

Mathieu Beaucage<sup>1</sup>, Louis Gosselin<sup>2</sup>, Martine Dorais<sup>1</sup>, Steeve Pepin<sup>1</sup> and Mathieu Bendouma<sup>1</sup>

<sup>1</sup> Faculté des sciences de l'agriculture et de l'alimentation, Université Laval, Québec, QC, Canada

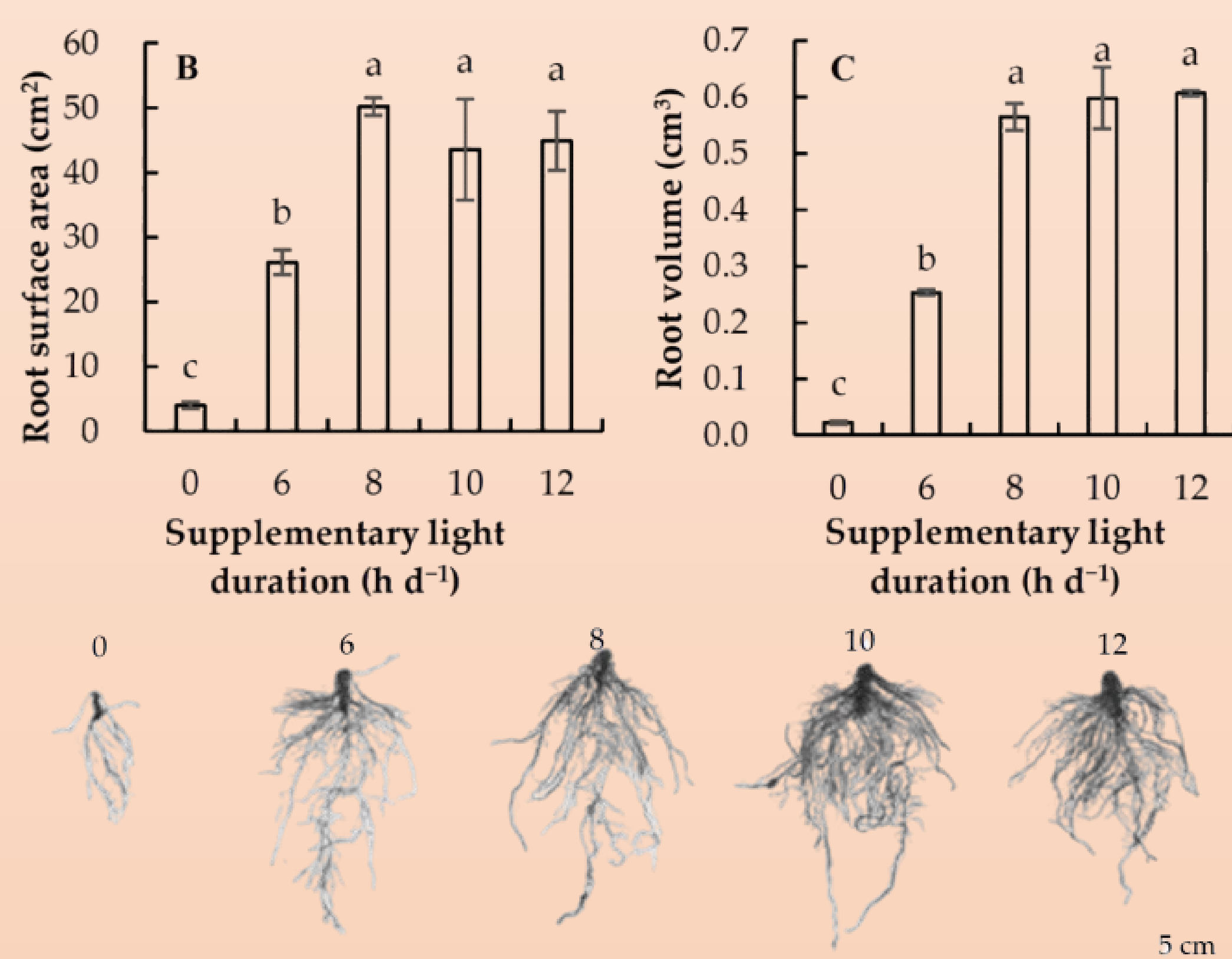
<sup>2</sup> Faculté des sciences et de génie, Université Laval, Québec, QC, Canada  
mathieu.beaucage.1@ulaval.ca

## Introduction

- Differential pricing of electricity granted to greenhouse producers by Hydro-Québec.
- Producers could be encouraged to interrupt the use of electricity, for photosynthesis, during winter.
- Load shedding can present a risk for the development of crops, and indeed, a financial risk for farmers.
- The project aims to analyze the influence of these disturbances on the development of cultures.
- The first tests will focus on cucumber production for its growth speed.

## Literature review

- An increase in cucumber root volume was measured when the lighting duration increased from 6h to 8h.
- No significant difference was found when the light duration was 8h to 12h (Yan & al, 2021).



- Mini-cucumber plants can grow under continuous lighting with LEDs (T2, T3 and T4) without morphological, physiological and yield difference compared to conventional photoperiod (T1).
- First study that shows no injury to the plants with continuously light (Lanoue et al, 2021).

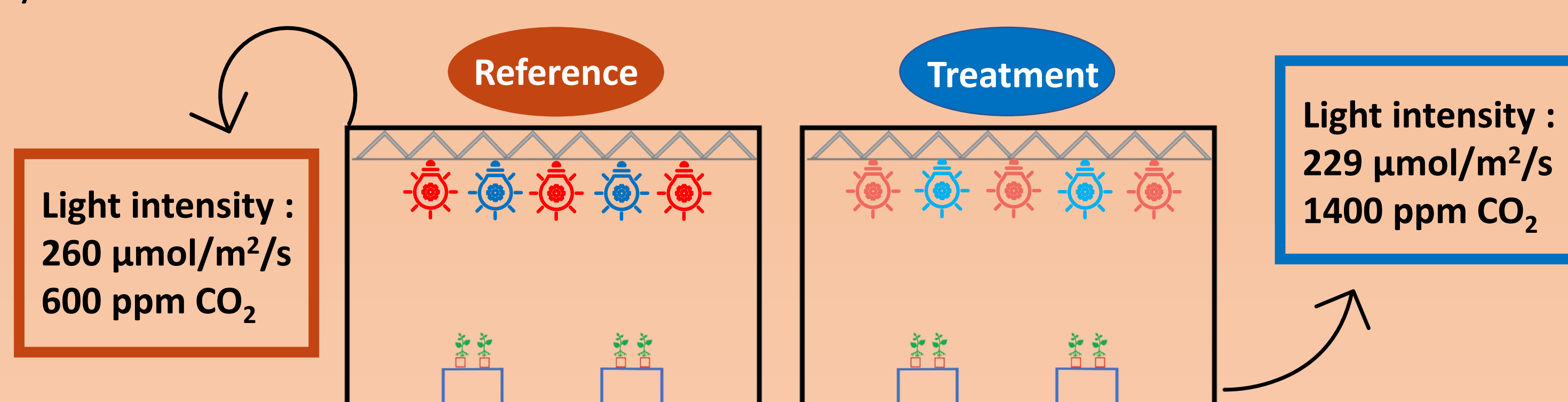
Yield Period	Light Treatment	Total fruit weight (Kg m <sup>-2</sup> )
19 November 2019 - 20 March 2020	T1	36,50 <sup>A</sup>
	T2	36,34 <sup>A</sup>
	T3	36,49 <sup>A</sup>
	T4	36,76 <sup>A</sup>

Letter groups represent a significant difference between the lighting treatments at  $p < 0,05$ .

- T1 : 16 h of combined red light and blue light and 8 h of darkness.
- T2 : 24 h continuously with red light and blue light.
- T3 : 24 h continuously with 16 h with red light and 8 h with blue light
- T4 : 24 h continuously with 12 h of red light and 12 h of blue light.

## Projected methodology

- Based on Gubbels' et al. study - Gubbels et al. (2022)
- They aimed to assess whether increasing CO<sub>2</sub> input could reduce the effects of lower lighting intensity in greenhouse cucumber production.
- Reference growth chamber had higher yield but there is no significant difference for dry matter between the reference and the treatment.



## Reference

Gubbels et al. (2022). Improving light use efficiency of cucumber in a plant factory setting. (Report / Stichting Wageningen Research, Wageningen Plant Research, *Business Unit Greenhouse Horticulture*,; No. WPR-1191). Wageningen Plant Research. <https://doi.org/10.18174/582811>

Lanoue et al.(2021). Continuous Light Does Not Compromise Growth and Yield in Mini-Cucumber Greenhouse Production with Supplemental LED Light. *Plants* 2021, 10, 378. <https://doi.org/10.3390/plants10020378>

Yan et al. (2021). Morphological and Physiological Properties of Greenhouse-Grown Cucumber Seedlings as Influenced by Supplementary Light Emitting Diodes with Same Daily Light Integral. *Horticulturae* 2021, 7, 361. <https://doi.org/10.3390/horticulturae7100361>

## Objectives

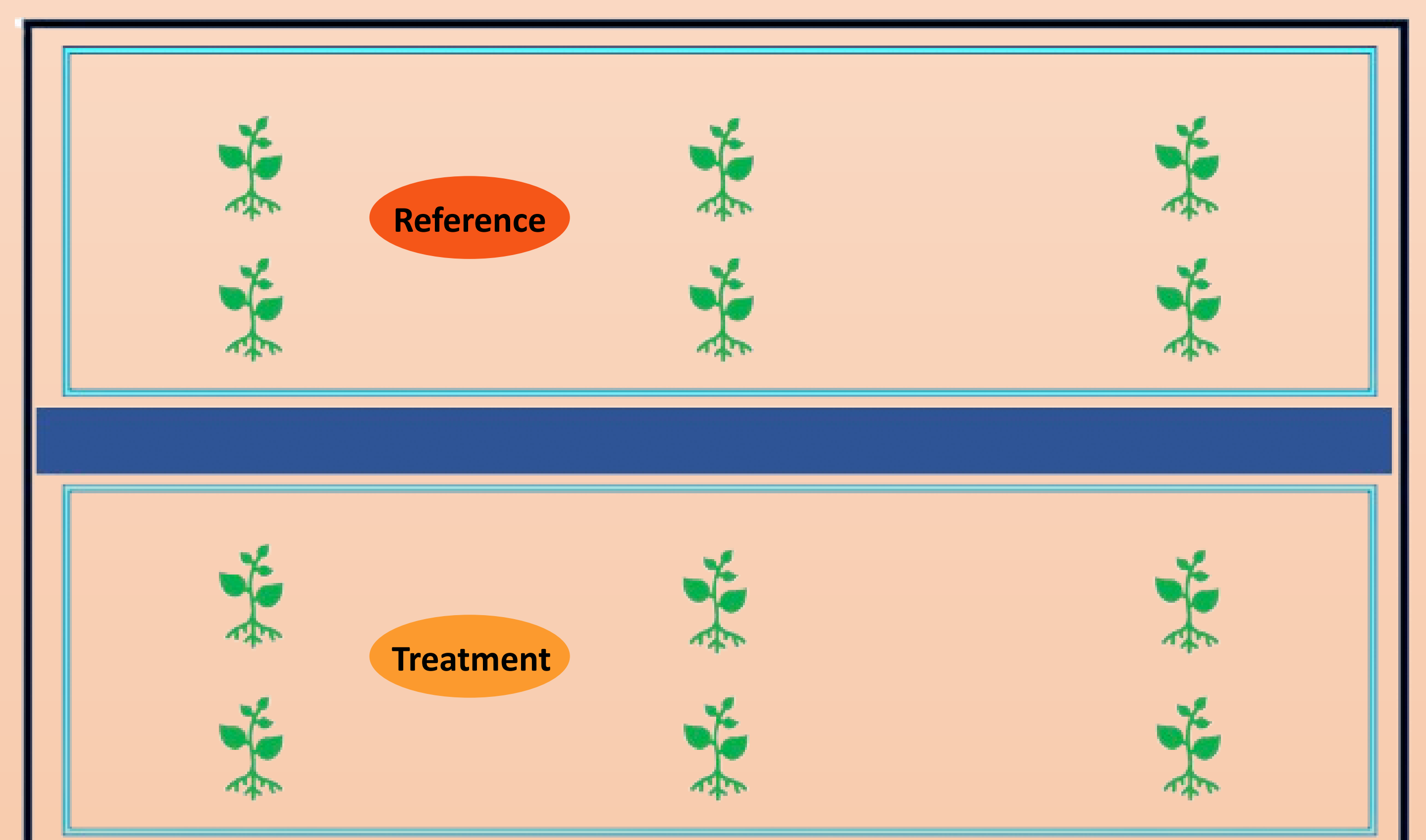
- Set up an experimental device to study the development of vegetables under different light treatment in a controlled environment.
- Set up the necessary instrumentation to monitor the environmental variables, and the energy consumption of the systems.
- Develop a protocol and monitor agronomic data of the tested crops.
- Quantify the impacts of lighting interruption (considering duration and frequency) on crop development.
- Propose measures to mitigate the effects of interruption

## Experimental set-up

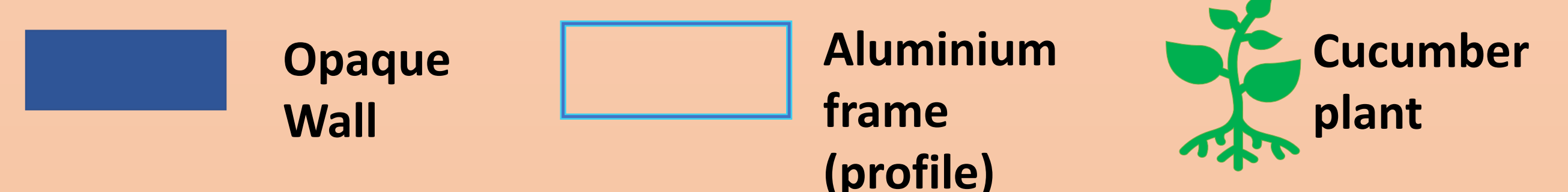
- Growing cucumber plants in a 7 m<sup>2</sup> growth chamber.
- The growth chamber will be divided into two where we will find a control treatment and a treatment with load shedding simulation.
- Use of an opaque wall to separate the two lighting treatments present in the growth chamber
- Type of lamps used: LED and Metal halide (MH)

### Advising growing conditions for cucumber production in greenhouses according to agricultural institutes (CRAAQ, OMAFRA) :

Daytime temperature :	28°C
Nighttime temperature :	18°C
Relative humidity :	60% to 80%
Photoperiod :	16 hours
CO <sub>2</sub> concentration :	1000 to 1500 ppm



Plan of the experimental device with the reference side and the treatment side.



## Conclusion

- With the large amount of electricity demanded during peak periods in Quebec, Hydro-Québec wishes to encourage greenhouse producers to reduce or interrupt their electricity consumption, which could be harmful to the production and finances of greenhouse producers.
- The project consists of planting a cucumber crop in a growth chamber divided into two, each side of which will have different lighting treatments.
- There will be a reference treatment and a treatment subject to electricity interruption conditions.
- The aim is to evaluate the effect of lighting interruptions on plant development.
- First tests will be launched at the end of autumn 2024.