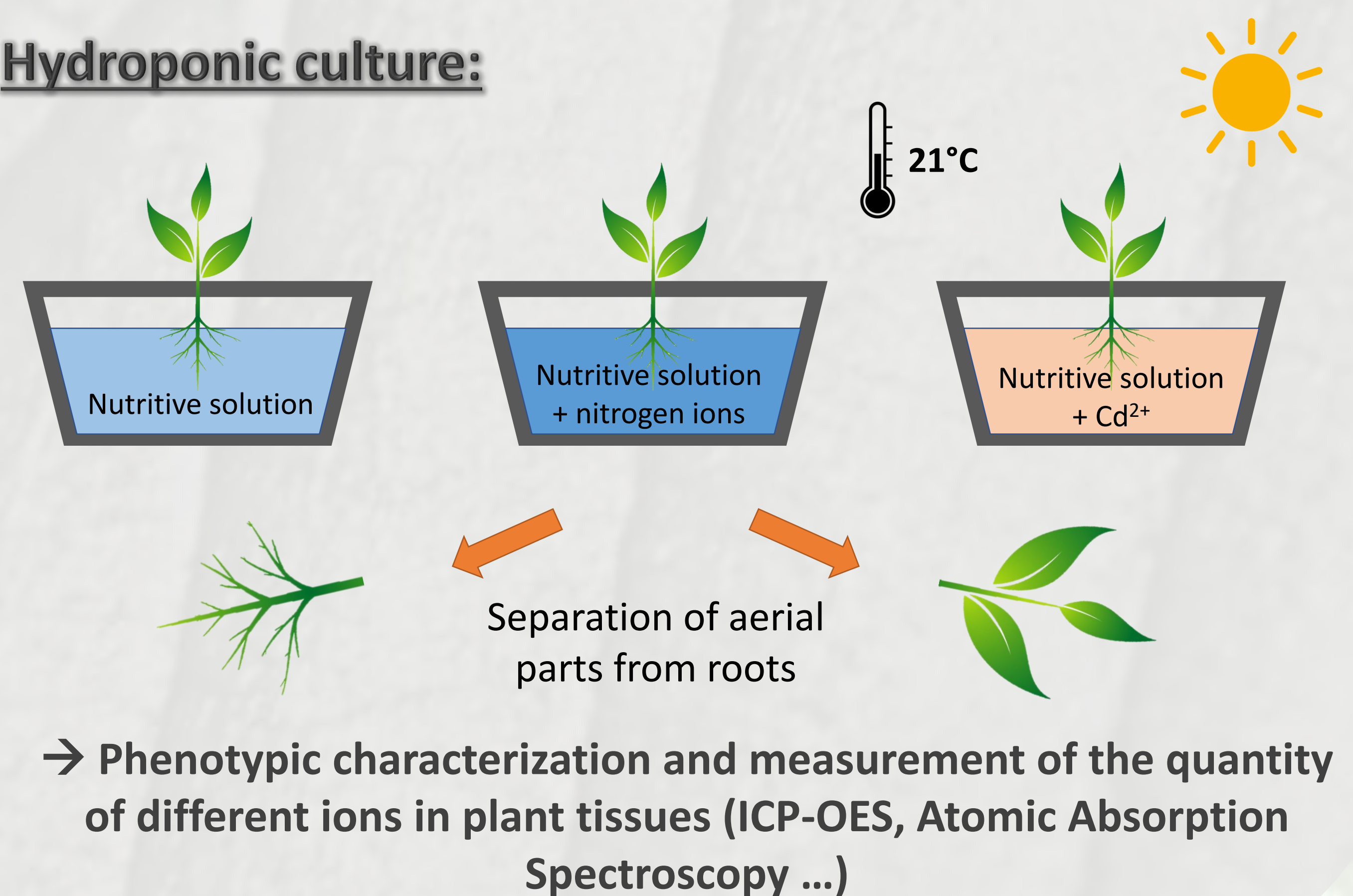
Dexamethasone induction system [10]:

→ Allows expression of a gene at the desired time



Impact of modifications on the absorption and transport of ions

Hydroponic culture:



Perspectives

This project is part of a national and regional strategy for the reduction of phytosanitary products allowing increased protection of cultivated soils and the environment, in particular on the preservation of soils, groundwater and biodiversity. In addition, the project will also focus on the ability of the plant wall and more particularly the remodeling of pectins by PMEs to fix heavy metals which are extremely common pollutants in the soils of industrial wastelands, particularly present in the Hauts-de-France region and could also provide new innovative solutions in soil phytoremediation strategies.

References

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