COLUMBIA
SPACE INITIATIVE

PH-LORA

COLUMBIA UNIVERSITY

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Meet Our Team

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Current Pest Control:

Fundamental to agricultural industry. However, insecticide is also...

Human Impact

Cancer causing, linked to **congenital defects**, **endocrine disorders**, and **neurobehavioral disorders** such as **Parkinson's disease.**

Current Pest Control:

Fundamental to agricultural industry. However, insecticide is also...

Environmental Impact

Harmful to non-target flora & fauna, **contaminating water**, contributing to **soil infertility**, **polluting air**, and leading to **insect resistance**.

Farms utilizing organic pest control account for less than 2% worldwide and less than 1% in the USA

What Can Be Done About These Pesky Pests?

Pheromones

What are pheromones?

The chemical signals that insects use to communicate with other members of the same species.

What makes pheromones a good alternative to traditional insecticides?

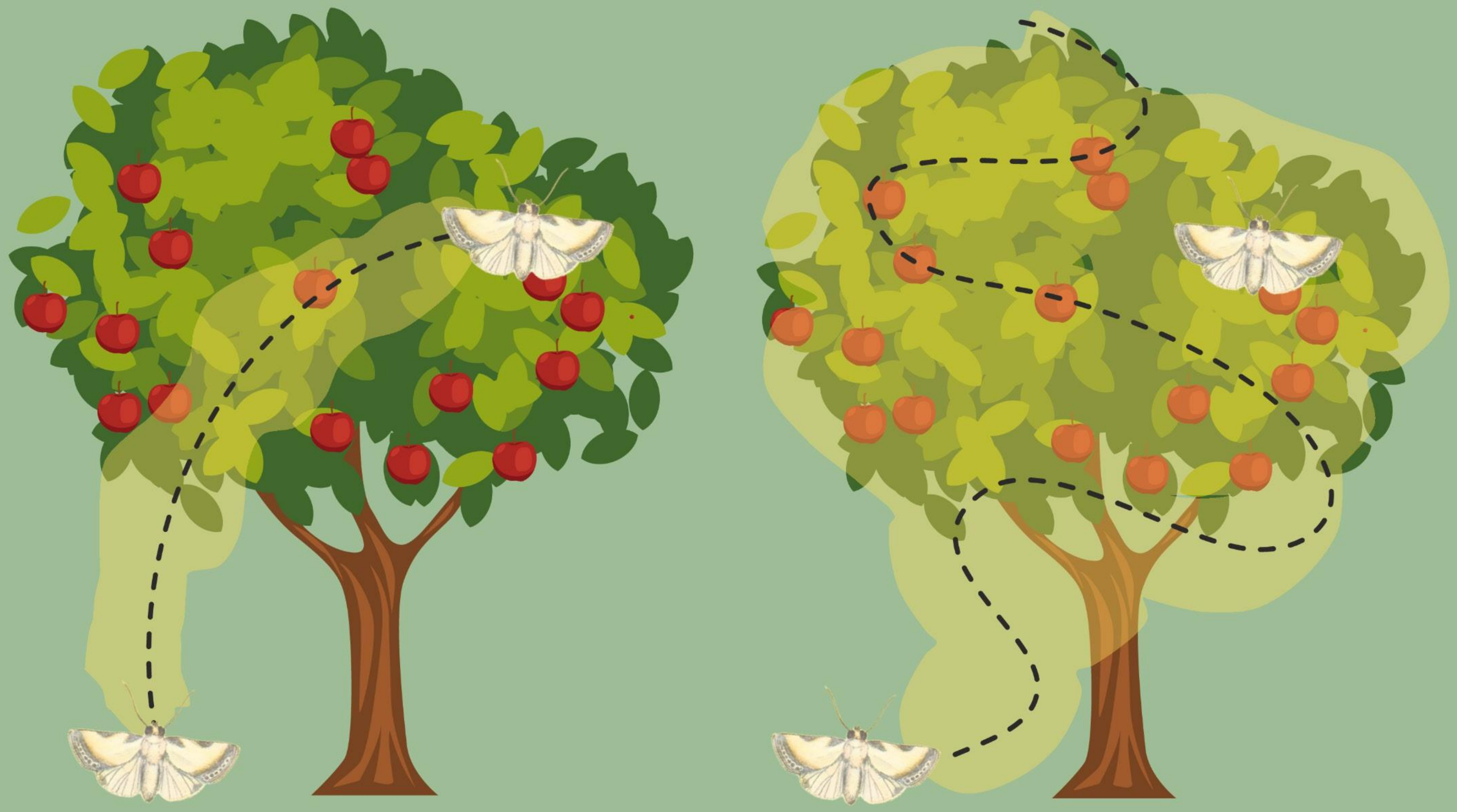
Species Specific

Environmentally Friendly

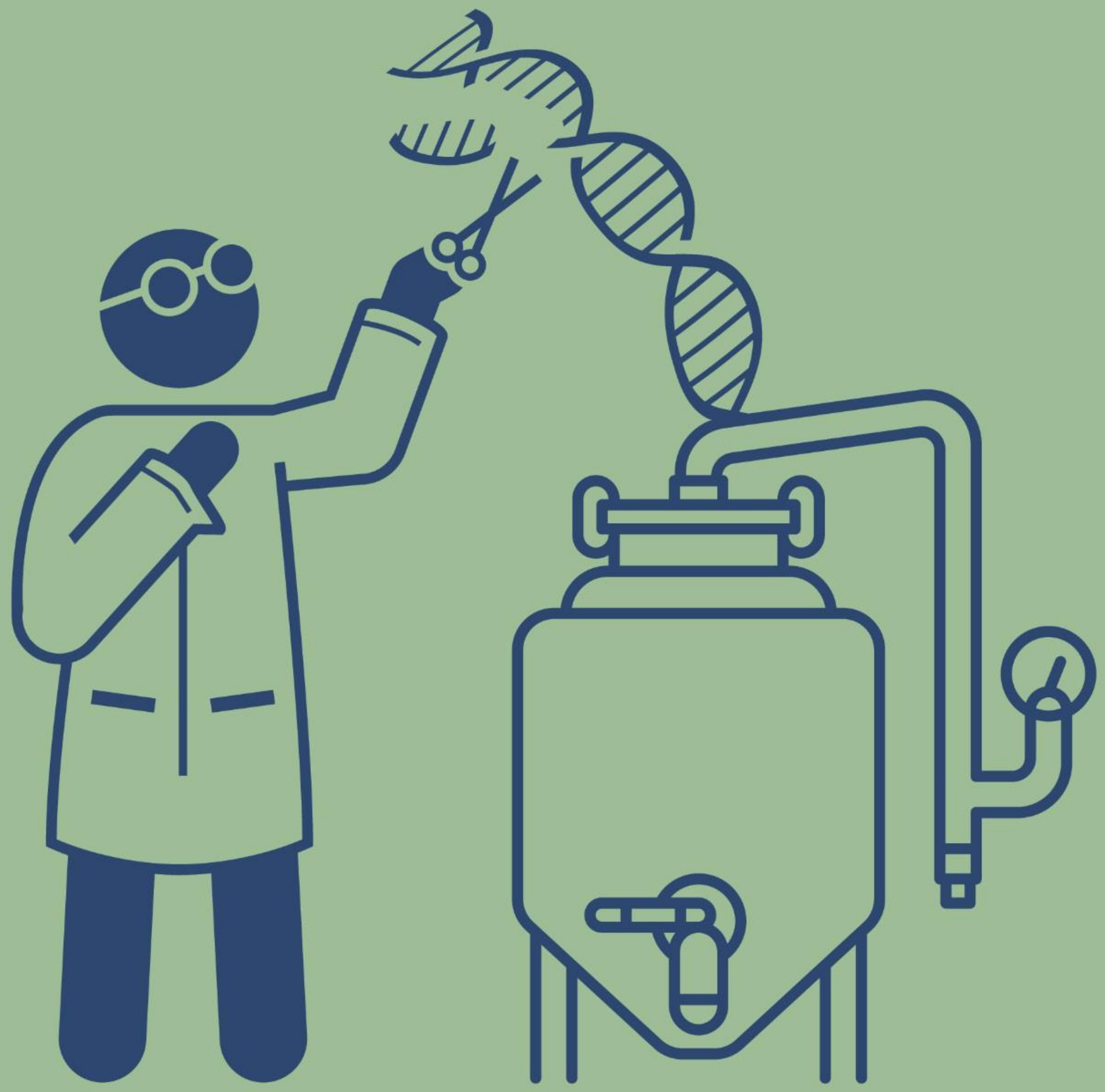
No/Slowed Resistance

How Mating Disruption Works

When an area is flooded with the target insect's pheromones, potential mates are unable to locate the source.



Chemistry & Production



Types of Pheromones: Hydrocarbons, Alcohols, Acetates

Need for stereochemical accuracy

Formulations: Microcapsules, Polymer Matrices

Production: Engineered Yeast Fermentation

- **Genes encode pheromone-synthesizing enzymes**
- **Lower cost, high yield vs. traditional synthesis**
- **Suited for large-scale agriculture**

Sounds too good to be true...

Manual Labor Needs

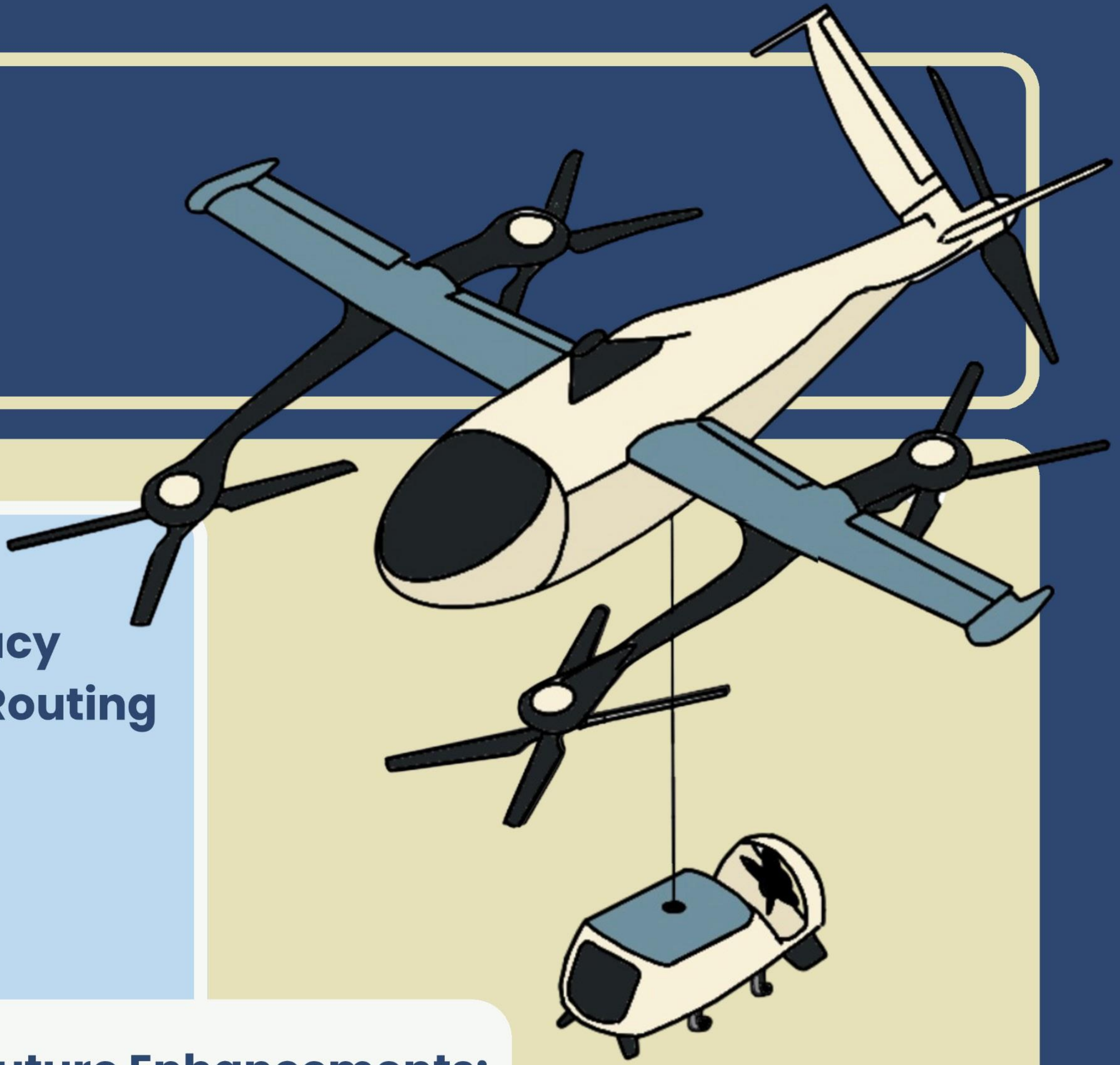
- **Checking traps** for population monitoring and maturity indicators
- **Refilling and replacing dispensers** (Often 100+ per acre)

Species Specificity

- **Where on the crop** target insect mates
- **What time of day** target insect mates
- **Species-specific pheromonal solution**

PH-LORA

PHEROMONAL LOCALIZED OVERPOPULATION REGULATION AIRCRAFT



Equipped with:

- Airspace Detection
- Collision Avoidance
- Centimeter-Precise Accuracy
- Route Planning & Auto Re-Routing

Necessary Modifications:

- Nozzles for Pheromonal Distribution on Retractable, Tethered Droid
- Connection Capabilities to Oracle & GaiaScope
- Pre-Set Species Specific Flying Conditions

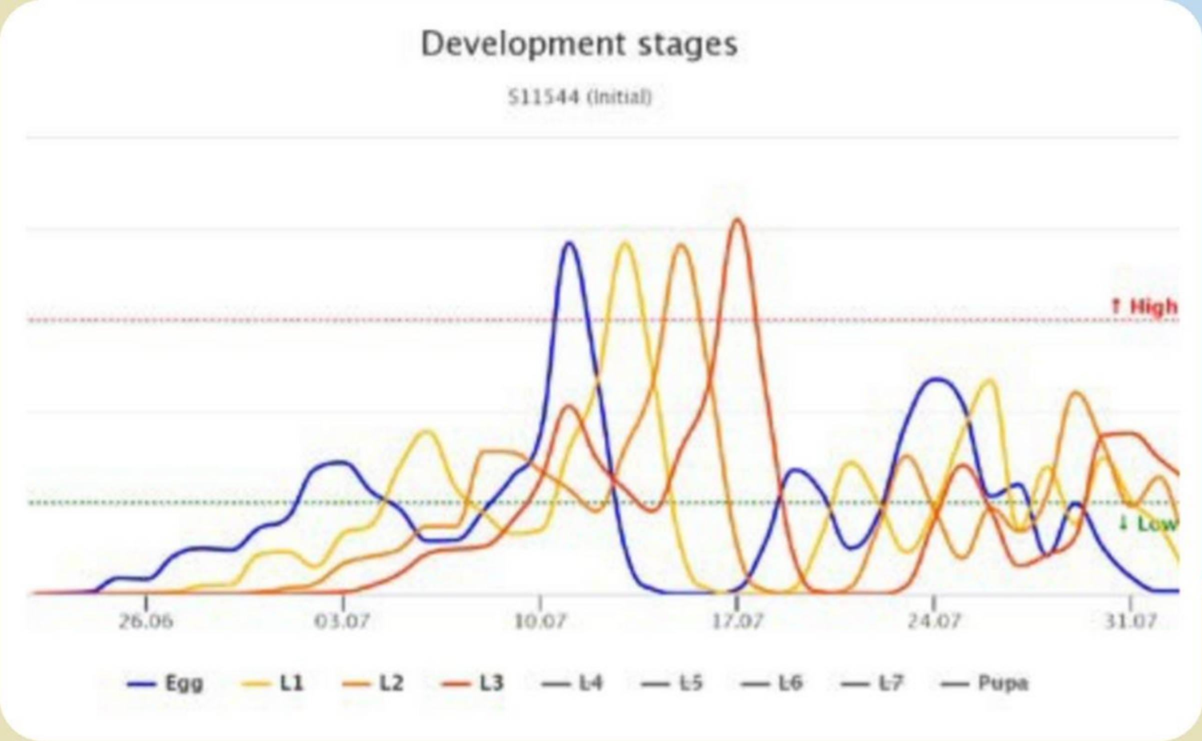
Future Enhancements:

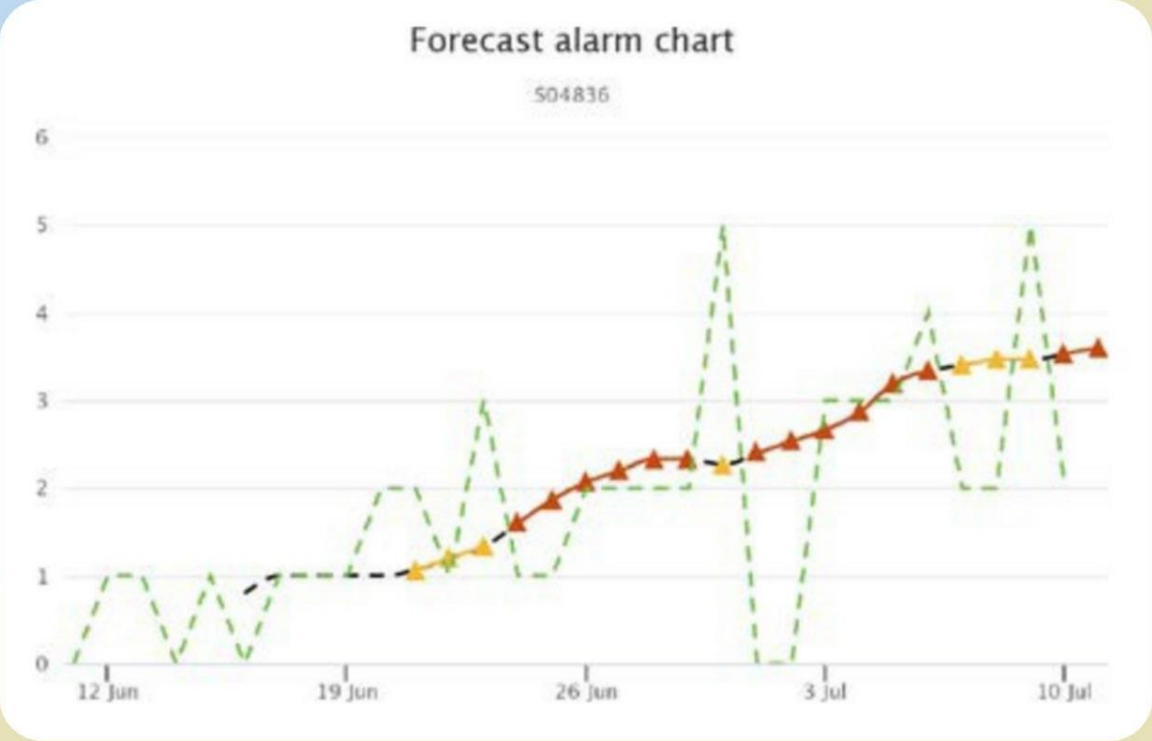
Increased Weight Limit & Battery Life

Oracle

Equipped with:
- Data Processing & Forecast
- Energy Independence
- Self-Cleaning Mechanisms
- Radio Connectivity

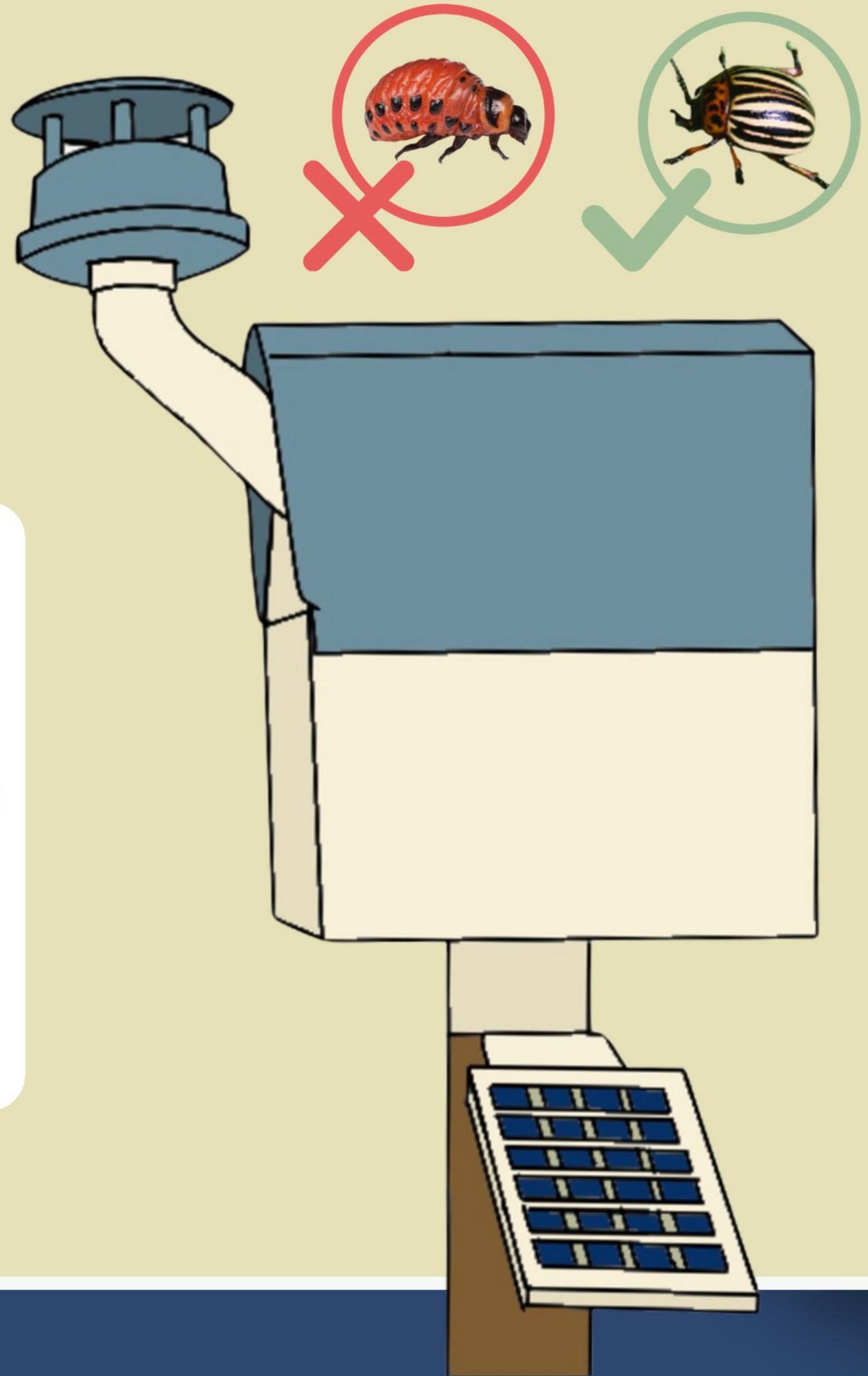
Necessary Modifications:
- Determine Pheromonal Needs & Insecticide Intervention
- Expanded Insect Species Monitoring Ability



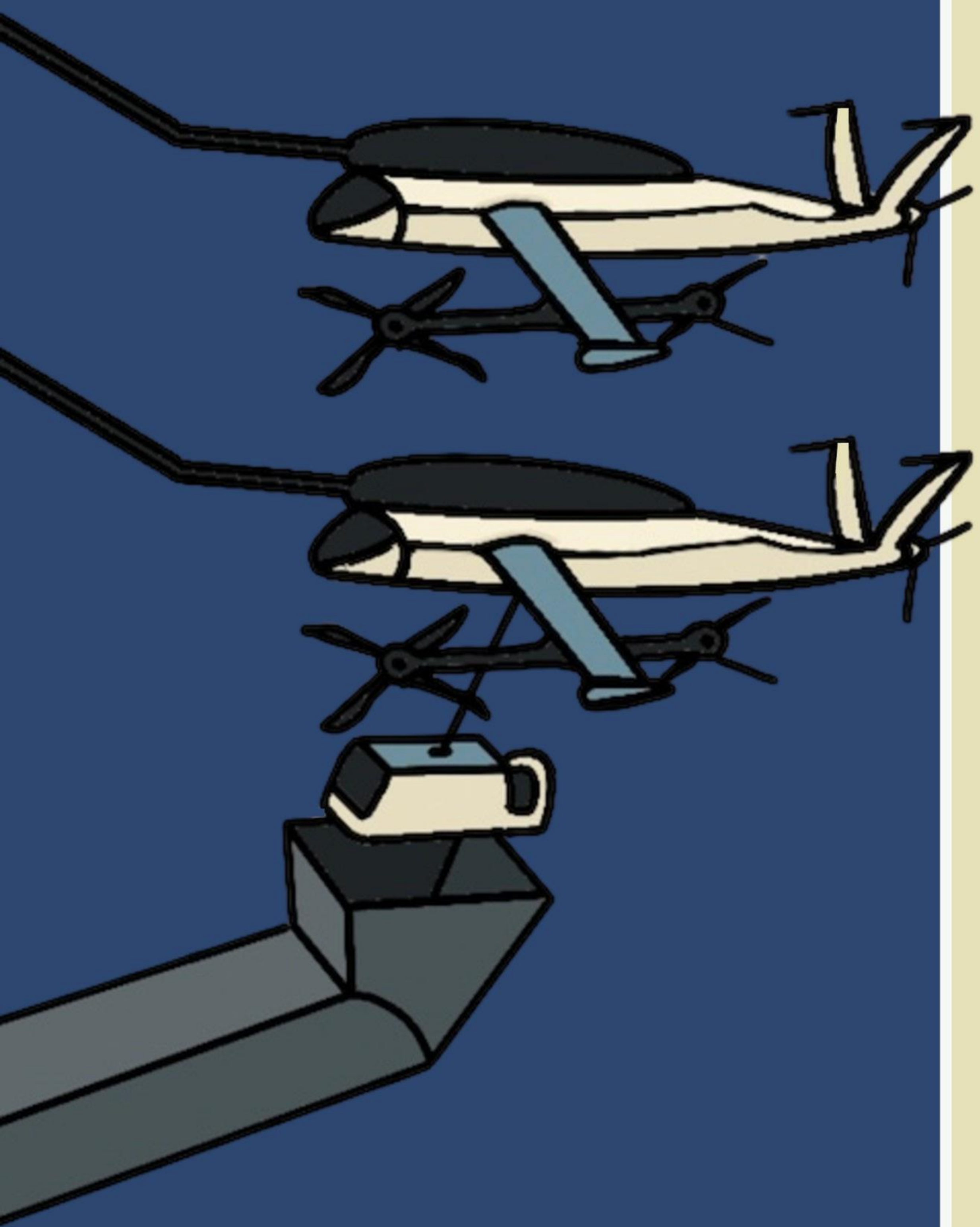


Trapview's modeling of maturity and population forecasts

Colorado Potato Beetle at different life stages



NOSTOS



Equipped with:

- Docking Station
- Electric Charging
- Easily Attachable

Necessary Modifications:

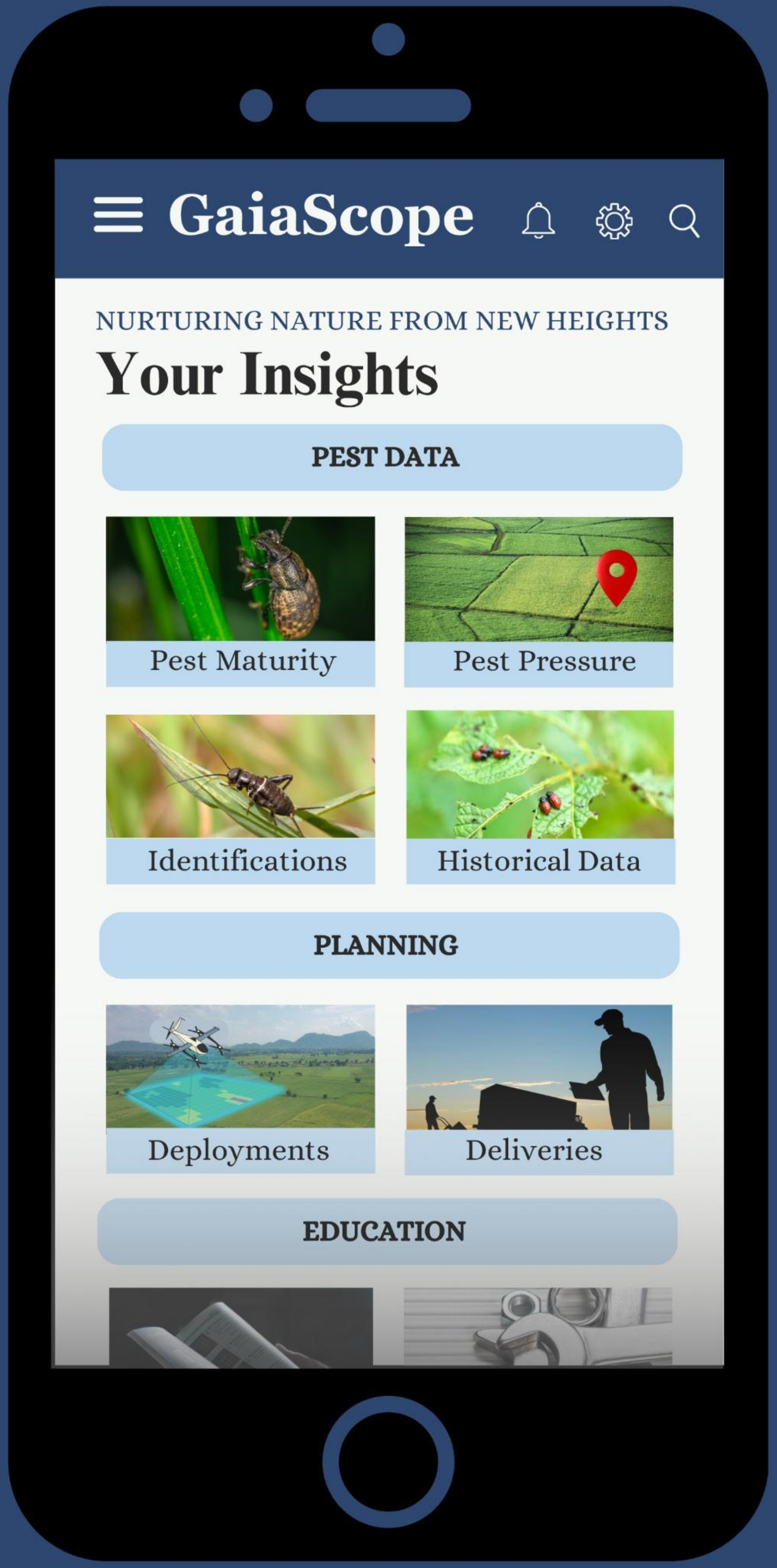
- Autonomous Loading Feature & Pheromone Treatment Containment
- Connection Capabilities to Oracle & GaiaScope
- Connectivity Systems for Rural Communities

GaiaScope

A Combination Of Oracle & PH-LORA's Data + The Following Capabilities

Features:

- **Real-Time Pest Monitoring**
- **Deployment Scheduling and Manual Controls**
- **Data Analytics**
- **Maintenance Alerts & Assistance**
- **Historical Records**
- **Education**



Support Systems and Connectivity

Support Systems:

Nostos is backed by regional maintenance hubs, a multilingual helpline, and an in-app trouble shooting guide

Farmers have 24/7 access to training networks

Connectivity:

Nostos safeguards data from connectivity issues by prioritizing local data processing and device inter-connection

Improvement Over Existing Practices

Pest Management Comparisons

Features	Traditional Chemical Insectides	Organic Pest Control Methods	Stationary Pheromonal Pest Control	PH-LORA
Low Manual Labor Requirments	✓			✓
Cost- Low Initial	✓			
Cost- Low Long Term	✓			✓
Low Toxicity		✓	✓	✓
Minimal Environmental Damage		✓	✓	✓
Non-Target Fauna Protection			✓	✓
Slowed Resistance		✓	✓	✓

Higher Safety Standards:
Minimizes farmer exposure
Environmentally safe

Improved Monitoring and Decision-Making:
Real-time pest data
Predictive analytics

Precedents

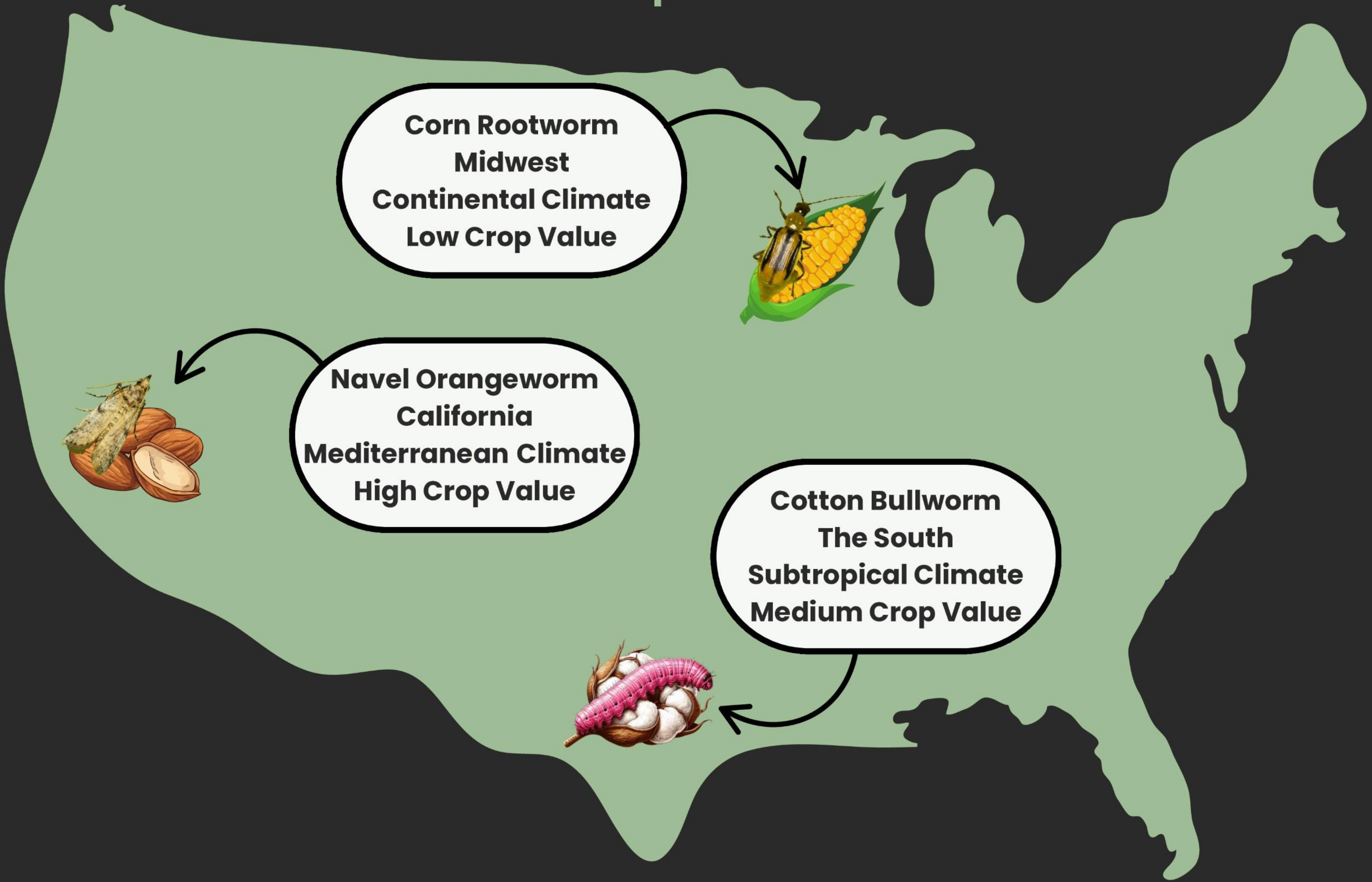
Use of Drone-Based Pest Management:

- South Korea & Japan: 30% of crops are sprayed using drones.
- China: Multi-rotor drones for large-scale aerial pesticide dispersion.

Key Advantages of Drones:

1. Effective in difficult terrain.
2. Ideal for small or irregularly shaped fields.
3. Minimizes farmer exposure to harmful chemicals.

Pheromone Use Cases For Different USA Regions And Crop Values



TIMELINE

2025

- Begin initial component testing
- Enhancing AI capabilities
- Pheromonal solution development and research

2027

- Systems integration and prototype demonstrations
- Increasing public awareness and comfortability with pheromonal solution

2030

- Comprehensive flight validation to achieve operational readiness
- Field-testing efficacy of the platform with developed pheromones

2032

- Final preparations, including regulatory compliance and farmer training
- Phased operational deployment

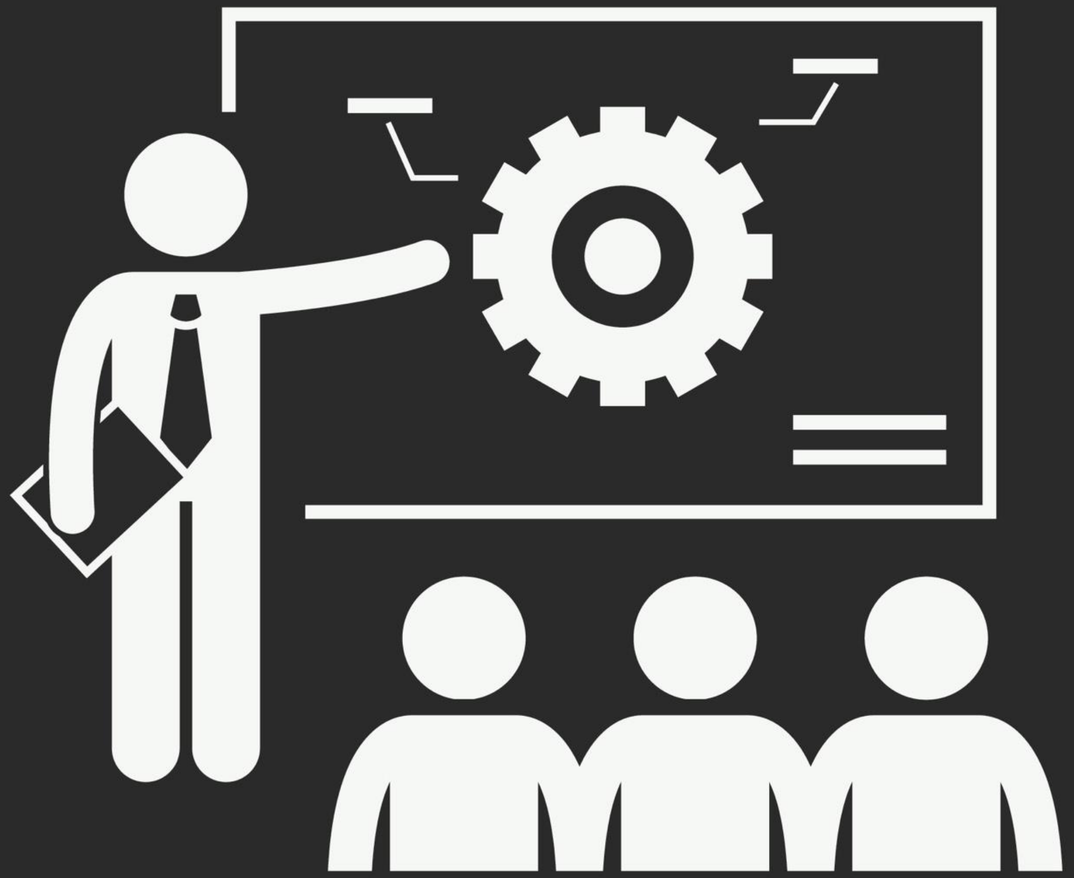
2035

- Full-scale system implementation and ensuring operational sustainability
- Continued expansion of pheromonal species coverage

Training

Encouraging farmer confidence to integrate PH-LORA system through training on:

- **Pheromone Solutions and Pest Behavior**
- **Federal Regulations and Safety**
- **How to interpret GaiaScope data visualizations**
- **Drone operations by guided sessions**
- **Maintenance support:**
  - **How to care for drone, insect monitoring technology, and docking stations**



Interoperability with Existing Processes, Organizations, Solutions, and Technologies

Zipline

trapview

FEDERAL AVIATION ADMINISTRATION

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY

USDA

Integration:
Pesticide Companies for Integrated Pest Management (IMP)

Collaboration:
Partnerships with agricultural cooperatives (CHS Inc., Land O'Lakes).
University research support and/or data collection from agricultural/ecological/entomology programs.

Barriers

Regulation Barriers

- FAA approval for agricultural pesticide drone use & approval for autonomous features
- USDA & EPA approval for each pheromone solution produced

Solutions:

Comprehensive field testing to ensuring efficacy & environmental protection

Training programs to ensure maximum human safety

Adoption Barriers

- High Cost
- Public perception and familiarity with pheromones
- Industry Resistance

Solutions:

Initial Cost: Government subsidy
Recurring Cost: GMO yeast production

Education & Partnerships

Government Support

Technology & Deployment Barriers

- Connectivity issues in remote areas
- Harsh Weather Conditions

Solutions:

Local network and backup

Weather mitigation
- emergency landing
- return to NOSTOS
- Re-routing

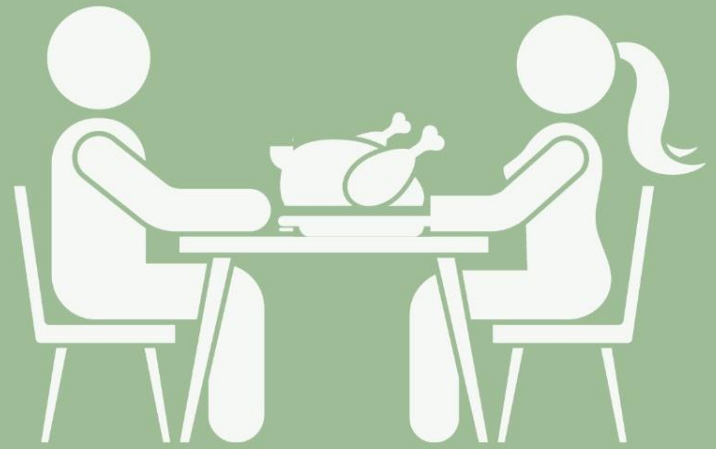
System recommendation to pursue alternative pest control.

Scaling

Initial focus: High-value crops + insecticide resistant insects

End goal: Large farms of low-value crops

Drone design allows expansion to other crops & terrains at no additional cost



Cost

GaiaScope Features

Component	Cost Breakdown
PH-LORA Unit: Drone Hardware	~$10,000 per unit ("Sprayer Drones" 2025) (Using commercially available agri-drones as an estimate as no pricing data available for Zipline)
Oracle AI Development & Integration	~$500,000 (one-time initial investment, based on large-scale industry model) (Ta 2024)
Oracle Hardware: Self-Cleaning Insect Sensors	~$25-50 per acre per year on a subscription basis (Courtney 2025) (Using Cropview as an estimate as no pricing data available for Trapview)
App Development & Dashboard Interface	~$50,000 ("Application Development for Agriculture: Process, Steps, & Cost - IDAP Blog" 2023)
Docking Station & Loading Infrastructure	~$10,000 per location ("DJI Dock 2" 2024) (Estimation from commercially available docking systems)
Pheromonal Production	~$70/kg (Stokstad 2022) if utilizing yeast biosynthesis, compared to ~$200/kg for chemically synthesized pheromones (Stokstad 2022)

Cost Analysis

Pest & Crop	Location	Climate / Environmental Landscape	Crop Value	Cost Analysis
Navel Orangeworm in Almonds	Central Valley, California	Mediterranean climate (hot, dry summers; cool, wet winters)	High	Avg. profit ~$2,000/acre profit. Farms average 100 acres → ~$200,000/year profit. Pheromone cost ~$145–170/acre. PH-LORA system requires ~3% of annual profit if financed over 5 years. Helps prevent aflatoxin contamination & yield loss.
Pink Bollworm in Cotton	American South (e.g., TX, GA, MS)	Warm temperate to subtropical; prone to high humidity	Medium - Low	Avg. profit ~$200/acre. Avg. farm: 500 acres → ~$100,000/year profit. Capital cost is ~5% of profit if financed over 5 years. Pheromone + monitoring ~$102–127/acre. Effective when pesticides fail due to pest hiding in bolls.
Corn Rootworm in Corn	Midwest (e.g., IA, IL, NE)	Continental climate; fertile soils, moderate rainfall	Low	Avg. profit ~$164/acre. Avg. farm: 280 acres → ~$45,920/year profit. Capital cost ~1% of profit if financed over 10 years. System + monitoring: $25–50/acre. Still feasible with careful budgeting; pheromone market still maturing.

Return on Investment

Cost Savings

Reduction in labor costs
Lower pest control solution use (precision targeting)

Increased Profit Margins:

Higher Yield Protection
Premium Product Pricing
Cost-Effective Monitoring

Long-Term Financial Benefits:
PH-LORA System Cost: ~3-5% of farm profit over 5 years for high-value crops (almonds, cotton).
Studies have shown that pheromone intervention yields returns of about 3:1 in Cotton, and performs better than pure insecticide use in Almonds

Environmental & Human Benefits:
Reduced chemical runoff, exposure, consumption, and non-target species impact.

If Used to Fullest Operational Potential...

POUNDS OF PESTICIDE USED YEARLY	% OF PESTICIDE THAT IS INSECTICIDE	% OF PESTS THAT RELY ON PHEROMONES FOR MATING	% INSECTICIDE REDUCTION USING MATING DISRUPTION	TOTAL LBS OF INSECTICIDE KEPT OUT OF THE ENVIRONMENT ANNUALLY
5.6 BILLION POUNDS	29.5%	75%	90%	1.115 BILLION POUNDS

$5.6 \times 10^9 \times .295 \times .75 \times .90 =$ 1.115 BILLION POUNDS

Additionally,

% MAKEUP OF PFAS IN INSECTICIDES: 14%

156,114,000 lbs of “forever chemicals” being kept out of the environment yearly with this solution

Why it matters

Finding a sustainable, nature inspired solution is essential to protecting our ecosystems while ensuring food security for Earth's growing population