Novel Weed Control Technology

Where Do We Stand, Where Are We Going, And What Will It Take To Get There

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Cornell**CALS** College of Agriculture and Life Sciences   Cornell**AgriTech** New York State Agricultural Experiment Station

Weeds in Perennial Crops

- **Competition for water, light, nutrients (especially during the establishment phase)**

- **Large vegetation can impact the deposition of other crop protection chemicals**

- **Habitat for vertebrate and invertebrate pests**

- **Interfere with crop production and harvest operations**

- **Hazardous to human laborers**

Herbicides Are Frequently Used For Weed Management

9,254 Farms in NYS
1.8 M Acres in NYS
2022 USDA Census of Agriculture

Why We Need To Adapt

533 unique cases of HR to 168 herbicides

Export Market

Consumer Perception

Worker Protection, Crop Safety

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Cost and speed of discovery and development

Finite target sites?

Novel Technology For Future Weed Management

- **Westwood et al. (2018)** Weed Management in 2050: Perspectives on the Future of Weed Science. Weed Science, 66:275.

- **Brainard et al. (2023)** A survey of weed research priorities: key findings and future directions. Weed Science, 71:330.

- **Korres et al. (2019)** New directions for integrated weed management: modern technologies, tools, and knowledge discovery. Advances in Agronomy, 155:243.

- **Monteiro and Santos (2019)** Sustainable approach to weed management: the role of precision weed management. Agronomy, 12:118.

- **Fennimore and Cutulle (2019)** Robotic weeders can improve weed control options for specialty crops. Pest Management Science, 75:1767.
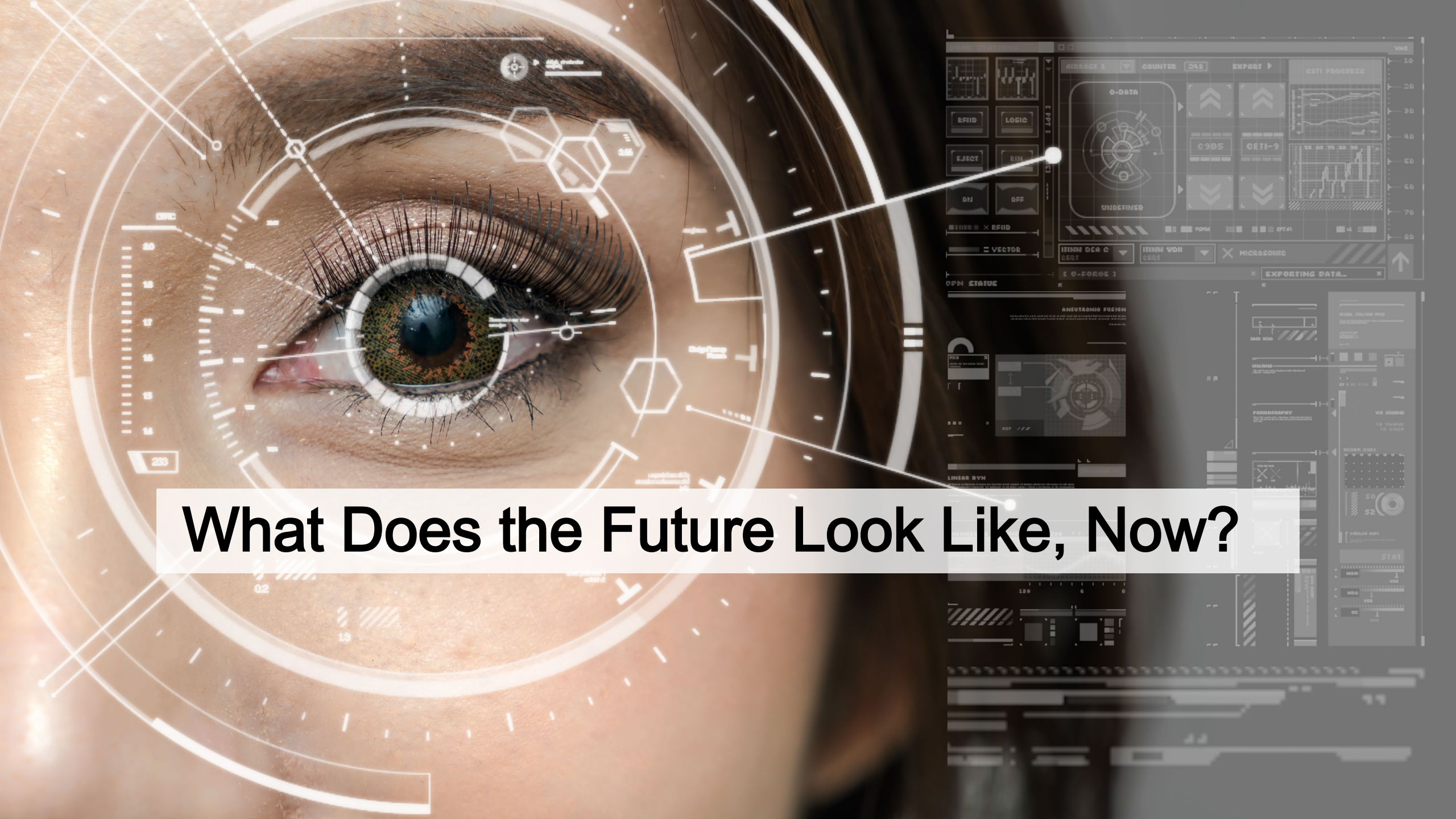
What Does the Future Look Like, Now?

Novel Weed Control Technology

Current Tools with New Delivery Mechanisms

Autonomous Tool Carrying Platforms

Naio Technologies Ted
Farm-ng Amiga
Burro

Ted

Discover the first robot dedicated to vineyards, an alternative to the use of herbicides that respects your soils and improves your working conditions.

INTERESTED IN TED →

Technical specifications

Length
400cm

Width
190cm

Height
240 or 275cm

Weight
2.1 t

Energy
100% electrical

Work output
Up to 5ha/day

Autonomy
Up to 8 hours

according to the terms of use

Speed
Up to 4.5 km/h

Traction
Up to 20% slope

Navigation
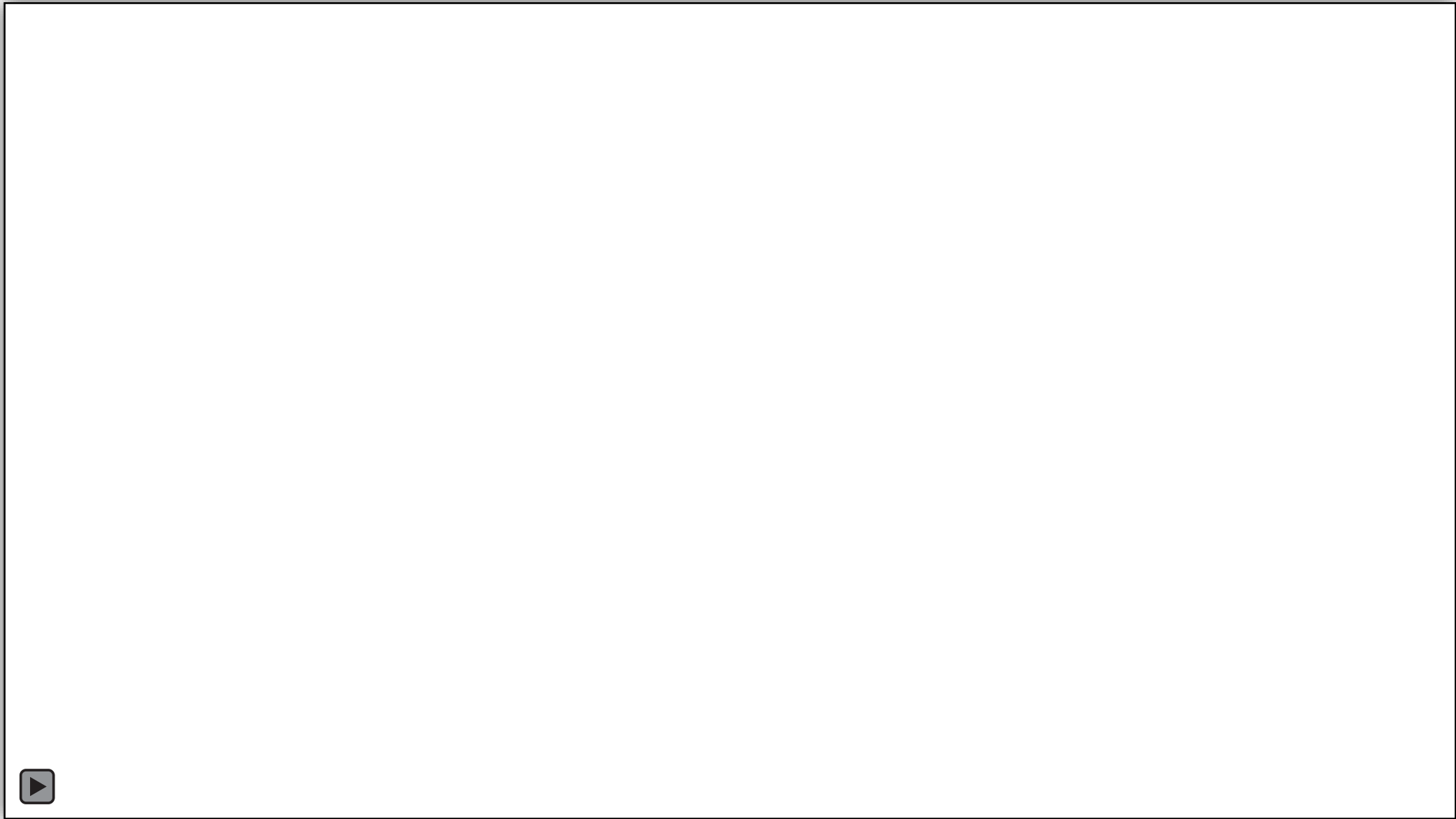GPS RTK

Safety
Augmented Autonomy

compliant

Made in France

INTEREST

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naïo Technologies

https://www.naio-technologies.com/en/home/

https://www.naio-technologies.com/en/home/

Adaptable Tools

Hiller   **Optical Sprayer**   **Mower**   **Electric Weeder**
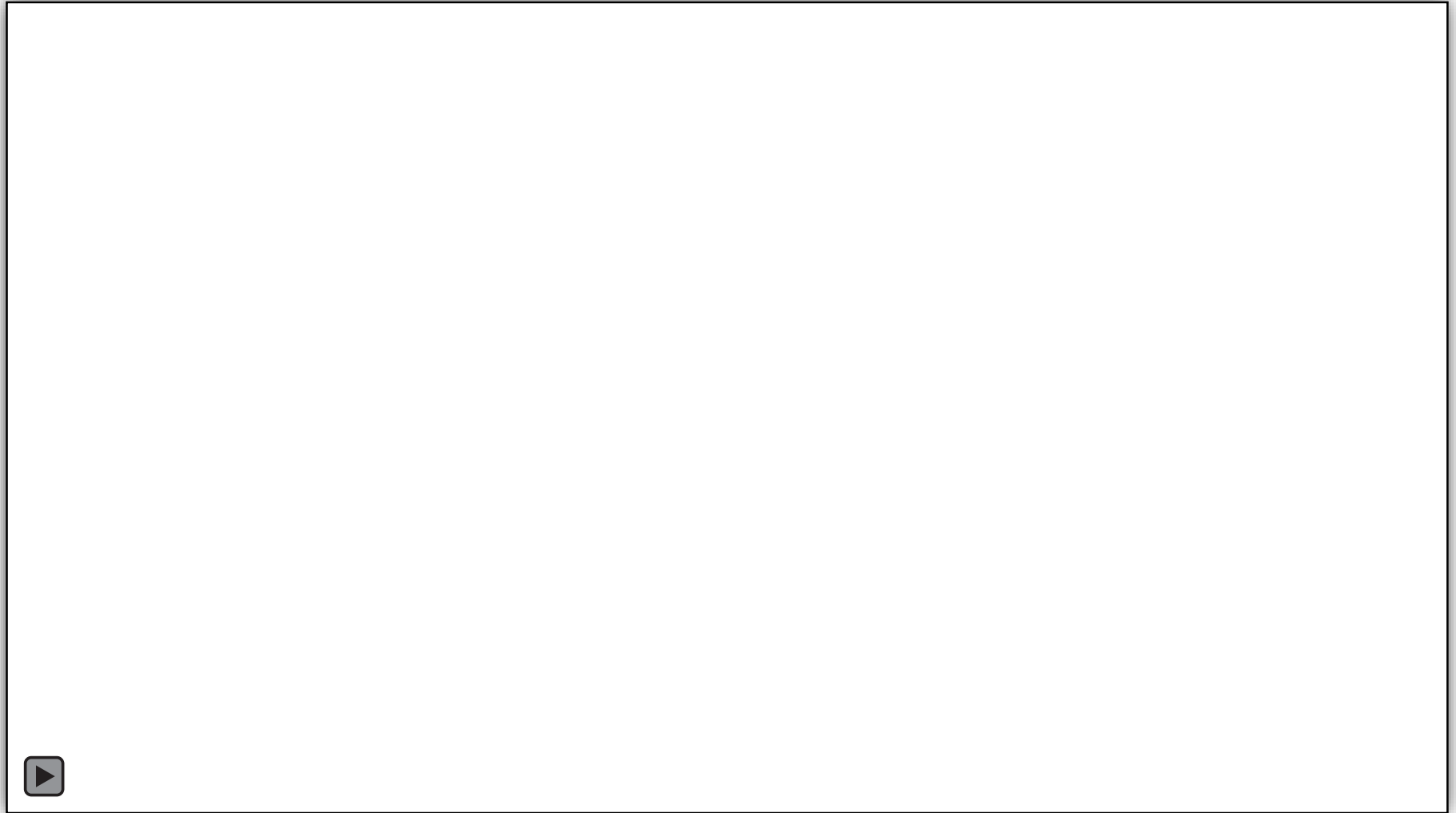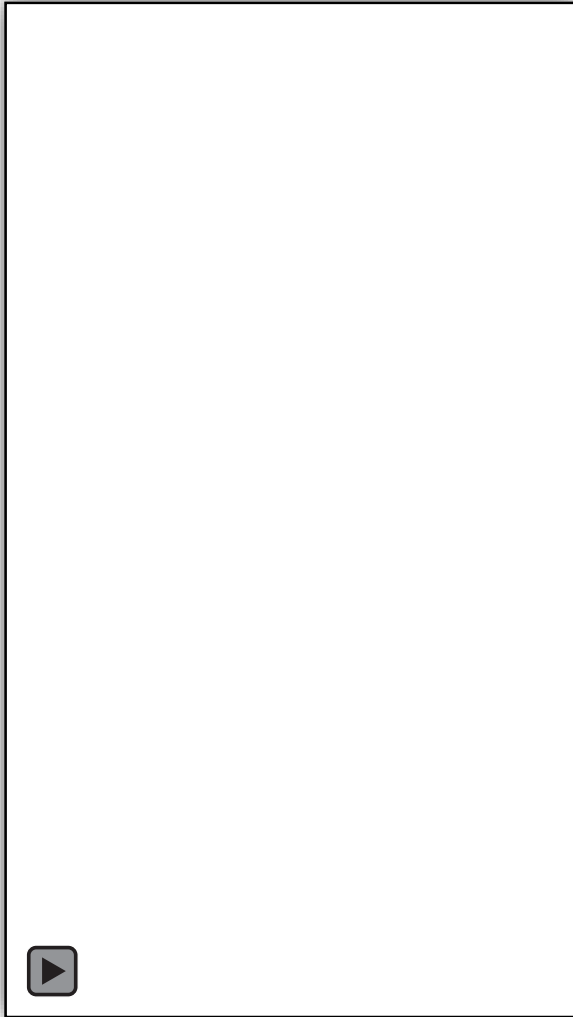
EVOLT Electrical Intervine

Meet the Amiga

Modular Robots for Every Acre

Learn More

>_
farm-ng
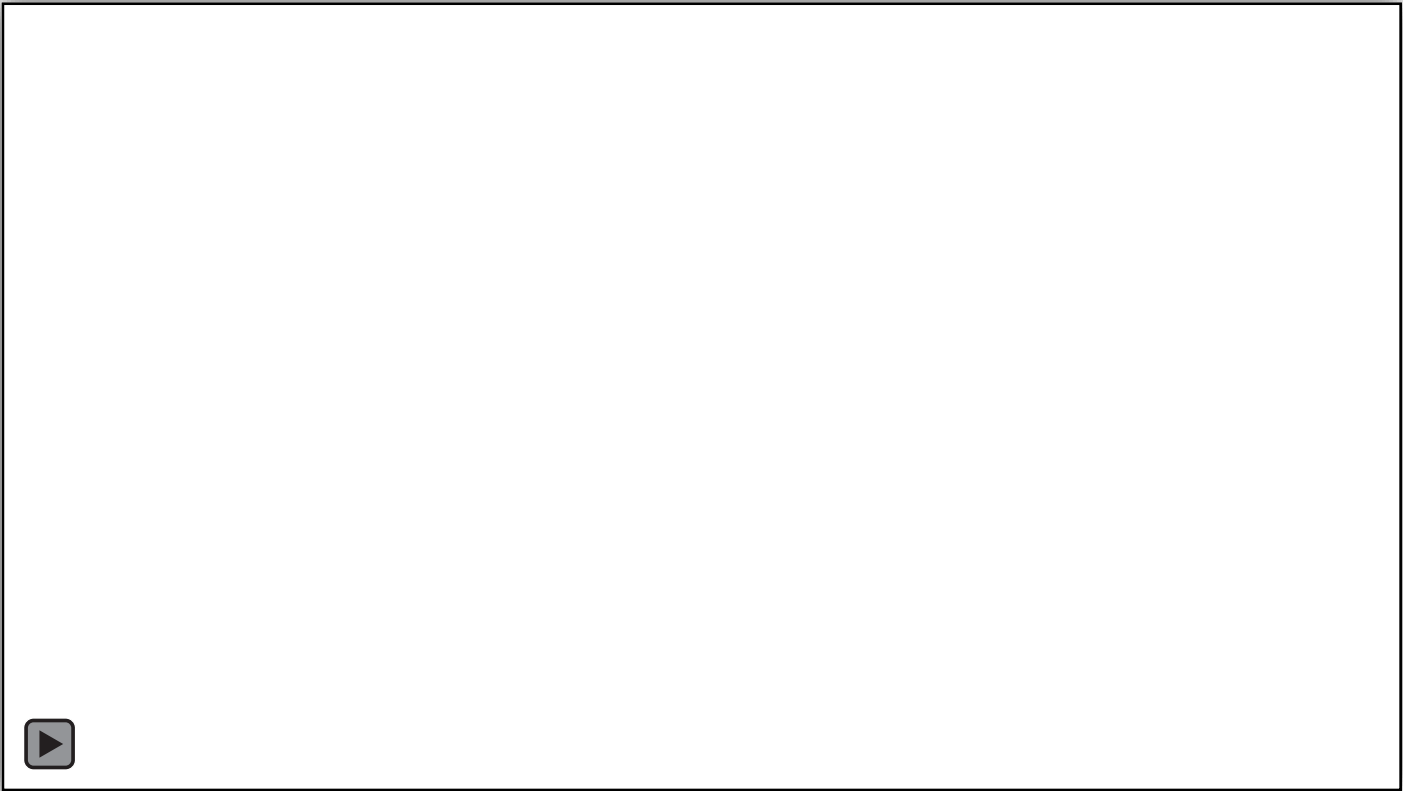
PAYLOAD CAPACITY	AVERAGE RUNTIME	TOP SPEED	WEIGHT
500 Lbs	**8 Hours**	**5.5 MPH**	**325 Lbs**

AMPLIFY YOUR WORKFORCE

Meet Burro: a first-of-its-kind autonomous workhorse collaborative robot. Embrace autonomous solutions to enhance productivity and combat the challenges of labor scarcity.

Get a free evaluation of your farm　　**Find a Dealer**

Side-by-side Collaboration

ur autonomous robots work alongside farm rkers to amplify their work, both indoors and outdoors.

Offset 1–2+ employees each day per Burro

An 8 person harvest crew can harvest 15% to 30%+ more fruit daily using a single Burro. One Grande can offset one tractor plus operator towing trailers in nurseries.

Multipurpose

Burros save labor in nurseries, vineyards, berries, construction, and beyond, unlocking autonomy for countless new applications.

Burro

Our flagship product. Designed to be compact and adaptable for a variety of applications. Commonly used for harvest assist and other outdoor-only applications.

	Carry Capacity	500 lbs
	Towing Payload	2,000 lbs
	Horsepower	5.2
	Range	8-10 miles

Learn More

Verde

Created with greenhouses in mind, Verde is our small form factor robot with built-in sensors for both indoor and outdoor navigation. Perfect for carrying and towing in narrow spaces.

	Carry Capacity	500 lbs
	Towing Payload	2,000 lbs
	Horsepower	5.2
	Range	8-10 miles

Learn More

Grande

Our most powerful robot. Designed to autonomously tow more, carry more, do more in agricultural settings. Seamlessly navigate indoor/outdoor with the addition of lidar.

	Carry Capacity	1,000 lbs
	Towing Payload	5,000 lbs
	Horsepower	12
	Range	13-15 miles

Learn More

Cortador

Take Back Your Terrain with our most powerful robot, and a beastly mower. Areas, handle, Rows, handled, Slopes, handled.

	Carry Capacity	1,000 lbs
	Towing Payload	5,000 lbs
	Horsepower	12
	Range	Up to 8 acres per charge

Learn More

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BURRO https://burro.ai/

New Tools

Electric Weeders

Zasso Electroherb Electric Weeder

ELECTRICAL WEEDING

First patents for electrical weed control devices were issued in the 1890's and explored in sugar beets in 1980's

The physical contact of the target plant with the high voltage electrodes establishes a current flow

Generation of heat disrupts cells leading to tissues wilting and dying

Current can pass through roots resulting in "systemic" damage

Welcome to **Zasso.**

We design and commercialize technologies that support electric weeding in the Agriculture and Municipalities Segments.

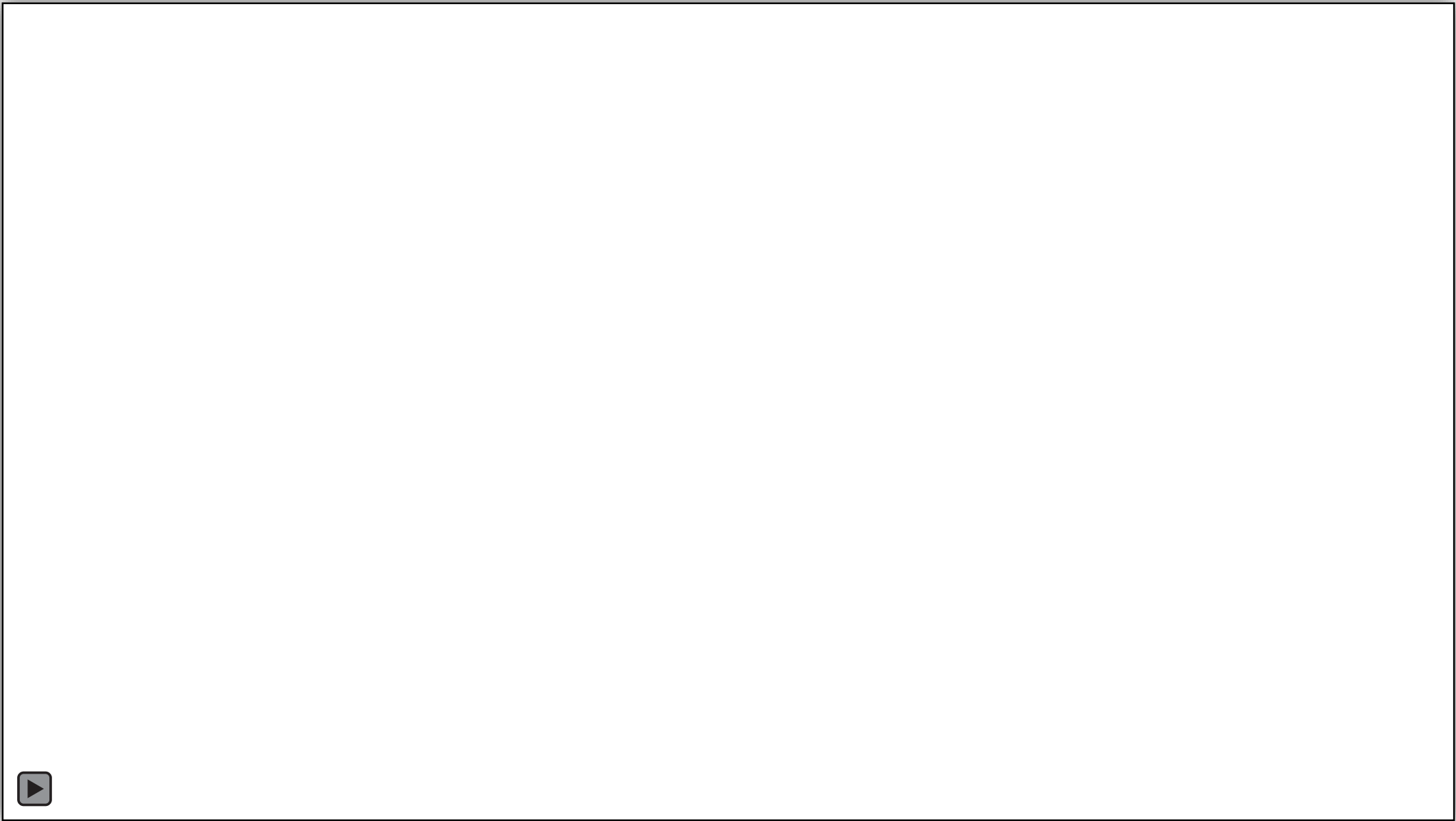OUR PRODUCTS ➡

Generator, transformer **Front-mounted applicators** **Metal, flexible electrodes**

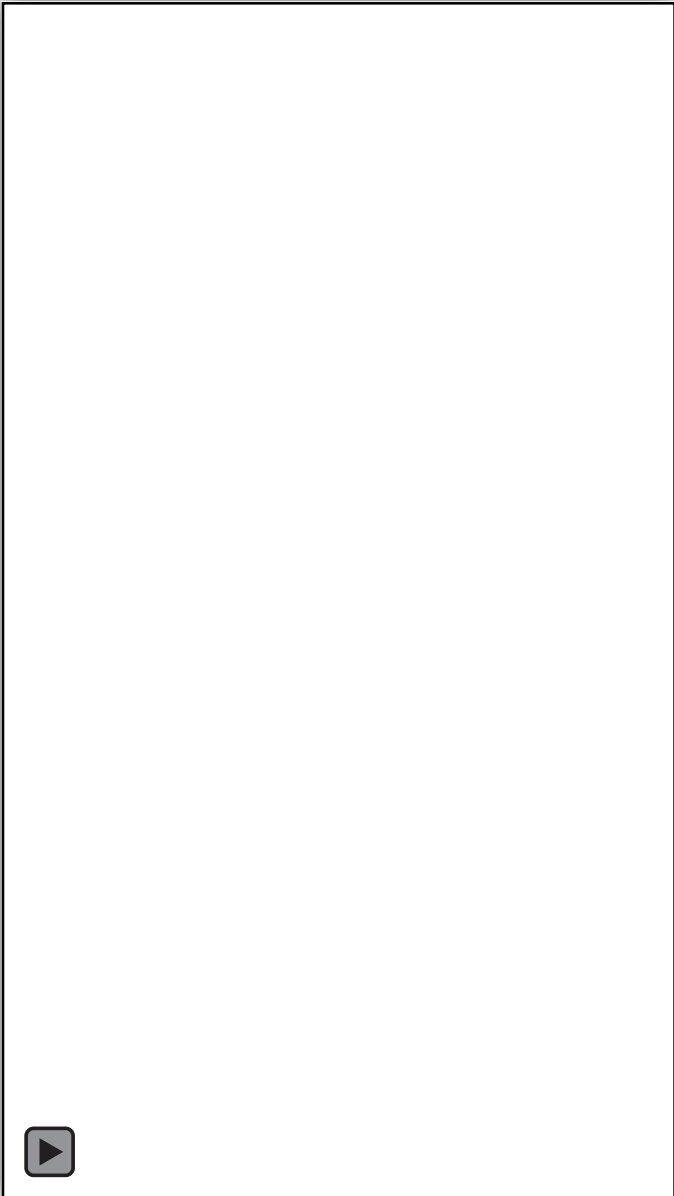ZASSO, AC, 180 hz Frequency 30 kW power, 1200 kg

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zasso *https://zasso.com/*

Weed Responses to Electricity

24 Hours After Treatment

1 Week After Treatment

ZASSO https://zasso.com/

Organic apple block at Cornell University in Ithaca, NY
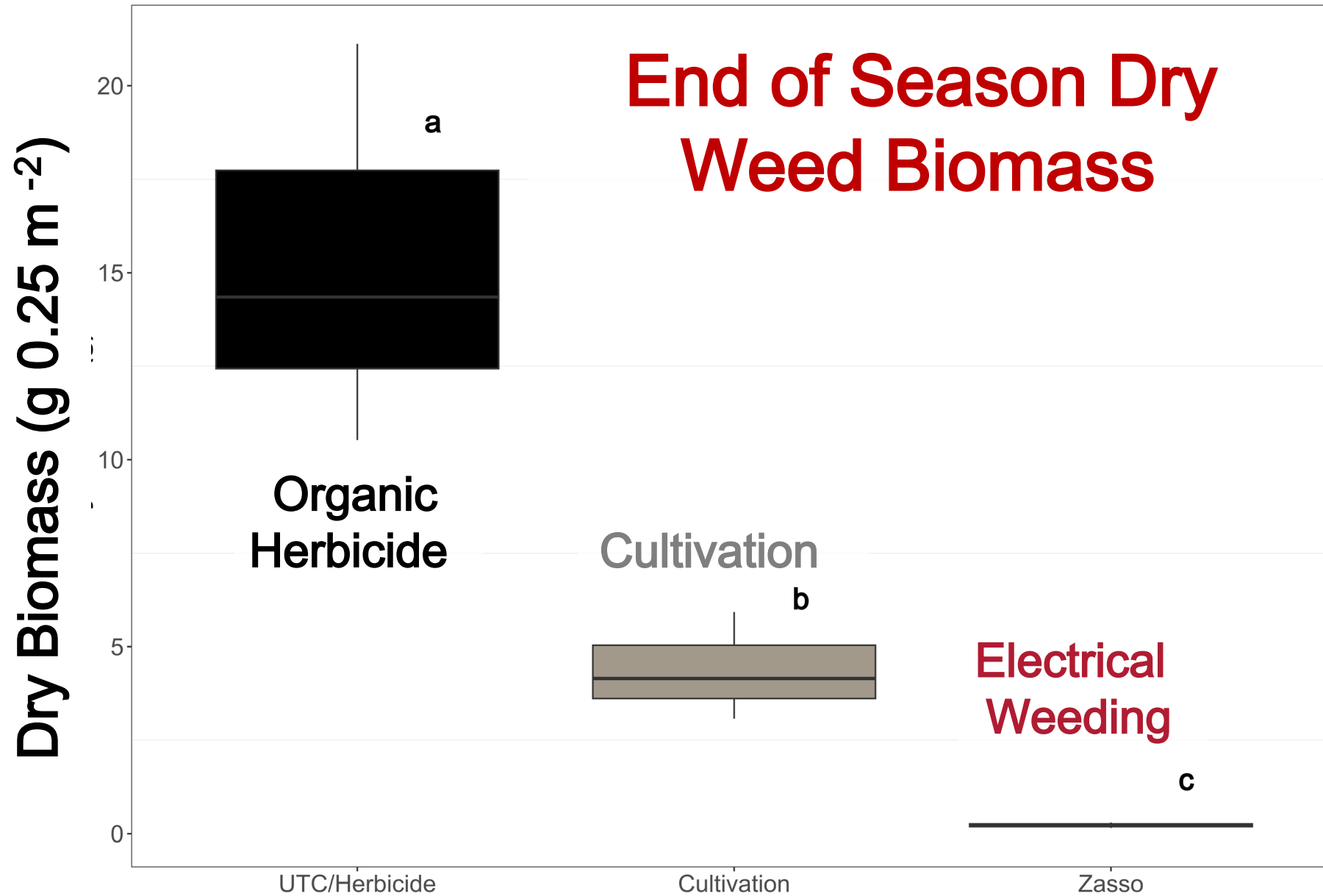
What About Crop and Soil Health?

No damage to trunks (except that one tree we hit…), no effects on canopy size, leafing out, bloom phenology

No impacts on soil physical, chemical or biological properties (microbial biomass, respiration, microarthropod density, diversity)

What's Next?

- Repeat trials in mature organic apple blocks

- Economic analyses (monitoring time to weed, fuel use, maintenance expenses, etc...)

- Comparisons of electrical weeding versus autonomous mowing and robotic cultivation in newly established organic apples and grapes

Principal Collaborators
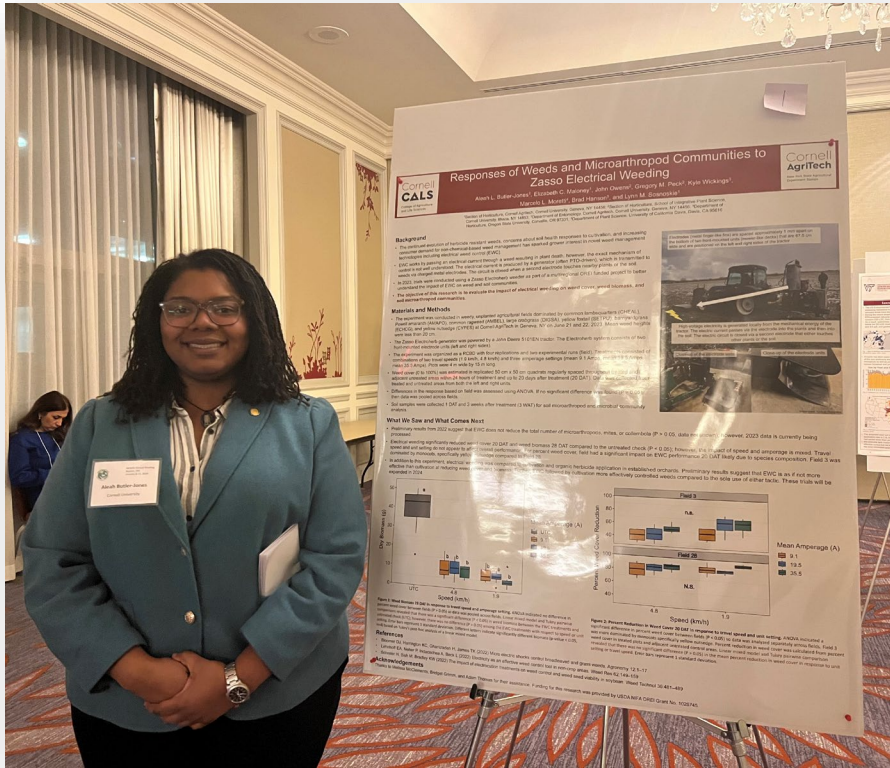
Aleah Butler-Jones
PhD Student Cornell University

Marcelo Moretti
Oregon State

Brad Hanson
UC Davis

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and Life Sciences

AI-Powered Technology

Weed Detection, Crop Row Detection, Crop-Weed Discrimination

AgriTech America Weed-IT

WEED-IT Precision Spraying

Beyond Accurate

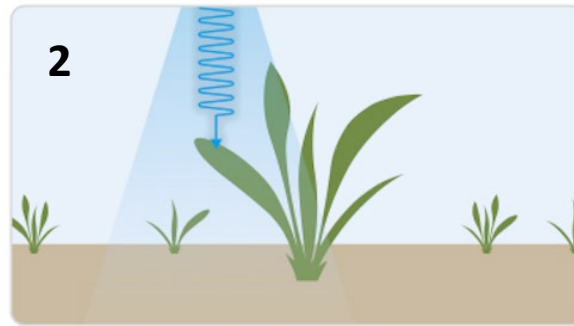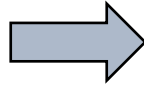## Save up to 95% on chemicals

Calculate your ROI   Find a distributor
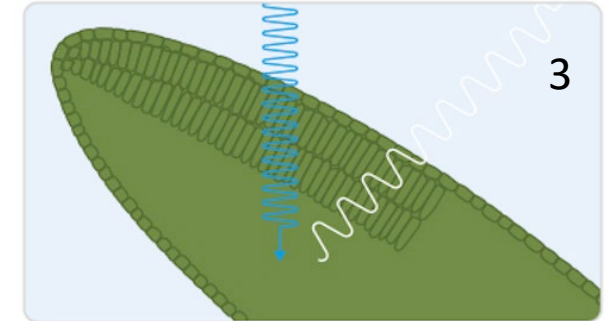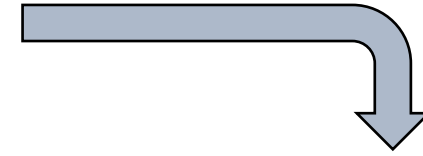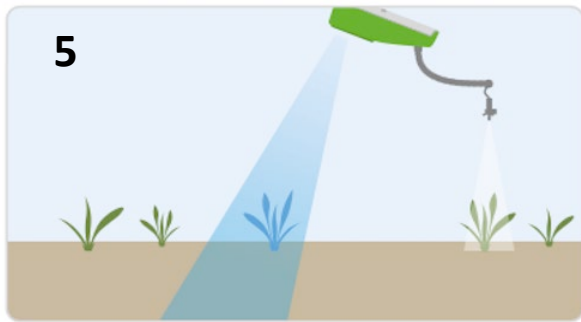
1 — Sensor emits blue light

2 — Blue light absorbed by chlorophyll

3 — Chlorophyll emits near infra-red (NIR) in reaction to blue light

4 — NIR signal received and analyzed by the sensor

5 — Sensor triggers an affiliated nozzle to "turn on" and spray weeds

No crop-weed discrimination, so fast when weeds and sensitive commodity tissue are separated in time/space

Specifications

- Detection height: 110 cm
- Detection width: 100 cm, divided in 4 zones of 25 cm
- Sensor weight: 700 grams
- Sensor size l x w x h: 20x10x7 cm
- Sensor power consumption: max. 18.5 Watt
- Solenoid power consumption: max. 2.5 Watt
- Maximum width: 48 meters
- Operating speeds: up to 25 kph (16 mph)

1 cm² detection size at 15 mph

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WEED·IT precision spraying https://weed-it.com/

Take care of specialty/high value crops with WEED-IT precision technology

Specialty crops in orchards and vineyards deserve to be cared for by the best technology available, don't they? By creating optimal circumstances for your high value crops to grow, you can yield the best and tastiest berries, fruits and nuts. WEED-IT helps you optimise weed, spray deposition, spray drift and thinning management. How? Let's take a look!

It might not be in the name, but with WEED-IT you can do so much more than just manage weeds in orchards, vineyards and other permanent tree crops like almond, avocado, citruses and pistachio. The reason, or rather secret behind the multifunctionality and versatility of the technology? The
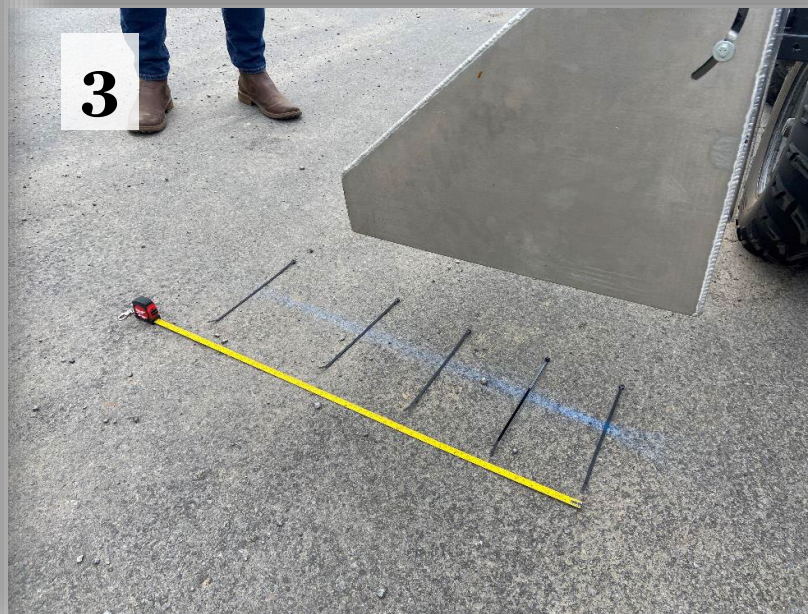
Interested in this system in perennial crops because of spatial separation and speed

Results to Date

Better POST performance when densities are low (part of an IWM program)

Reductions in POST herbicide use, but also dependent on weed density

Crop safety depends on crop (reduced damage potential in grapes, increased in blueberries, depending on herbicide)

Can be used for grape sucker control (good success in NY and NJ trials)

What Next?

- More automation!

- Farm-ng is a robotics company focused on developing innovative, adaptable agricultural robots designed to assist farmers with tasks like cultivation, harvesting, and transportation.

- Their flagship product, the Amiga robot, is a modular, electric-powered machine specifically designed for small and mid-sized farms.

- Swarm technology?

Valuable Mitigation Tool for Reducing Off-Target Movement?

"However, in site-specific cases, users may be able to...reduce per acre annual application rates and achieve associated mitigation points by using...precision spraying equipment that may allow for the use of less pesticide overall while maintaining an efficacious application rate."

Principal Collaborators

Thierry Besancon
Rutgers University

Terry Bates
Cornell Lake Erie Research and Extension Laboratory

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Choose Your Fighter!

2022 CROP ROBOTICS LANDSCAPE

These companies (and others) are in the sector, but are they ready to WORK?

Questions We Need to Ask About Technology

COST – Units themselves, but also parts and services (money as well as time...if service providers are not local), cost of associated equipment, fuel expenditures, etc...

ADAPTABILITY – Western vs Eastern US, soils, farm sizes (e.g., acreage needed for adoption), field shapes, production conditions, etc...

INFRASTRUCTURE AND REGULATORY READINESS – Cellular and internet service, base stations (personal, public?), safety and transportation, etc...

CHANGING NATURE OF LABOR – Who will build, operate and service new technology, are we training them properly, what about recruiting from the people who know the job best, what about communities that have provided the labor that is being replaced

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Funding and Support

- Interregional 4 Project
- New York State Ag and Markets
- New York Wine and Grape Foundation
- New York Vegetable Research Council and Association
- Genesee Valley Regional Market Authority
- New York Farm Viability Institute
- Cornell College of Agriculture and Life Sciences
- USDA Federal Capacity Funds
- USDA Organic Research and Extension Initiative
- USDA Specialty Crop Research Initiative
- USDA Crop Protection and Pest Management

Thank You!

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