

Vertikaalaianduse infopäev 14.12.2023



Päevakava: 10.30 -15.30

- Vertikaalviljelus meil ja mujal maailmas. Taimede kasvunõuete tagamine vertikaalviljeluses. Priit Põldma EMÜ
- Vertikaalviljeluseks vajalik tehnika ja abivahendid. Roland Rool; Jaanus Järving, Baltic Agro AS.
- Vertikaalviljeluseks sobivad taimeliigid ja sordid. Marge Olo, Baltic Agro AS
- Vertikaalviljelussüsteemi tutvustus kohapeal. Danko Tolic, Farmony, Iirimaa
- Vertikaalviljeluse võlu ja valu - praktiku kogemus . Artur Sirkel, Urban Farm OÜ.

Vertikaalviljelus meil ja mujal maailmas. Taimede kasvunõuete tagamine vertikaalviljeluses

Priit Põldma

Eesti Maaülikool, aianduse õppetool



Vertical farming
Urban Farming
Rooftop farming
Plant factory

jne

Vertikaalaiandus = vertikaalhaljastus?



Kasvuhoonete liigitus erinevate tunnuste järgi Ristlõike kuju

- 1960-ndatel Austrias
- konstrueeris O.Ruthner
- Kõrgus kuni 40 m
- püstise liikuva konveieriga 0,5-3 m/min.

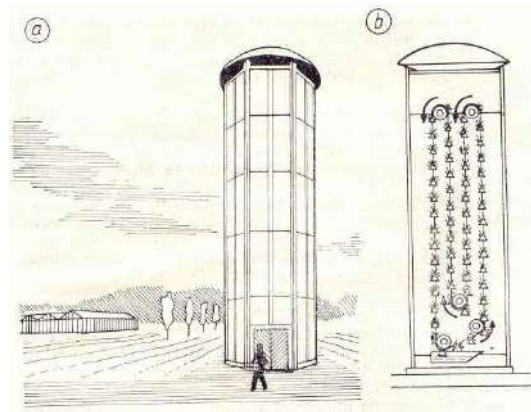
+

Kütuse kokkuhoid 20-25%

Väike tööjõukulu

-

Elektrienergia kulu, amortisatsioon
töökindlus



Vegetable and Gardening Tower of Othmar Ruthner in the Voivodeship Park of Culture and Recreation in Chorzów—The First Example of Vertical Farming in Poland

by Justyna Kleszcz^{1,*}, Piotr Kmiecik² and Jakub Świerczawski³

<https://www.mdpi.com/2071-1050/12/13/5378>



Figure 2. (A) A view of the gardening tower at the WIG 64 exhibition in Vienna, 1964. (B) A view of the gardening tower, 1963. (on the basis of [21] (p. 42)).

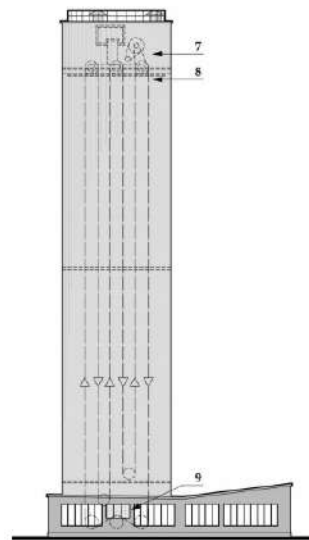


Article

Vegetable and Gardening Tower of Othmar Ruthner in the Voivodeship Park of Culture and Recreation in Chorzów—The First Example of Vertical Farming in Poland

Justyna Kleszcz^{1,*}, Piotr Kmiecik² and Jakub Świerczawski³

Sustainability 2020, 12(13), 5378; <https://doi.org/10.3390/su12135378>



Lufa Farms

- 2011 Montreal, Kanada – maailma esimene kommerts katusekasvuhoone (5800 m²)
- Järgmised 2013, 2017, 2020



<https://montreal.lufa.com/en/>

Laval Greenhouse, Lufa Farms

2013



<https://montreal.lufa.com/en/>

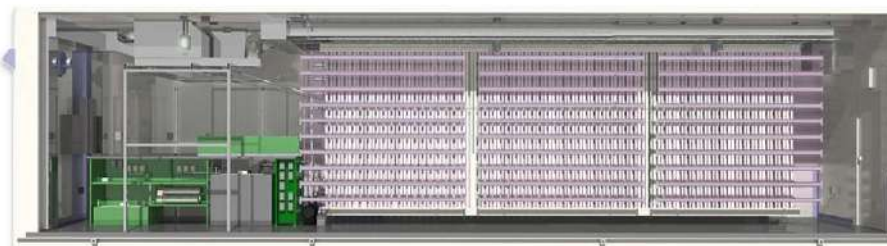
Agrotopia 2021



<https://inagro.be/agrotopia>

Konteinerfarmid

- Toidu tootmiseks
- Söödatootmiseks



<http://www.modularfarms.com.au/primary-module-2/>

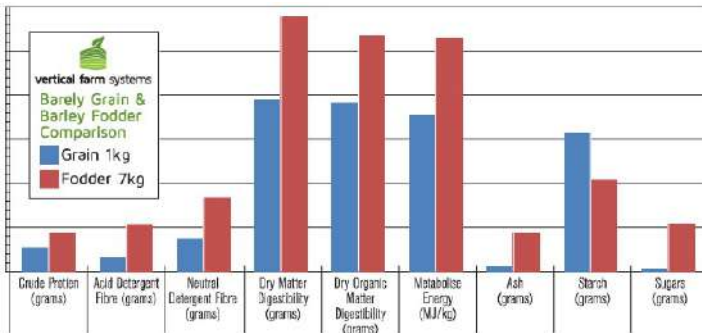
Konteinerfarmid

- XF fodder systems

Grow Cost of Fresh Fodder

Growing fodder using the XF system is extremely economical. To produce 1000 kg of fresh fodder per day the XF system typically uses:

- **Barley grain:** 143 kg feed grade
- **Power:** 124 kWh
- **Water:** 1200 L
- **Labour:** <30 minutes

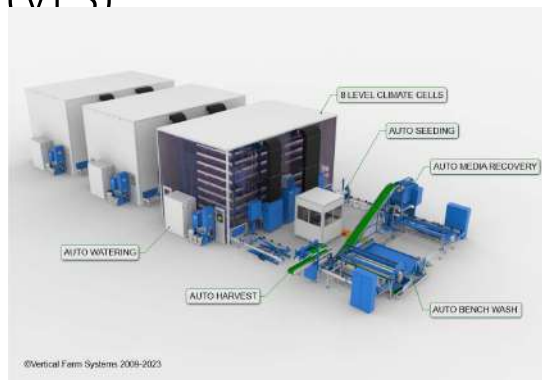
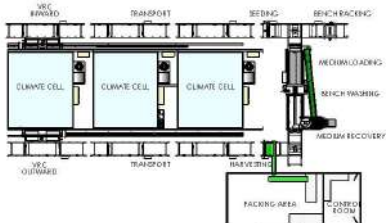


<https://verticalfarms.com.au/xf-fodder-systems>

Vertical Farm Systems (VFS)

- nn ladu-farm

Typical Layout of a small XA Series System



<http://www.verticalfarms.com.au/warehouse-systems>

Sky Green Farm – Singapur



- Pöörlevad rennid
- 9 m kõrgus, 38 „riiulit“
- Salat, spinat, idamaised kapsad.
- Väga efektiivne energia ja veekasutus

Mini-farms

- Koju, kontorisse, restorani, supermarketisse jne



<https://farm.one/vertical-farms/custom-units>

<https://www.clickandgrow.com/>

Philips LED Solutions



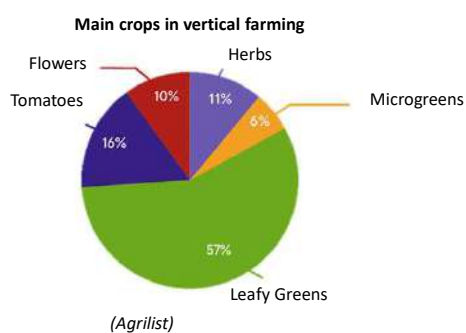
VF - Systems

Tower - System

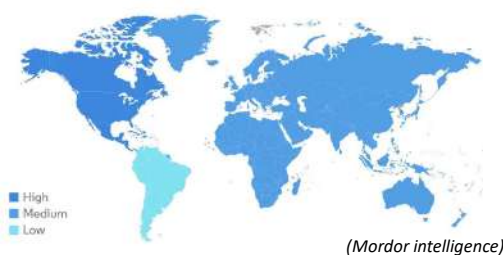
- common type of VF
- central tower with growing shelves
- made out of plastic, metal
- Crops: leafy greens, herbs, microgreens



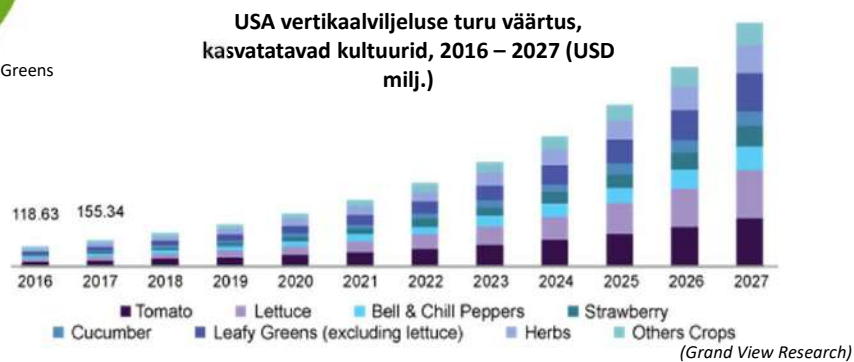
Vertikaalviiljeldus maailmas



Vertical Farming Market by Region, Global 2020



USA vertikaalviiljelduse turu väärtus, kasvatatavad kultuurid, 2016 – 2027 (USD milj.)



Top 8 Vertical Farming Companies

October 2023

1. AgriCool (France) - US \$103 Million

- strawberries, specialized leafy greens and herbs, and cannabis products
- sells about 200kg of strawberries each week

2. Bowery Farming

3. Freight Farms

4. AeroFarms

5. GP Solutions

6. Crop One Holdings, Inc.

7. One.

8. Altius Farms, Inc.

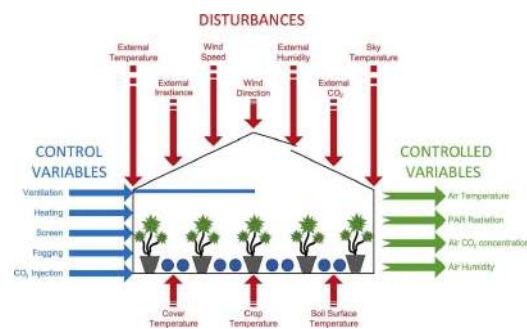


<https://www.agriitecture.com/>

Mida tuleks kontrollida / automaatiseerida?

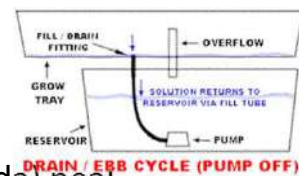
Tootmise kõiki etappe: →

- Küte, ventilatsioon
- Kastmine, väetamine, CO₂
- Valgustus



- Saagikoristus/ sorteerimine

Ebb & Flow (Tõus/mõõn)



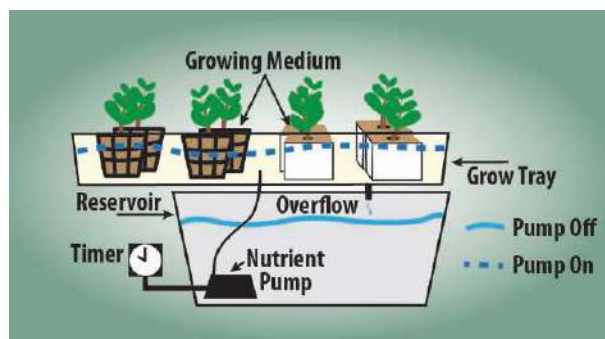
- Flood & Drain. Taimed on pottides lavati (betoonpõranda) peal ja TL anakse päevasel ajal 2-4 h intervalliga 10-15min tsükliga
- Enamasti potilillede, konteinertaimede puhul



- Lihtne/odav ülesehitus
- Lihtne hooldus
- Ringlev TL



- Vetikate kasv
- Tehniline rike võib põhjustada suuri probleeme



Nutrient Film Technique (NFT)

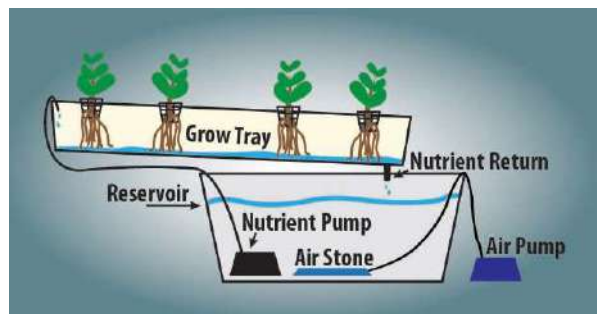
- Enamasti on taimed väikeste pottidega asetatud renni ja TL voolab mööda renni põhja. Päevasel pidevalt või 10-15min tsüklites
- Enamasti salat, maitsetaimed



- Piisavalt O₂
- Ringlev TL
- Ruumi efektiivne kasutus



- ummistumine
- Tehniline probleem võib hävitada kõik taimed
- Vajab regulaarset puhastust



- Vertical farming

Aeroponics (aeropoonika)

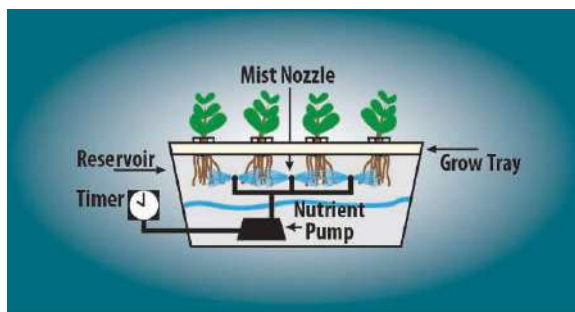
- Enamasti on taimed väikeste kuubikutega asetatud läbi plaadi renni ja TL pritsitakse/udustatakse pidevalt või tsüklitena renni sees. salat, maitsetaimed, jpm



- Piisavalt O₂
- Ringlev TL
- Maksimaalne toitainete omastamine



- High-tech / kallis
- ummistumine
- Tehniline probleem võib hävitada kõik taimed



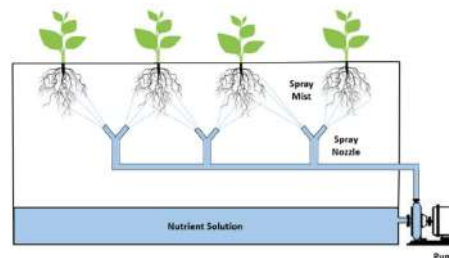
Aeropoonika

➤ Väga efektiivne süsteem

- 90 % vähem vett
- Kiire kasv
- 60 % vähem väetiseid
- Taimed võiksid olla tervemad

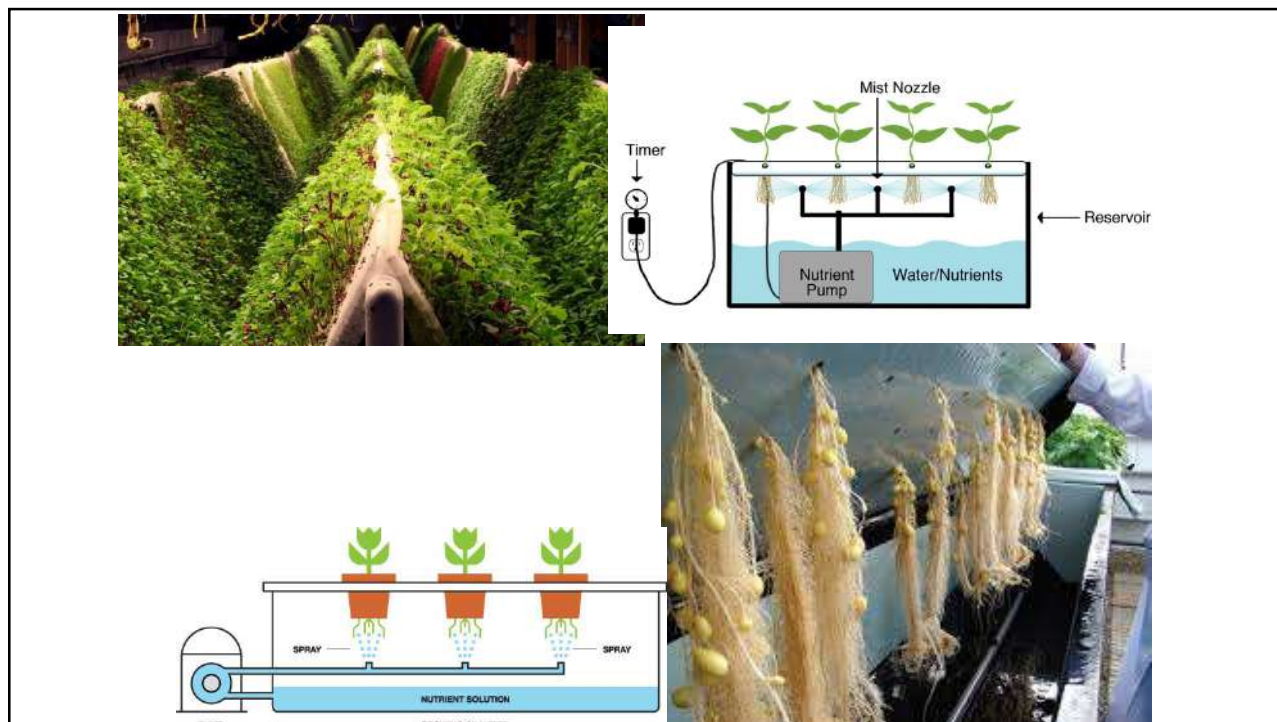
➤ ☹️:

- Kallis investering
- Pidev süsteemi puhastamine ja kontroll



(Kumar et al., 2019)



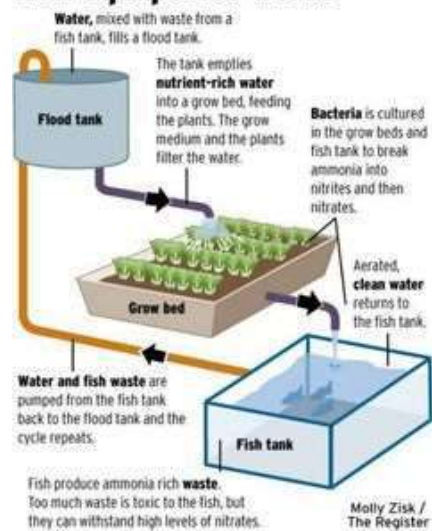


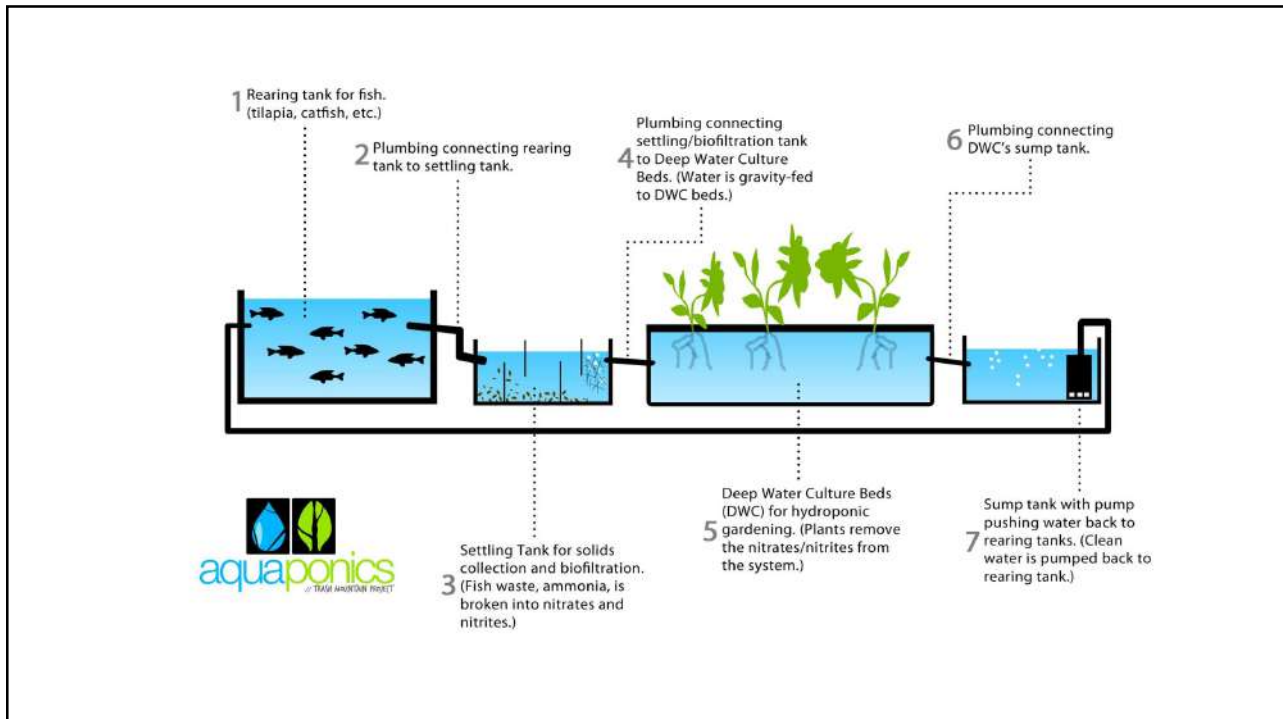
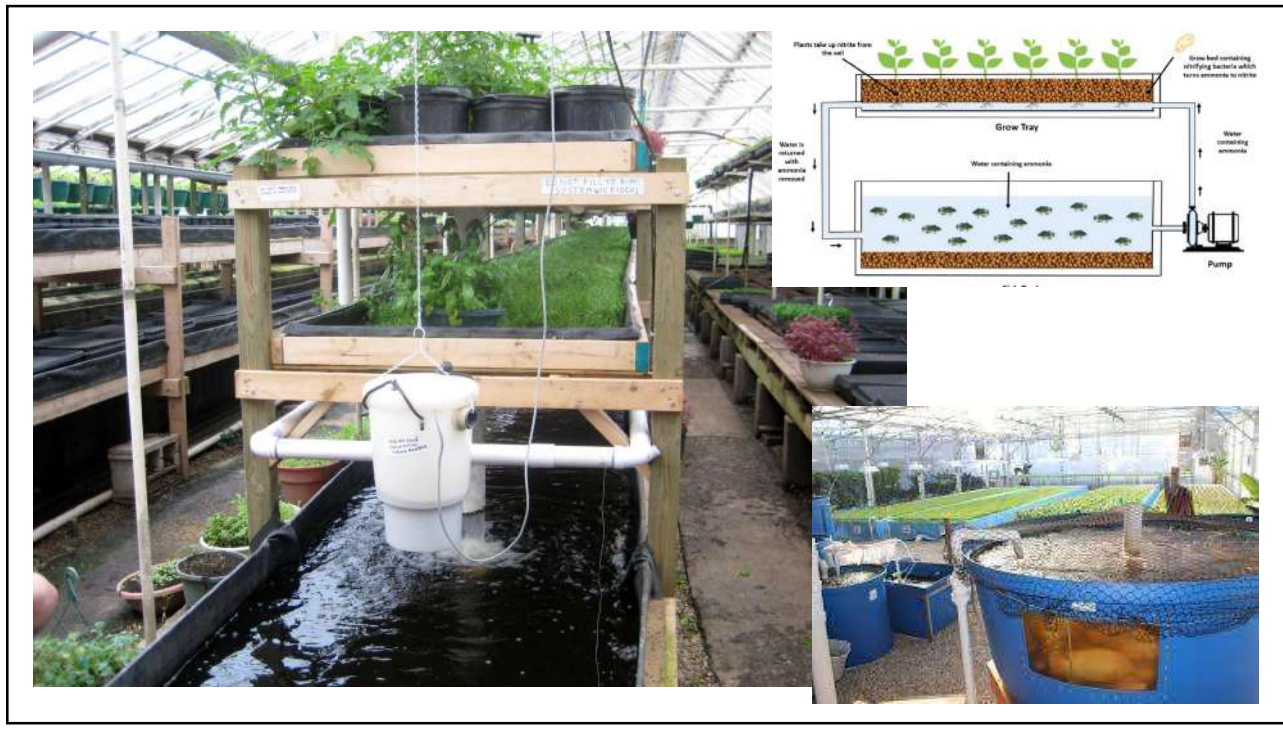
Aquaponics (akvapoonika)

- mitte akvakultuur
- Kalade ja taimede koos kasvatamine



How aquaponics works





Kontroll !!

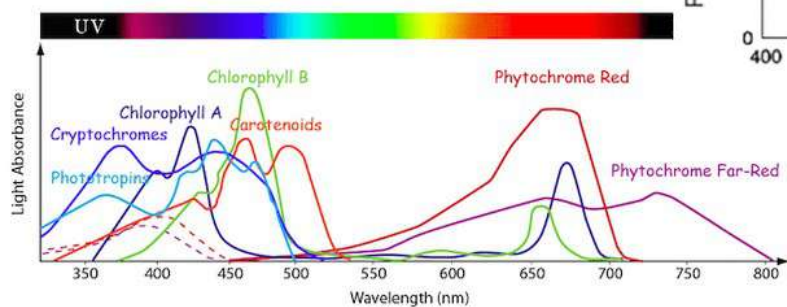
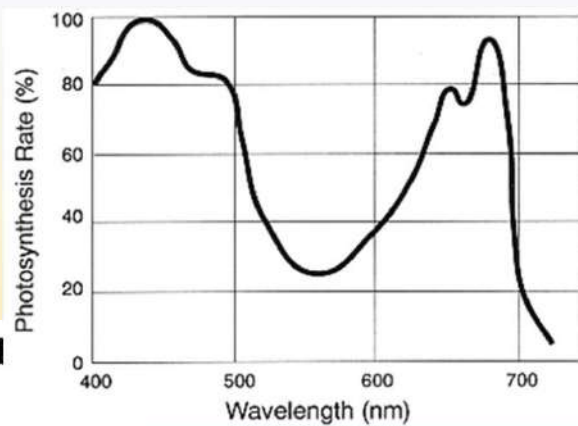
- Süsteemis olevad sensoreid tuleb pidevalt kontrollida
- pH
- EC
- Infrapuna termomeeter



Fotosünteesiliselt aktiivne kiirus FAR 400 - 700 nm (380-710nm)

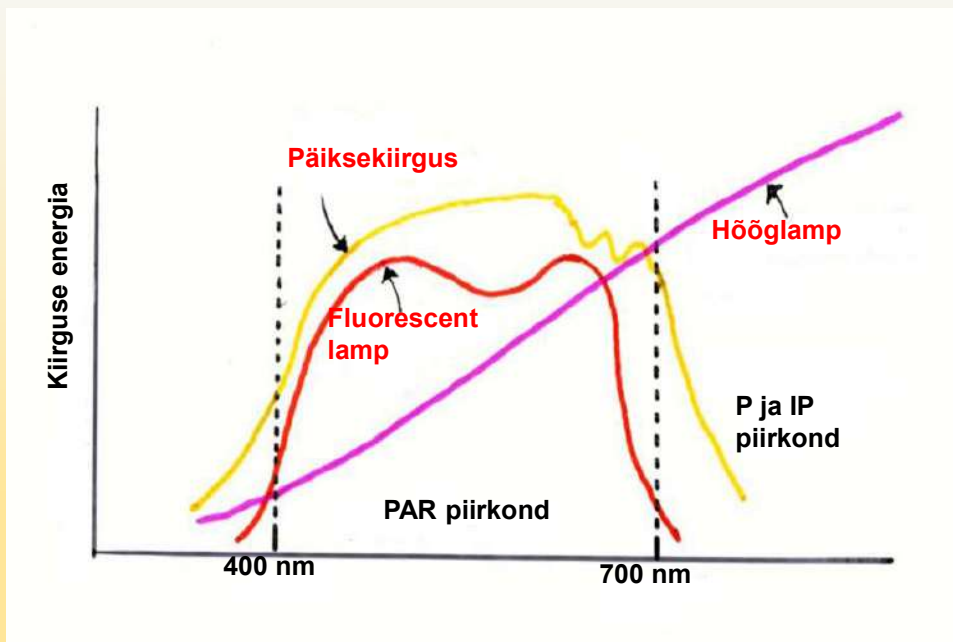
- Valgustundlikud pigmendid taimedes

... mõjutavad taime fotosünteesi aktiivsust ning taime arengut



<https://www.ledgrowlightshq.co.uk/>

Erinevate valgustite spekter

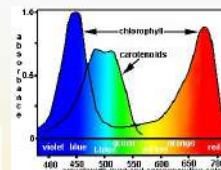
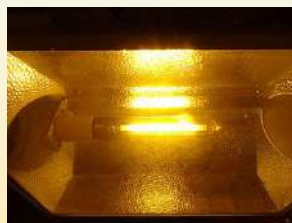


Erinevate valgustite spekter

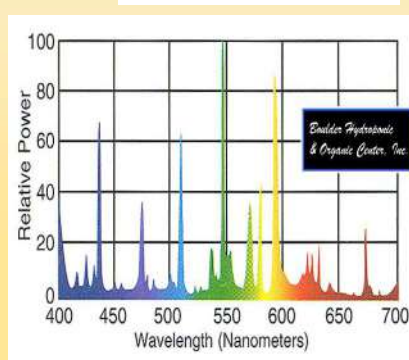
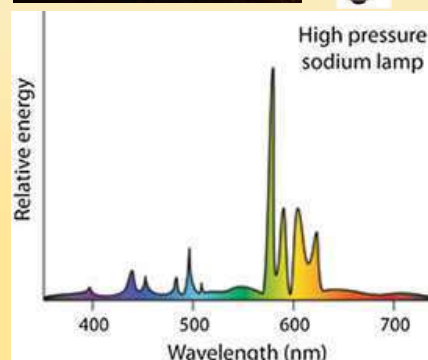
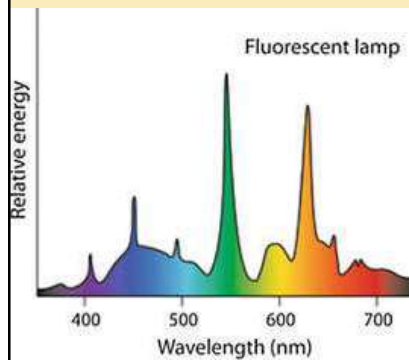
Päevavalguslamp



HPS Lighting



Metall-halogeniid



LED katmikaianduses



- Tarbib vähe energiat
- Ei küta ruumi
- Kestavad kauem (h 10000 +)
- Potentsiaalselt parem spektri kontroll

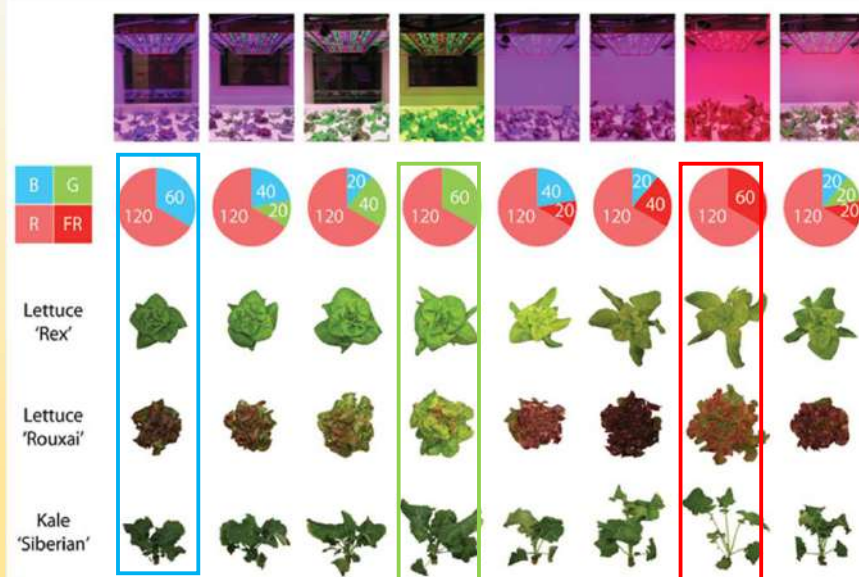


- Valguse intensiivsus madal
- Suure hulga puhul vaja jahutada
- Madalama temperatuuri kompenseerimise vajadus lisaküttega (?kas on energia kokkuhoidu?)
- Praegu veel liiga kallid (€/Watt)

Katse: Sinise valguse asendamine Rohelise ja Kaug-punasega

→ Ilma loomuliku valguseta kasvatamisel

- Värske mass suurenes kõigil sortidel
- Lehtede värvus oli roheline lisamisel kahvatu ja FR intensiivsem



<https://www.producegrower.com/article/2019-lighting-guide-leafy-greens-leds-green-far-red-blue/>

Automation and Robotics

Harvester

- **Harvesting Algorithm**
 - Plant or no Plant
 - Colour – green
 - Day of seed
 - Size of the Plant
 - Feedback about nutrient level of plants
- Cutting plants **automatically**
 - **Different systems**
- cameras and sensors
- Depends on system and plant :
 - harvesting **whole day** , or more than once a week



<https://www.srf.ch/wissen/nachhaltigkeit/vertical-farming-kommt-unser-gemuese-bald-aus-dem-hochhaus>

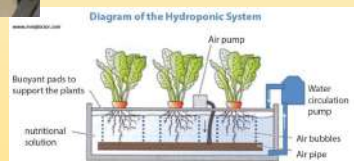
Vertical greenhouses



<https://www.pinterest.com/pin/777504323146899540/>

<https://auclimate.wordpress.com/2018/04/05/vertical-farming-science-fiction-or-the-future-of-agriculture/>

Vertical greenhouses



<https://auclimate.wordpress.com/2018/04/05/vertical-farming-science-fiction-or-the-future-of-agriculture/>

<https://www.npr.org/sections/thesalt/2012/11/06/164428031/sky-high-vegetables-vertical-farming-sprouts-in-singapore?ft=1&f=1001?ft=1&f=1001&t=1602749855931>



Täna tähelepanu eest!