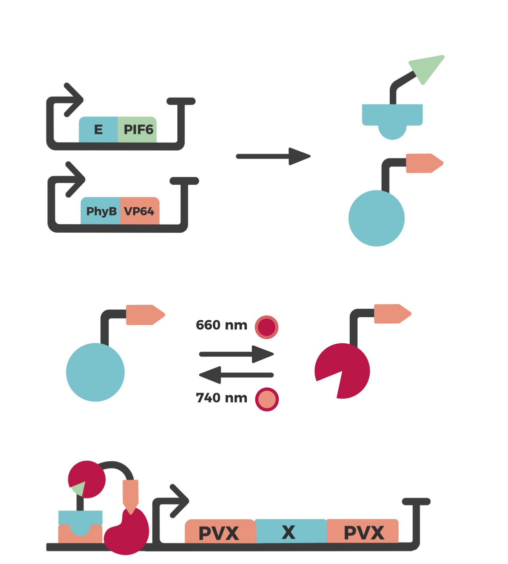
SYNBIO



Constitutive expression

$$\dot{y}_P = k_P \cdot \frac{k_{mP_C} \cdot c_{nP}}{d_{mP}} - d_P \cdot y_P$$

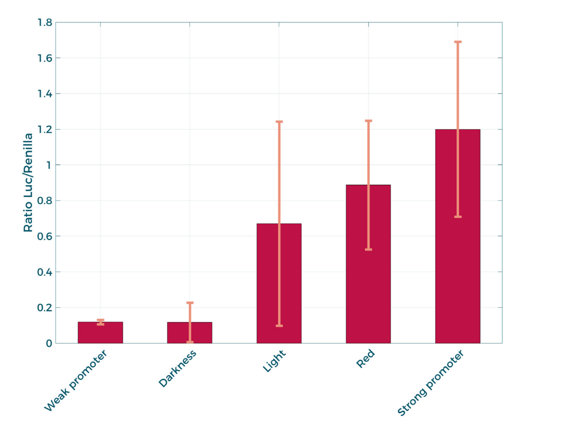
Regulated expression

$$\dot{y}_P = K_P \cdot \frac{\alpha_0 + \alpha_1 \cdot y_1 \cdot y_2}{\beta_0 + \beta_1 \cdot y_1 + \beta_2 \cdot y_1 \cdot y_2} - d_P \cdot y_P$$

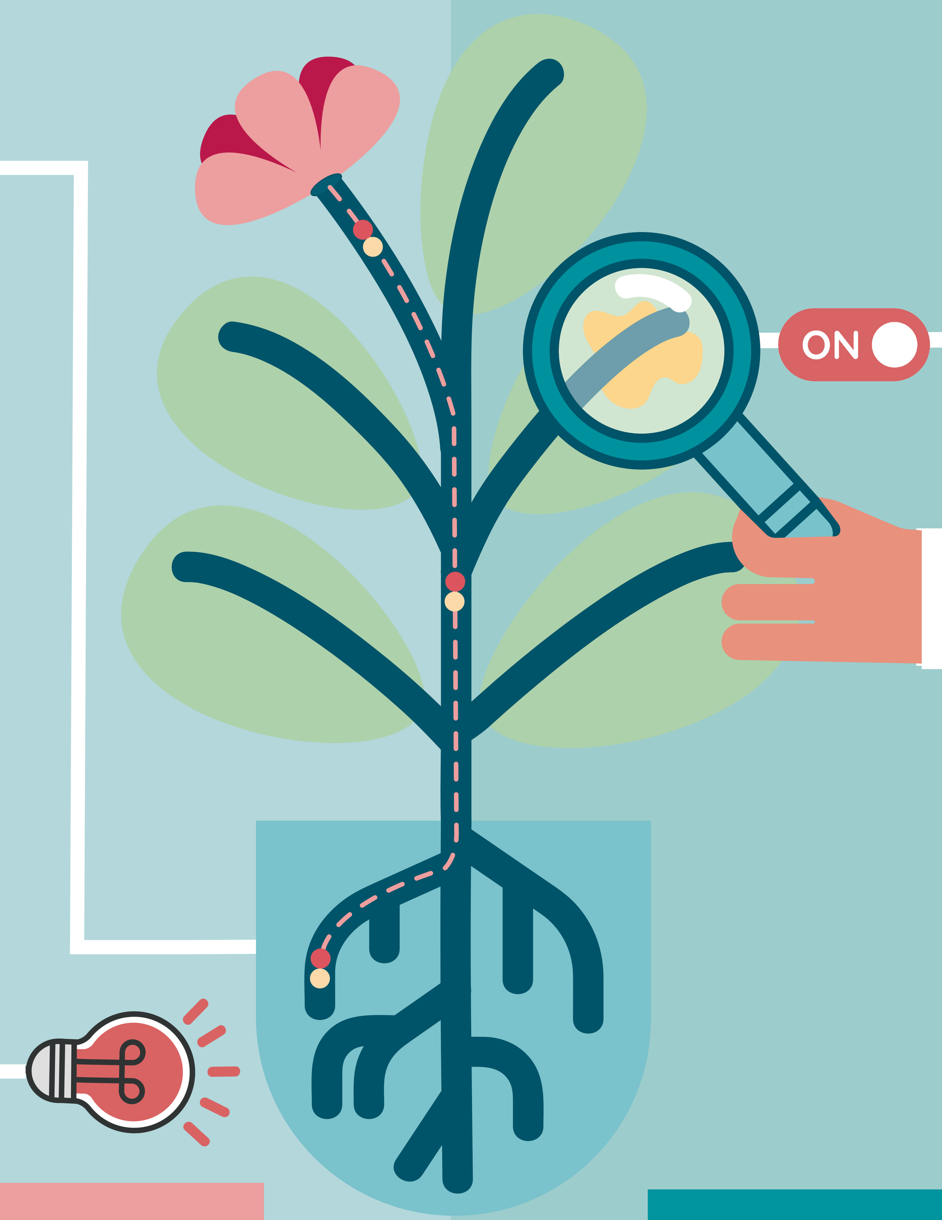
Human-plant communication Optogenetic circuit

A root-specific modular optogenetic circuit confers the ability to communicate with plants. This element enables control of the expression of any target pathway, by customizing the final element of the system. Furthermore, we take advantage of viral movement to transport signals to aereal parts of the plant.

Results

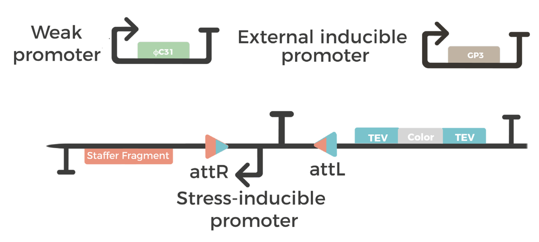


Luciferase expression in all conditions after 23 hours from red-light activation.

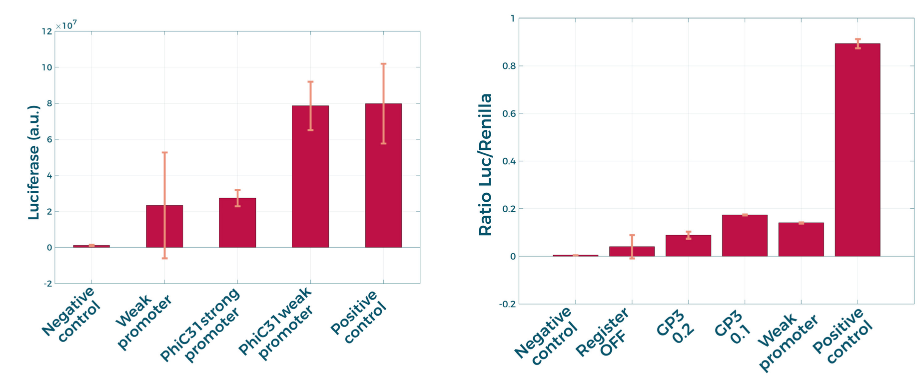


Plant-Human Color System

Biotic and abiotic stresses are determined using a modular genetic AND gate. A leaf color change triggered by stress-inducible promoters and recombinase activity notifies whether plants are affected by a determined stress. Each condition is discriminated through our Color Code System, carried out with viral vectors due to its auto-replicative and systemic movement.



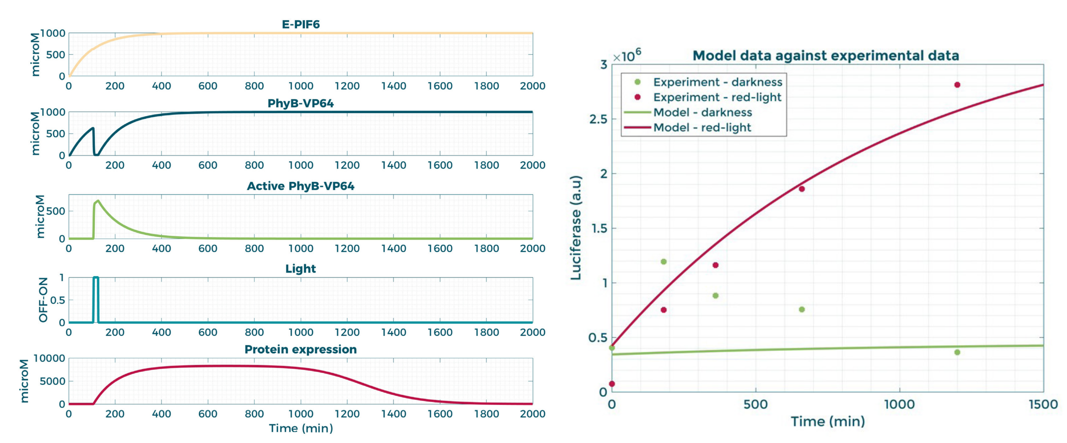
Results



Luciferase expression levels before and after induction with PhiC31.

Difference of luciferase expression levels obtained before and after RDF induction.

Modeling



Optogenetic circuit dynamics

Representation of experimental data and adjusted model

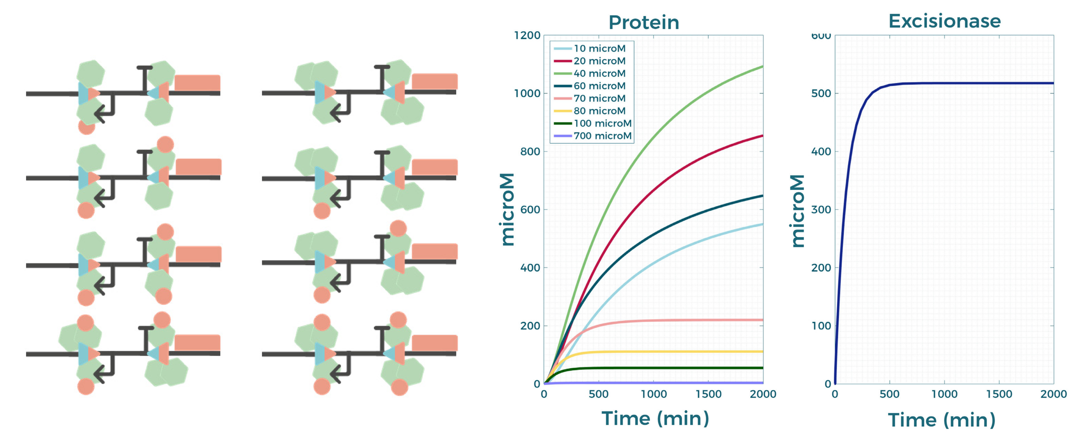
Conclusions

Human plant communication was demonstrated by our *in vivo* and *in silico* results. A significant difference was observed between plants irradiated with red light and those in dark conditions. Interestingly, white light also activates luciferase, highlighting the need to restrict expression to roots using specific promoters.

Conclusions

Recombinase-RDF activity was proved. Its behavior under different protein concentrations and promoter strengths was characterized.
A correct ratio of PhiC31 and RDF is mandatory to obtain a good behavior of our genetic device. Thus recombinase concentration must be 4-fold higher than RDF concentration.

Modeling



Unproductive complexes forms

Protein output at different integrase-recombinase concentrations.

HARDWARE

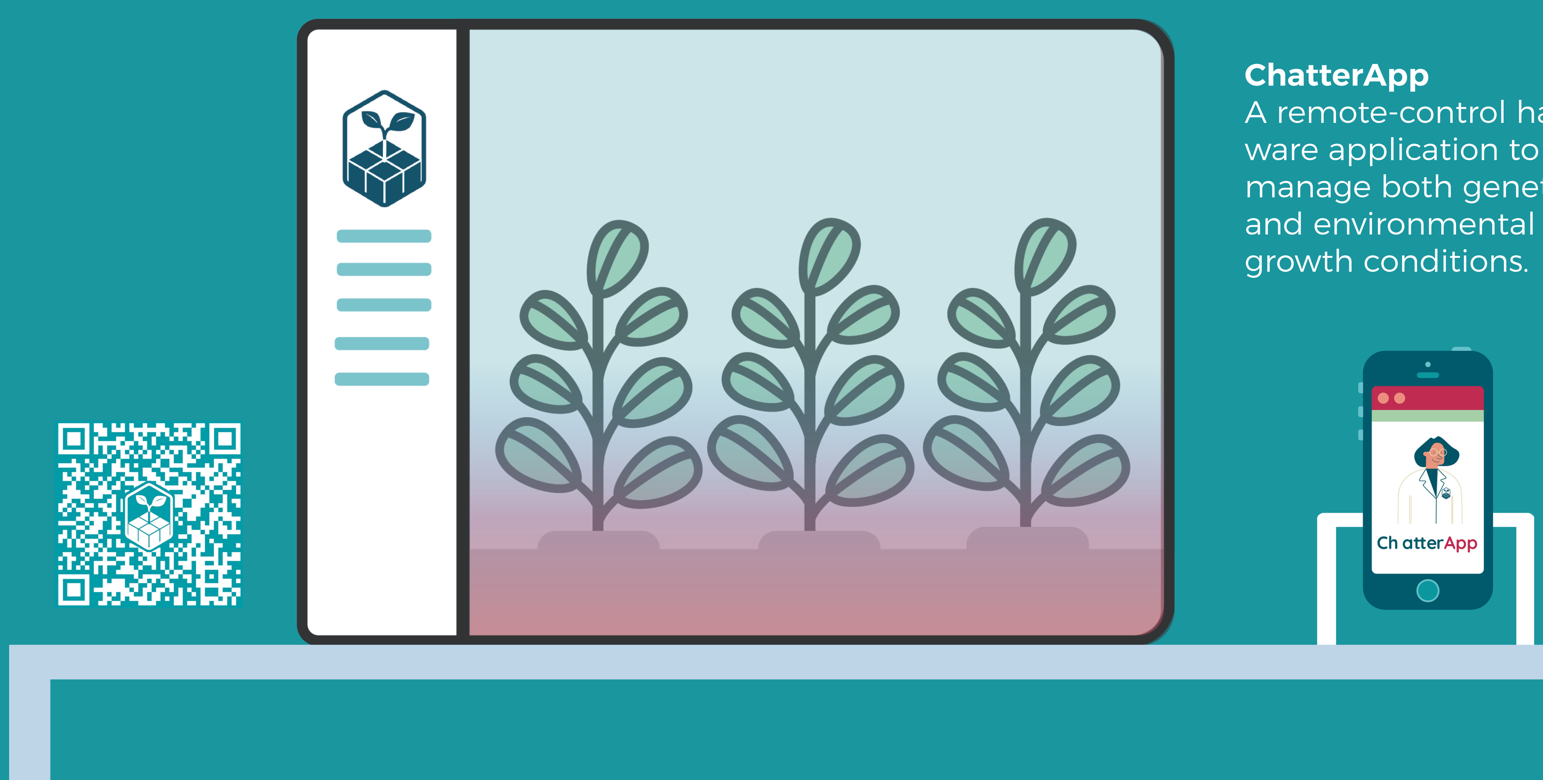
ChatterBox is a modular, open-source and scalable hydroponic device to improve agriculture sustainability by implementing SynBio technology.

Control over genetic conditions:

- Camera and recognition software to detect plant color changes.
- Two wavelengths lamps for optogenetic circuit controls.
- Controlled by Arduino and Raspberry.

Control over climatic and growing conditions:

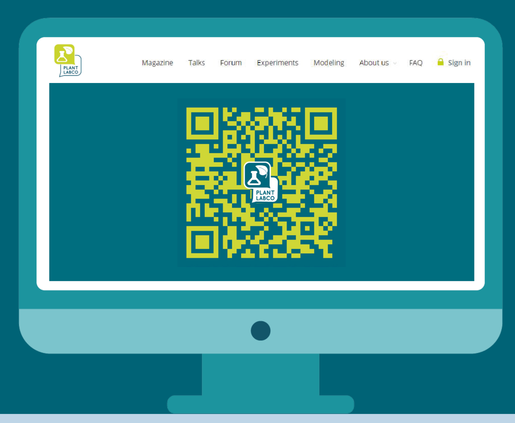
- Temperature
- Humidity
- Circadian cycles



ChatterApp
A remote-control hardware application to manage both genetic and environmental plant growth conditions.

SOFTWARE

PlantLabCo arises to fight today's Plant SynBio problems providing an online platform with plentiful tools to tackle this situation:



- Forum for researchers to interact, discuss and inquire with the whole community.
- An experiment repository where researchers are able to register their own and consult other members work.
- Modeling tool, in order to transform simple SynBio parameters in a set of interconnected formulas through a graphic interface.
- Informative magazine, to spread science, Plant SynBio and GMOs to the general public.

plantlabco.org

HUMAN PRACTICES

Control over plants can promote a future sustainable agriculture. Thus, we discussed with greenhouse supervisors their real necessities about plant growth control.

Obtained conclusions allowed us to improve and modulate our project.

An innovative pilot project was delineated to face GMOs social rejection. Planning the usage of university and urban public spaces as primary social tests with ChatterPlant.

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