

# **Evaluation of EcoRobotix Green-on-Green Herbicide Sprayer in Sugarbeet**

**ASSBT**

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# Outline

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- What is a green-on-green sprayer?
- How does Nevin Imagine this technology would be used in sugarbeet?
- Why EcoRobotix?
- Experiment 1: Evaluation of herbicide candidates.
- Experiment 2: Trouble shoot the operation of the sprayer.
- Experiment 3: Evaluation of sprayer performance.



# What is a green-on-green sprayer?

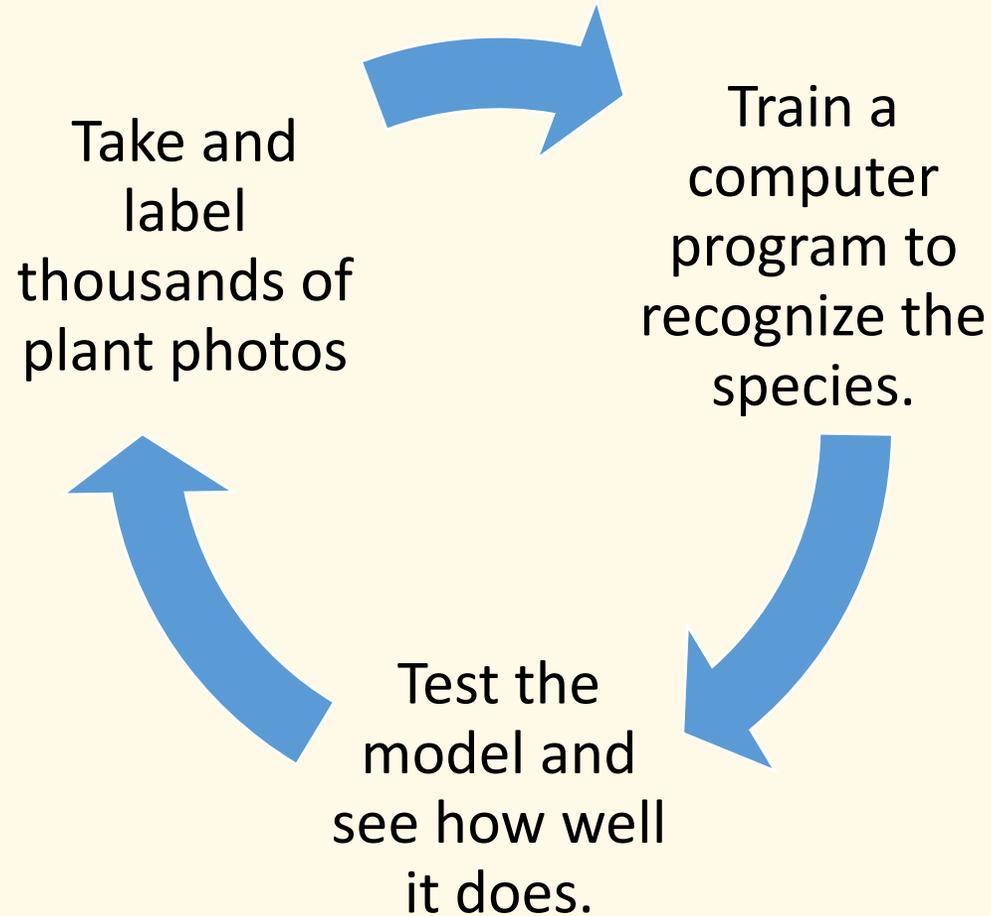
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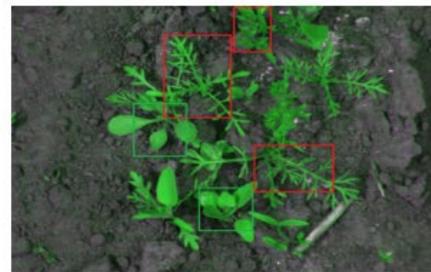
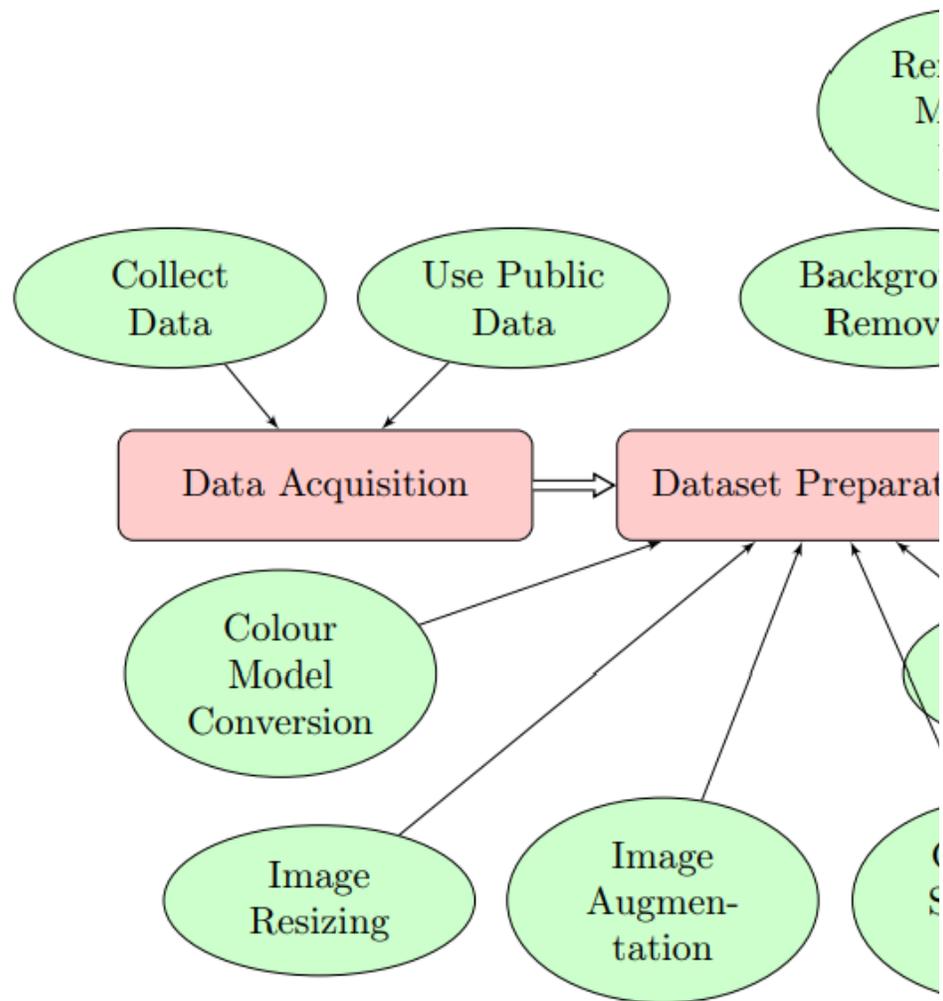
- Green-on-green sprayers “only target” the weed.
- “Up to a 95% reduction in chemical costs”.
- Require advanced imaging and “deep learning”.



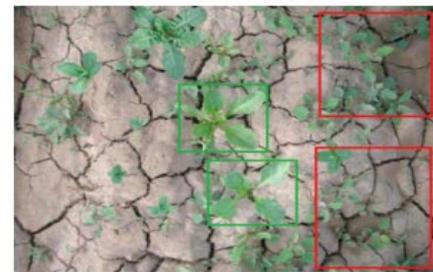
# What is a green-on-green sprayer?

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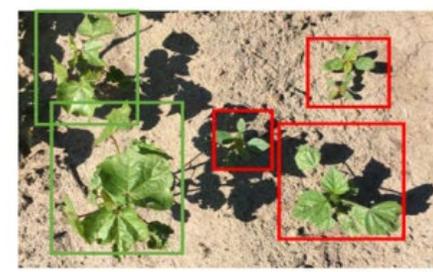




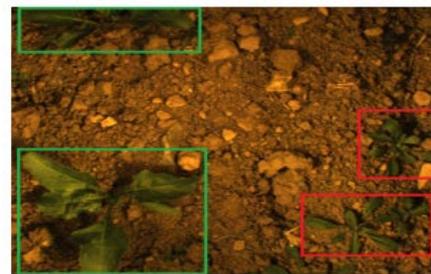
(a) Occlusion of crop and weed (Haug & Ostermann, 2014)



(b) Colour and texture similarities between crop and weed plants (Bakhshipour & Jafari, 2018)



(c) Shadow effects in natural weed image (PyTorch, 2020)



(d) Effects of illumination conditions (Di Cicco et al., 2017)



(e) Four different species of weeds that share similarities (inter-class similarity) (Olsen et al., 2019)



(f) Sugar beet crop at different growth stages (intra-class variations) (Giselsson et al., 2017)



(g) Effects of motion blur and noise (J. Ahmad et al., 2018; Giselsson et al., 2017)



(h) Weeds can vary at different geographic/weather locations: weed in carrot crop collected from Germany(left) (Haug & Ostermann, 2014) and Macedonia (Right) (Lameski et al., 2017)

# What is a green-on-green sprayer?

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- Green-on-green sprayers “only target” the weed.
- “Up to a 95% reduction in chemical costs”.
- Require advanced imaging and “deep learning”.
- You can make this simpler by only “learning” what the crop looks like.
- Each crop requires a different model.
- So far, these are all proprietary models.



# Why would this be a benefit in sugarbeets?

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- Situation one: We can spray less herbicides.
  - Save farmers money.
  - Make the EPA happy.
  - Make consumers feel good.
- Situation two: We can “only spray the weeds”.
  - We can use herbicides that normally kill beets, and but only spray weeds.
  - Plus have all the above benefits.



# Why Ecorobotix?



the world's first commercially available

Photo Credit: John Deere



# Why Ecorobotix?

- Swiss company
- “Deep learning” model already in use for sugarbeet
- 7.2 km hour<sup>-1</sup>
- 4 ha hour<sup>-1</sup>
- 6 m boom width.



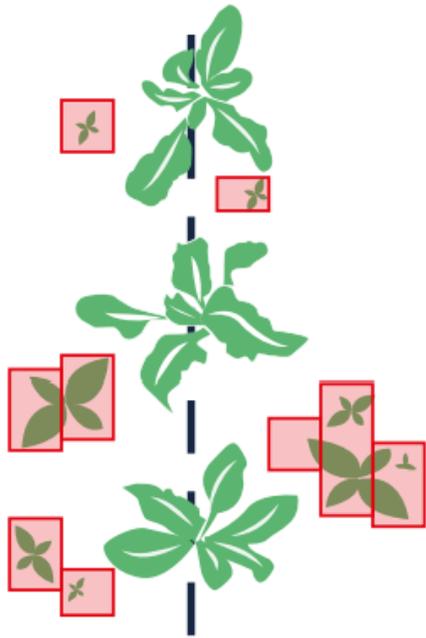
# Ecorobotix

- Three “wings”.
- Each wing contains two camera/computer controllers.
- Each camera/computer controls 25 nozzles.
- Nozzles spaced 4 cm apart.
- Three-point mount + hydraulics + PTO to generate electricity.

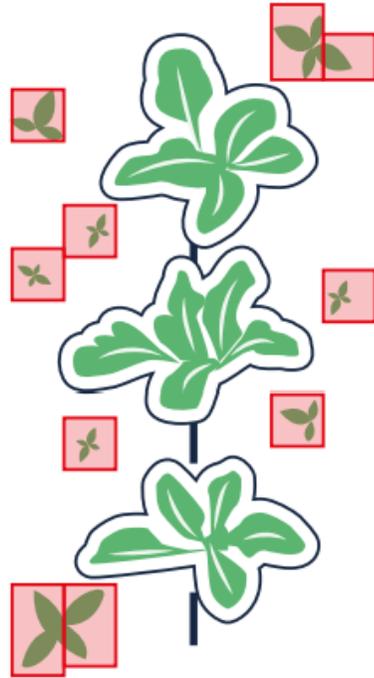


# Ecorobotix

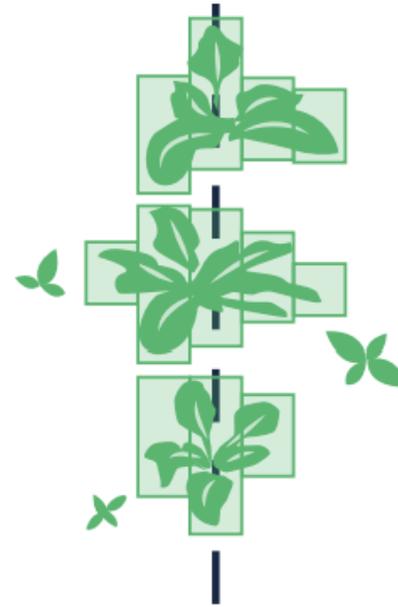
## Crop-Specific Algorithms



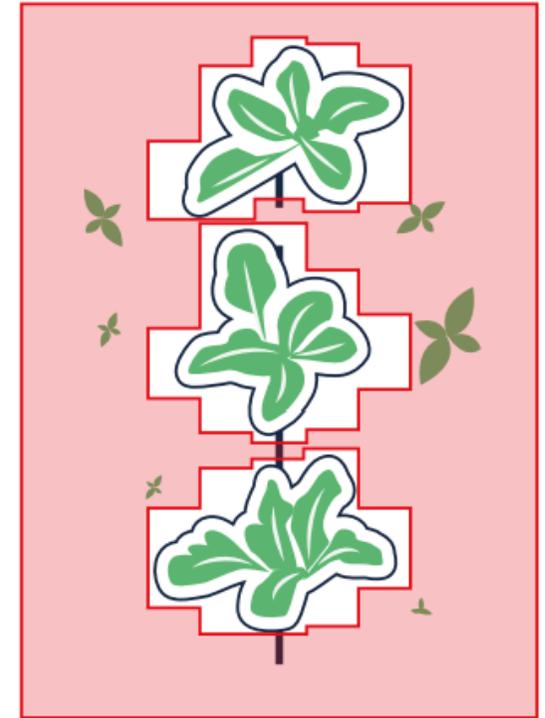
Application of selective herbicides **on weeds even close to crops.**



Application of non-selective herbicides **with an adjustable safety zone.**



Application of fungicides, insecticides, fertilizers and biostimulants **on the crop only.**



Spray all but crop **with an adjustable safety zone.**



# Experiment 1: Evaluation of herbicides

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Can we spray herbicides that would normally kill the beet, but selectively target a weed?

- Herbicides that won't work:
  - Herbicides that have soil activity.
    - Atrazine, dicamba, most HPPD inhibitors
  - Herbicides that are volatile.
    - Dicamba, 2,4-D
  - Herbicides that would be hard to gain EPA approval.
    - Atrazine, dicamba, paraquat.



# Experiment 1: Evaluation of herbicides

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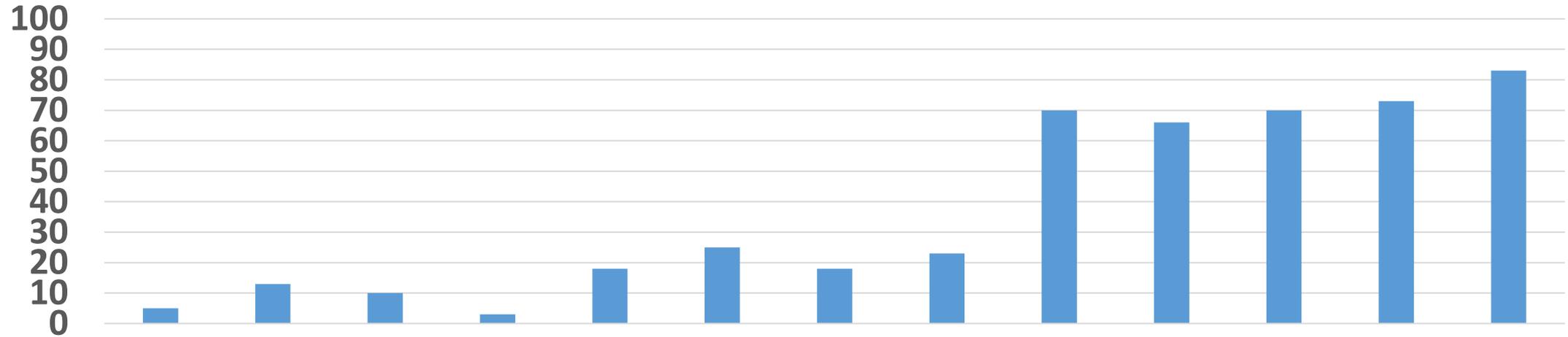
Can we spray herbicides that would normally kill the beet, but selectively target a weed?

- Herbicides that might work:
  - Non-selective herbicides
    - Glufosinate, pyridate
  - Organic herbicides
    - Axxe, sulfuric acid, acetic acid.
  - Urea
  - Older sugarbeet herbicides at high rates.
    - Desmedipham, phenmedipham



# Experiment 1: Evaluation of herbicides

Kochia Control (%)



# Experiment 1: Evaluation of herbicides

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- Poor performance
  - Desmedipham, phenmedipham, pyridate, sulfuric acid, acetic acid, urea.
- Acceptable performance
  - Axxe, glufosinate



# Experiment 2: Trouble

- Ex



# Experiment 3: Evaluation

Treatment	Herbicide	Timing
1	Check	-
2	Urea	4 TL
3	Axxe	4 TL
4	Liberty	4 TL



# Experiment 3: Evaluation

Treatment	Herbicide	Timing
1	Check	-
2	Urea	4 TL
3	Axxe	4 TL
4	Liberty	4 TL
5	Urea	2 TL fb 4 TL
6	Axxe	2 TL fb 4 TL
7	Liberty	2 TL fb 4 TL



# Experiment 3: Evaluation

Treatment	Herbicide	Timing
1	Check	4 TL
2	Urea	4 TL
3	Axxe	4 TL
4	Liberty	4 TL
5	Urea	2 TL fb 4 TL
6	Axxe	2 TL fb 4 TL
7	Liberty	2 TL fb 4 TL
8	Urea	Ctl fb 2 TL fb 4 TL
9	Axxe	Ctl fb 2 TL fb 4 TL
10	Liberty	Ctl fb 2 TL fb 4 TL



# Experiment 3: Evaluation

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- April 23<sup>rd</sup> – Planting
- April 24<sup>th</sup> – PRE Application
- May 16<sup>th</sup> – Cotyledon Application
- May 22<sup>nd</sup> – 2 True Leaf Application
- May 30<sup>th</sup> – 4 True Leaf Application
- Visual Estimates of Control & Crop Injury: 2 TL, 4 TL, 2 WAT, 4 WAT, 6 WAT
- Stand Counts: 2 TL, 4 TL, 2 WAT
- Weed Density 2 WAT, 4 WAT, 6 WAT
- Weed Biomass: 6 WAT
- W058NT
- 136,000 plants ha<sup>-1</sup>, 55.9 cm rows
- Sand Loam, 8.0 pH, 2.2% OM



# Experiment 3: Evaluation

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2 TL



# Experiment 3: Evaluation



Non-treated check



Urea



# Experiment 3: Evaluation



Axxe



Liberty



E



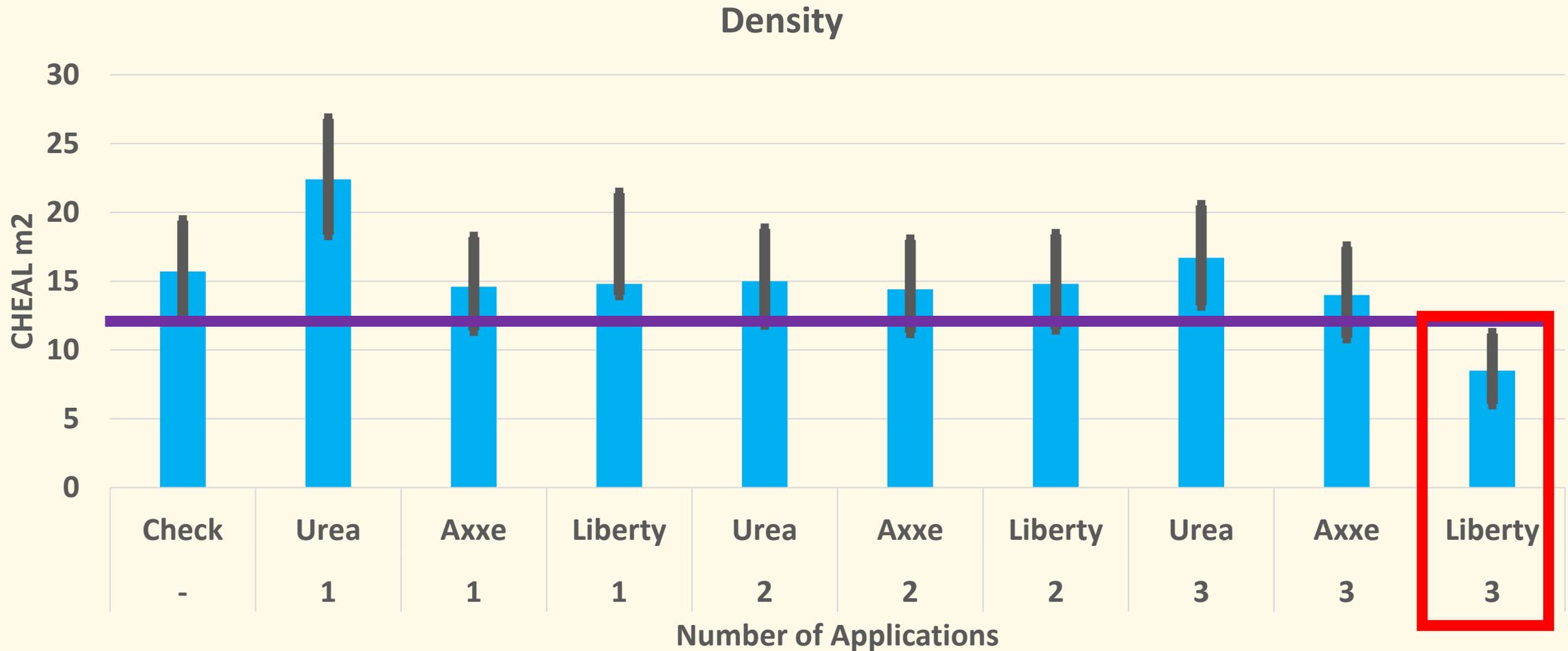
# Experiment 3: Evaluation



4 WAT



# Experiment 3: Evaluation



# Experiment 3: Evaluation

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## What did we learn?

- 1. Glufosinate is probably the best option moving forward.**
- 2. The sprayer is extremely easy to operate and use.**
- 3. The sprayer is very good at distinguishing beets from weeds.**
- 4. “Coverage” is better with smaller beets.**
- 5. “Coverage” begins to suffer as beets become larger.**



# Experiment 3: Evaluation

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## Next steps.

- 1. 2025 we will be doing a field experiment to compare efficiency between the Ecorobotix, a shielded sprayer, and a cultivator; with group 15 herbicides.**
- 2. The sprayer also has a “spray just the crop only” mode.**
  - 1. Potential SSBRI project.**
  - 2. Fungicide efficiency for rhizoctonia and cercospora.**
  - 3. Herbicide reduction on commercial fields.**

