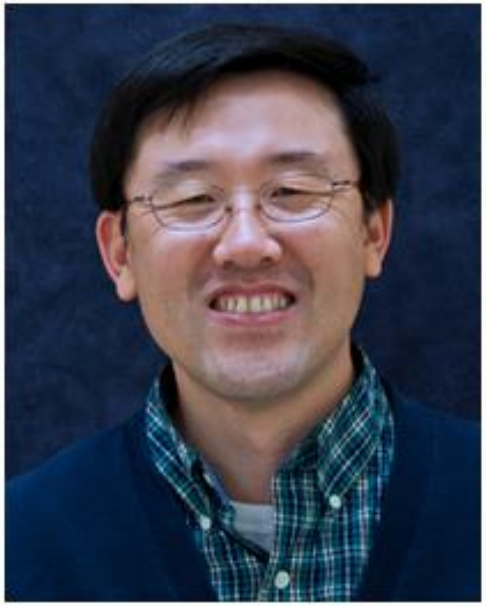
Aerial Survey and Management of Invasive Pests

Using Aerospace and Geospatial Technologies

Yong-Lak Park and Srik Gururajan

West Virginia University



Yong-Lak Park, Ph.D.

Associate Professor of Entomology

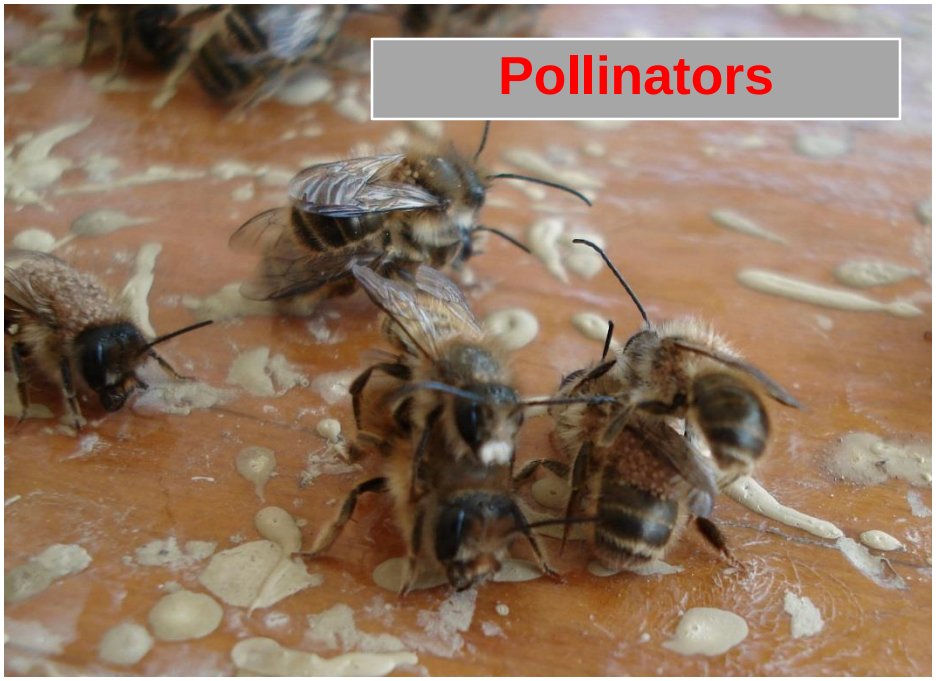
Mailing Address:

Division of Plant & Soil Sciences

1090 Agricultural Sciences Bldg

P.O. Box 6108


Stink bug

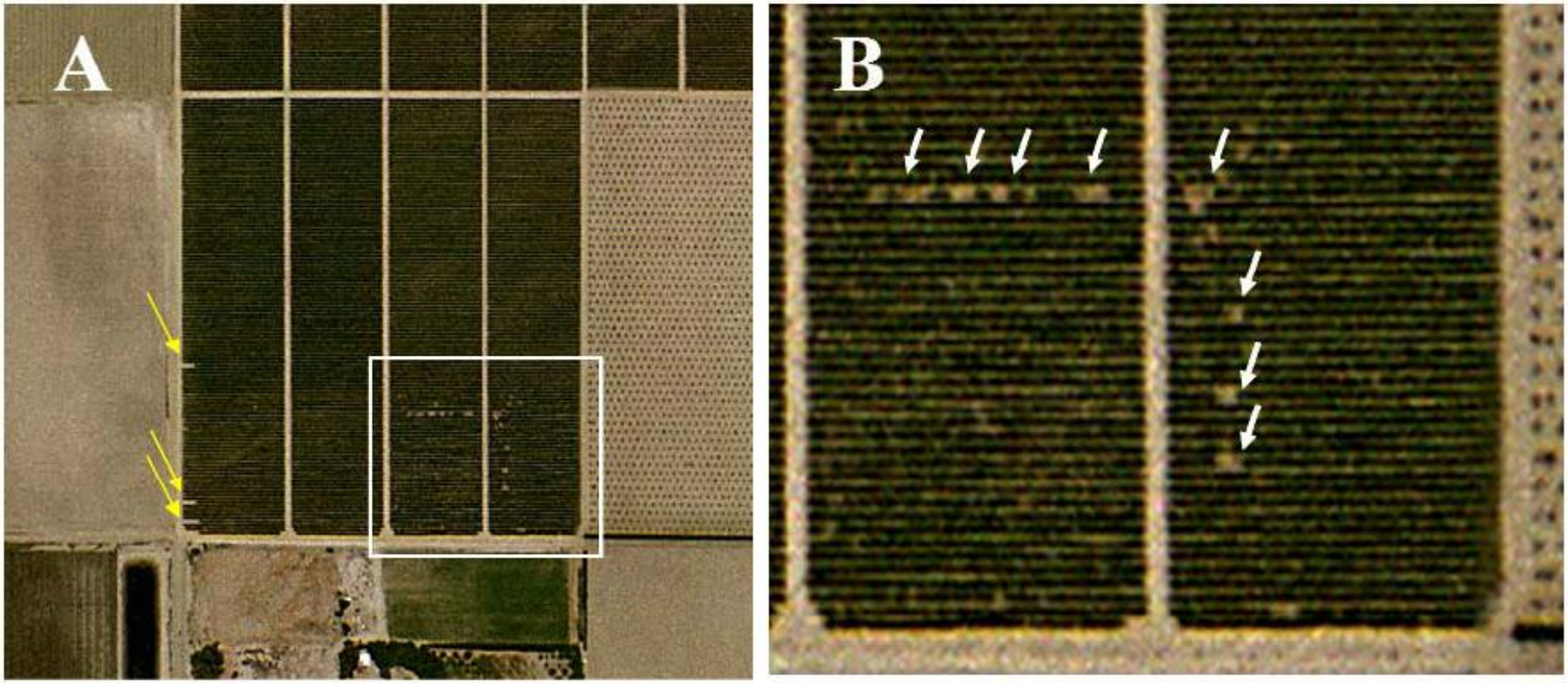

Pollinators


Forest pest management


Aerial survey

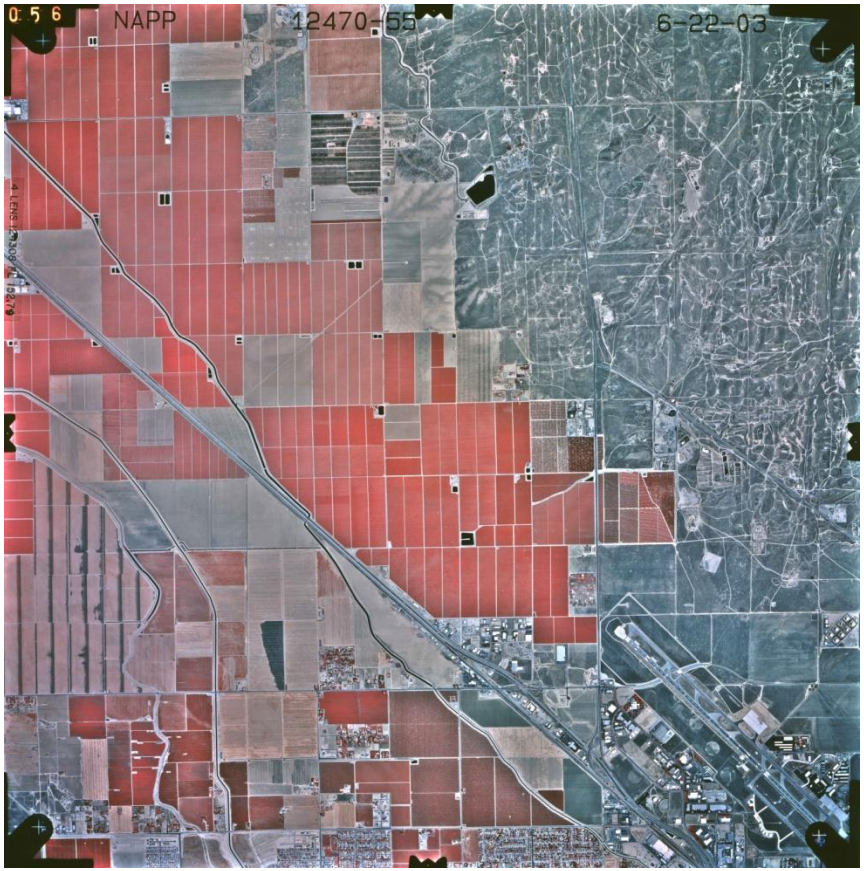
Remote Sensing with Satellites

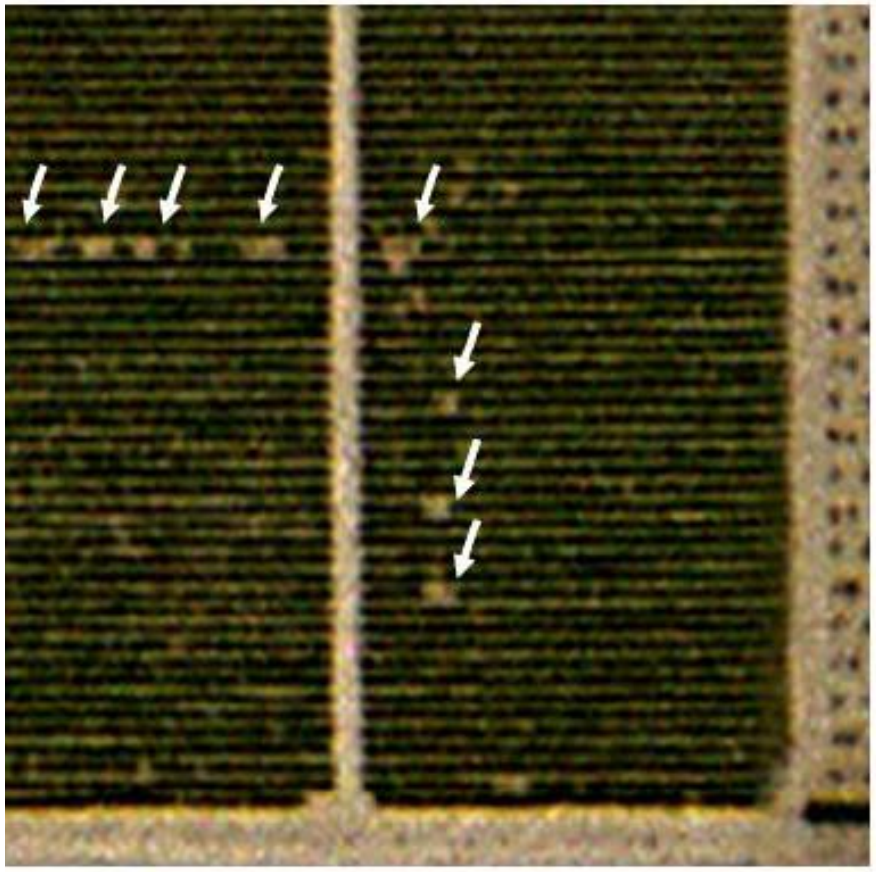
Remote Sensing with Airplanes



Remote Sensing

Real time?





Images may be outdated

Sometimes, We Need…

Surveying real-time

Acquiring high-resolution images

Covering large areas in a short period

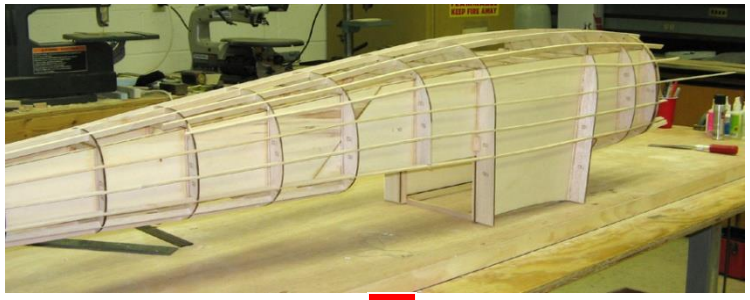
Monitoring hard-to-reach areas

→ **Use of Unmanned Aerial Vehicle (UAV)**

Unmanned Aerial Vehicle (UAV)

No on-board pilot!
Light, Cheap, Safe, and Easy to Control

Aerospace Engineering at WVU



UAVs at West Virginia University

Common UAV Systems

Sensor module

- Digital photography
- Digital videography

Data module

- Black box
- GPS

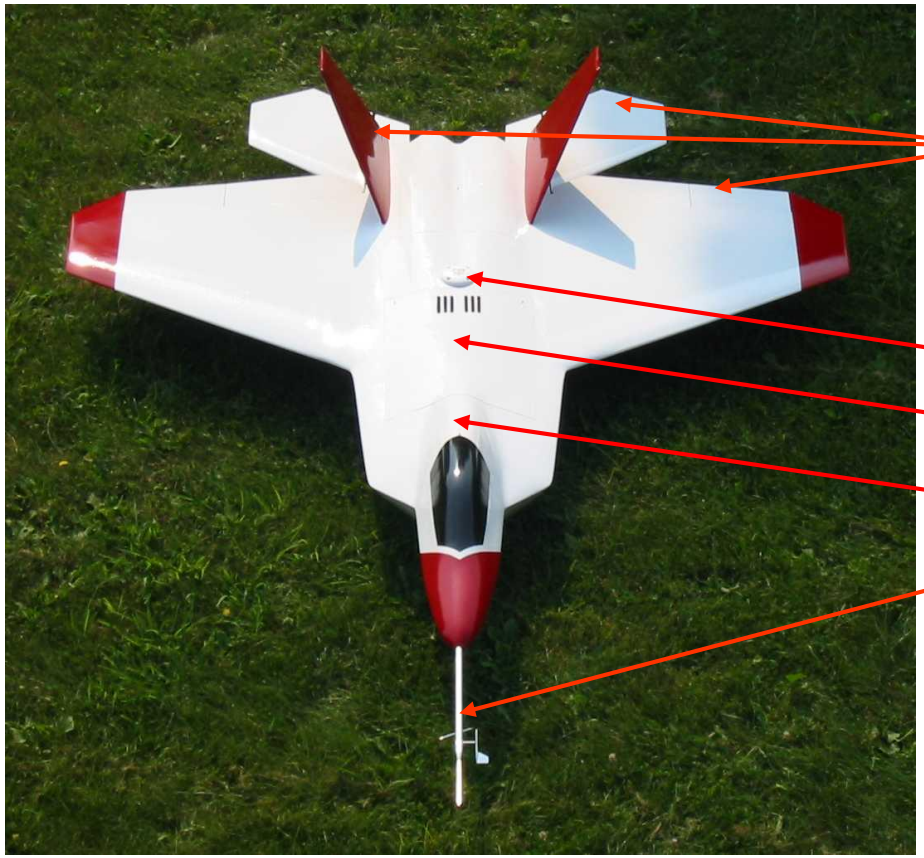
Other modules

- Can be added

Example UAV: Jet

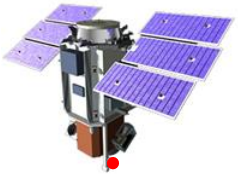
Specification

- Length: 8 ft, Wing span: 6.5 ft, Payload: 12 lbs,
- Speed: max. 150 mph



Autonomous UAV

GPS-based



Take picture

Spray pesticide

No ground pilot

2007

Preliminary Remote Sensing Using UAVs

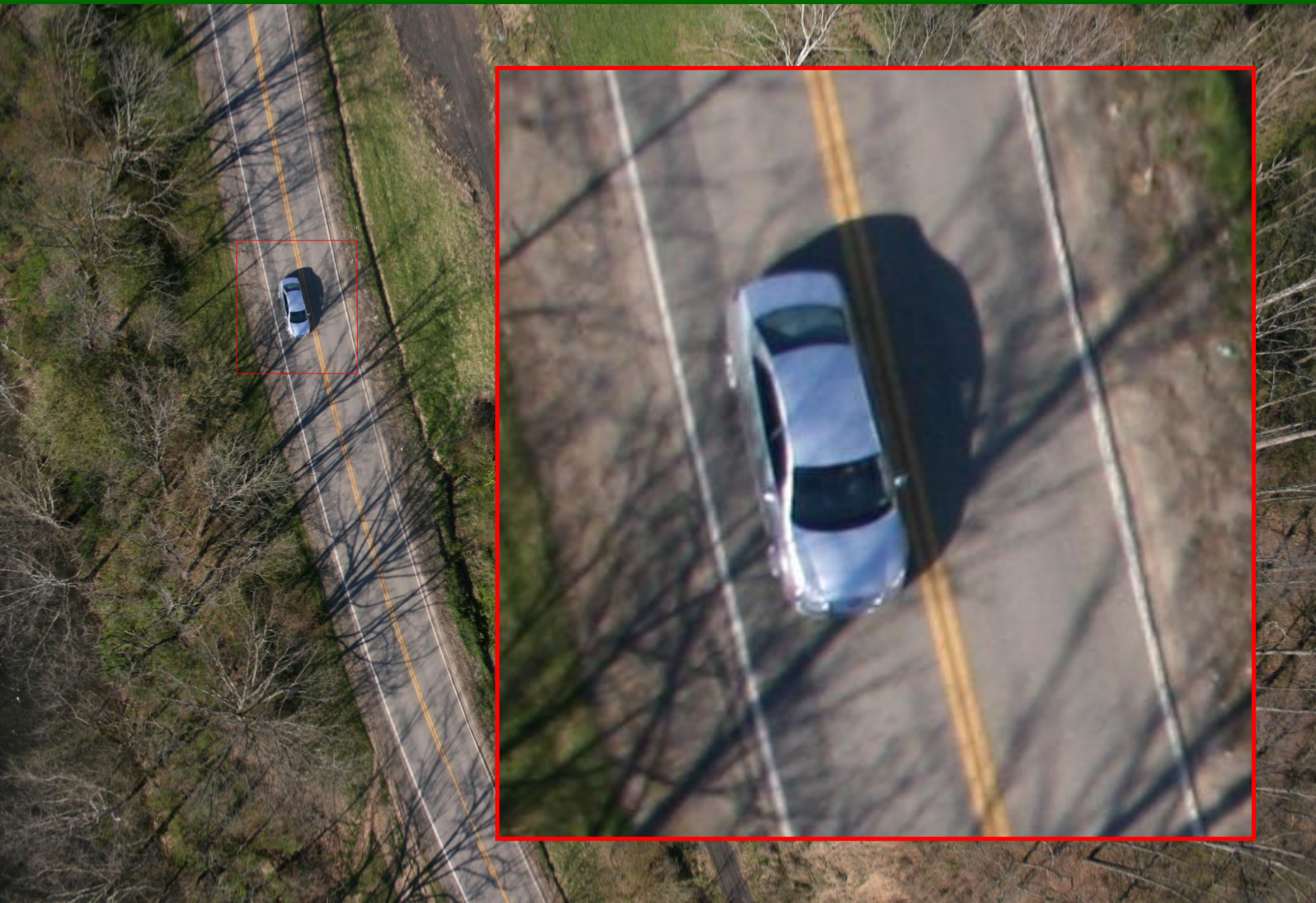
Jane Lew, West Virginia

UAV for Aerial Photography

- Specification
  - Material: Styrofoam
  - Payload: 15 lbs
  - Length: 6 ft
  - Wing span: 5 ft
  - Max. speed: 60 mph

Images taken by UAVs

Images taken by UAVs



Images taken by UAVs

2008-2009

Detection of Pests in Vineyards

Central Valley, California

UAV for California Experiment

Digital Still Camera

- Canon Rebel XT
  - 10 MP
  - 55 mm lens
  - Remote Operation

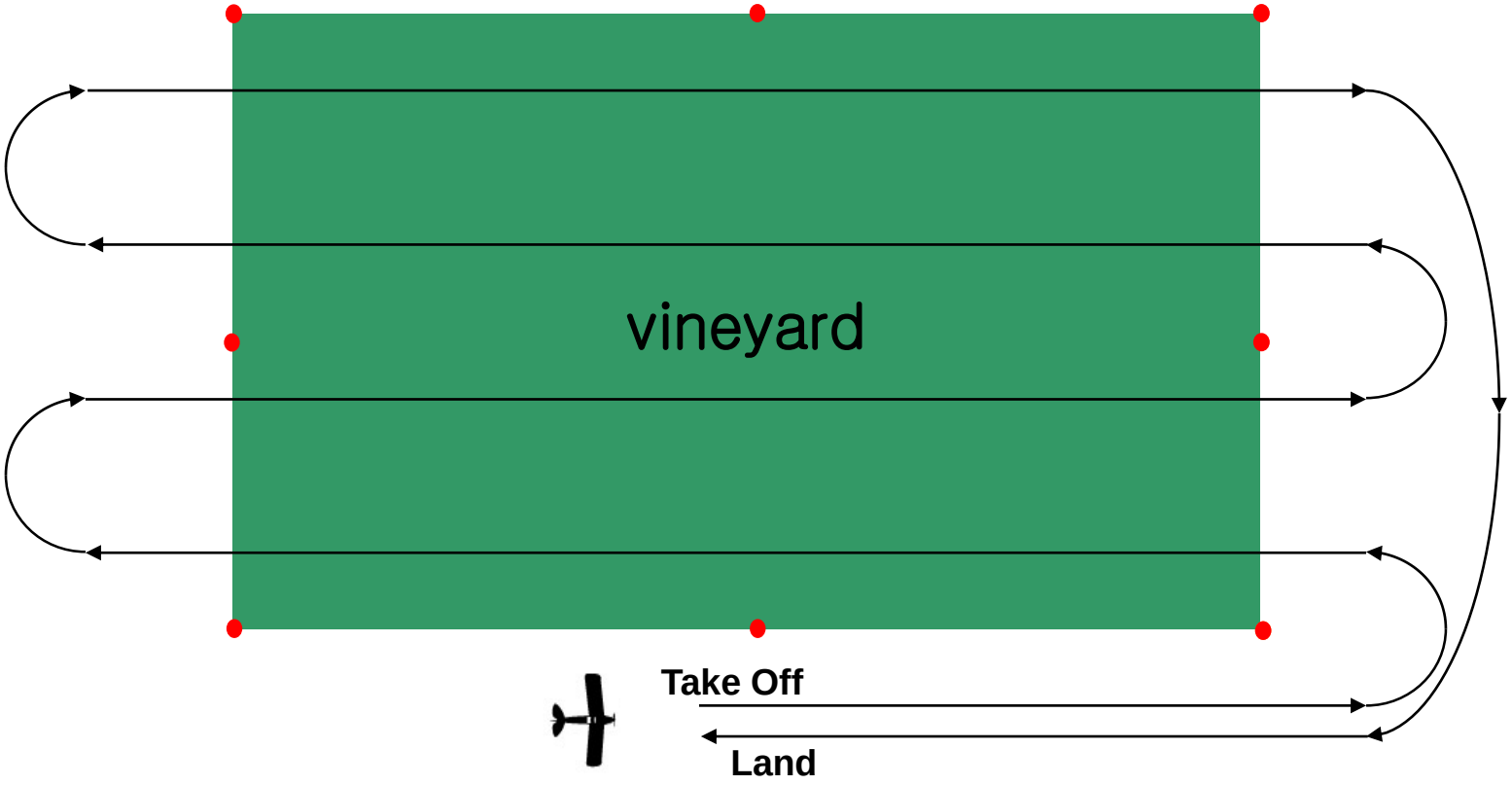
Data Recorder

- Eagletree Systems
  - Black box
- GPS

Shipping UAVs from WV to CA

Flight Preparation

UAV Operations



- GPS coordinates of field landmarks

UAV flight path tracked by GPS

In-Field Coordination

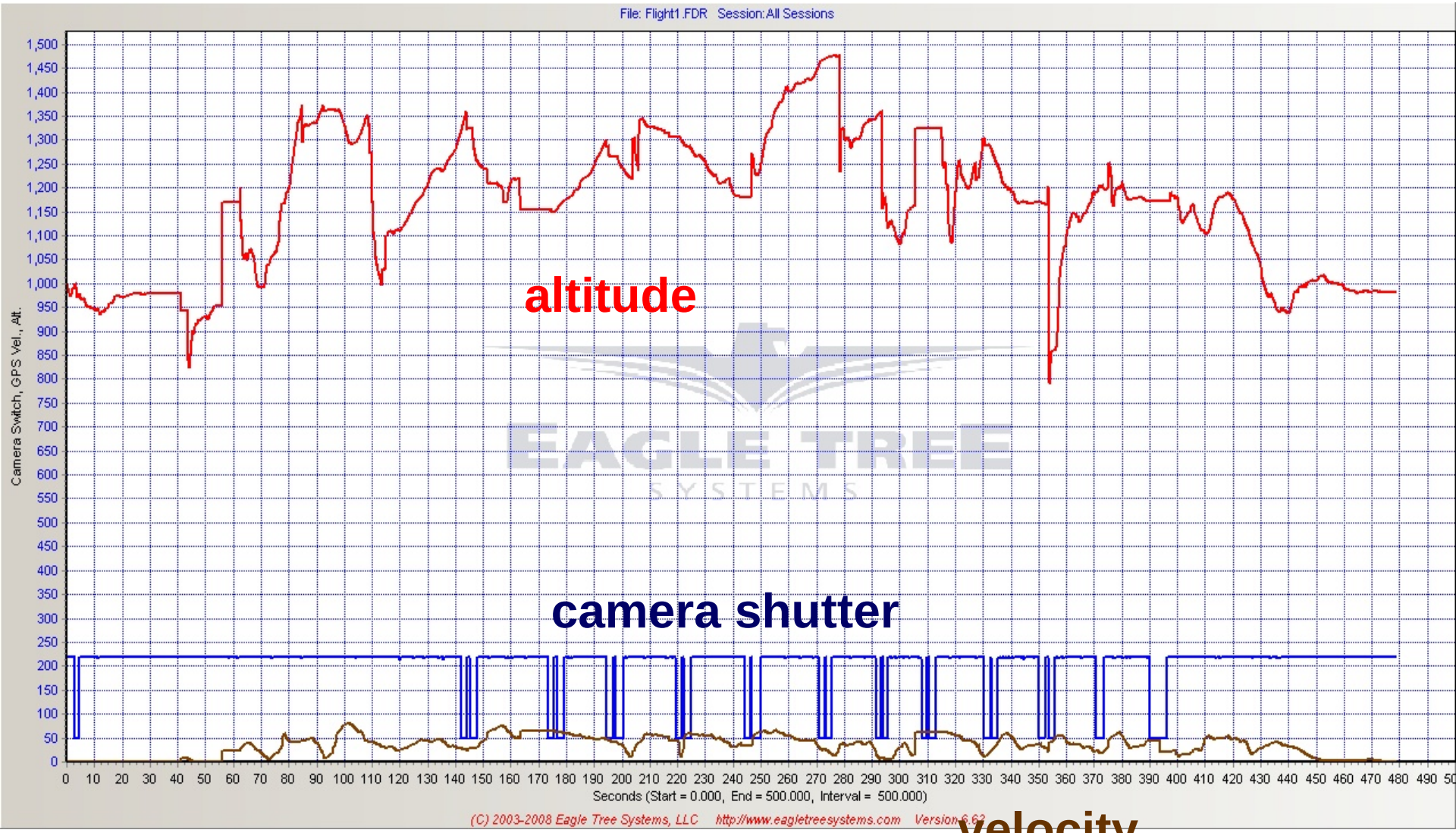
UVA Flight

UVA Flight

UVA Flight

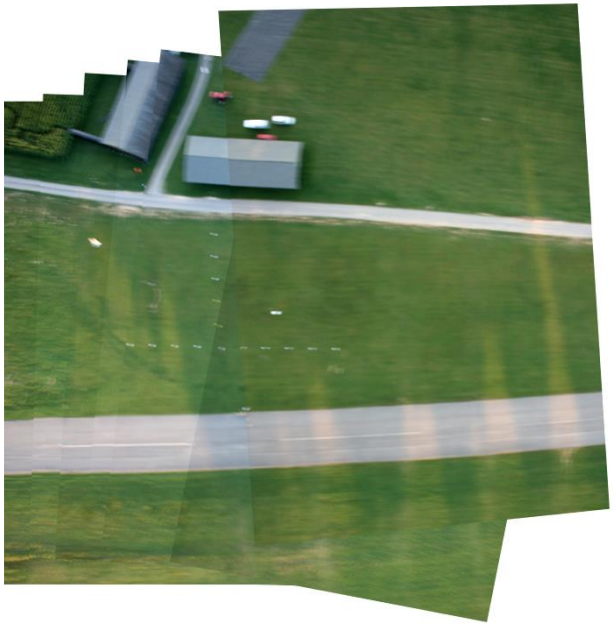
UVA Flight

UAV Flight Record



time

Image Stitching to Produce Composite Image

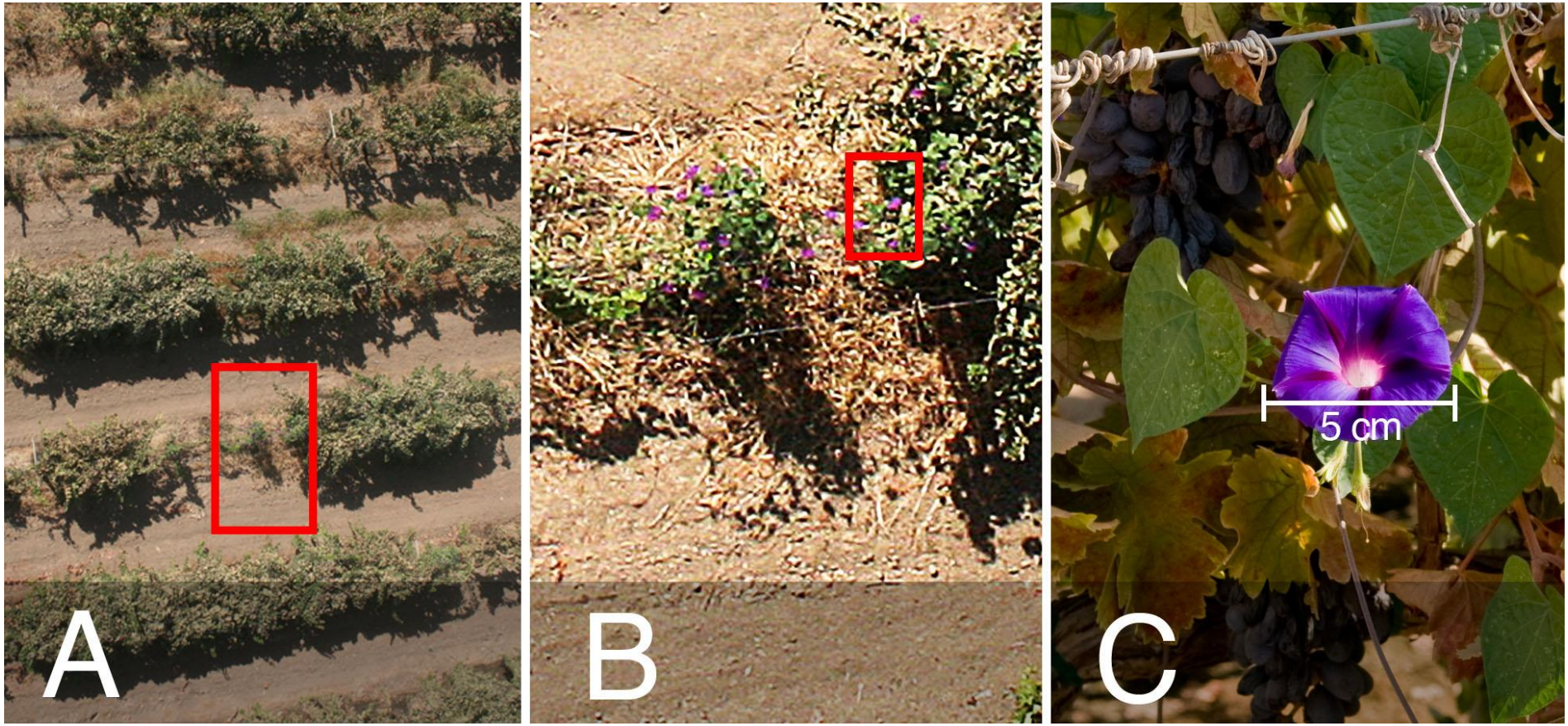


Aerial Image Taken by UAV

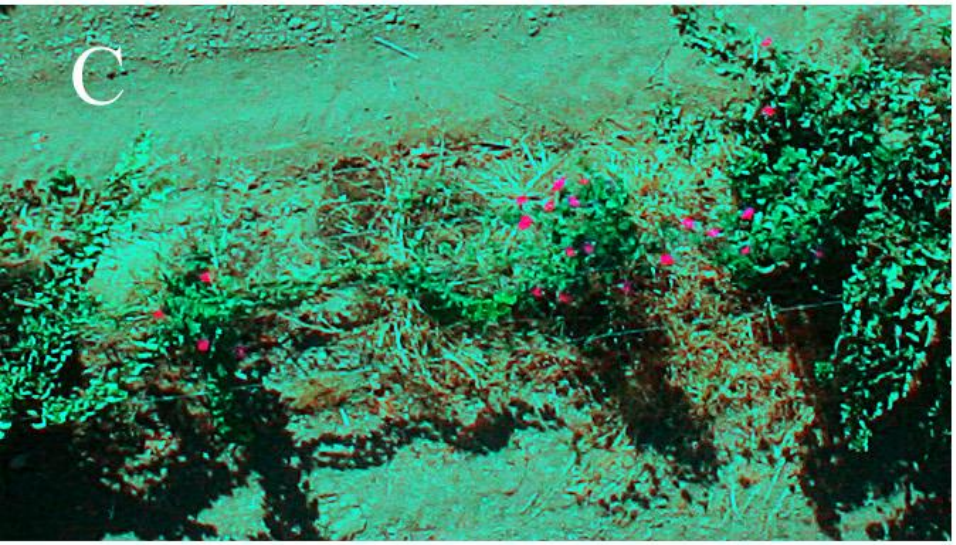
Aerial Image Taken by UAV

Composite Aerial Images

Detecting Weeds (Flowers)?



Automated Detection with Image Analysis



UAV Crash

UAV Crash

2010

Detection of Insects on the Ground

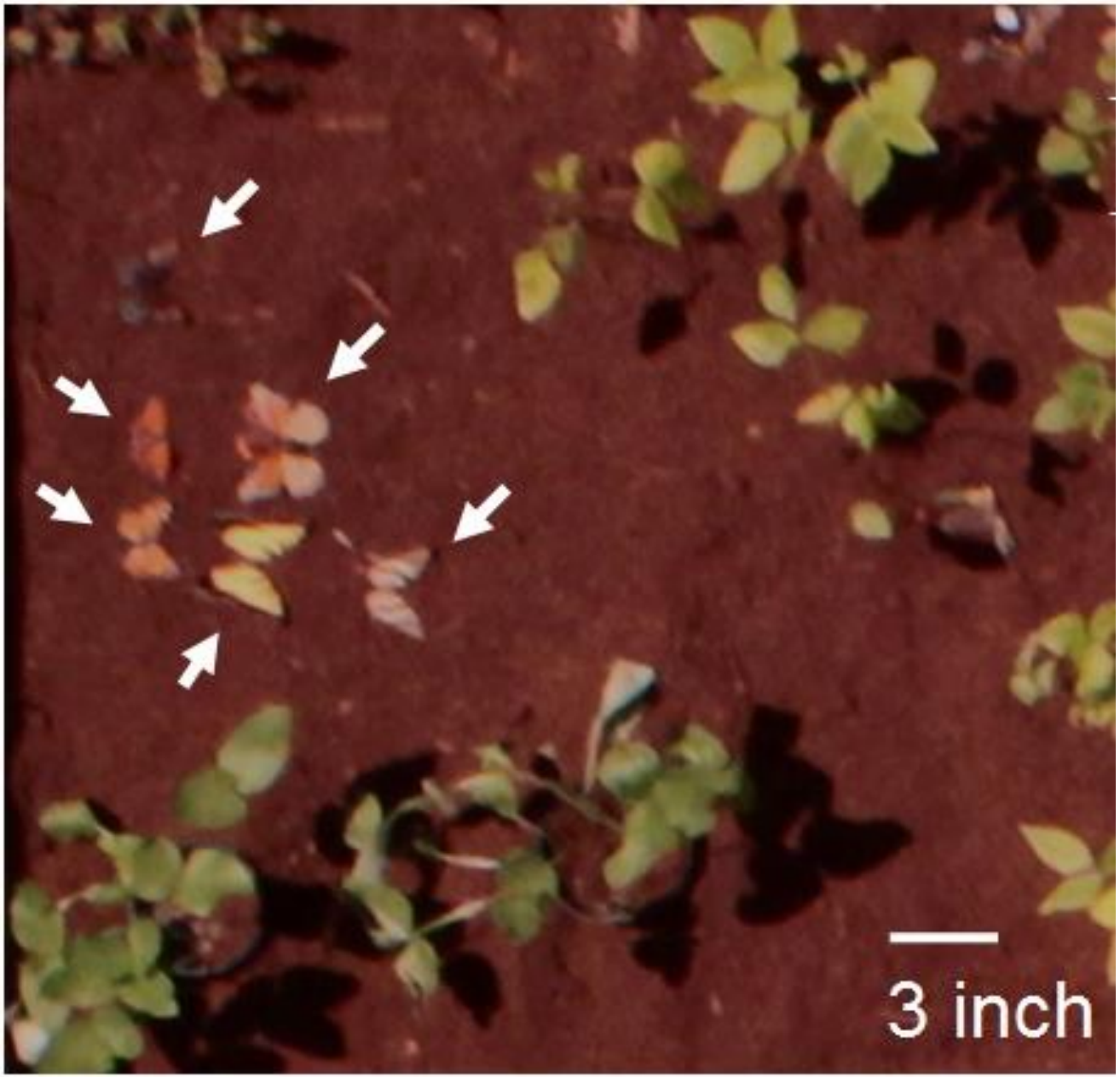
Friendship Hill, Pennsylvania

Detecting Insects?

Detecting Insects?

Detecting Insects?

Detecting Insects on the Ground

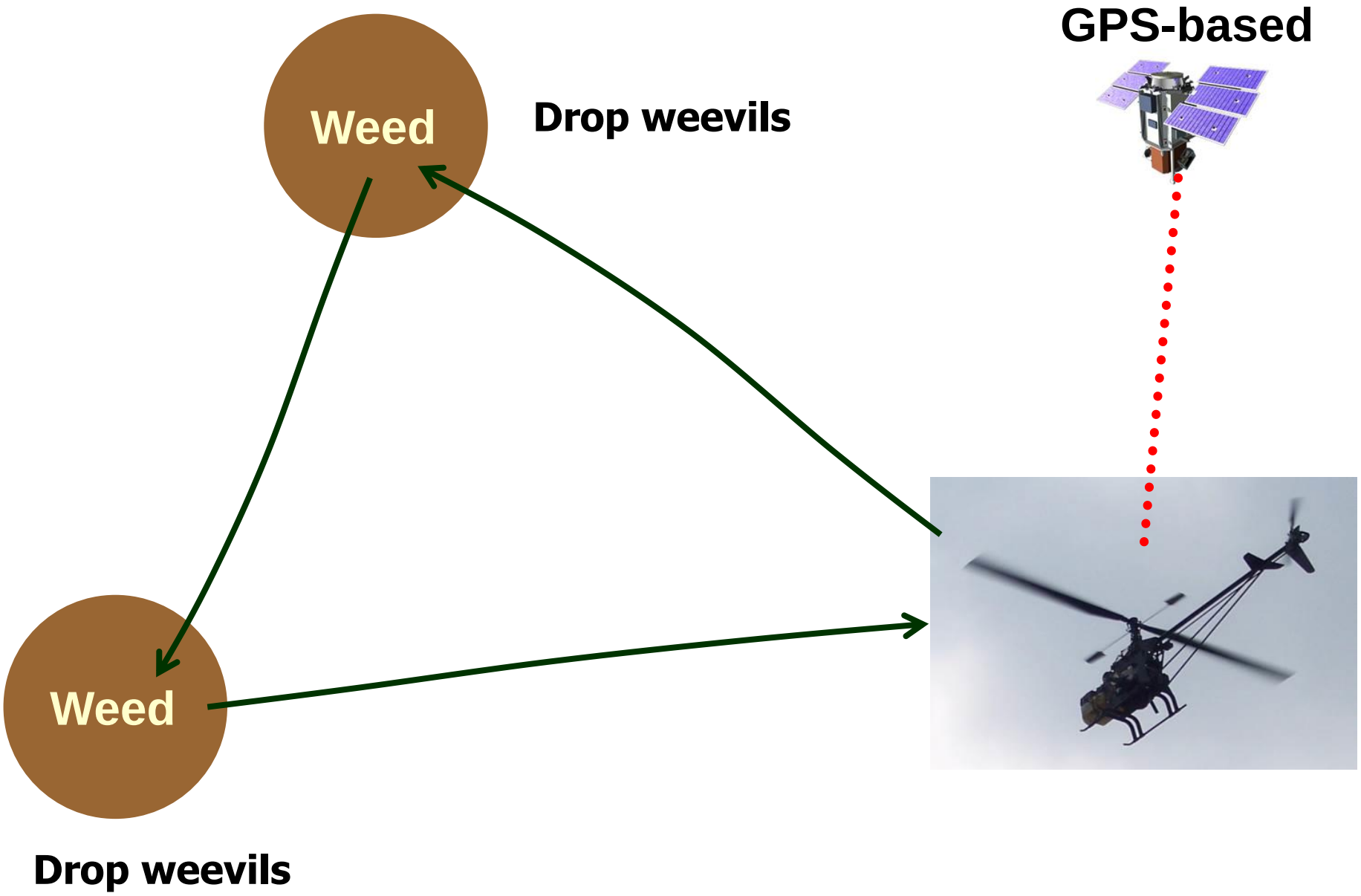


2011-2014

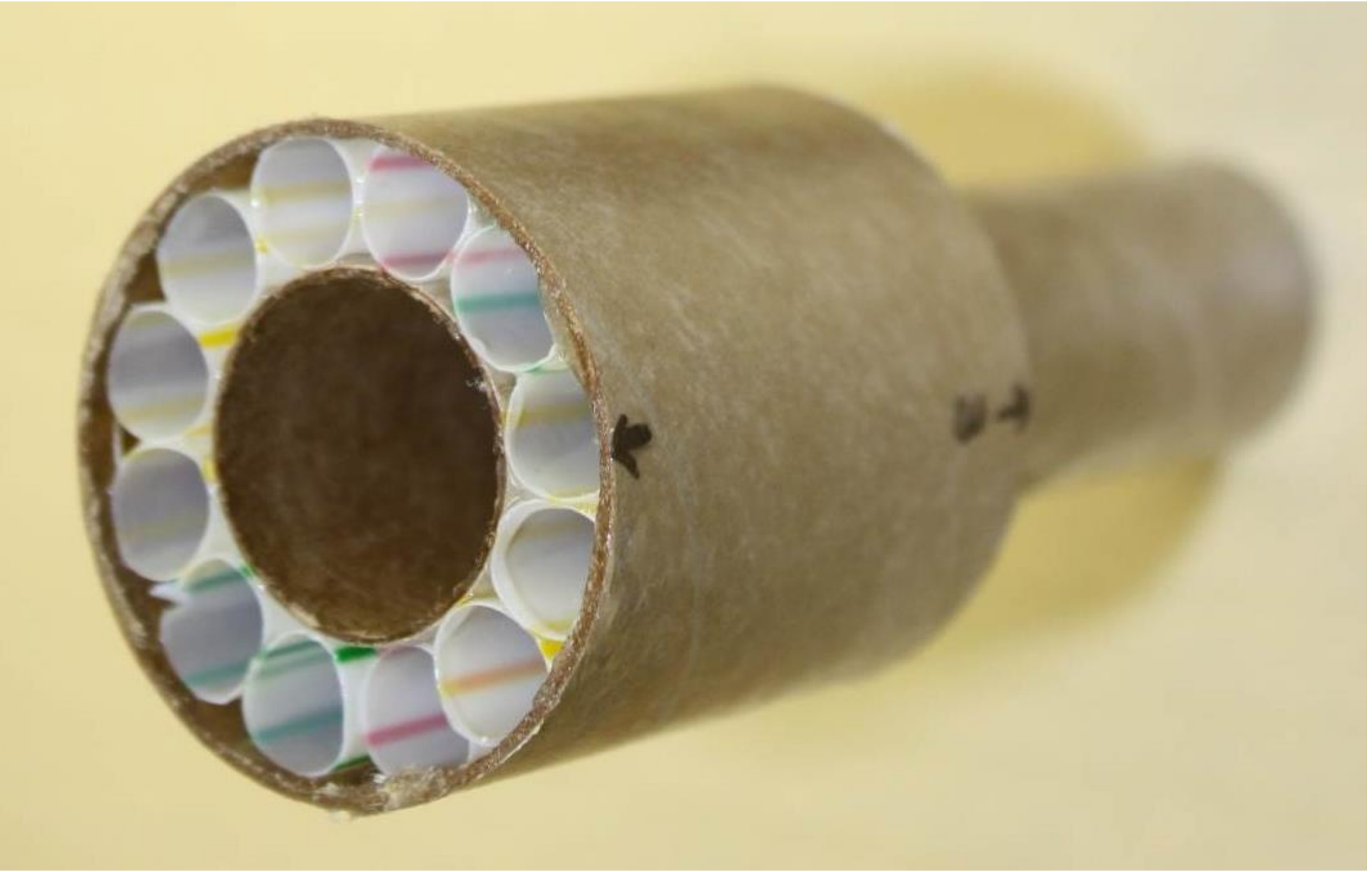
Aerial Delivery of Natural Enemies

Waynesburg, Pennsylvania

Autonomous UAV for Releasing Weevils



Development of Bug-Bomb

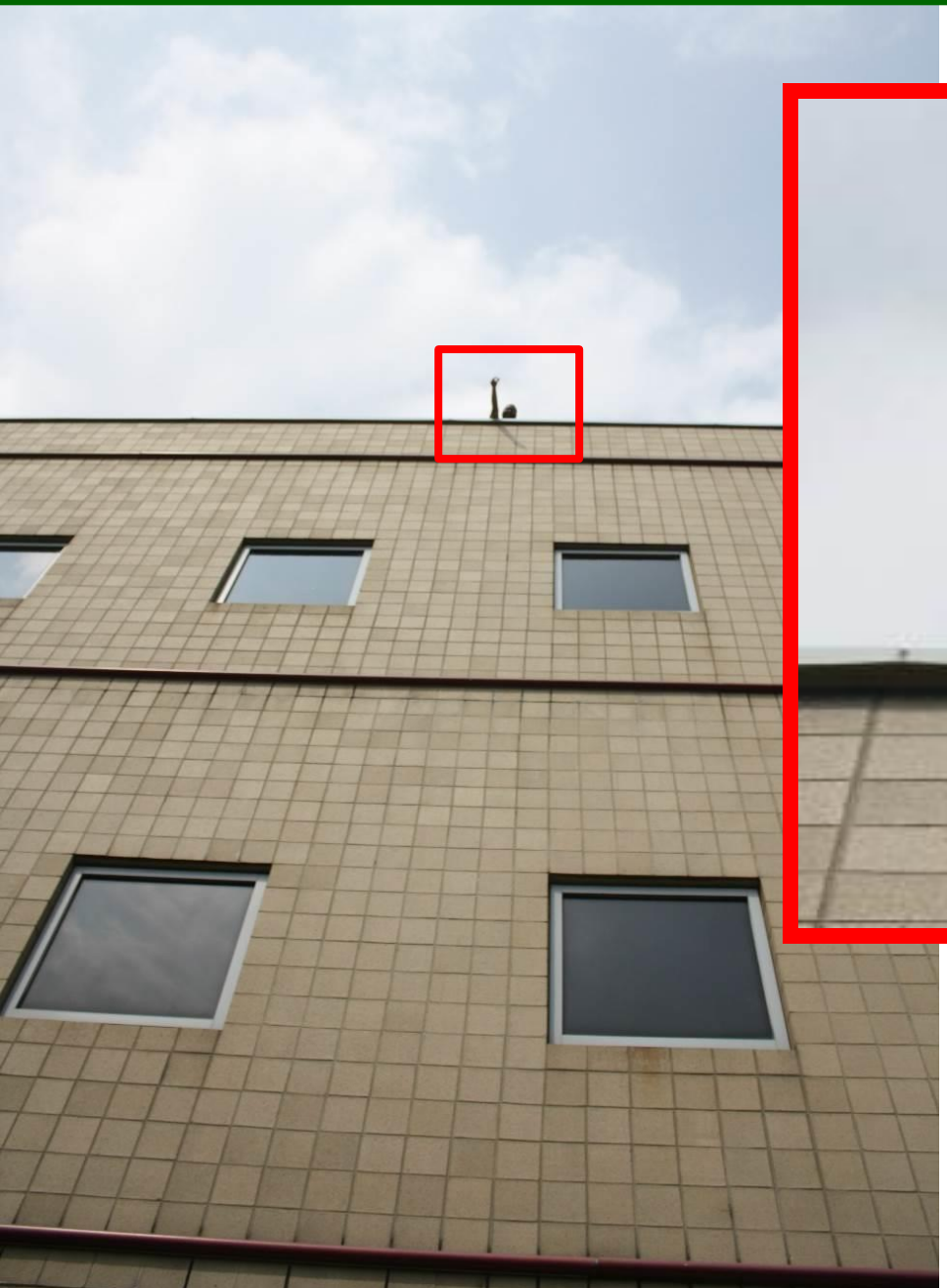


Development of Bug-Bomb

Development of Bug-Bomb

Development of Bug-Bomb

Bug-Bomb Preliminary Study

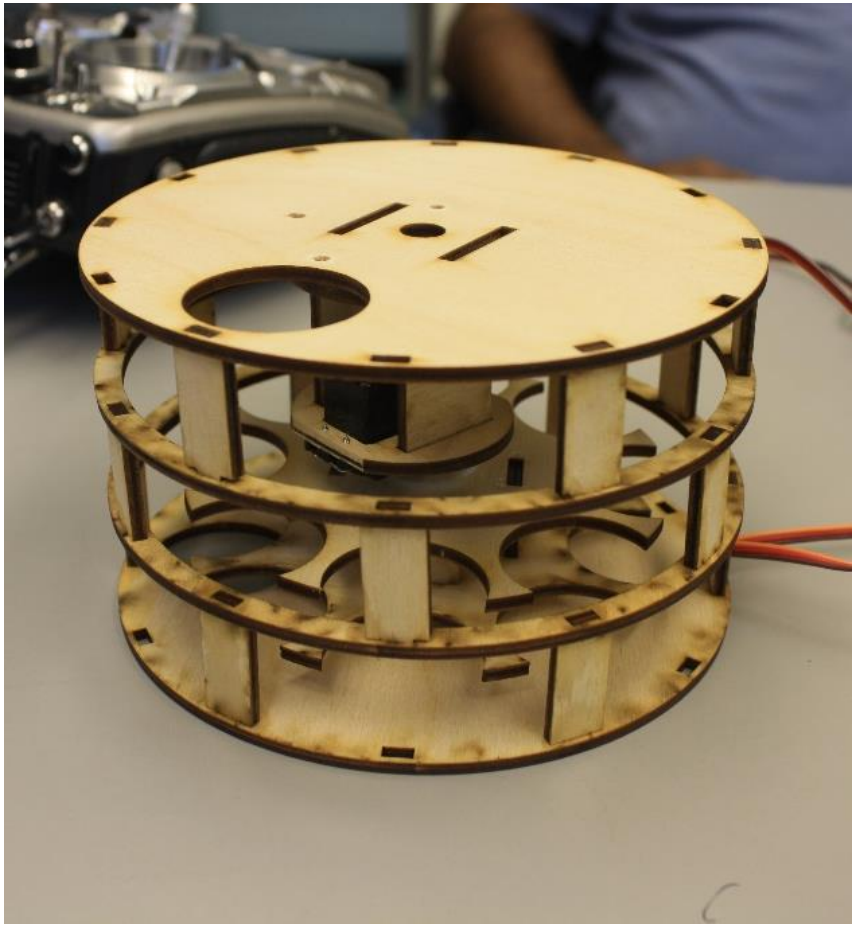


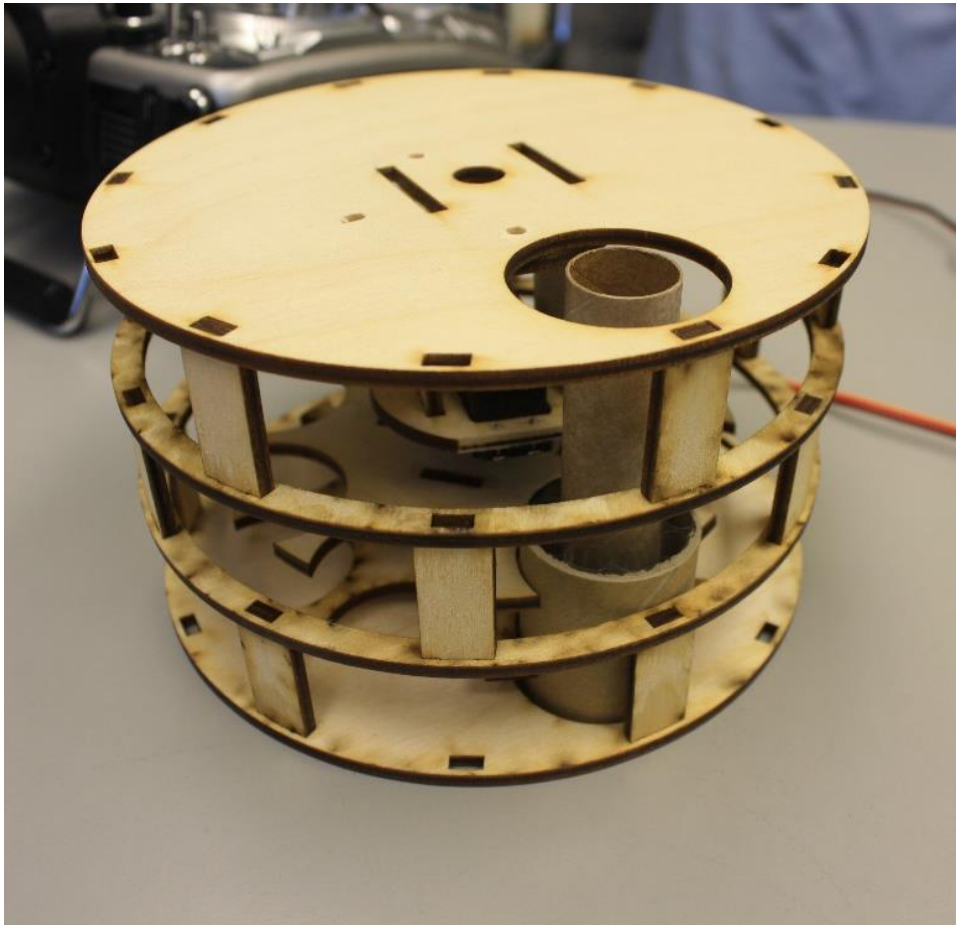
Bug-Bomb Preliminary Study

Bug-Bomb Preliminary Study

Treatment (20 m drop)	Mortality just after release	Mortality 3 wk after release
Free drop (n=20 initially and recovered n=12)	**23.1%**	**46.1%**
Drop in a bomb (n=10)	**10%**	**10%**
No drop (control) (n=10)	**0%**	**10%**

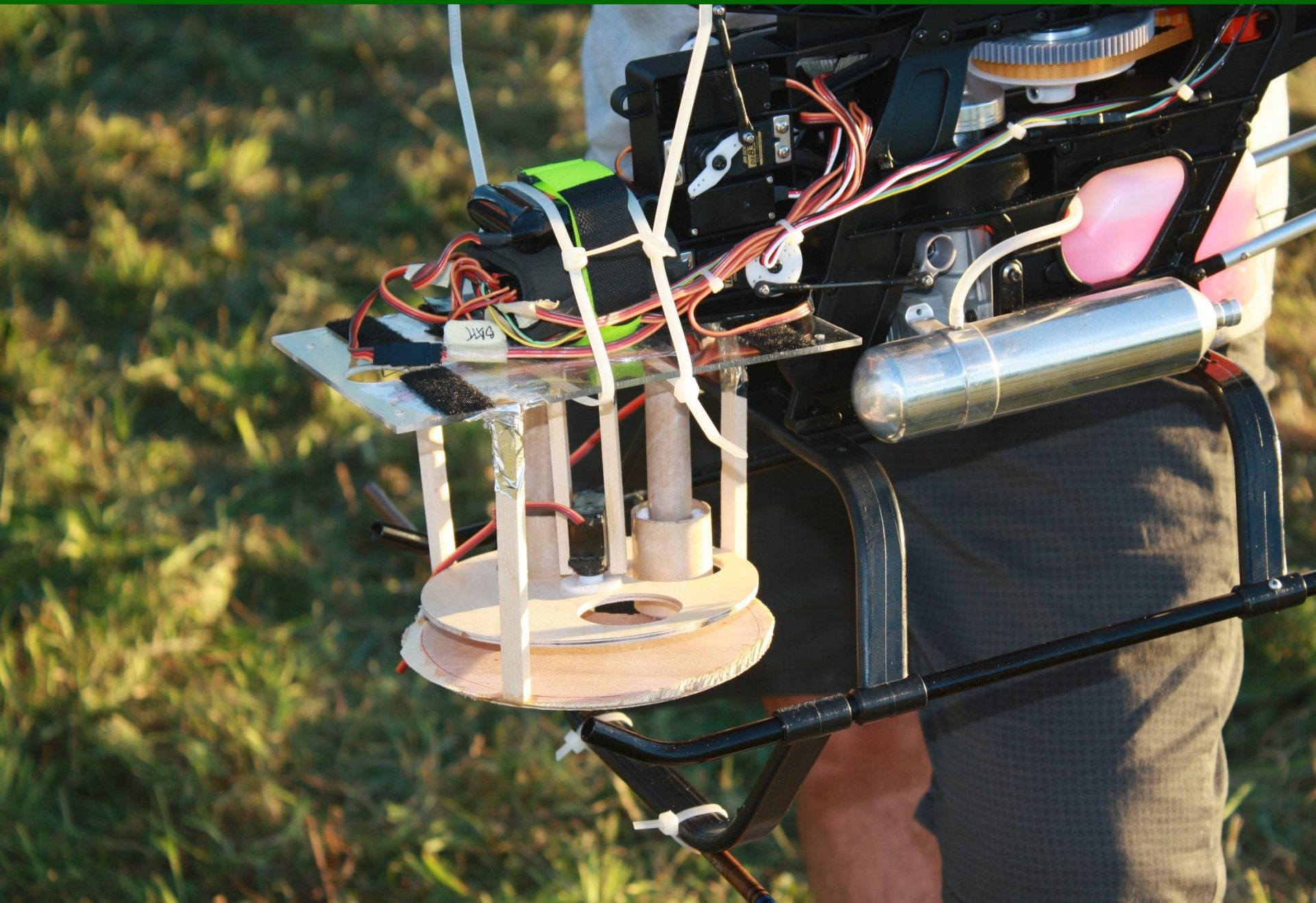
Bug-Bomb Dispenser



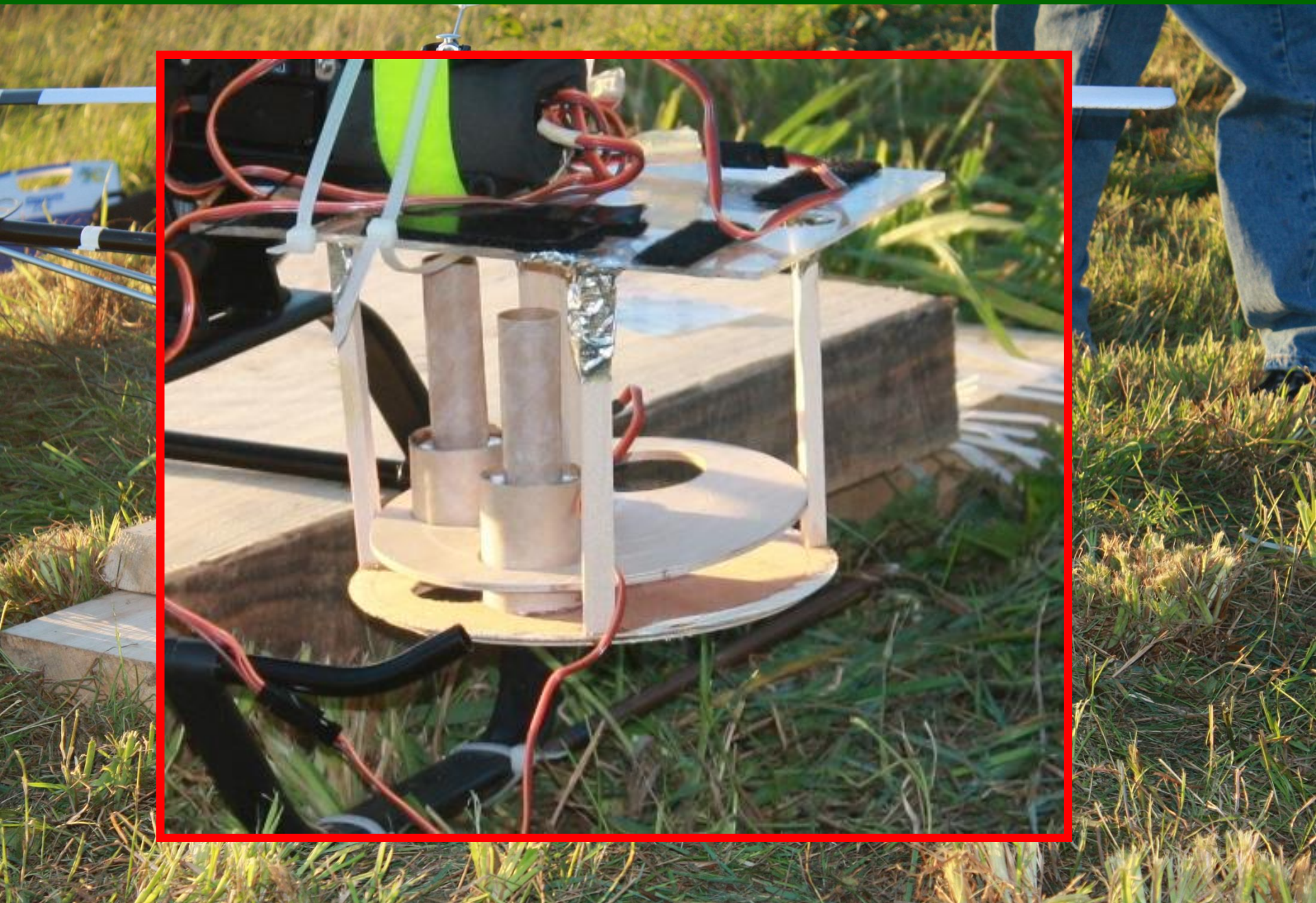


Field Validation

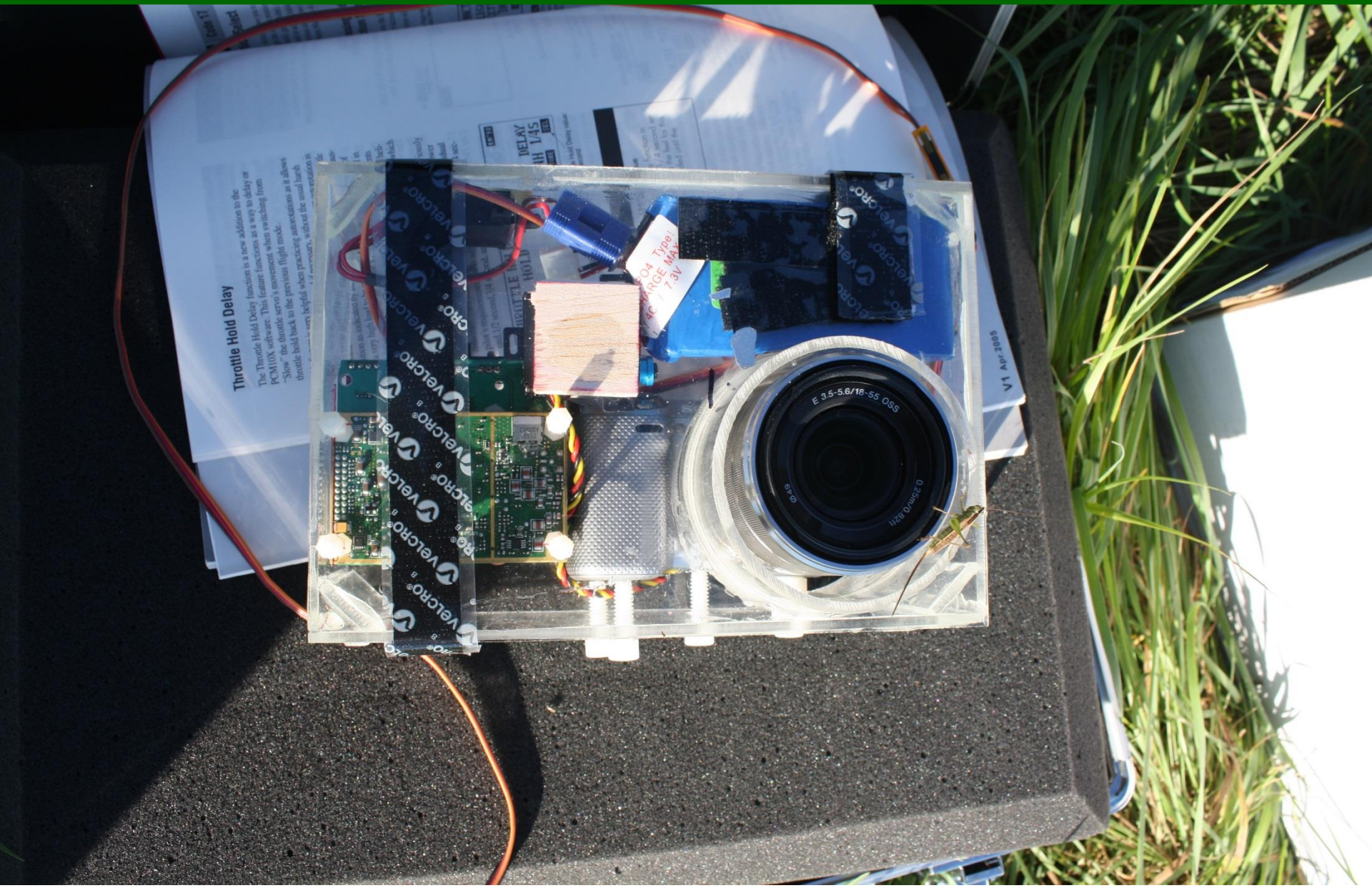
Bug-Bomb Dispenser



UAV Equipped with Bug-Bomb Dispenser



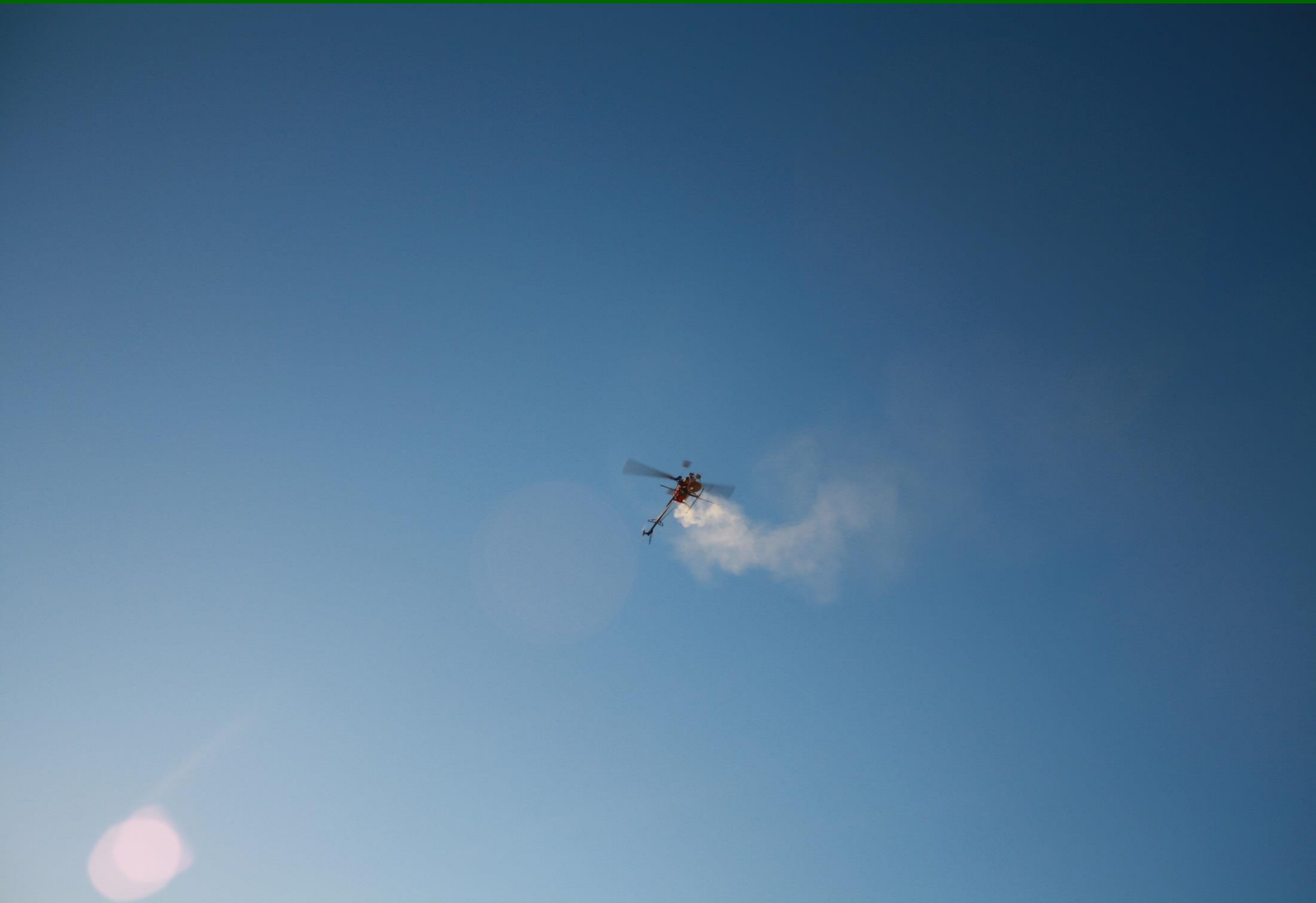
UAV Equipped with Camera System



UAV Equipped with GPS

Fueling UAV

UAV Flight



The First and Last Image from UAV

UAV for Pest Monitoring

Advantage of using UAVs

- Light
- Cheap
- Safe
- Excellent maneuverability

UAVs for pest monitoring

- Pests in hard-to-reach areas
- Providing high-resolution images
- Autonomous flight with planned flight path

Funding Sources

United States Department of Agriculture

United States Forest Service

West Virginia University

- PSCoR Stimulus Fund

- Environmental Research Center