



LES *Journées*  
HORTICOLES & GRANDES CULTURES





# HAGGERTY AGROBOTICS

# Haggerty AgRobotics Company, Ltd.



# Haggerty AgRobotics Company



- Agriculture is under pressure from multiple fronts
  - Changing consumer trends affect our production methods
  - Debate about role of crop protection products
    - Weed, insects, pathogens
    - Fertilizer nutrients
  - Labour shortages
- We at Haggerty AgRobotics Company want to help provide solutions to our customers

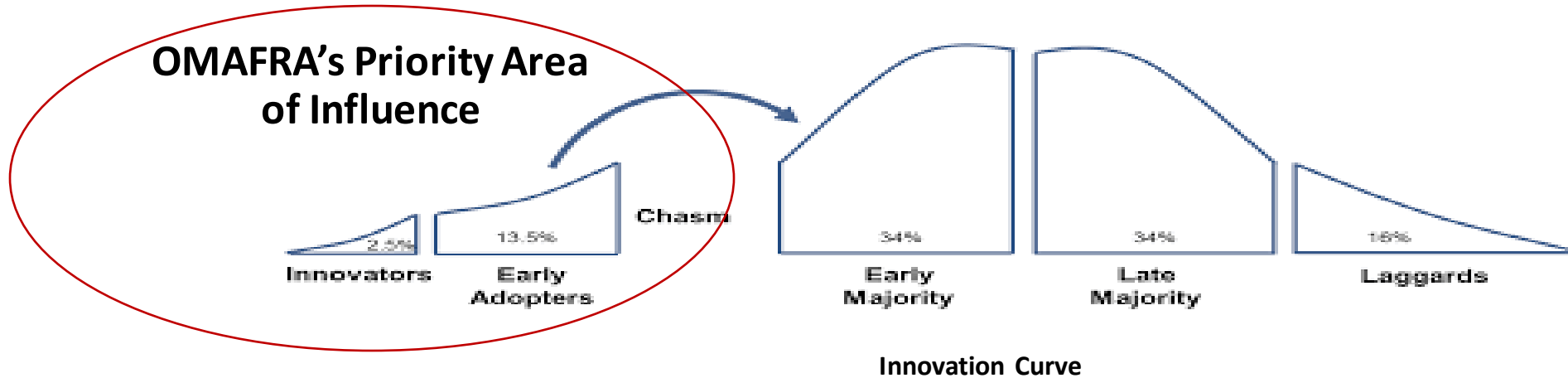


# INNOVATION FARMS

Powered by AgExpert 



# Background – The Story – The How



- One phone call in the spring of 2021 started it all
- OMAFRA specialists did what they do best
  - **Identified “Robotics/Automation” as the opportunity** – to solve critical issues facing the agriculture sector
  - **Brought a network of key stakeholders together** – all levels of government, research institutions, technology companies, agri-business, growers and grower associations (innovators and early adopters)
  - **Established the AgRobotics Working Group** to build cross functional teams to minimize duplication of efforts and build efficiencies to influence the rate of robotics/automation adoption

## We Greatly Appreciate The Support From:

- The AgRobotics Working Group
- **Producers**
- **OMAFRA staff**
- **Ontario Crops Research Centre – Bradford:** Mary Ruth McDonald, Kevin Vander Kooi, Shawn Janse and Jeff Farintosh
- **Industry Collaborators:** RH Accelerator, The Western Fair Association, Vineland Research and Innovation Center, and sponsors at Tech Alliance, OMAFRA, and BioTalent Canada



# Presentation Outline

- Background – AgRobotics Working Group
  - How, Who and What
- Robotic Weeders
  - FarmDroid
  - Naïo Orio
  - Naïo Ted
  - Nexus La Chevre (The Goat)
  - Carbon Robotics LaserWeeder™
  - Weeding Robots Conclusions
- Autonomous Weed Scouting Project
- Future of the AgRobotics Working Group – Innovation Farms



# FarmDroid FD20

- Company based out of Denmark
- Solar powered, CO2 neutral
  - Passive weeder/cultivator
  - Inter & Intra-row mechanical weeder
  - Geolocates each seed, plants in a perfect grid
- Up to 8 ac/day
- 24-hour autonomous operation
  - Sleep mode when batteries are low
- 0.8 km/hr
- Weighs 1050 kg



**FARMDROID**



HAGGERTY  
AGROBOTICS





## FarmDroid FD20 – <https://farmdroid.dk>

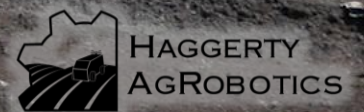
- 2022 Seeding and Weeding Sugar Beets and Rutabagas
- 2023 Seeding and Weeding Onions

- Solar-charged batteries, CO2 neutral
- 24-hours autonomous operation (sleep mode when batteries are low)
- Seeder, and inter- and intra-row mechanical weeder
- Geo-tags each individual seed
- Passive weeder - cultivator

# FarmDroid FD20



**FARMDROID**





FD 20

FARMDRUID

HAGGERTY  
AGROBOTICS

# Seeding Methods

## Single Row FD20

- 3.4 cm between seeds



## Conventional

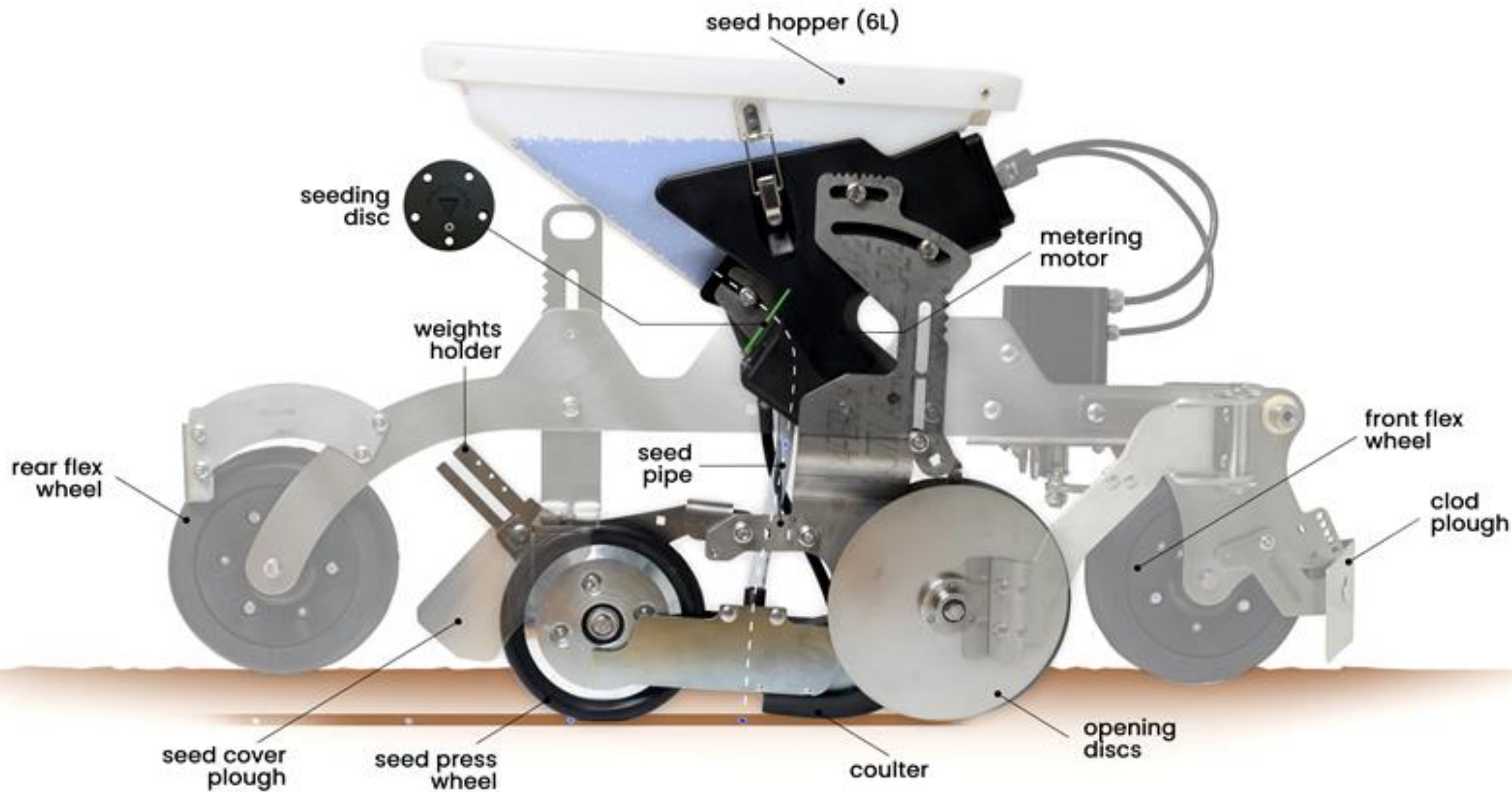
- 5 cm between seeds
- Double row



## Triple Cluster FD20

- 12 cm between clusters





#20220310059



Live mode **Off**



Droid is **On**



Details



Route view



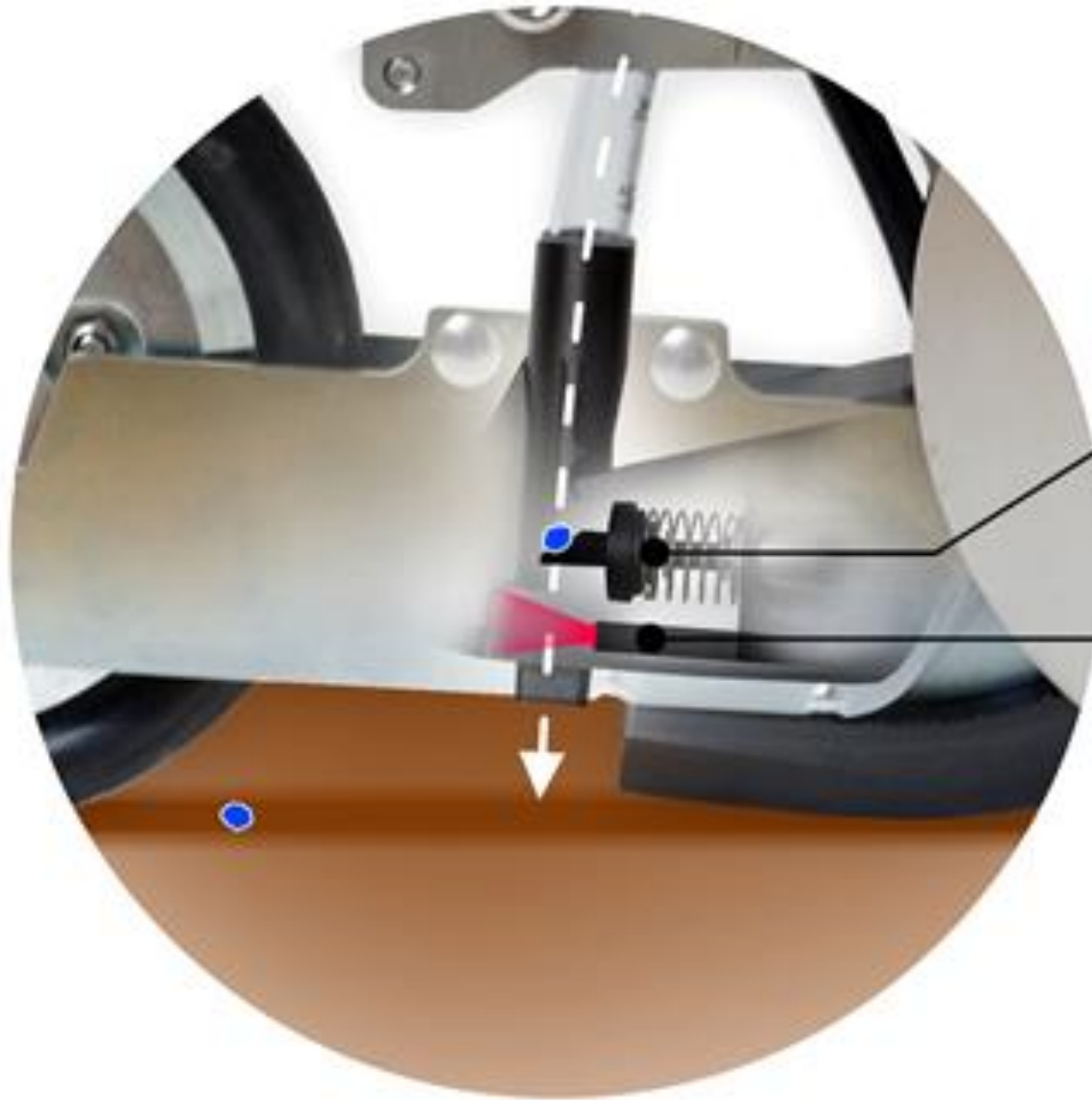
Camera



History



Settings



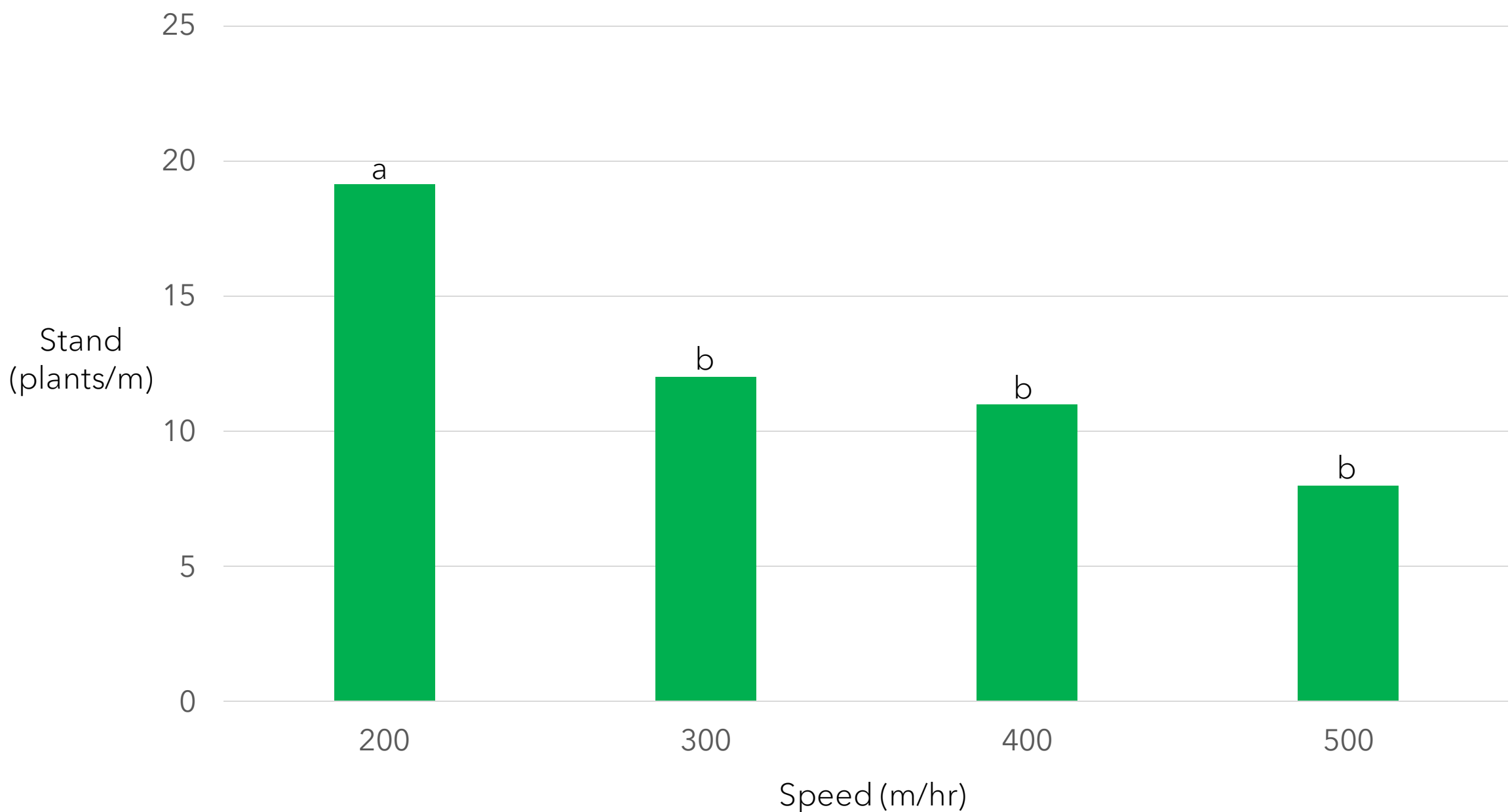
seed  
valve

seed beam  
sensor





# Onion Emergence

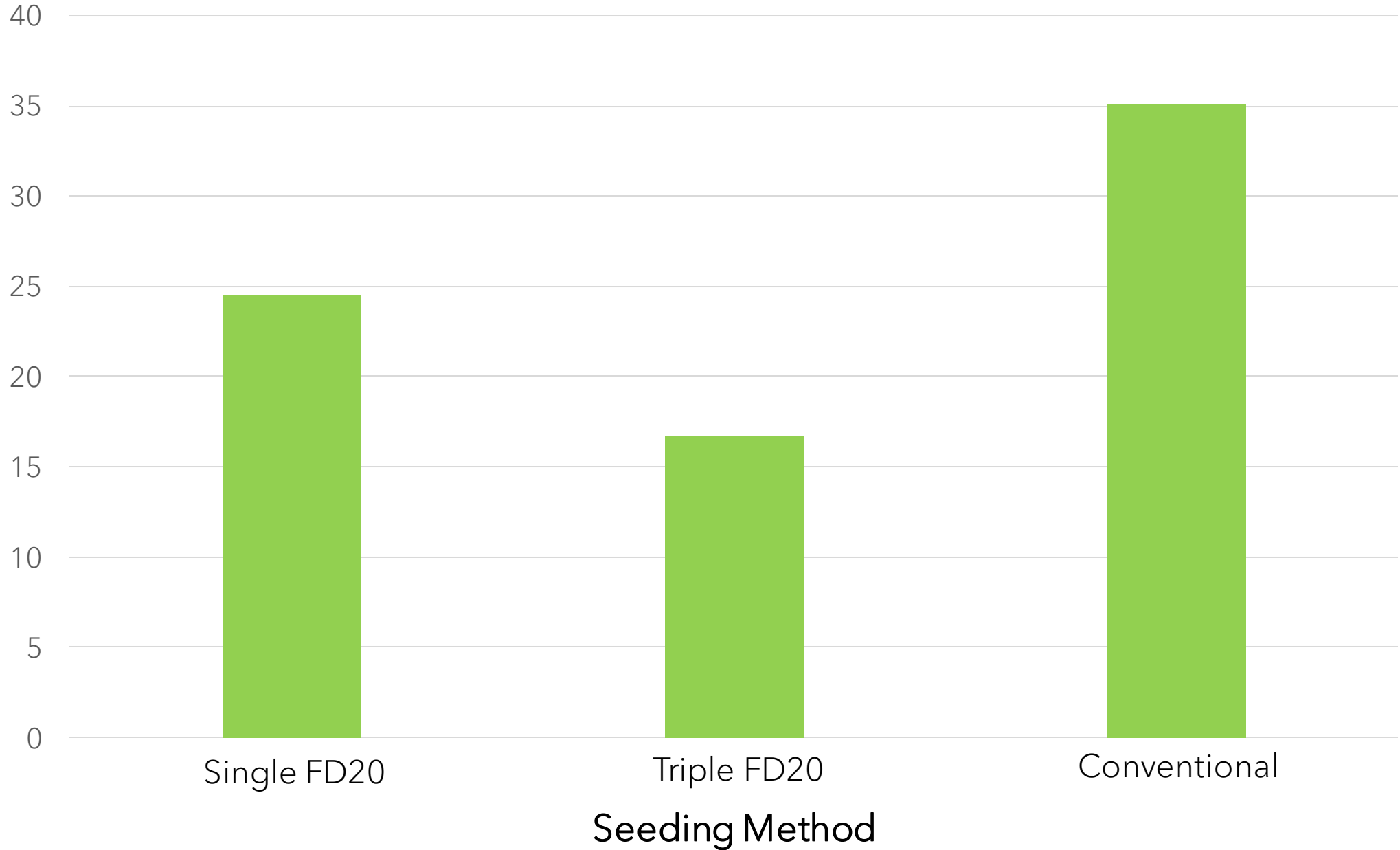






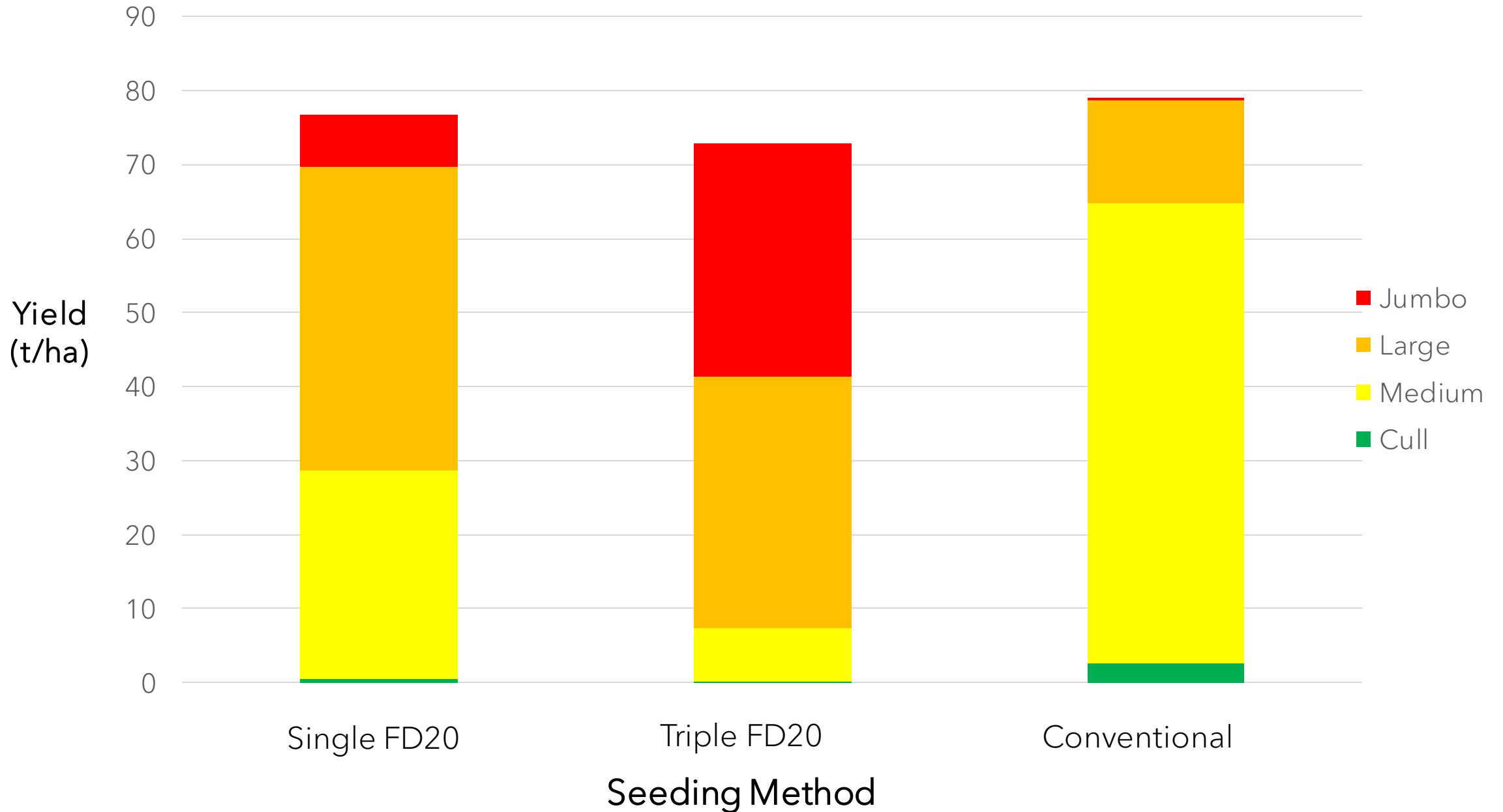


# Onions Per Meter





# Onion Yield and Size Distribution





# Oz - Naïo Technologies

- Company based out of France
  - Over 160 active units operating in 15 countries
- Battery powered
  - 7-9 hour run time
- Can fit between 30" rows
  - Multiple customizable implements
- 10-12.5 km of row/day
- Guided by RTK GPS
- On-board map creation tool to create guidance lines
  - Can record every crop row planted
- Up to 1.8 km/hr



# Oz - Naïo Technologies





# Orio - Naïo Technologies



- 1450 kg
- 100% electric autonomous platform
  - 8-10 hr/day run time
- Mid-mount or rear-mount for various implements
  - Spraying
  - Planting
  - Seeding
  - Weeding
  - Cultivating
- Up to 10 ac/day
- Up to 5.5 km/hr
- Designed for row crops and beds of vegetables





# Naïo Orio

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

- Autonomous tool carrier robot
- Rechargeable lithium batteries
- Up to 10 hours of autonomous operation
- RTK GPS guidance
- Worked in carrots and beets on muck and mineral soils with a camera guided hitch
- A band sprayer was also built to use with the Orio controlled by a Raven Industries field computer



# Orio - Naïo Technologies











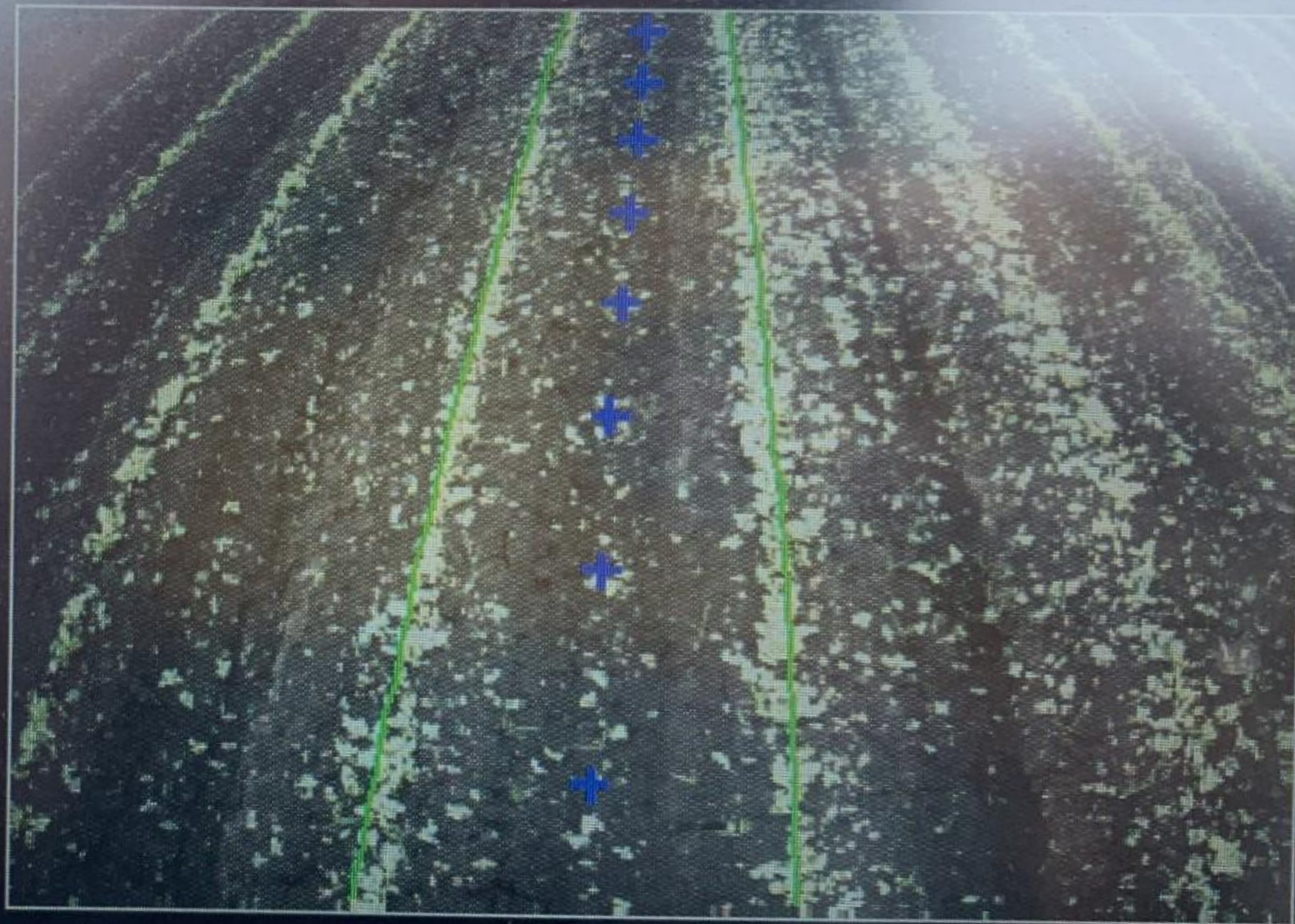
# Image Quality



Image Quality



Stopped



kpt



Offs



Tille





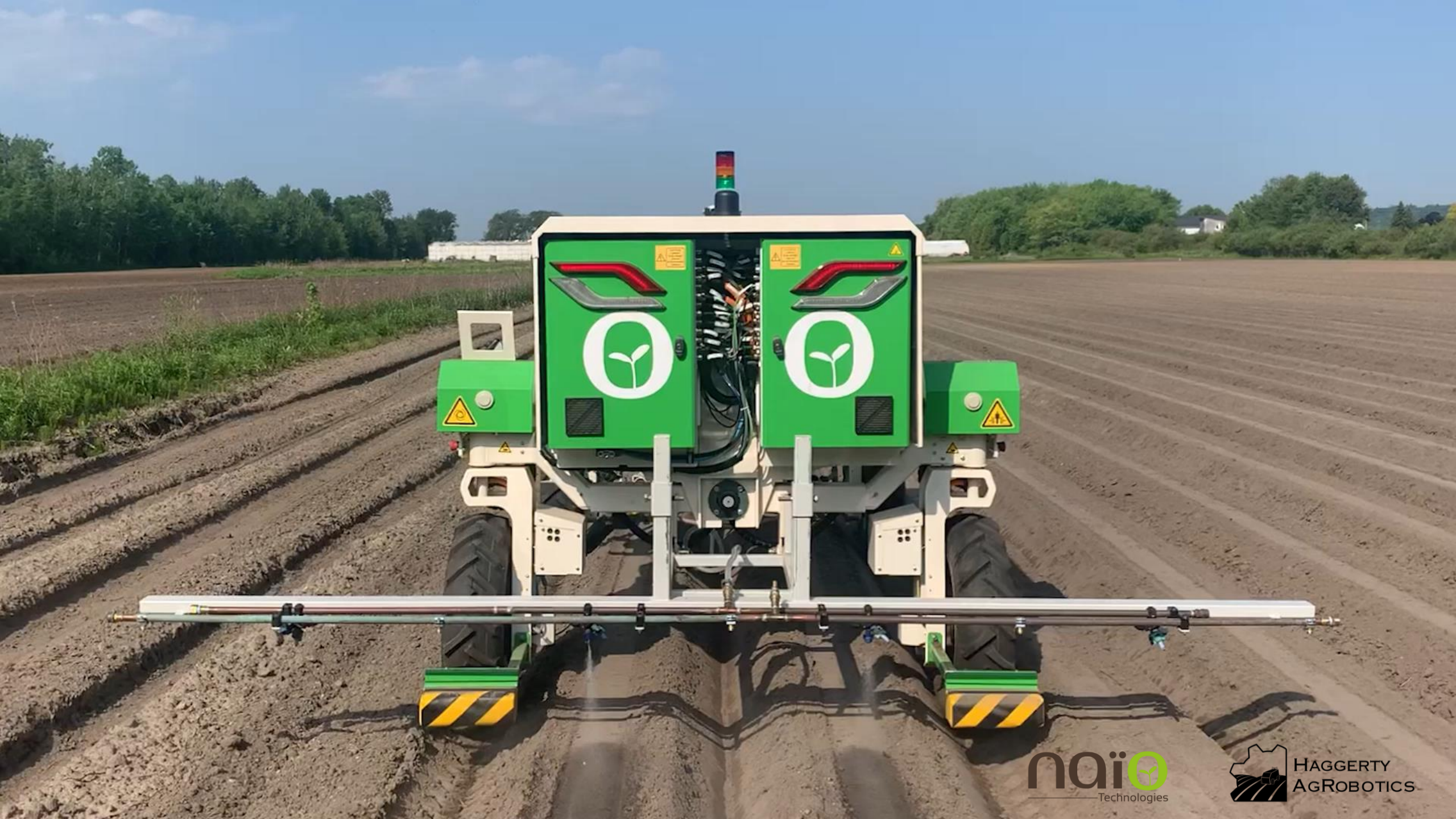




naiio  
Technologies

orio













RAVEN

RATE

MASTER

RAVEN

naio

64%

Remote locked (100)  
v23.1

naio Technologies

naio







# Ted - Naïo Technologies

- Company based out of France
- Designed for grapes and trellised fruit
- Autonomous 100% electric vehicle
  - Up to 10 hrs/day
- Guided by RTK GPS
- Inter- and intra-row weeder
  - Hilling and de-hilling
  - Vine hedger
  - Yield estimation
- Up to 10 ac/day
- Up to 6 km/hr



# Ted - Naïo Technologies







# The Goat - Nexus

- Company based out of Quebec, Canada
- Navigates and removes weeds autonomously (picks the weeds out)
- Uses cameras and a neural network to differentiate between weeds and crops.
- GPS RTK guidance
- 24 hours autonomous run time
- Hybrid – Electric battery and Diesel generator
- Speed varies depending on weed density



**nexus //**



## 2022 Nexus Goat – Weeding Onions and Carrots

<https://nexusrobotics.ca>

- Active weeder
- Electric hybrid motor
- 24-hour autonomous operation
- Machine vision inter- and intra-row mechanical weed removal



# 2023 Nexus Goat – Leaf Lettuce

- Success in leaf lettuce in 2023 winter in Arizona
- Decided to try in leaf lettuce in Ontario.
  - Removed > 80% of the weeds
  - **Grower pleased**



© Cranmer

# The Goat – Nexus Robotics



**nexus //**

 **HAGGERTY  
AGROBOTICS**



**nexus //**

 **HAGGERTY  
AGROBOTICS**



Carbon Robotics Laser Weeder

# Carbon Robotics LaserWeeder™

## 2023 – Trial Year

<https://carbonrobotics.com>

### 2 Demos (May and July)

- 1 shared unit in C-K Ontario
- Mixed reviews by growers

- Cost an issue \$2M Canadian with \$50K/yr tech fee
- Credit arrangements are available in the U.S.
- Company exploring options with FCC and OMAFRA funding programs



# Carbon Robotics LaserWeeder™

# 2023 – Trial Year

<https://carbonrobotics.com>



Conventional vs. LaserWeeder™



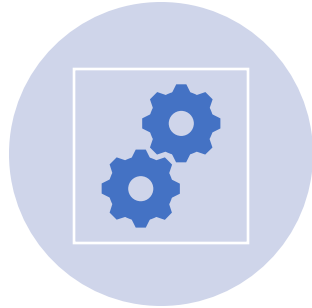
Accuracy of LaserWeeder™



# Robotic Weeders - Conclusions



AGROBOTIC TECHNOLOGY HAS DRASTICALLY IMPROVED JUST IN THE PAST YEAR, WITH NEW MODELS AND TOOLING OPTIONS AVAILABLE TO GROWERS



THERE IS STILL ROOM FOR IMPROVEMENT TO OPTIMIZE THESE TECHNOLOGIES FOR ONTARIO PRODUCTION SYSTEMS



CONDUCTING TRIALS ON COMMERCIAL OPERATIONS WITH HIGH VALUE CROPS CONTINUES TO BE CHALLENGING, DESIGNATED TEST PLOT AREAS ARE REQUIRED



FUTURE WORK WILL FOCUS ON ENHANCING TOOLING, RELIABILITY AND MODELLING TO DE-RISK THESE TECHNOLOGIES FOR GROWERS TO REDUCE APPREHENSION AND TO PROVIDE FEEDBACK TO MANUFACTURERS

# Robotti - AgroIntelli

- Company based out of Denmark
- Diesel powered autonomous unit
- 3-point hitch for mounting various implements
- Precision plant nursing
  - Seeding
  - Weeding
  - Spraying
- 60 hour run time
- Up to 5.5 km/hr
- Up to 50 ac/day



AGROINTELLI



# AgroIntelli - Robotti



AGROINTELLI





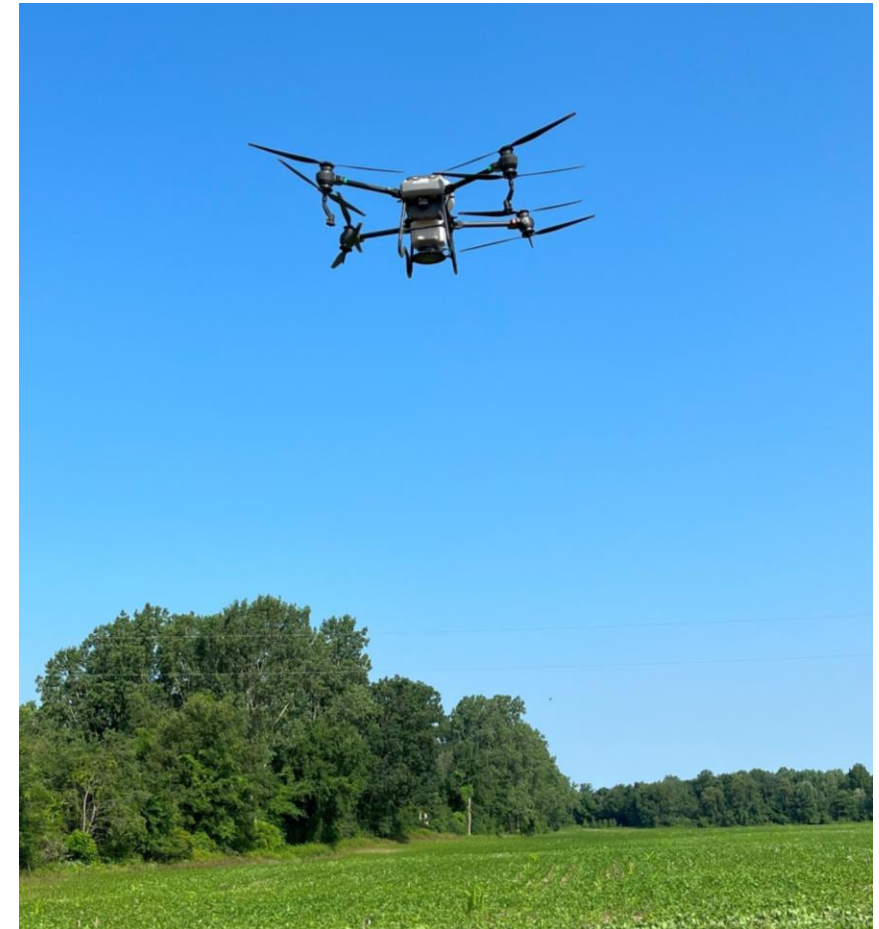
AGROINTELLI



HAGGERTY  
AGROBOTICS

# AGRAS T-40 - DJI

- Up to 40 acres/hour
- High precision radar
- RTK/GNSS
- Max spray flow: 7.2 L/min XR11001  
8 L/min XR110015
- 26.4 kg total weight
- Max take-off weight: 78 kg
- Max power consumption: 11,000 W
- Max flight altitude: 4,500 m
- Max operating flight speed: 7 m/s



# AGRAS T-40 - DJI



HAGGERTY  
AGROBOTICS

# RoamIO-HCW - Korechi Innovations

- Custom platform made in Ontario, Canada
- 7-8 hr/day run time
- Up to 10 ac/day
- Multiple Uses
  - Cover Crop Seeding
  - Scanning and Sensing
  - Mowing
  - Vineyard management
- Integration of Technology
  - Soil Testing Equipment
- High clearance platform

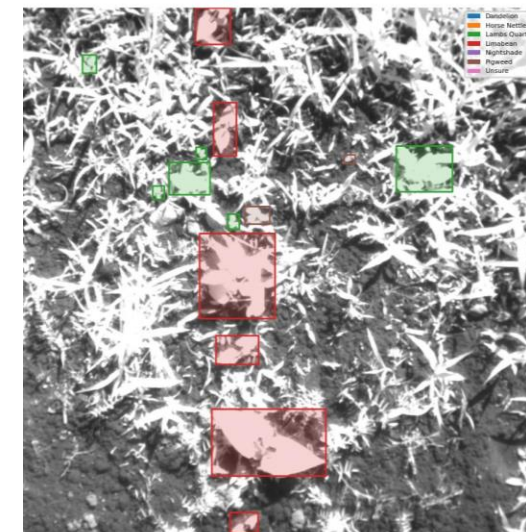
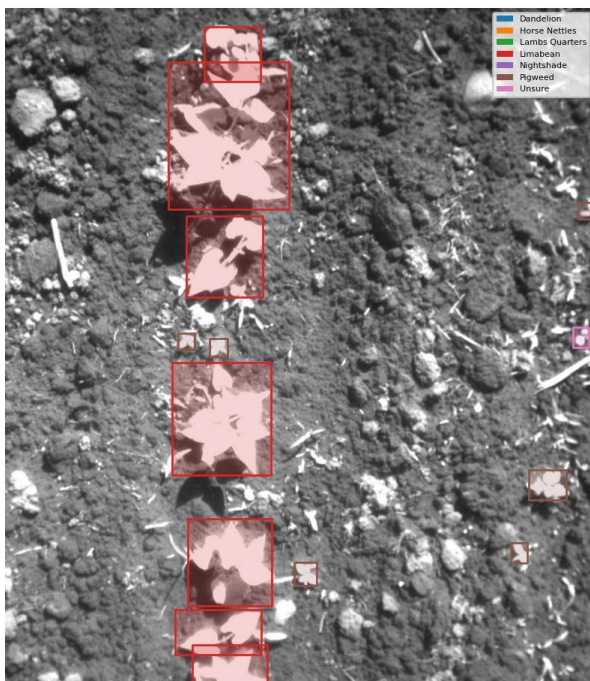


# Korechi – RoamIO-HCW





# 2023 – Autonomous Weed Scouting Project



**Goal:** To autonomously scout lima beans to create weed density maps for herbicide application and harvest avoidance.

Determine the maximum height the cameras can be positioned and the maximum speed the autonomous carrier can reach to collect accurate images of the crop and 3 weed species.



# Contacts



**Chuck Baresich**

Haggerty Creek

[chuckb@haggertycreek.com](mailto:chuckb@haggertycreek.com)



**Grant Elgie**

Haggerty Creek AgRobotics

[grante@haggertycreek.com](mailto:grante@haggertycreek.com)



**Jason Gharibo**

Haggerty Creek AgRobotics

[jasong@haggertyagrobotics.com](mailto:jasong@haggertyagrobotics.com)