



Large-scale production of containerized forest seedlings in Sweden as an example of nursery production in the boreal conifers regions

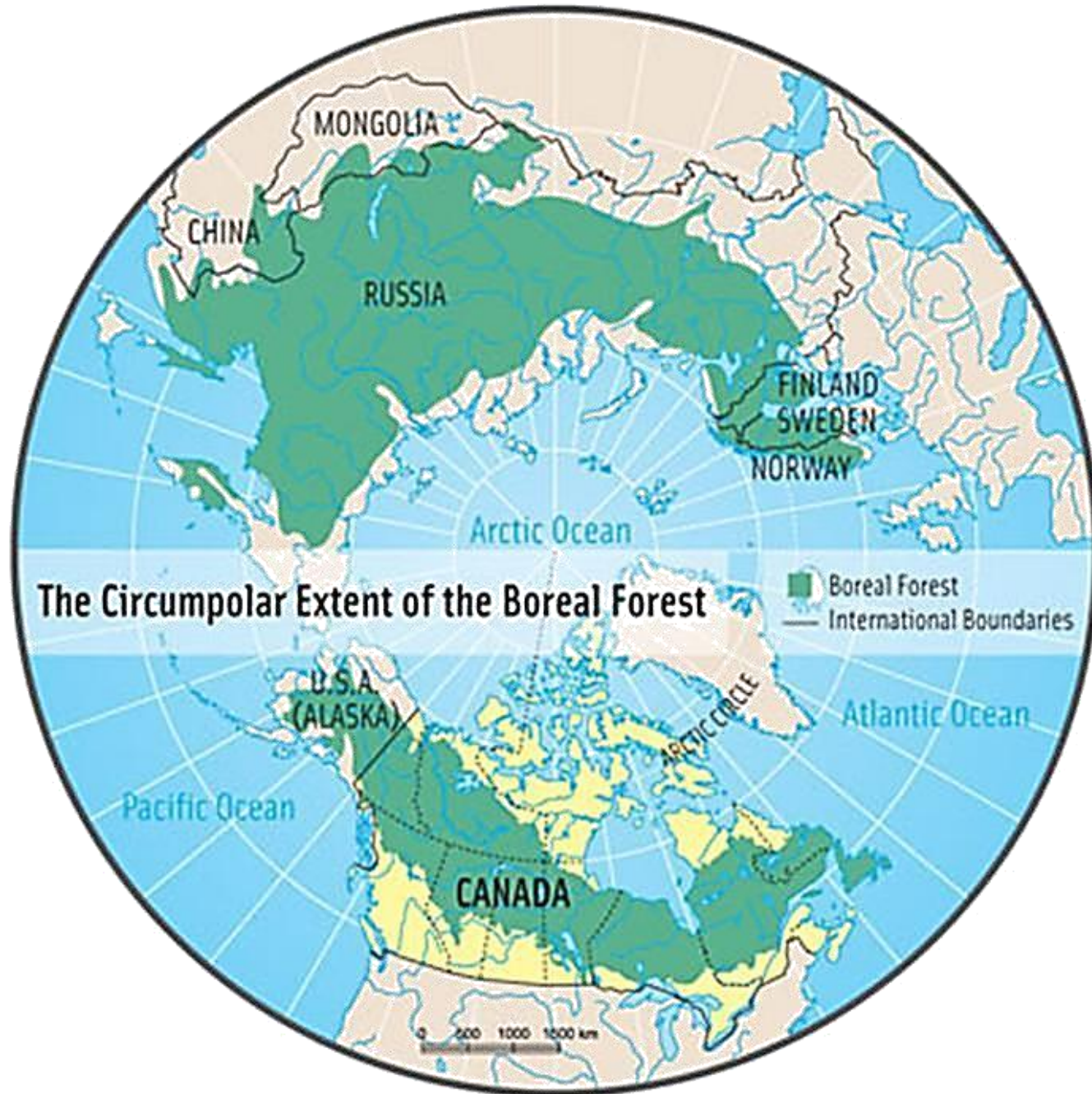


– State-of-the-art and technology transfer based on the Zephyr concept



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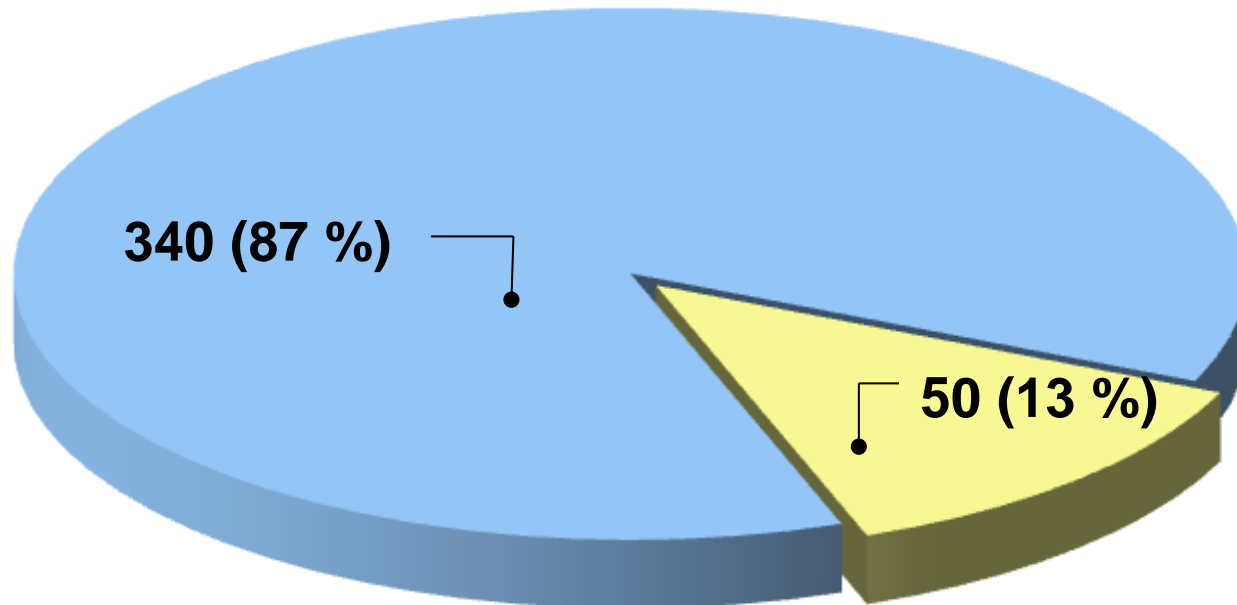
Milan, Italy. October 21, 2015





Forest seedling production in Sweden, 2014

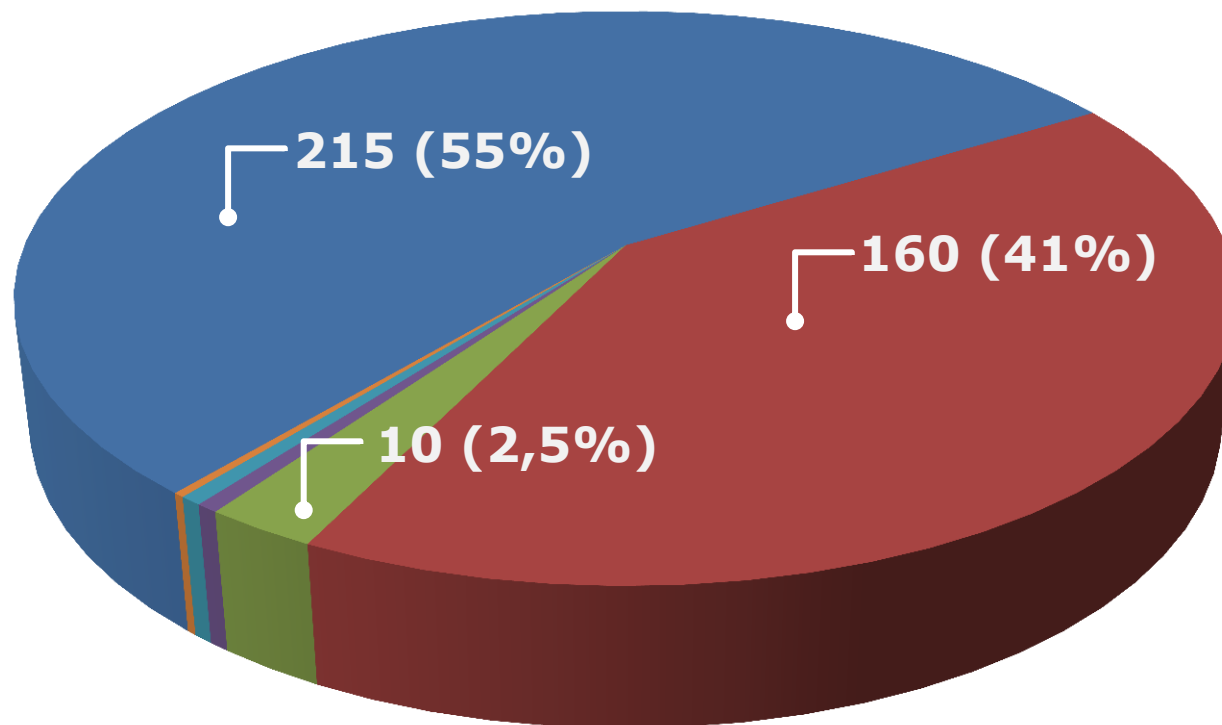
Total production for 2014: 390 million



■ container

■ bare-root

Forest seedling production in Sweden, 2014



- Norway spruce (55%)
- Scots pine (41%)
- Lodgepole pine (2,5%)
- Siberian larch (0.5%)
- Silver birch (0.5%)
- Others (0.25%)

Forest seedling production, important species

Scots pine (*Pinus sylvestris*)

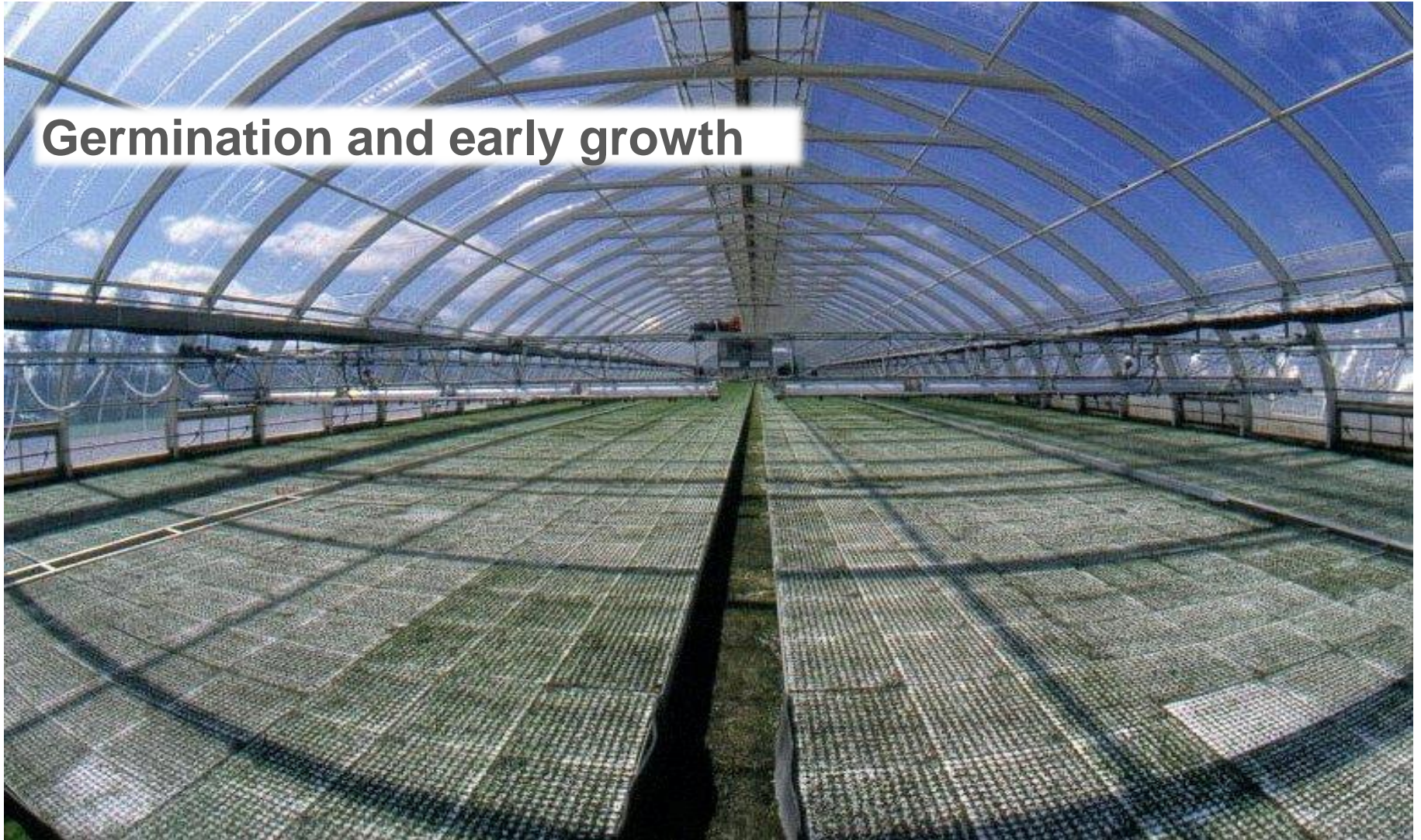


Norway spruce (*Picea abies*)

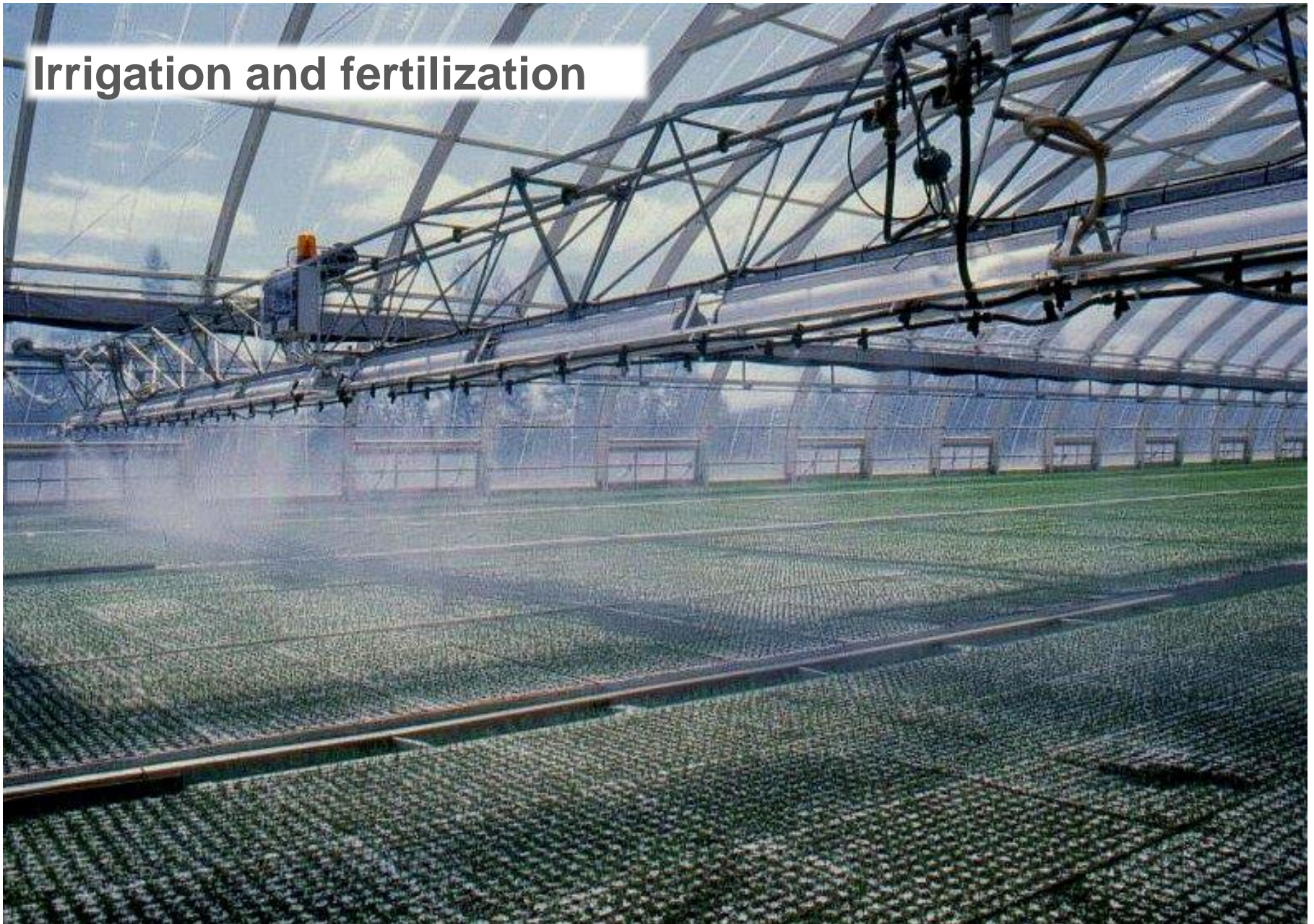


State-of-the-art regarding production of containerized forest seedling in Sweden

Germination and early growth



Irrigation and fertilization





Results of extended night length on needle biomass

1-year-old Scots pine seedlings

Primary needles



Secondary needles



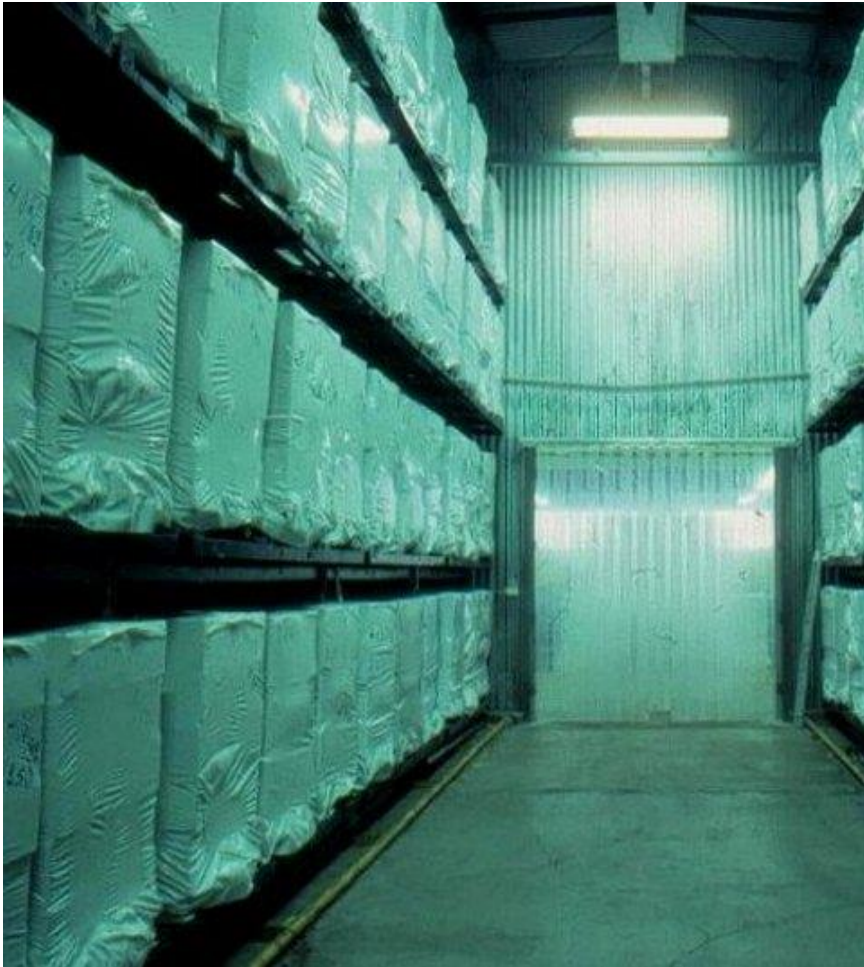
Outdoor growth



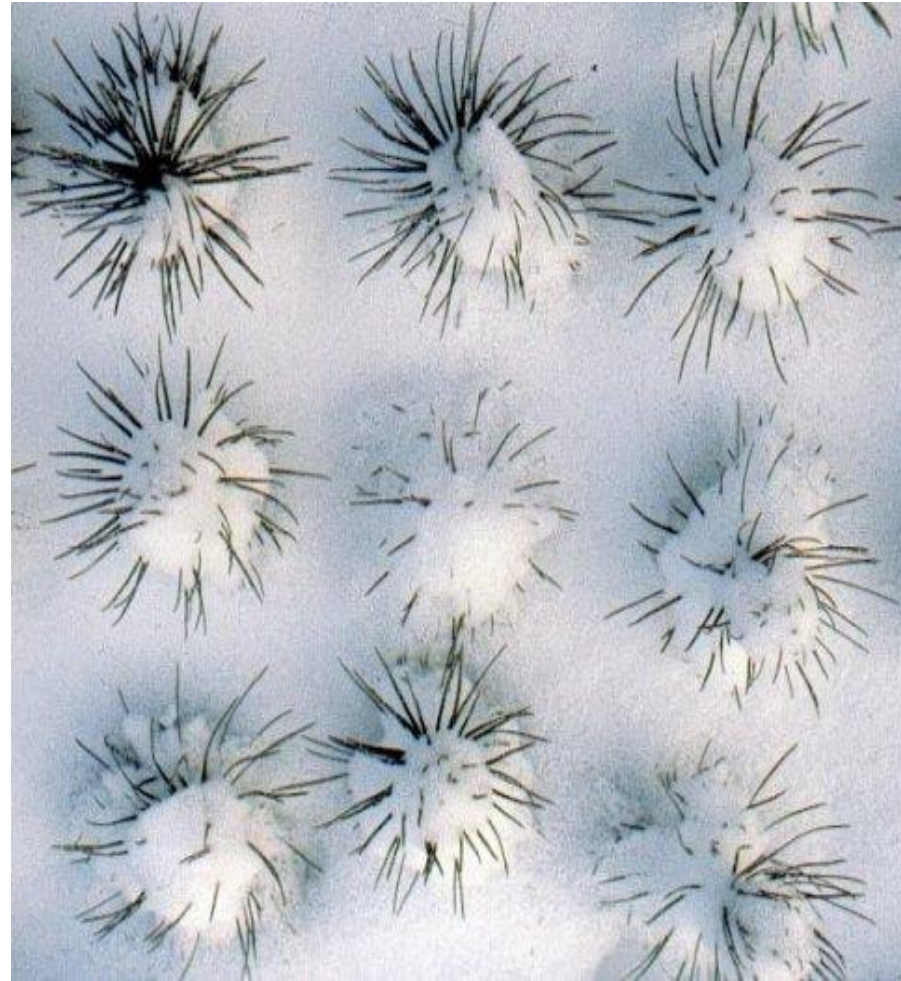
Extended night-length on open land for early initiation of bud-set in Norway spruce



Winter storage



Cold storage in cardboard boxes



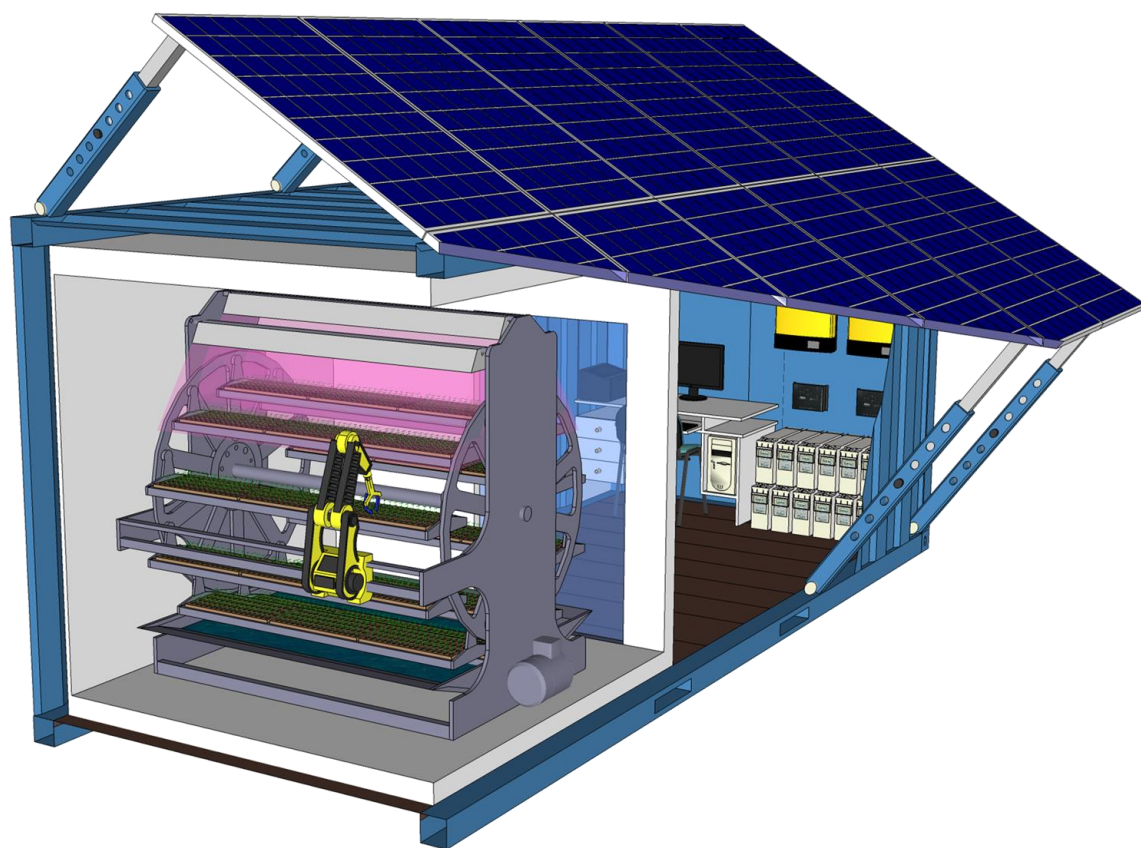
Outdoor storage

Technology transfer based on the Zephyr concept



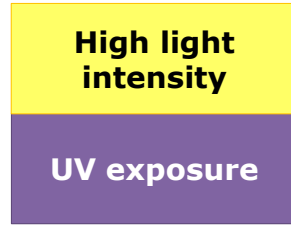
Innovative technology for pre-cultivation of high quality forest seedlings:

- Zero-impact
- cost friendly
- not affected by outdoor climate
- Optimal spectrum from LED lights
- Photovoltaic system
- Wireless sensors

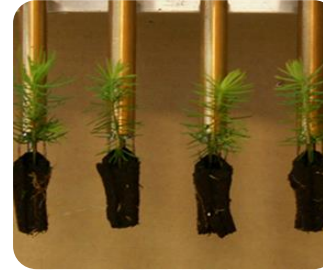




Pre-cultivation under LED lamps



Treatment to reduce light shock



Transplanting to any optional container system

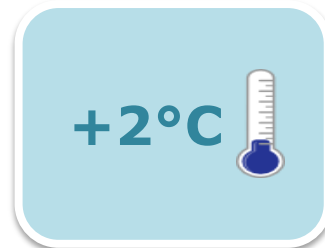


Outdoor cultivation for one vegetation period



Extended night length to induce cold tolerance

Pre-cultivation and transplanting 7 batches on a year-around basis



Cold storage



Transplanting to any optional container system



The Zephyr concept adapted to large-scale production of containerized forest seedlings



Example from a commercial forest nursery with a production of 14 million seedlings per year

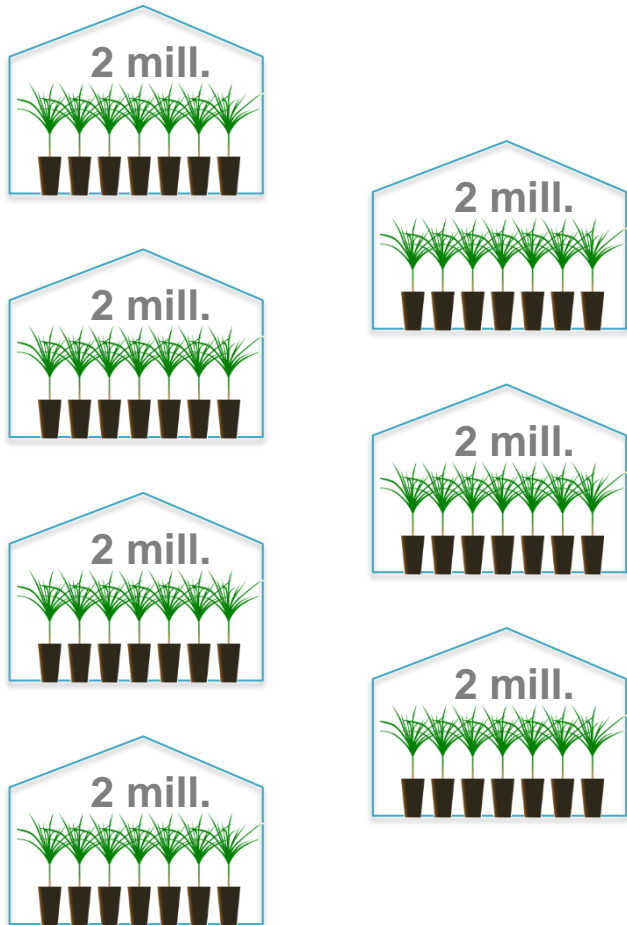


**DALARNA
UNIVERSITY**

State-of-the-art

7 greenhouses

Total 14.000m²



Total: 14 mill./year

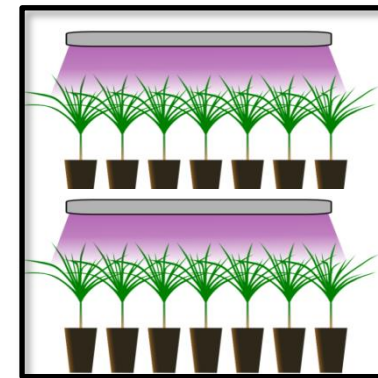
Zephyr concept

1 growth chamber

Total 100m²

Pre-cultivation in the growth chamber

7 batches per year each of 2 millions



No greenhouses needed

Total: 14 mill./year



The Zephyr concept advantages compared to state-of-the-art



- Significant reduction in energy consumption and related costs when going from heating by fossil fuels to alternative energy sources.
- Zero-impact of greenhouse gas emissions by not using fossil fuels for heating during germination and early growth.
- Significant reduction in leakage of nutrients and pesticides by zero-impact technology during the pre-cultivation phase.
- Significant reduction in water consumption by recycling during the pre-cultivation phase.
- **Development regarding technology transfer from forest to agri-food plant indoor cultivation.**



New LED growth chamber for year-round production

Capacity for
2 million seedlings per batch,
7 batches per year

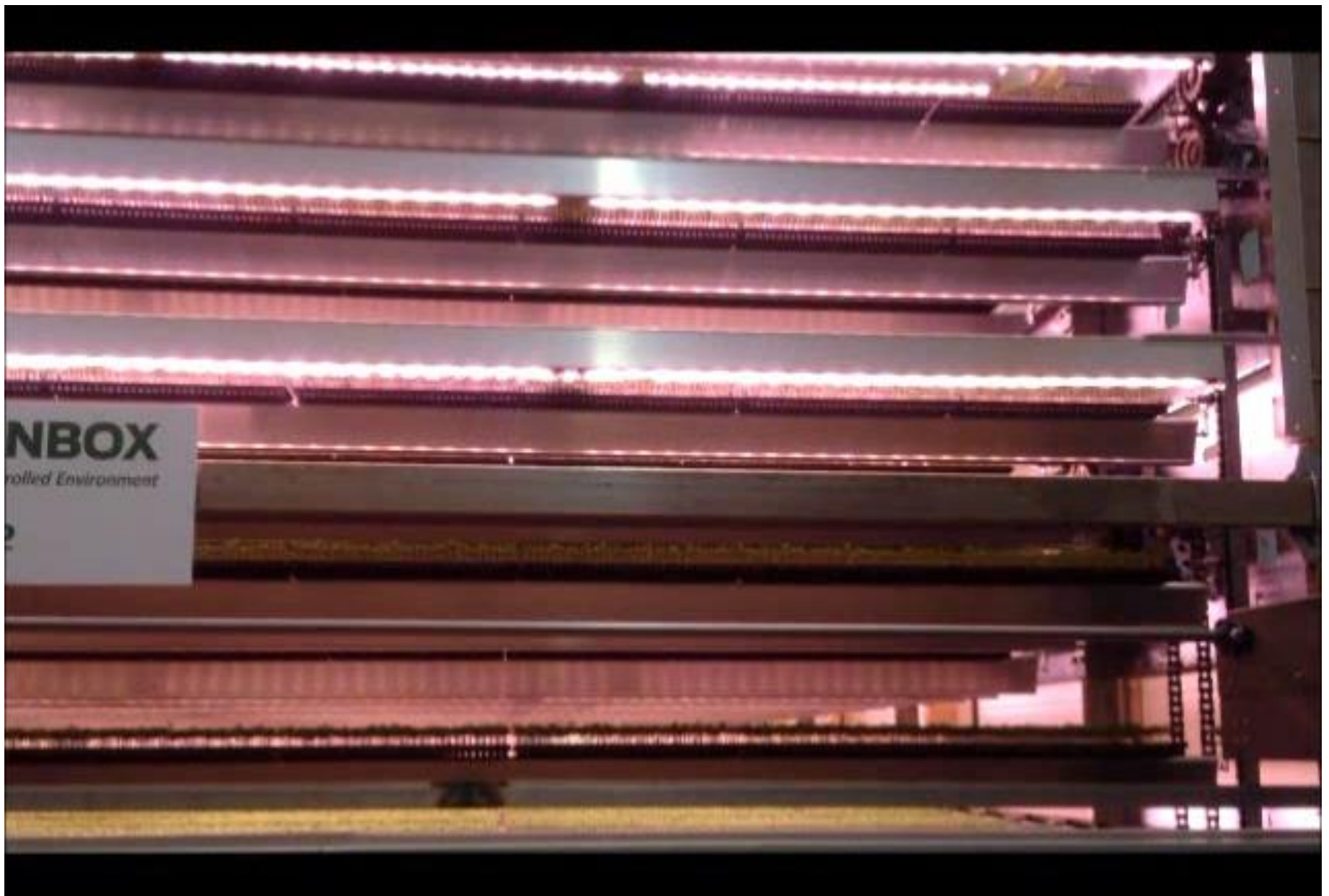


Size of the growth chamber

16m long x 6m wide x 5m high

8 levels of cultivation





Thank you for your attention!

