

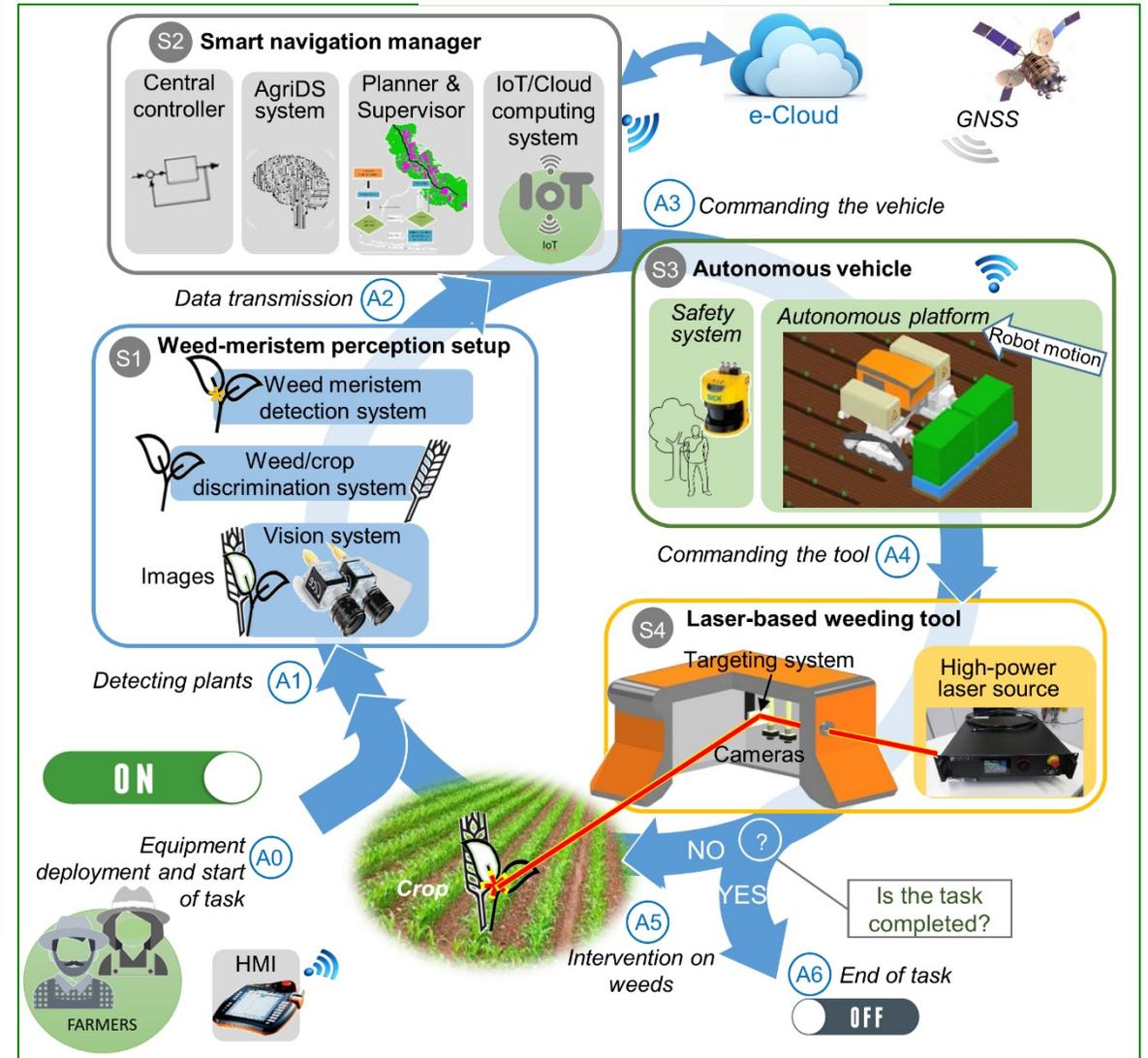
Technological breakthroughs in weed management

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Crop protection futures in agriculture
24th May 2023

UNIVERSITY OF COPENHAGEN



Integrated weed management

- Avoid weed infestation and weed seeds in the soil
- Establish competitive crops/crop rotation
- Site-specific weed management
- Mechanical weeding
- Electric weeding
- Laser weeding



Increasing biodiversity and spreading invasive weeds?

Harvest Weed Seed Control

- At crop harvest a combine harvester harvest crop and weed seeds
- The weed seeds are often returned to the field
- Collecting, destroying or moving the seeds out of the field can reduce weed infestation in the following season.



Seeds retained on the plants at wheat harvest

100%



Cleavers
(*Galium aparine*)

57%



Windgrass
(*Apera spica-venti*)

85%



Annual ryegrass
(*Lolium rigidum*)



Harvest weed seed control

- Seed destructors
- Baling directly
- Collect chaff



Chaff carts



Seed Destructor



Bale direct

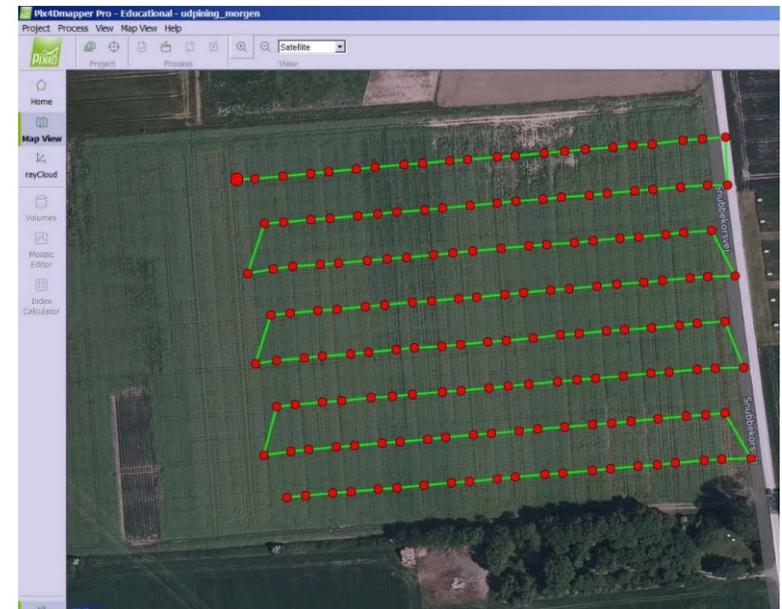
Site-specific weed management

Mapping weeds and only control where it is necessary

“Thistle tool” develop by J. Rasmussen, Uni. Copenhagen



Capacity: 35 ha takes about 25 minutes



Mechanical weed control

- Several robots are now on the marketplace



ROBOTTI 150D from Agrobotics

Farmdroid

The world's first seeding and weeding robot

FarmDroid FD20 is a solar powered field robot.
completely CO₂-neutral



Slow farming

GPS precision: 2.5 cm
Capacity: 20 ha sugar beet
Certified to drive day and night without surveillance

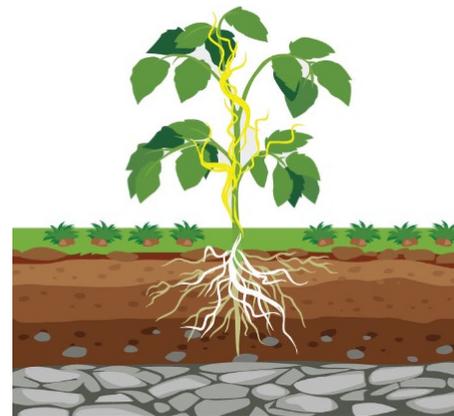
Electric weeding

Electricity used to boil weeds from the root upwards
Kill weeds at frequencies of 18kHz and above..

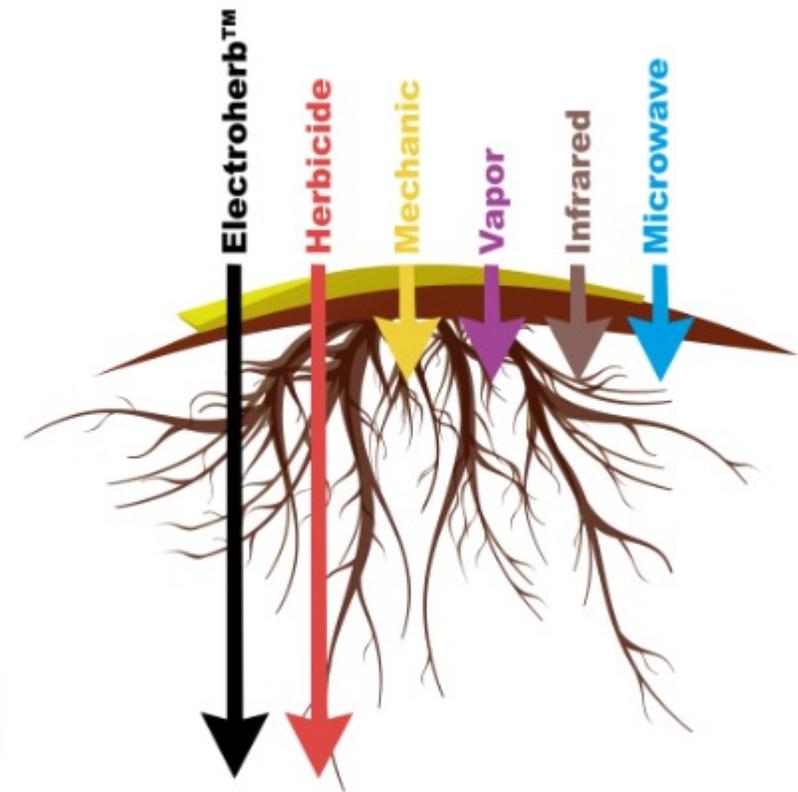


Electrical

Control of unwanted plants through electricity for sustainable destruction.



- Systemics mode of action
- Irreversible destruction of cell compartmentation
- Immediate plant death
- No environmental or social cost



RootWave

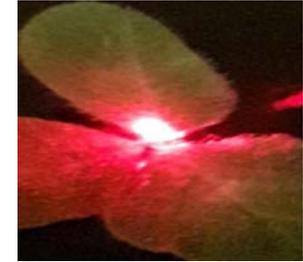
<https://www.youtube.com/watch?v=qBOQlvLJyPc>

<https://zasso.com/technology/>



Laser Weeding

- Laser beams can be focused to extremely small spots, achieving a very high irradiance
- (Beam diameter: 2 mm, wavelength 2 μm)
- The energy consumption is rather high
- Artificial intelligence and deep learning techniques make it possible to locate and identify weeds and crops
- The laser beam hits the meristem of the weed and damage or kill it.



Killing the shoot (Apical meristem)



<https://carbonrobotics.com/laserweeder>



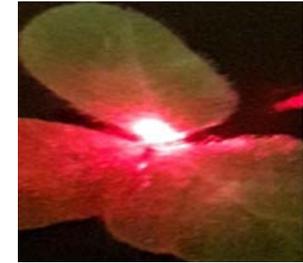
<https://welaser-project.eu/>



Laser Weeding

Advantages

- A laser beam can kill weed plants very close to the crop plant without harming the crop
- The exposed area is **less than 1%** even at high weed densities (250 weeds/m²)
- The risk of harming beneficial organisms are small
- The vehicle does not move the soil like mechanical weeding stimulating new cohorts of weeds to germinate
- Soil compaction can be avoided using small vehicles



Killing the shoot (Apical meristem)



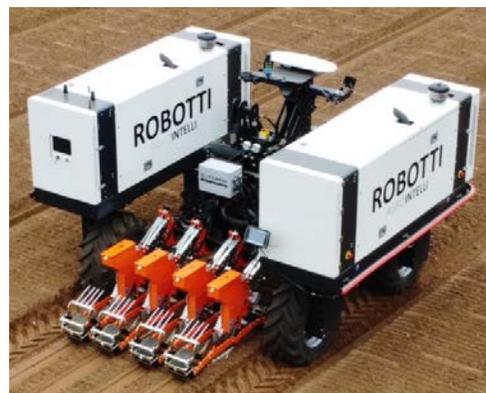
<https://welaser-project.eu/>

Conclusions

- New and well-know technologies can reduce weed infestation
- New technologies can replace or complement herbicides
- Small weeding robots have some advantage but may also a capacity problem
- Combining methods may reduce capacity problems
- Most autonomous vehicles still require surveillance!



<https://www.naio-technologies.com/en/dino/>



<https://agrointelli.com/robotti/>



<https://carbonrobotics.com/news-media>



<https://farmdroid.dk/en/product/>

Sustainable Weed Management in Agriculture with Laser-Based Autonomous Tools



Thank you for your attention!

<https://welaser-project.eu/>

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