

# Impact of Urban Cultivation Systems on Batavia Lettuce (*Lactuca sativa* L. var. Amaroza) : A Study on Agronomic Performance, Chemical Composition, and Organoleptic Qualities

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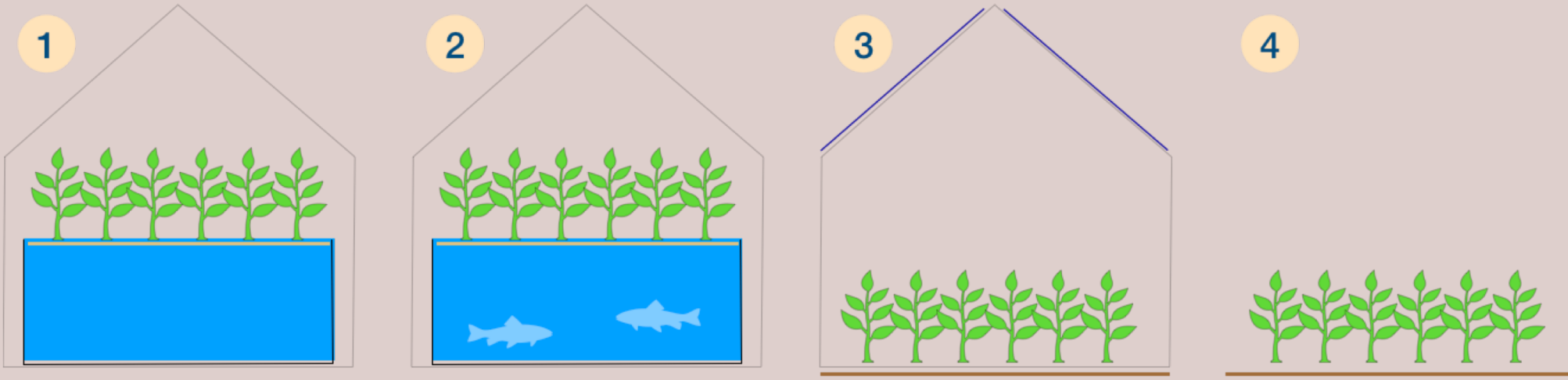


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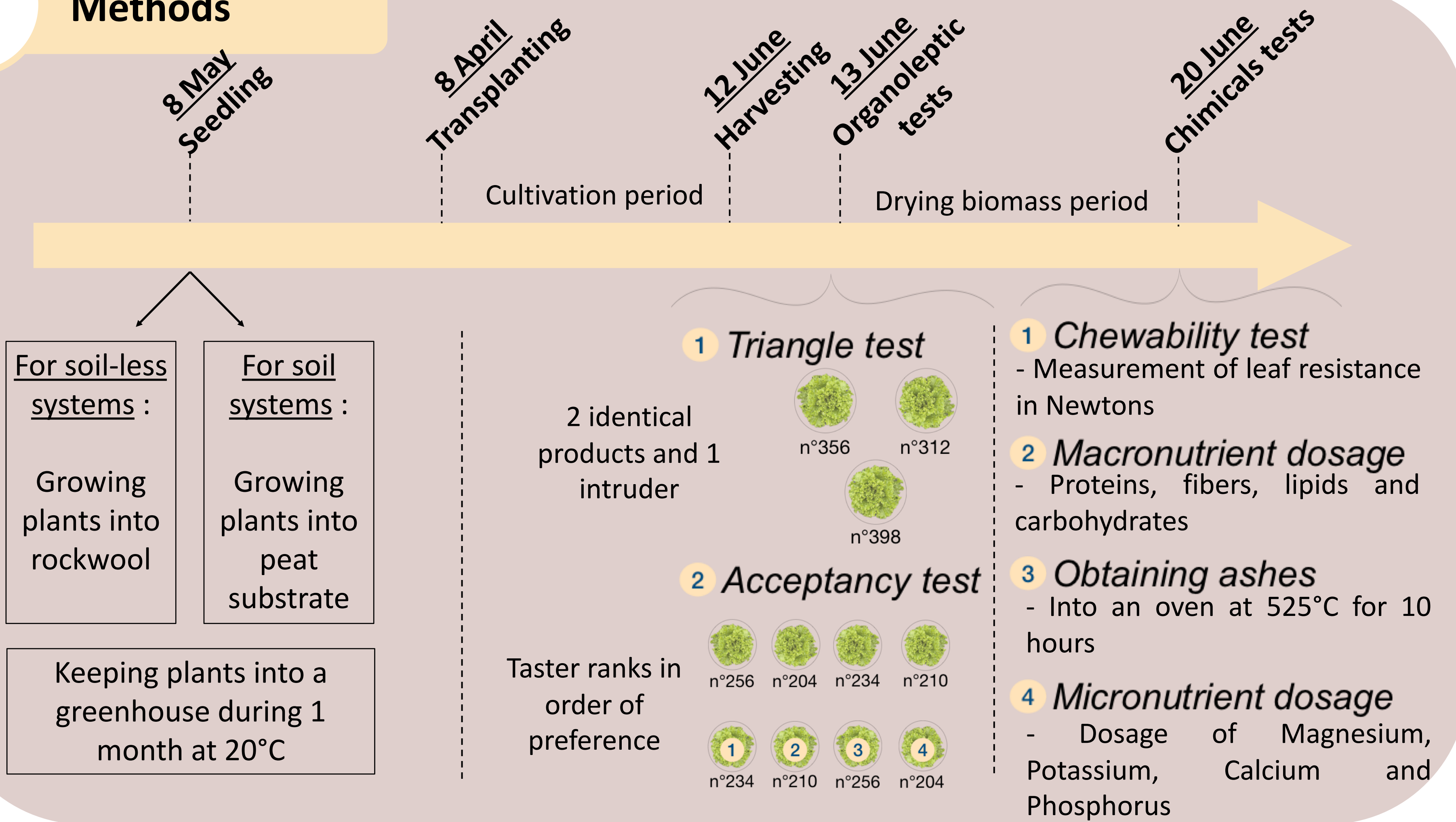


## 1 Introduction

This study aims to monitor the production of Batavia lettuce (*Lactuca sativa* L. var. amaroza) in four cultivation systems, including both **soiless and open-field methods**. We compare **agronomic yields, chemical composition, and organoleptic properties** of the harvested lettuce (study done in 2024). The quality and composition of food products have been increasingly well-documented in processed foods over the past years. At the same time, consumer **skepticism and criticism of soiless cultivation systems persist**. The studied cultivation methods included conventional hydroponics in a greenhouse(1), aquaponics (2) in a greenhouse (with Koï carp), open-field soil cultivation under a photovoltaic greenhouse with 33% of the roof covered by solar panels (3), and outdoor open-field soil cultivation (4).



## 2 Methods



## 3 Results

### Chemicals analysis results

	Hydroponic greenhouse	Aquaponic greenhouse	Photovoltaic soil greenhouse	Outdoor soil
Yield (g)	242,9 b	367,0 a	195,4 b	218,9 b
Chewability (N)	4,4 b	3,6 b	4,6 b	7,7 a
For 100g of fresh lettuce				
Dry biomass (g)	4,1 b	4,5 ab	5,1 ab	5,7 a
Fibers (g)	2,1 b	2,2 b	2,8 a	3,0 a
Total proteins (g)	1,2 b	1,3 b	1,5 ab	1,9 a
Carbohydrates (g)	0,4 b	0,5 a	0,4 b	0,4 b
Lipids (g)	0,1 b	0,1 b	0,1 b	0,2 a
Ashes (g)	0,2 b	0,1 b	0,3 a	0,3 a
P (µg)	28,4 b	16,6 c	44,9 a	31,2 b
Ca (µg)	29,4 d	40,3 c	55,7 a	48,1 b
K (µg)	138,1 c	48,0 d	392,9 a	328,2 b
Mg (µg)	12,2 bc	10,4 c	17,5 a	14,0 b



### Specific acceptance scores



## 4 Discussion/Conclusion

### Environemental context

The year 2024 was the least sunny in Belgium over the past 30 years, which did not favor open-field cultivation. Additionally, heavy rainfall at the beginning of the season led to increased pressure from slugs and rodents on outdoor crops compared to sheltered lettuces

### Lettuce composition

All the values obtained are consistent with the values from the literature regardless of the method (with the exception of Potassium in aquaponics). Aquaponic lettuces showed the highest fresh biomass but also had the lowest potassium content. This deficiency can be explained by the near absence of this mineral in such cultivation systems, both in the feed and fish waste. Soil-grown lettuces appeared to have higher mineral contents compared to soiless systems. The chewiness of the outdoor soil-grown lettuce was consistent with the results of the organoleptic tests, which indicated that consumers appreciated this modality less and did not perceive differences between the greenhouse production systems.

## 5 Perspectives

This study will be repeated in 2025, with the addition of a new cultivation modality and more detailed chemical analyses. We will also move towards analyses on health molecules such as vitamins. As the composition of the hydroponic solution is essential for proper nutrient uptake by the plant, the fertilizer dose will be slightly increased.

For this type of study, it would be relevant to extend compositional analyses to include the detection of microorganisms, both at the root and leaf levels.

While the systems studied here produce healthy products, it remains to be seen what level of living organisms are present around and on these plants, and whether they may contribute to their growth and development.