# PRECISION AGRICULTURE TECHNOLOGIES FOR WILD BLUEBERRY

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Nova Scotia Agricultural College

**Farm Meeting – Farming To Maximize Crop**
**February 2nd, 2011**

OXFORD

# Outline

- Precision Agriculture Objectives
- Overview of Precision Agriculture Research
  (On-Going Projects)

- Site-Specific Fertilization

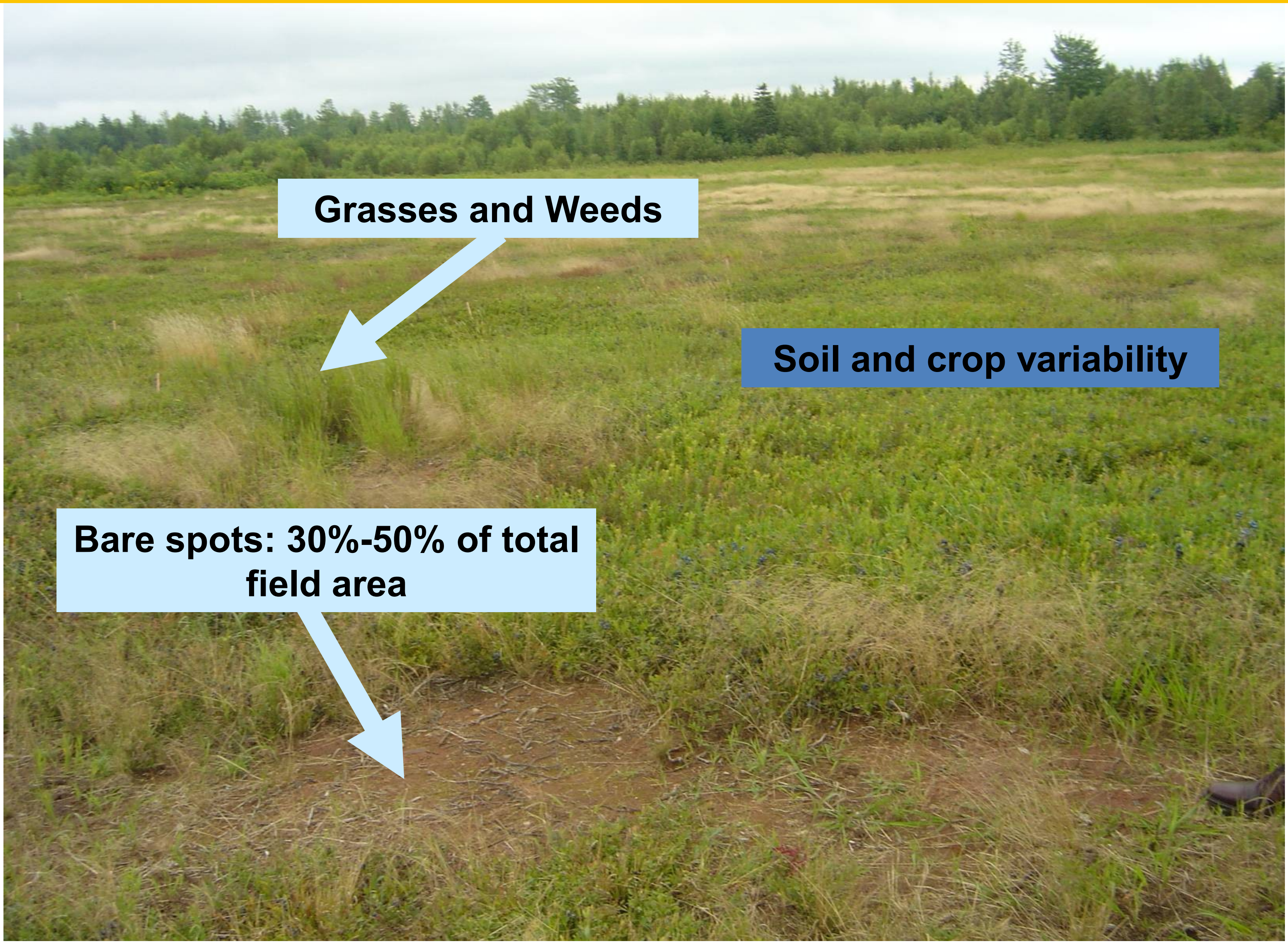
- Spot-Application of Pesticides

# Precision Agriculture (PA)

**PA covers a research area with the goal to optimize agricultural production systems in both time and spatial dimensions.**

**In practice, PA changes the way a farmer works**

# Wild Blueberry fields need to be managed site-specifically using Sensors, DGPS, Digital photography, GIS, VRT …..



# Objectives of Precision Agriculture

- Reduce the amounts of inputs required to grow crops = LOWER COST

- Increase the efficiency of agrochemical utilization by crops = LOWER ENVIRONMENTAL IMPACT

- Automate and log farm operations = DATA ANALYSIS, EFFICIENCY & CONVENIENCE

# Background of PARP and On-Going Research Projects

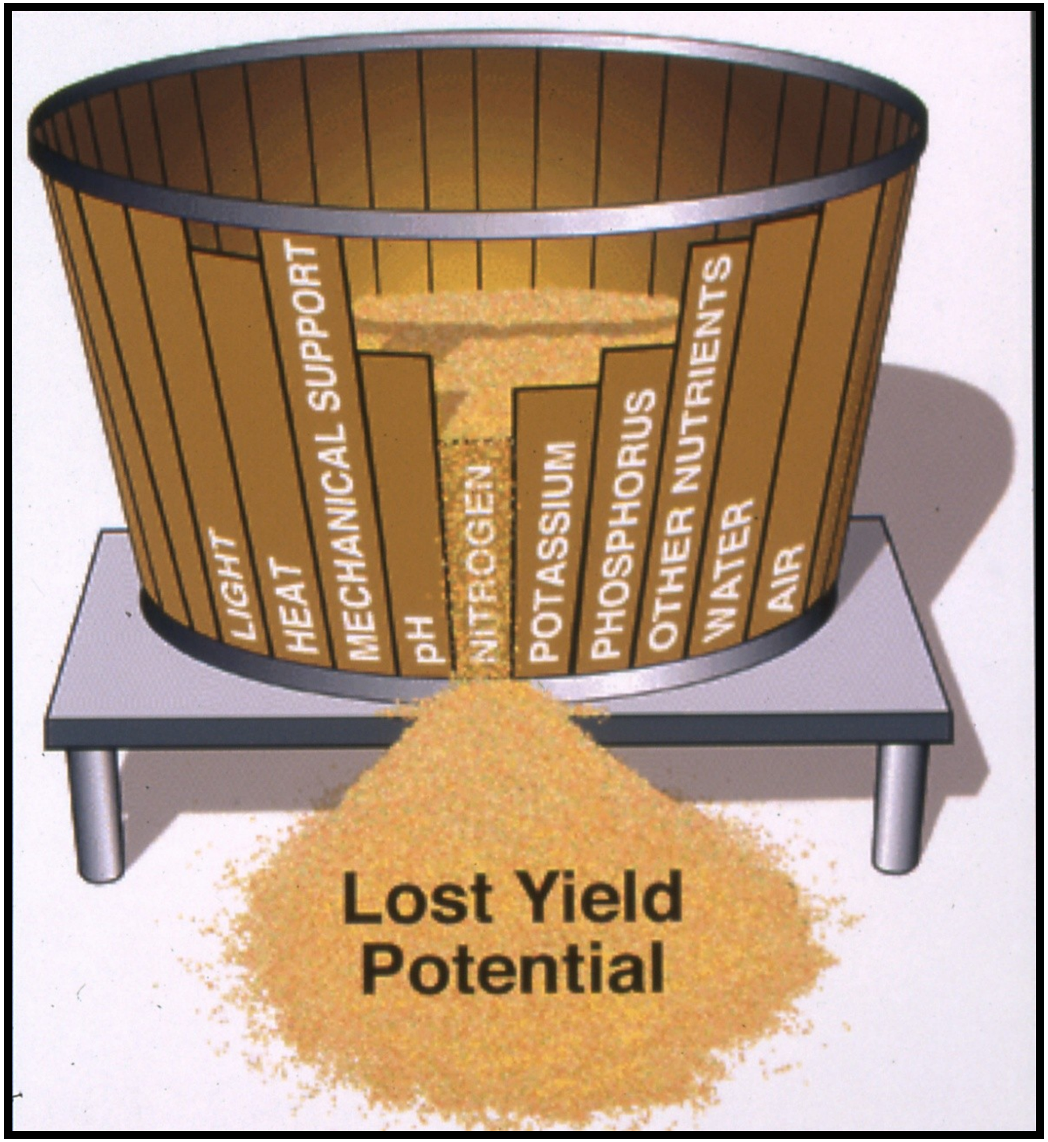
## PARP have been developing:

- Cost-Effective Automated Variable Rate Sprayer for Spot-Applications
- Automated Variable Rate Spreader for Site-Specific Fertilization
- Cost-Effective Automated Yield Monitoring System
- An Automated Slope Sensing System
- Cost-Effective Automated Machine Vision Systems to Map Bare Spot/Vegetation
- Site-specific Technologies using Electromagnetic Induction Methods
- Evaluate Environmental Impact of VR Technologies
- Assess the Cost/benefit of the New PA Systems

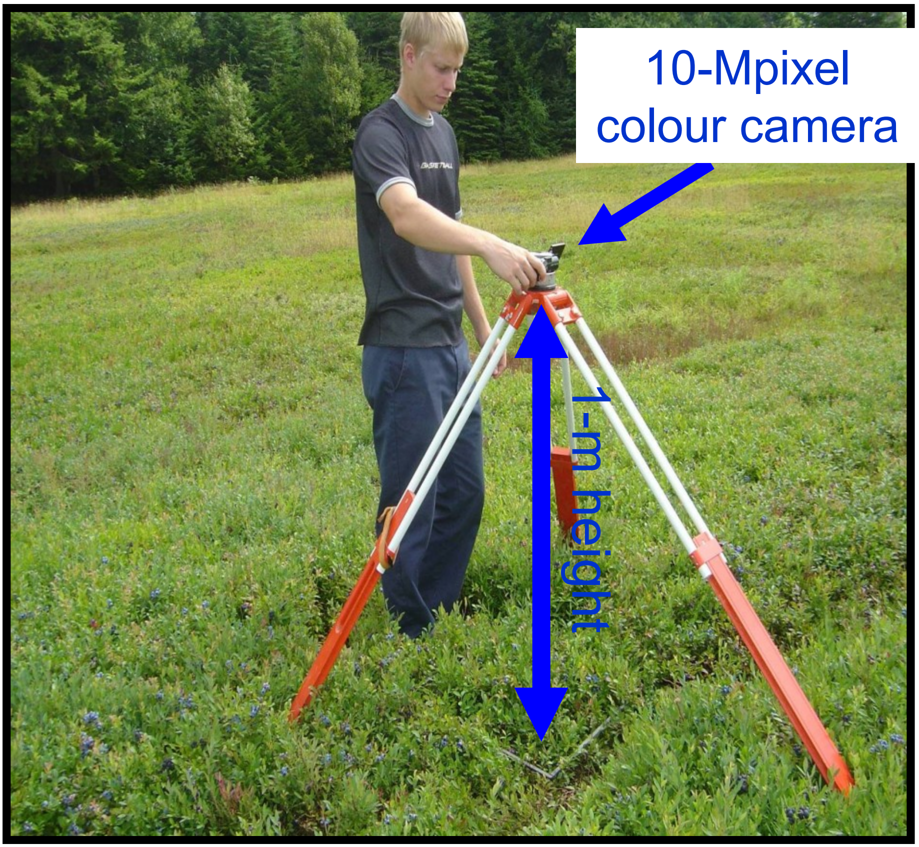
# Site-Specific Fertilization

# Limiting Factor Restricts Yields

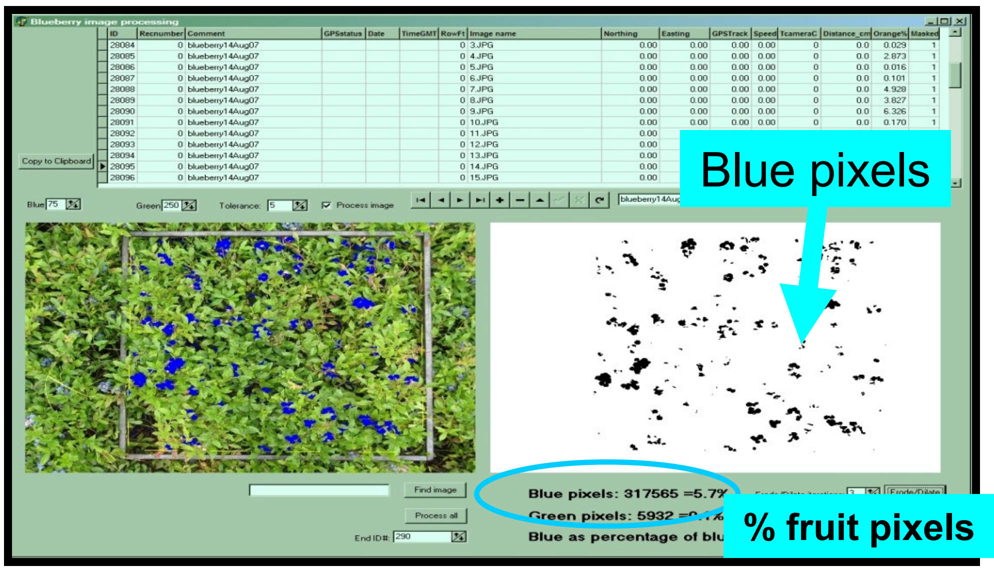
- **Find Limiting Factors**
- **Remove Their Restrictions**



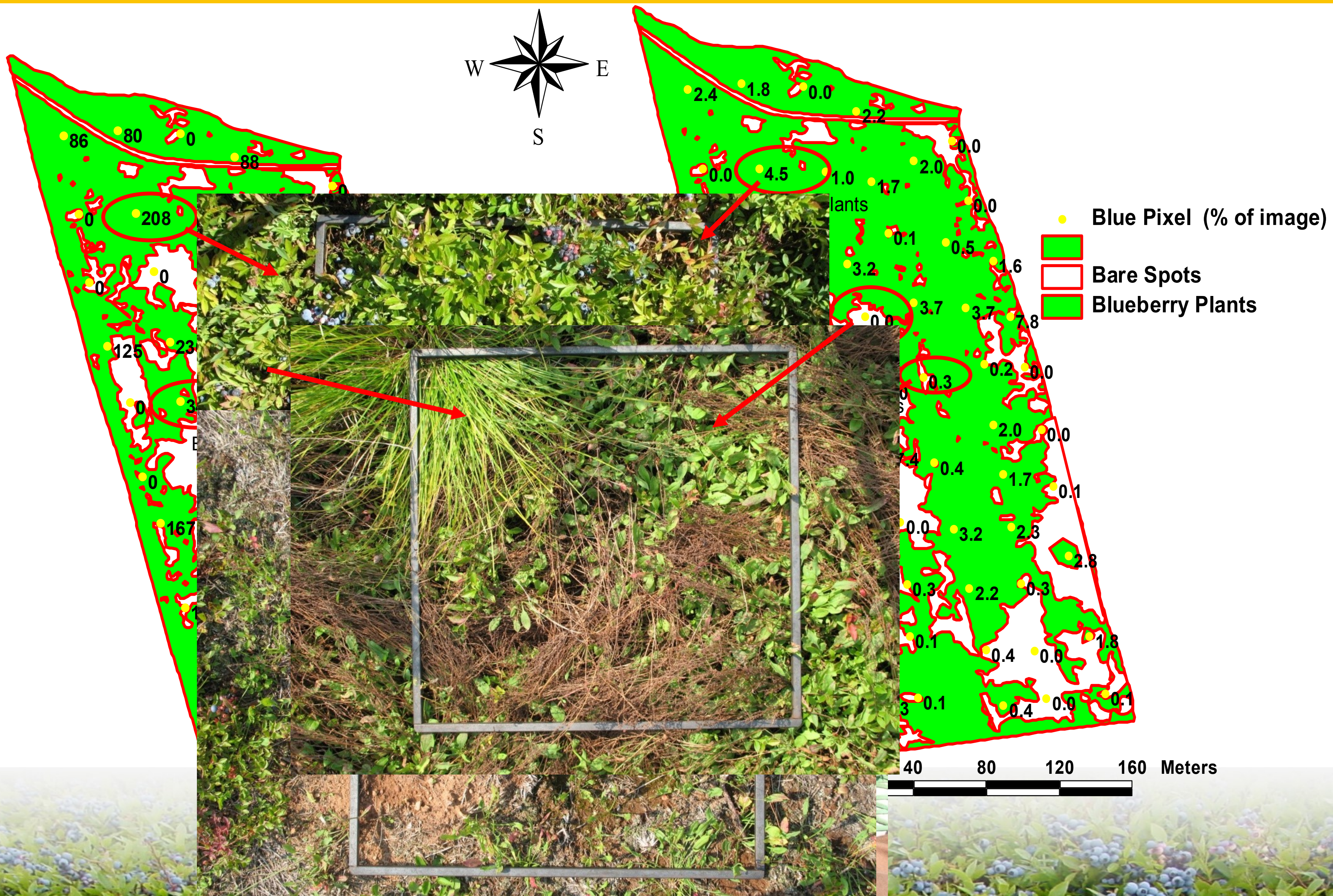
# Photographic Technique for Fruit Yield Estimation




## Custom Software



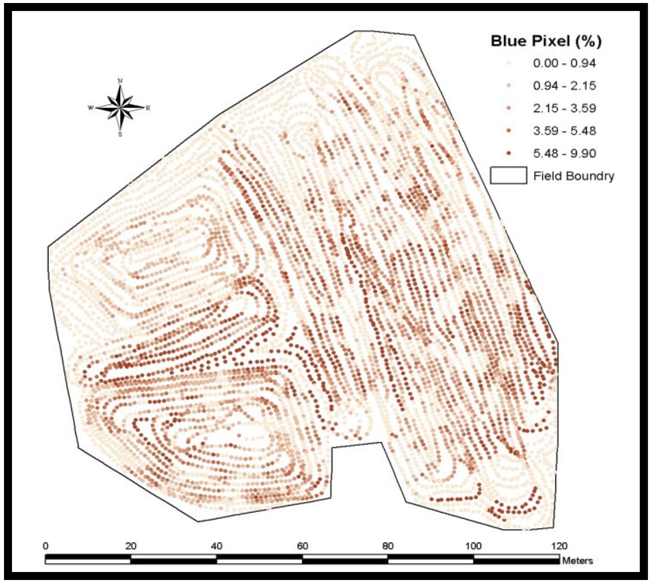
# Blue Pixels Ratio vs Fruit Yield



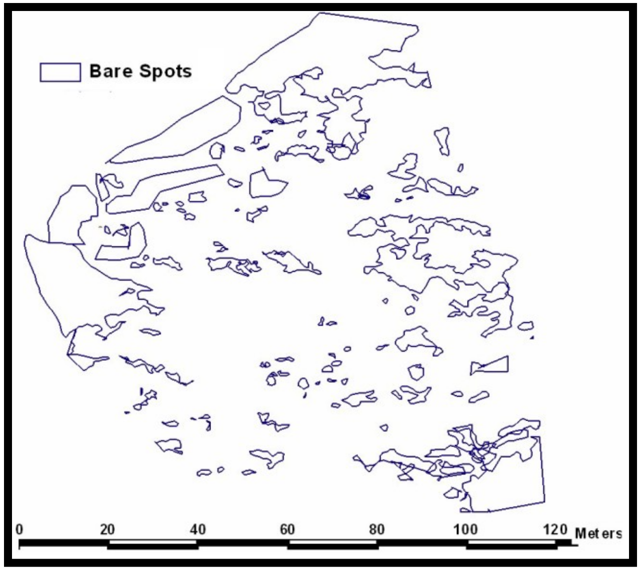
# Automated Real-Time Yield Monitoring System

# Fruit Yield and Bare Spot Map

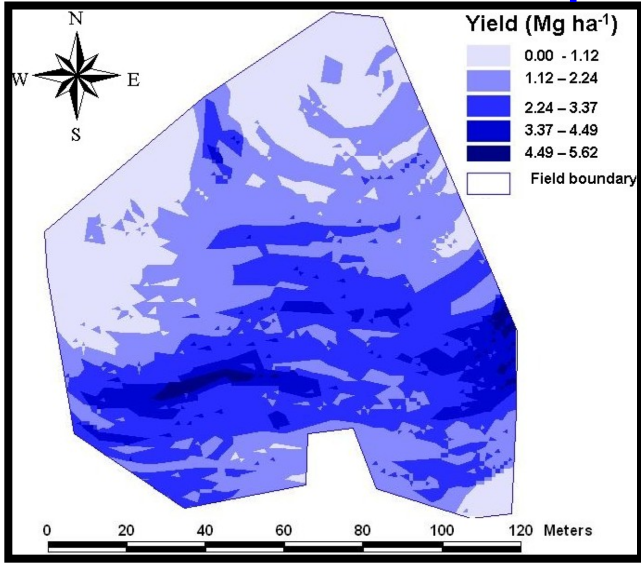
**Raw Data**




**Bare Spot Map**

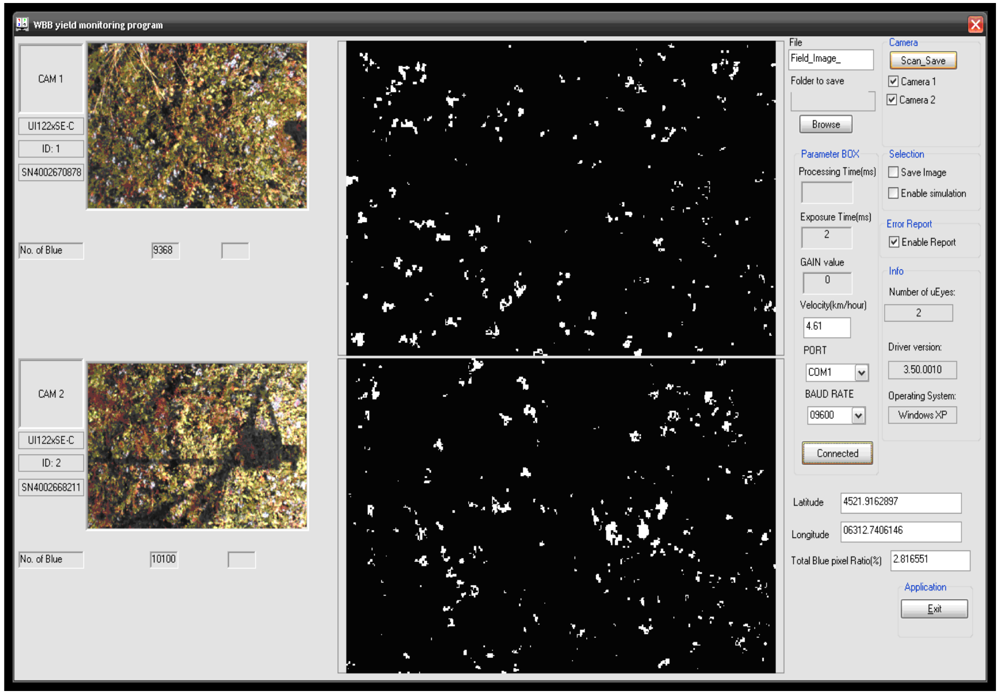



**Smooth Fruit Yield Map**

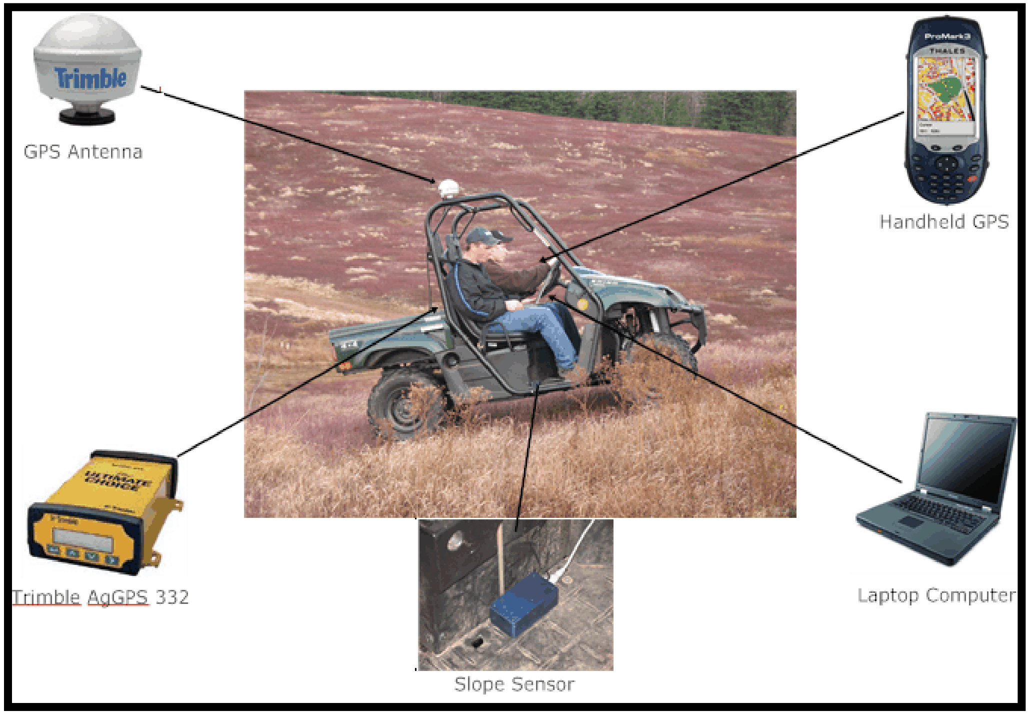


# Yield Monitoring System µEye for Double Head Harvester

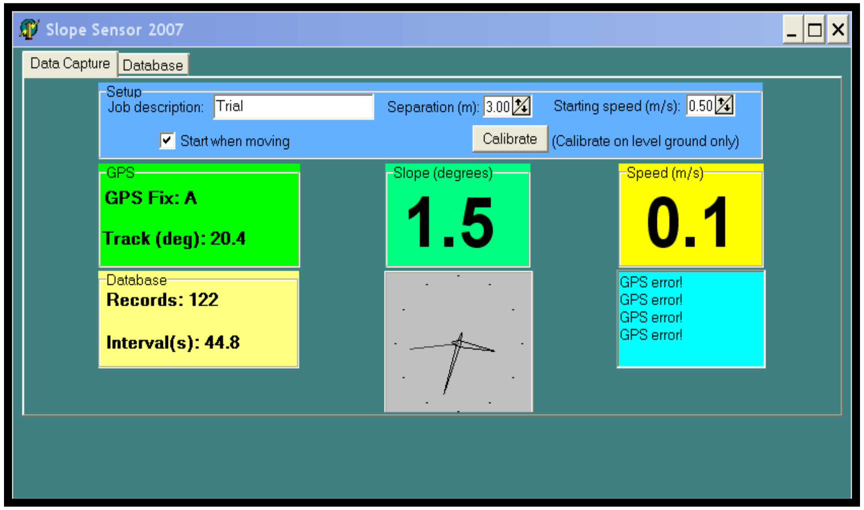
## Custom Software




# Cost-effective automated slope sensing system

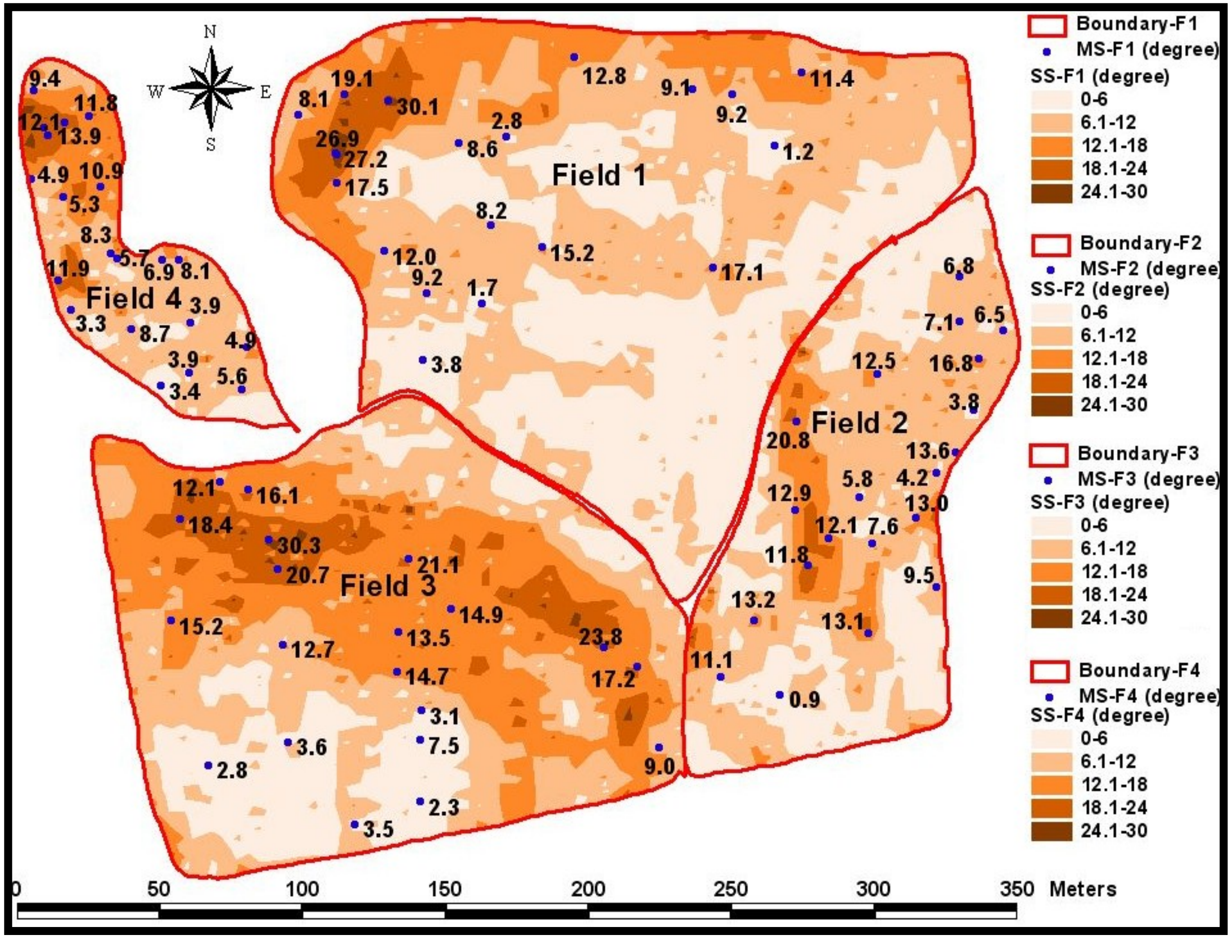



## Custom Software



# Automated Slope Sensing System - Video

# Sensed-slope and manually measured slope



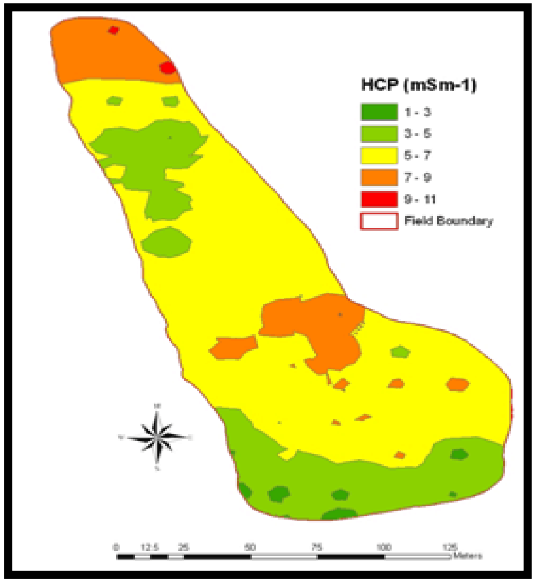
# Electromagnetic Induction Method for Soil Properties Mapping

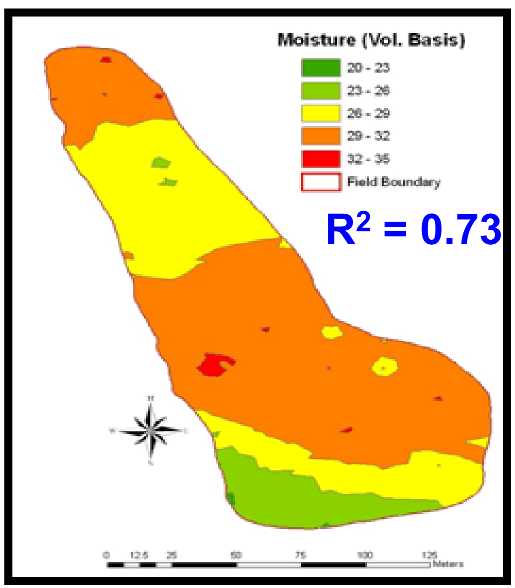
**DualEM-2**

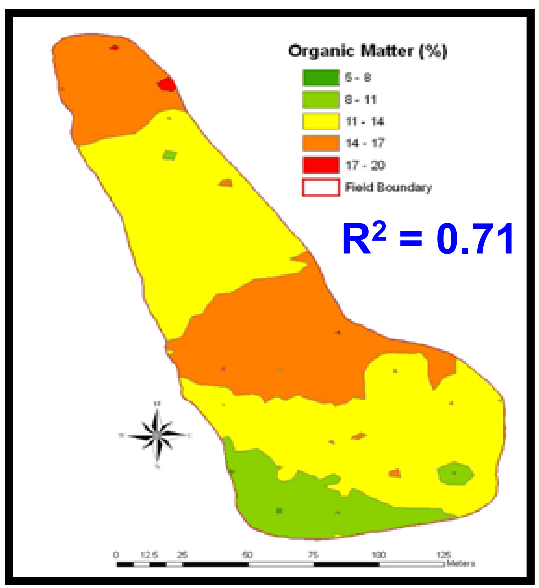
**Soil Sensing:**

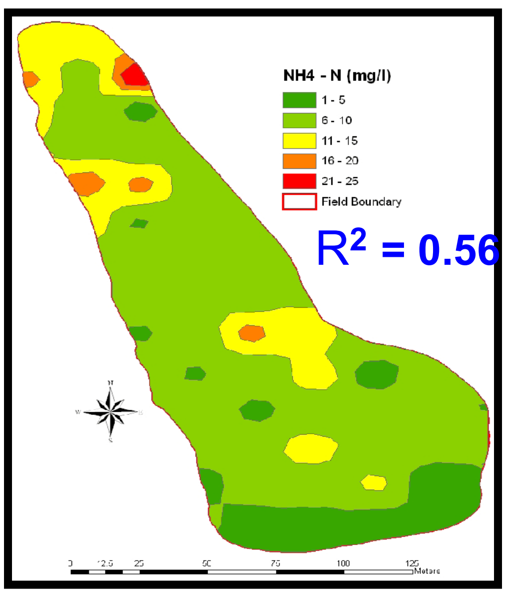
- **3 m below soil surface**
- **l m horizontal**

# Soil Properties and Nutrient Maps using DualEM

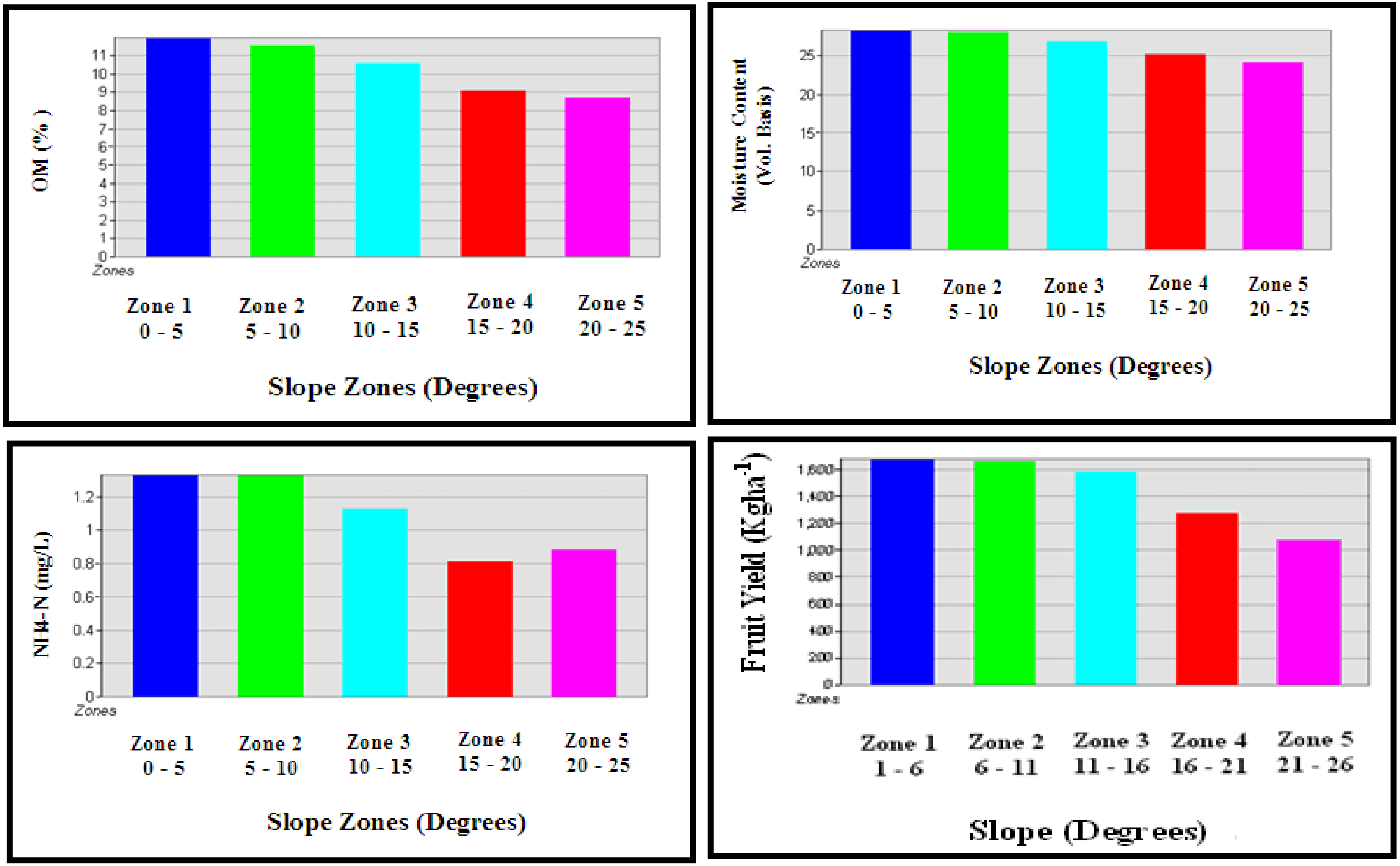


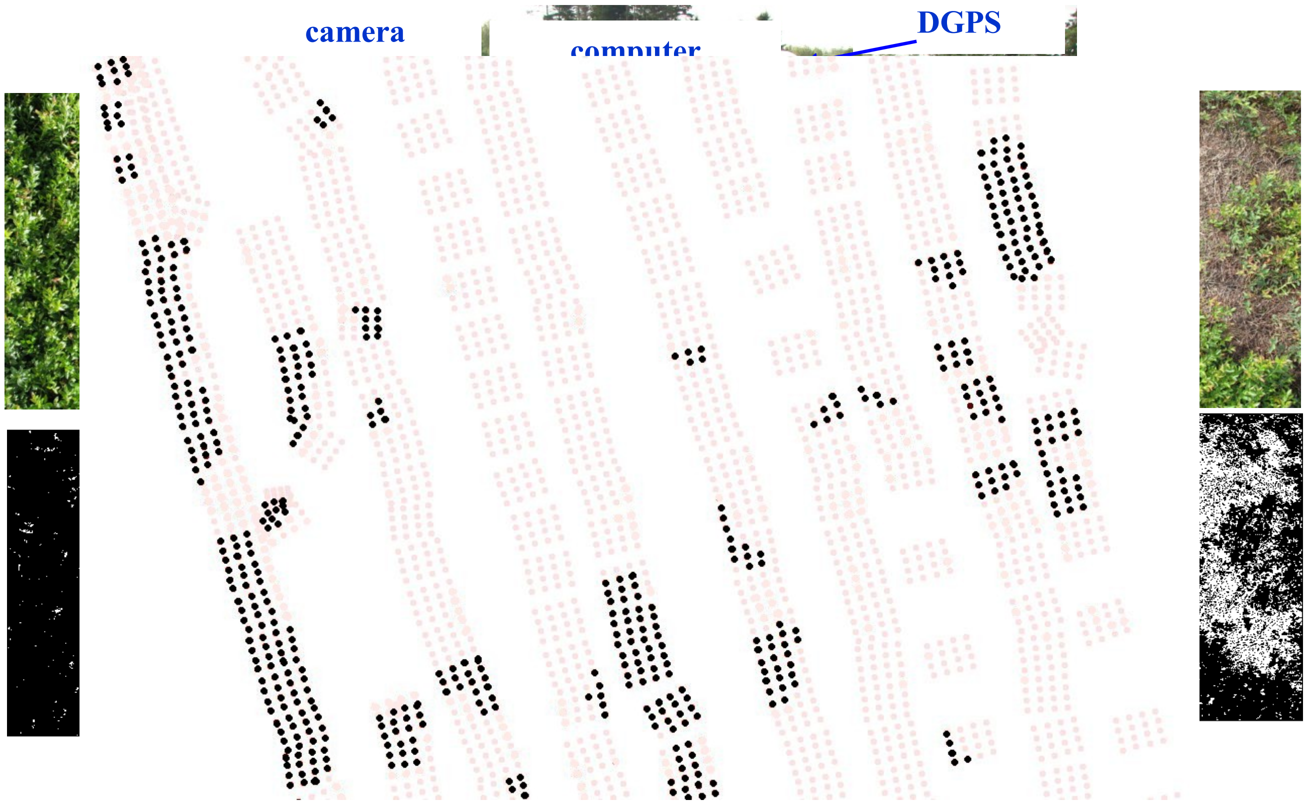



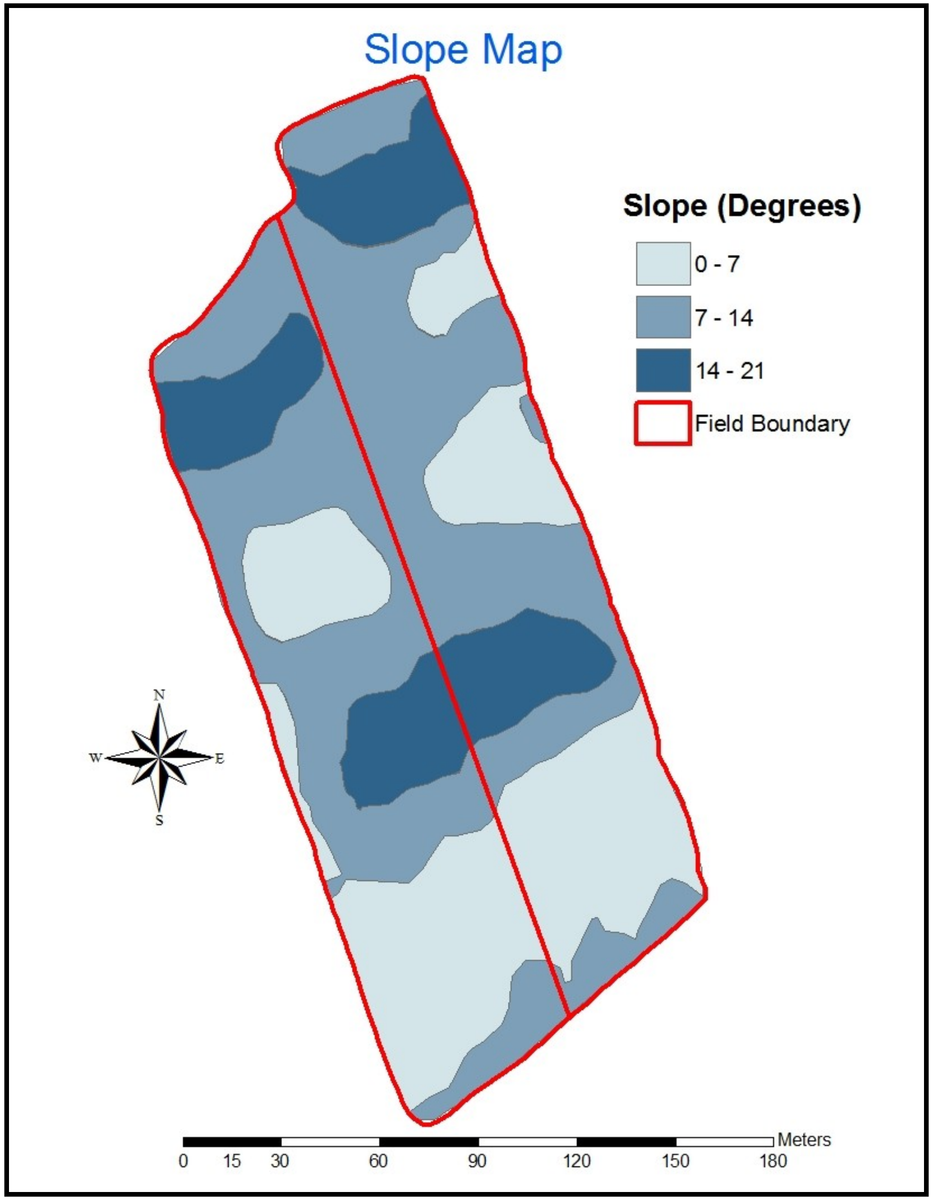
# Soil Properties, Nutrients Fruit Yield in Different Slope Zones

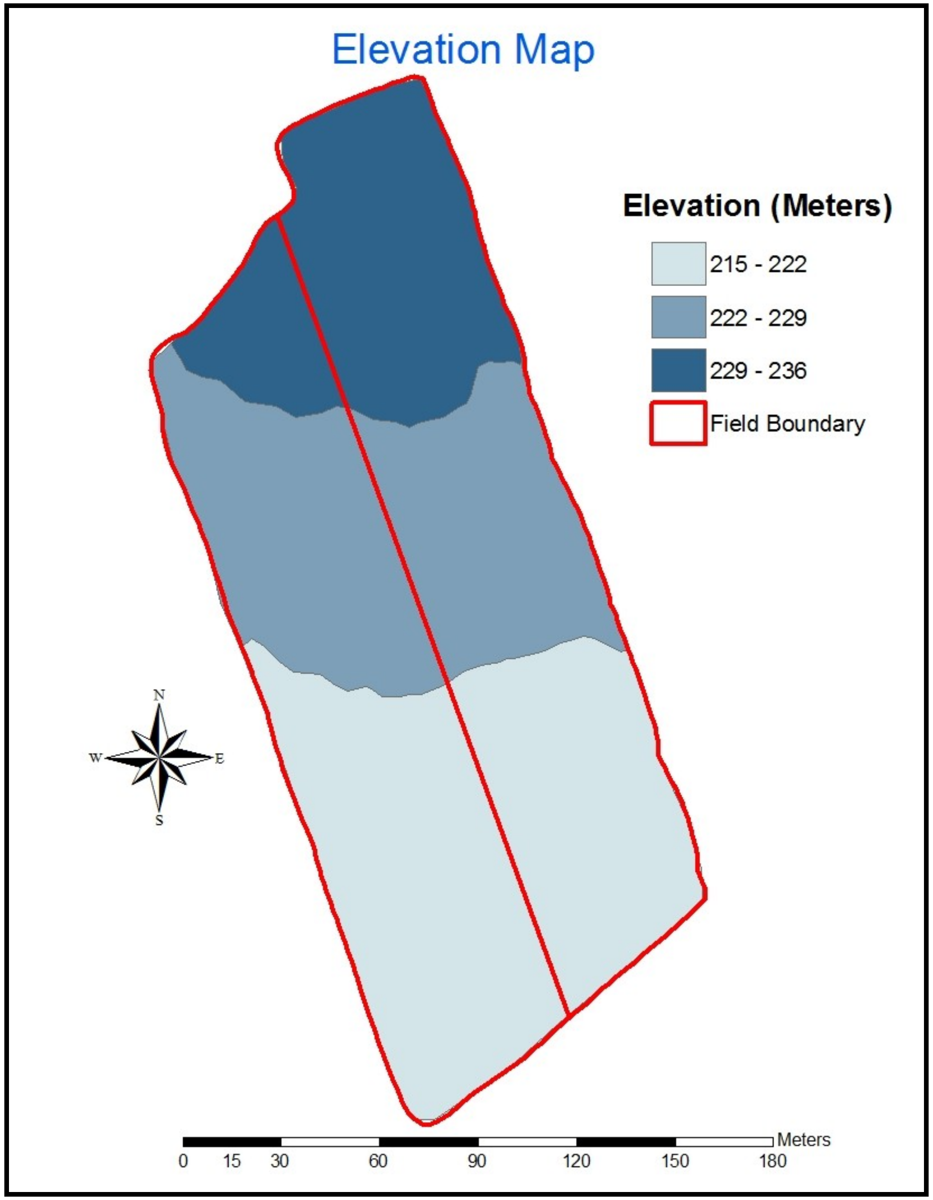


# Automated Machine Vision System for Bare Spot Mapping



# Slope and Elevation Map for Site-Specific Fertilization



# VRA Can Reduce Agrochemical Usage and Environmental Impacts

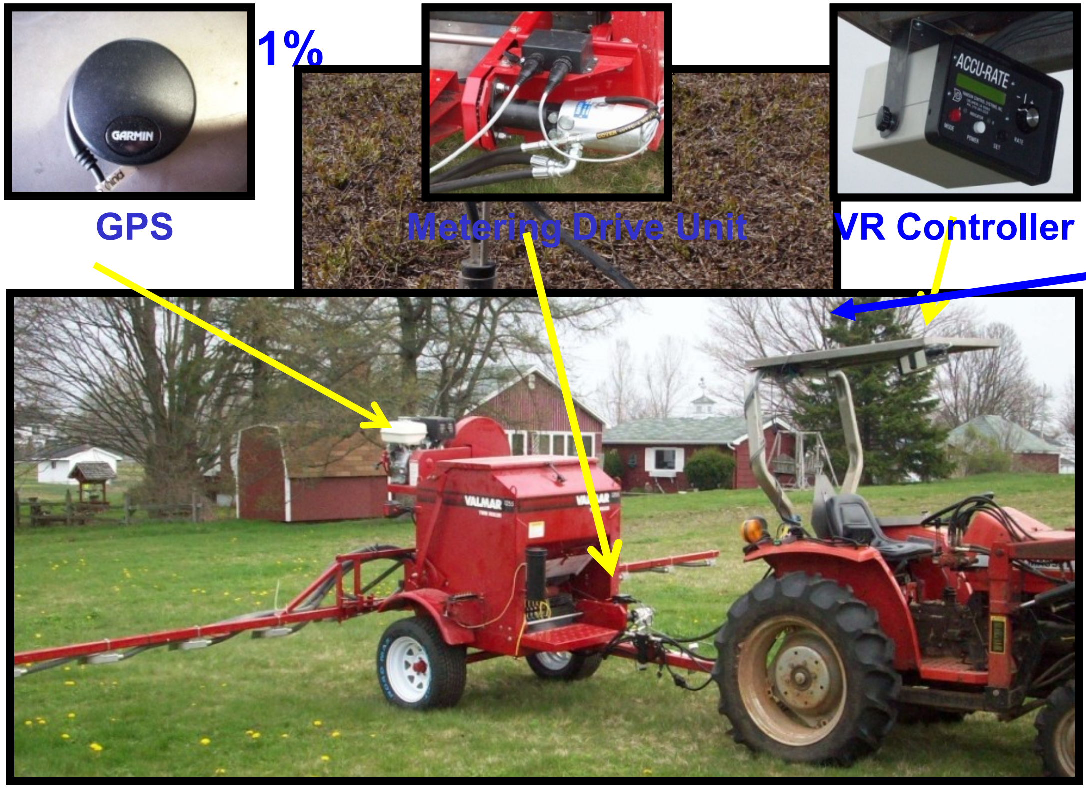
**Growers Uniform Rate = 200 kg/ha**

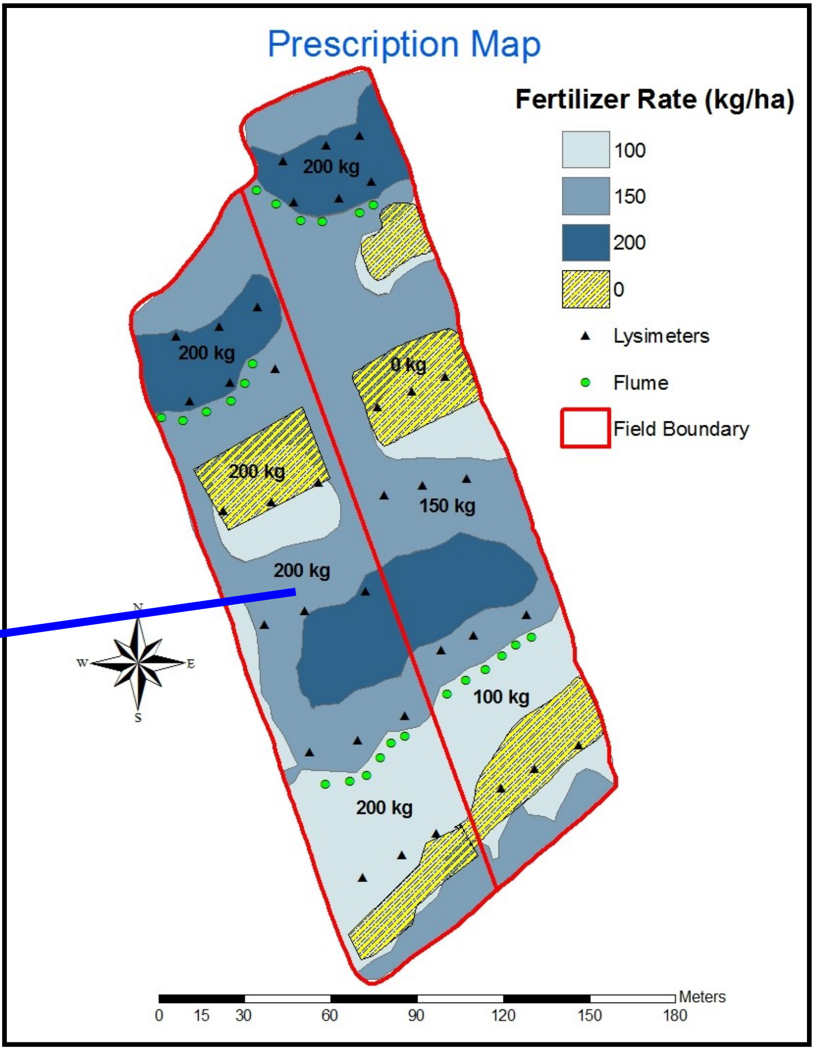
**Area -Site-specific = 1.48 ha**

**Area- Uniform = 1.37 ha**

**Bare spot Area (UA) = 0.17 ha**

**Bare spot Area (SA) = 0.26 ha**



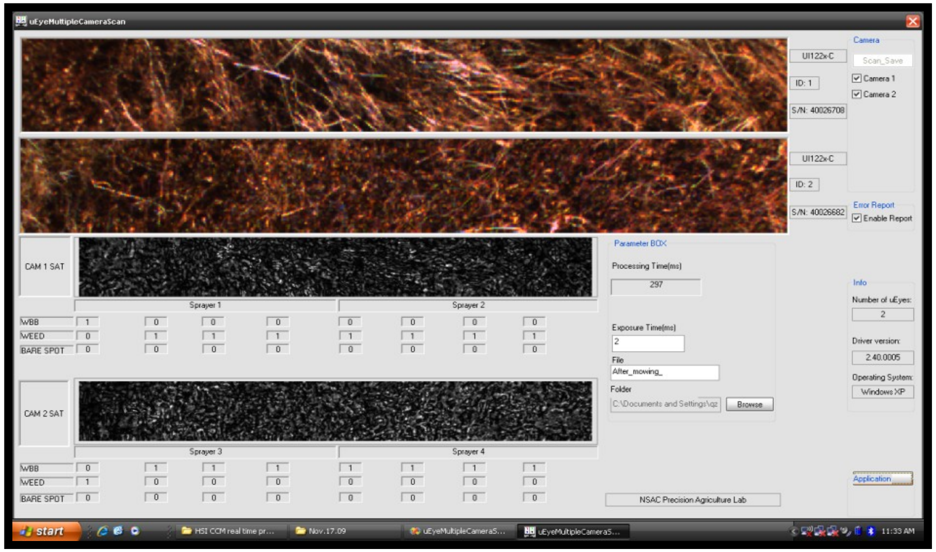



# Video- Prototype VR Spreader

# Spot-Application of Pesticides-VR Sprayer Technology

# Testing/Evaluation Sensors/Cameras – Custom Software Development


## Custom Software - 2 cameras



# Testing/Evaluation of Controllers - VR Sprayer Technology

## Dickey-john Controller Flow Test

## Computerized 8-Channel VR Controller- Response Time Test

# Cost-Effective Prototype Variable Rate Sprayer

Boom width = 20 ft

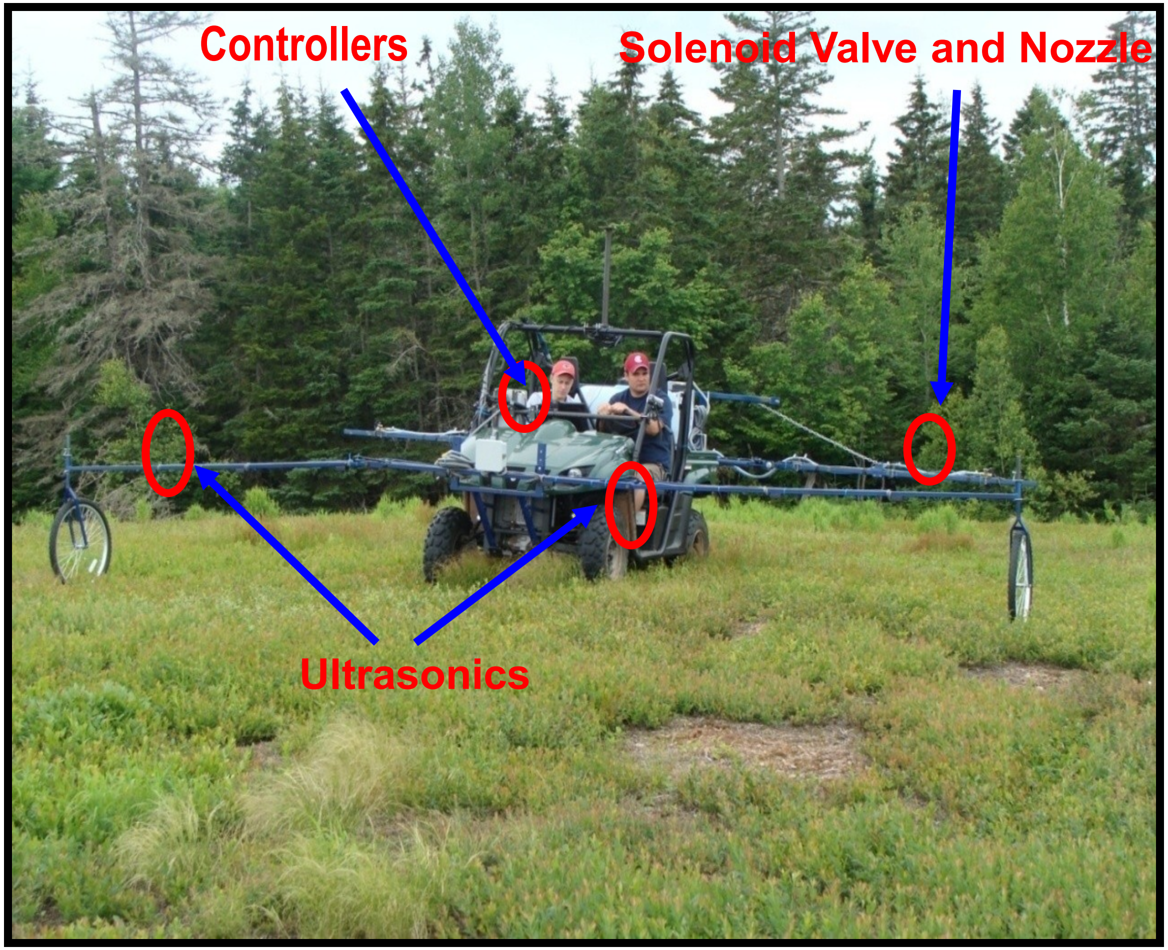
Boom sections = 8, each = 2.5 ft

Boom height = 30 in.

Each section = one ultrasonic

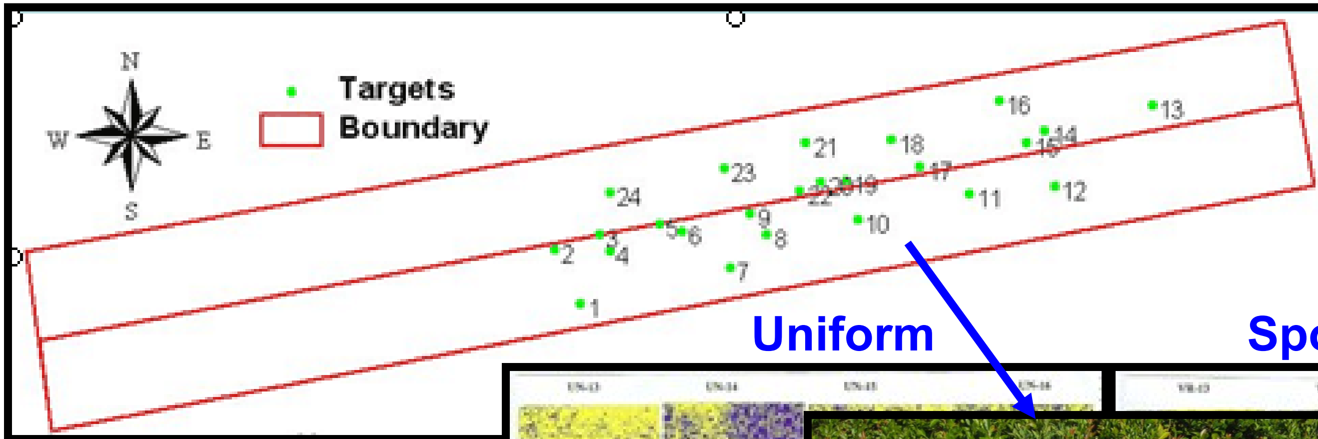
8-channel computerized controller

DJ *Land Manager II* controller



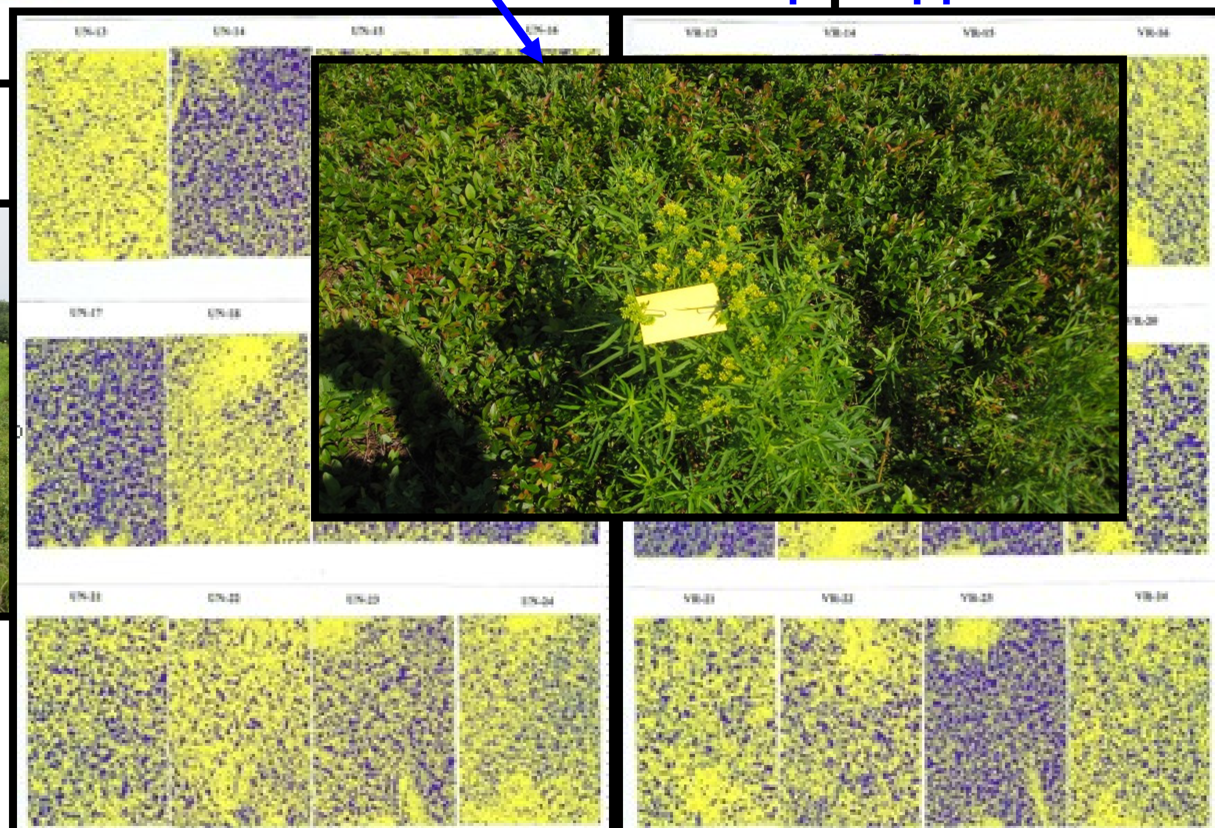
# Video- Prototype Sprayer Test in Hay Field

# Water Sensitive Papers in Uniform and VR side of the field



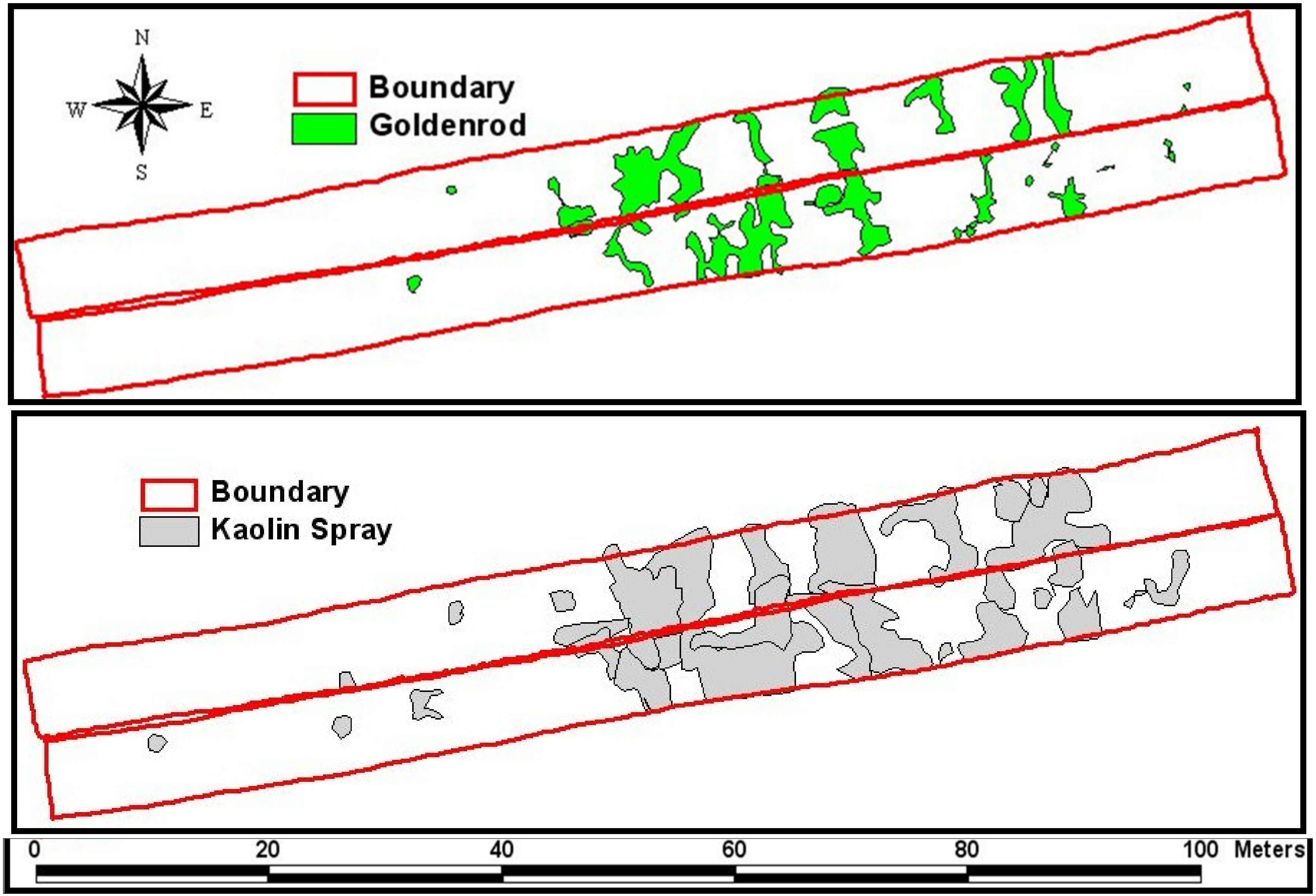

Uniform

Spot-Application

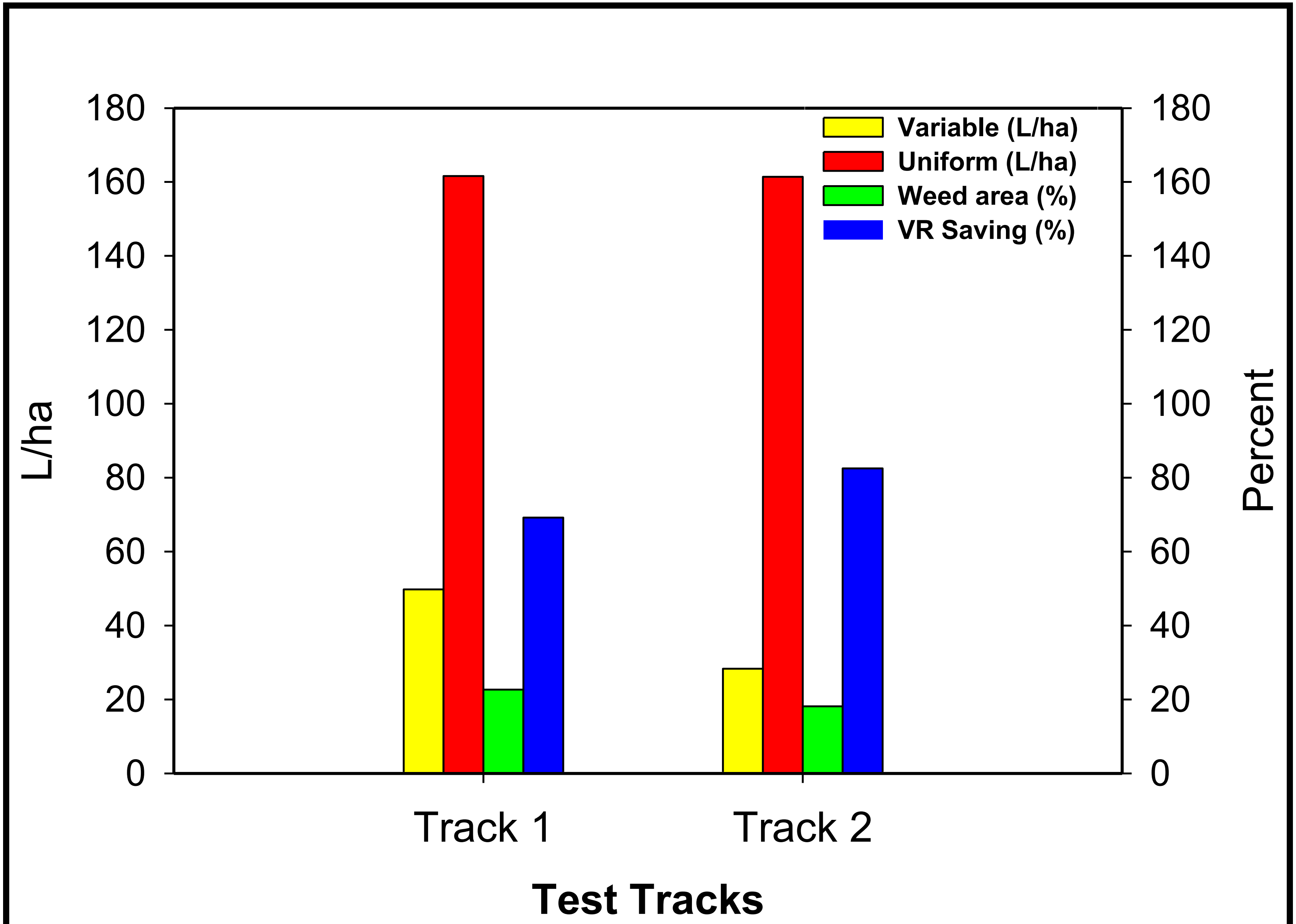


# Commercial Prototype VR Sprayer

# Weed and Spray Maps (Goldenrod)



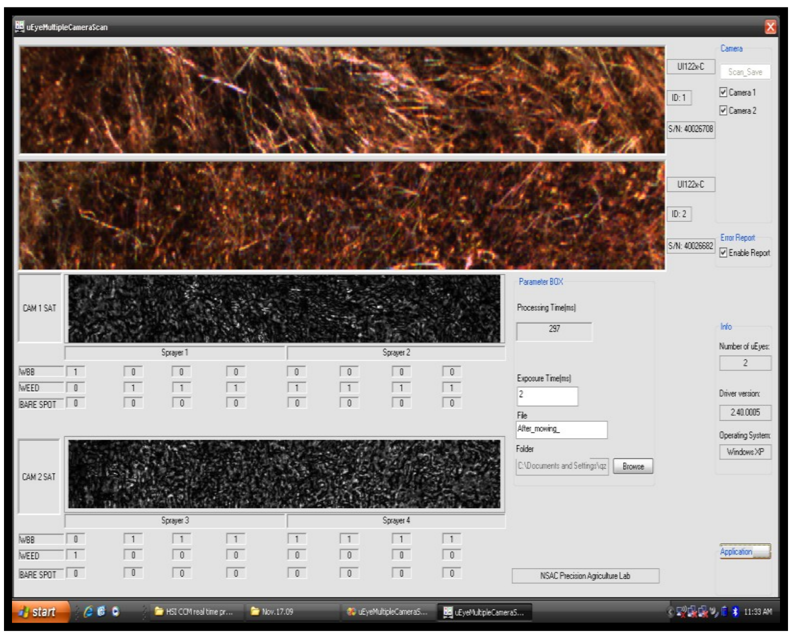
# Chemical Saving with Spot-Application



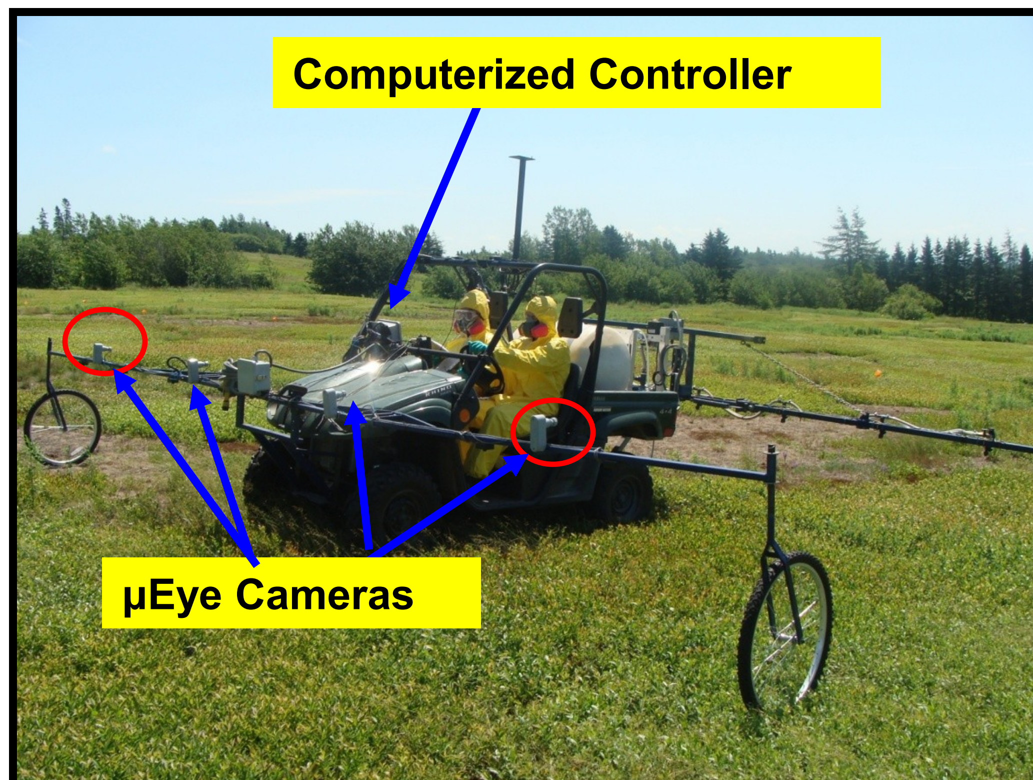
April-May

June- August

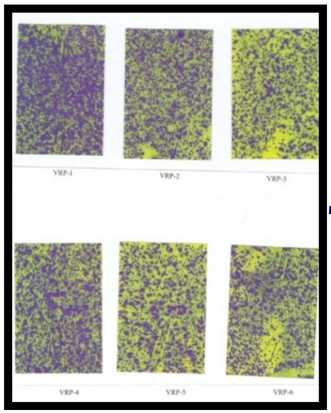
October-November

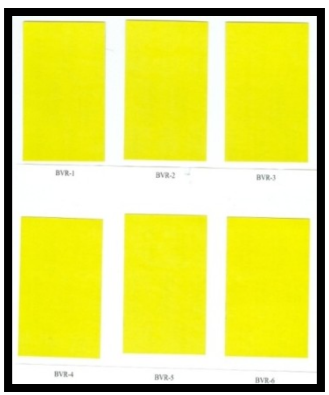


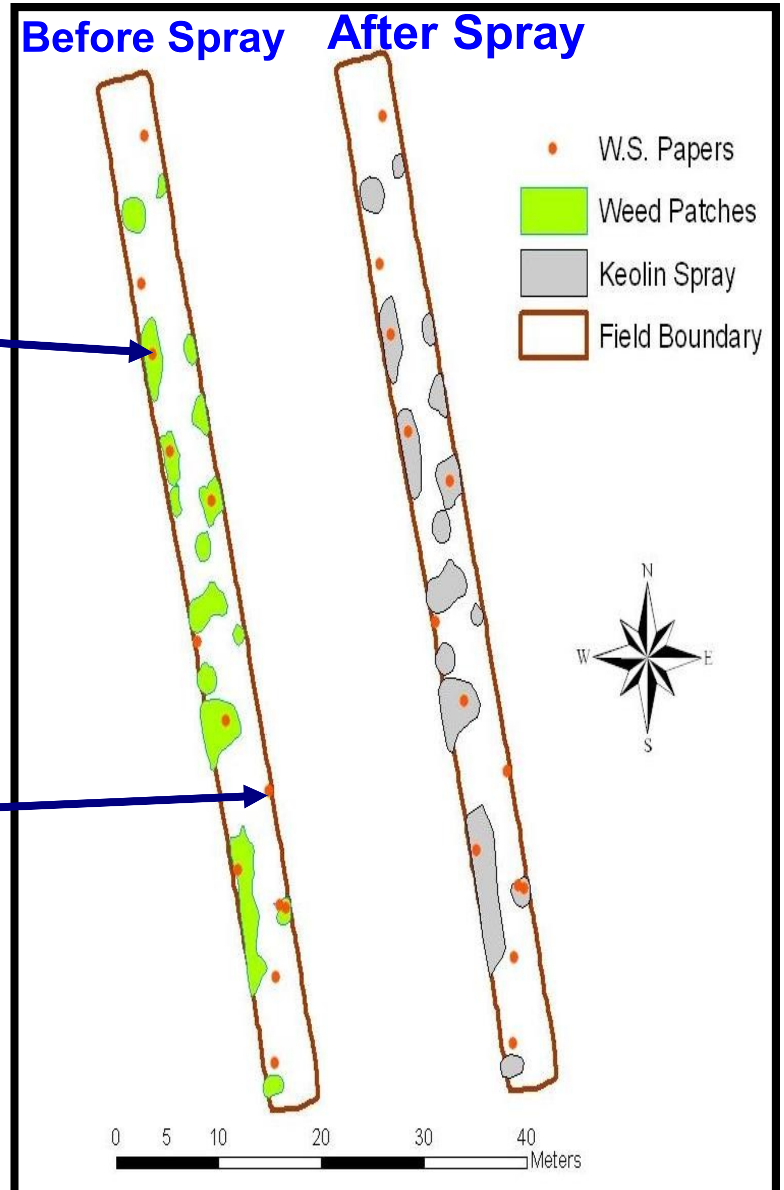
Customized Software for Weed, Bare Spot and Plant Detection



# Sheep sorrel, Fescue Grasses, Moss and Spray Maps

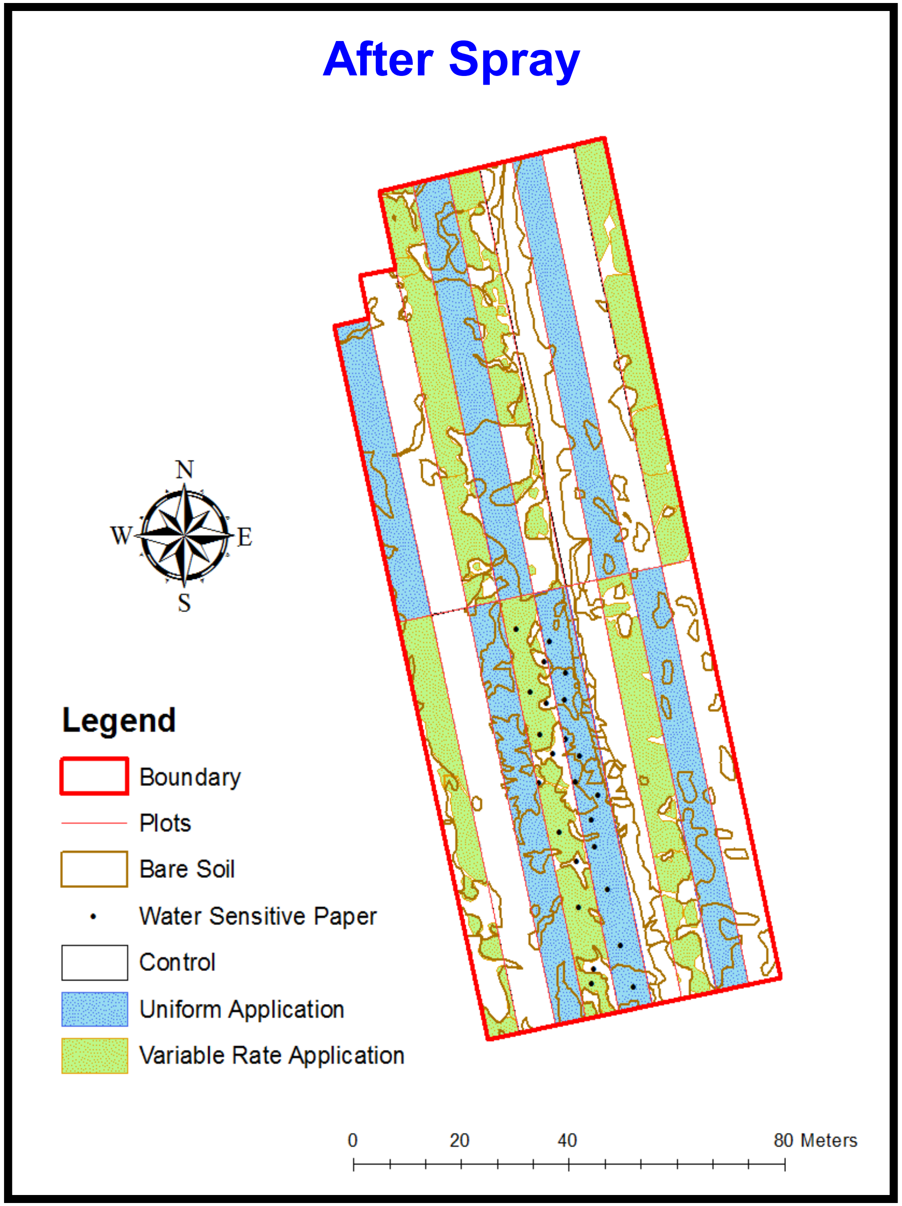






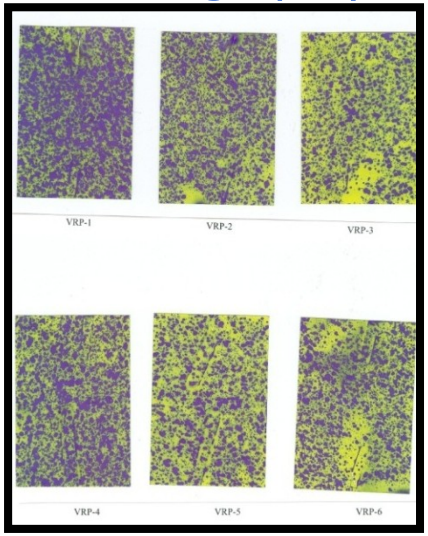
# Video-Spray on Sheep sorrel, Fescue grasses and Moss

# Spot-Application of Bravo – VR Sprayer with µEye Cameras

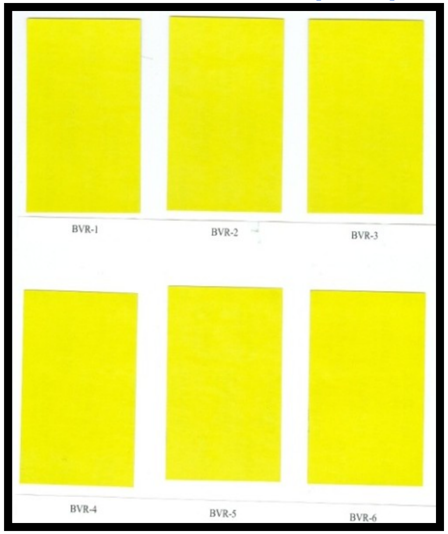



# Spot Application of Bravo with Prototype VR Sprayer

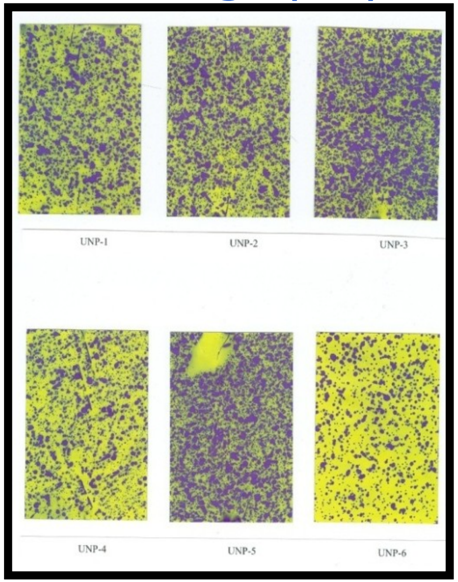
**Foliage (SA)**



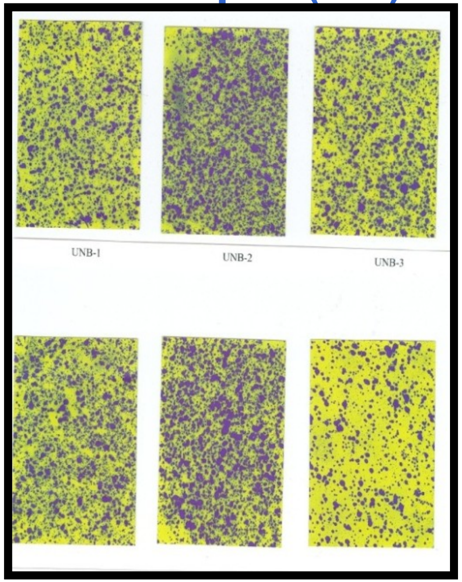

**Bare Spot (SA)**




**Foliage (UA)**




**Bare Spot (UA)**

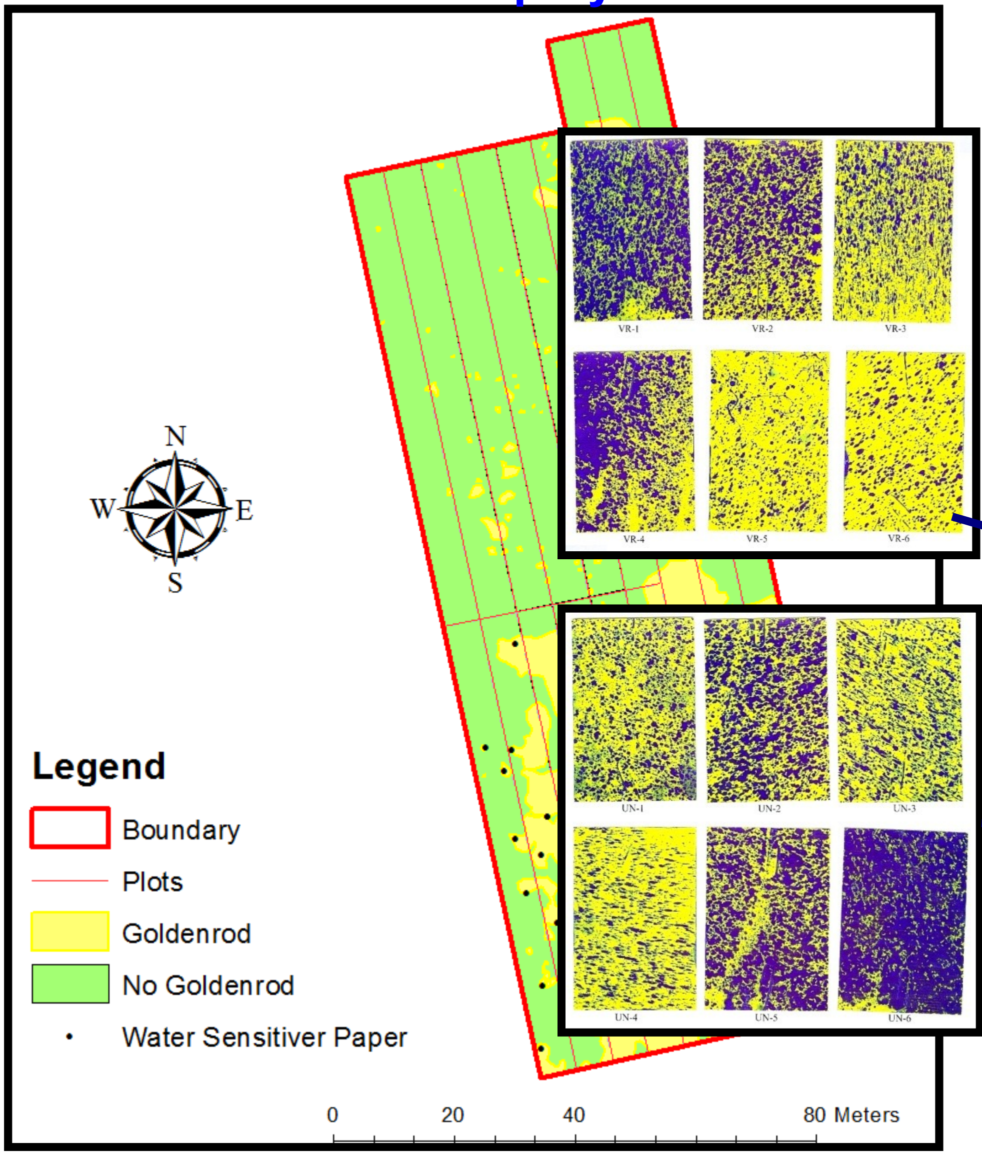


# Savings with Spot-Application (Bravo)

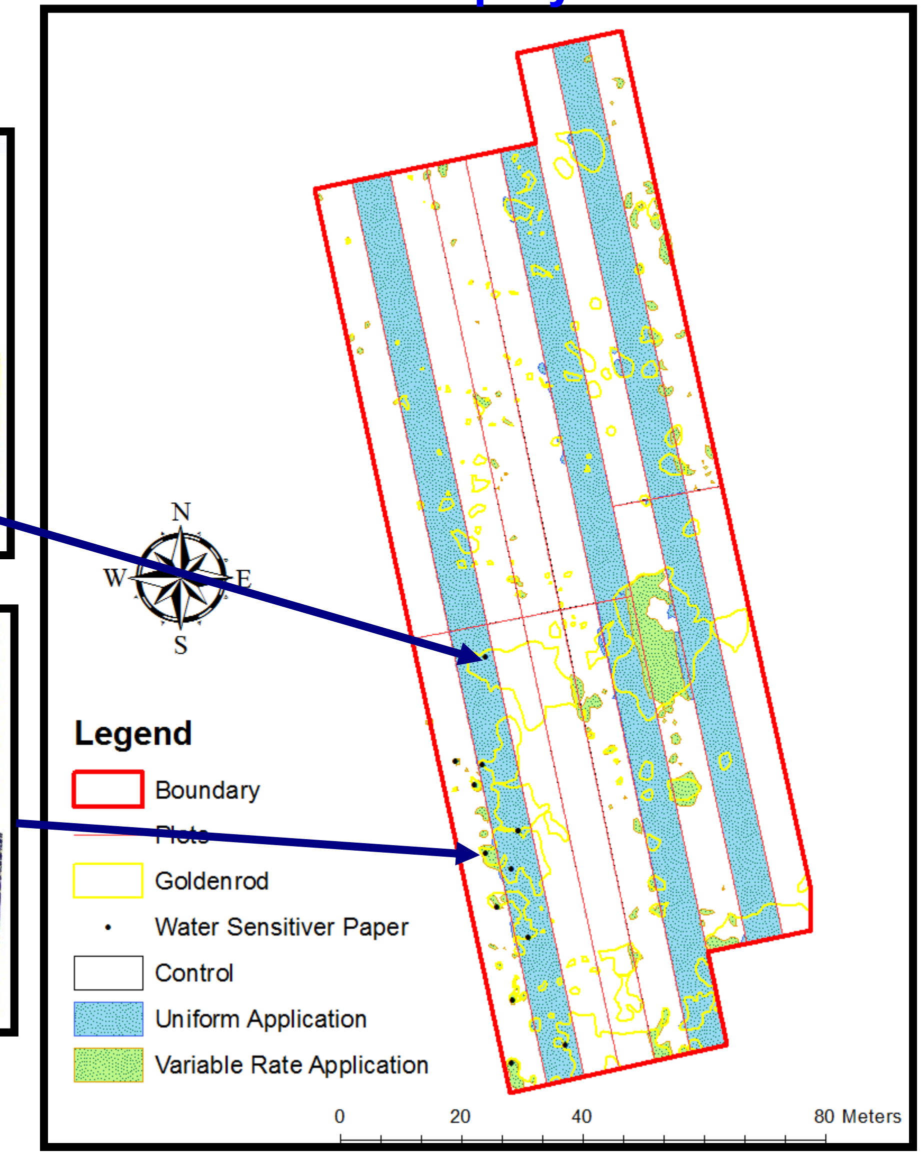
| Plot No. | Total Area ($m^2$) | B. S. Area ($m^2$) | Saving (%) |
|---|---|---|---|
| 1 | 523.67 | 188.21 | 35.94 |
| 2 | 497.25 | 102.13 | 20.53 |
| 3 | 502.39 | 44 .86 | 8.92 |
| 4 | 505.96 | 86.00 | 16.99 |
| 5 | 489.40 | 189.53 | 38.71 |
| 6 | 480.32 | 53.57 | 11.15 |

# Spot-Application of Callisto- Prototype VR Sprayer

## Before Spray




## After Spray



# Savings with Spot-Application (Callisto)

| Plot # | Total Area ($m^2$) | Weed Area ($m^2$) | Sprayed Area ($m^2$) | Actual Savings (%) |
|---|---|---|---|---|
| **1** | **476** | **40** | **45** | **90** |
| **5** | **462** | **32** | **58** | **87** |
| **7** | **488** | **170** | **177** | **64** |
| **10** | **466** | **3** | **5** | **98** |
| **13** | **500** | **4** | **35** | **93** |
| **18** | **442** | **16** | **54** | **88** |
| **Total** | **2834** | **265(9.3%)** | **374(13%)** | |
| **Ave. Saving** | | | | **87** |

# Commercial Prototype Variable Rate Sprayer

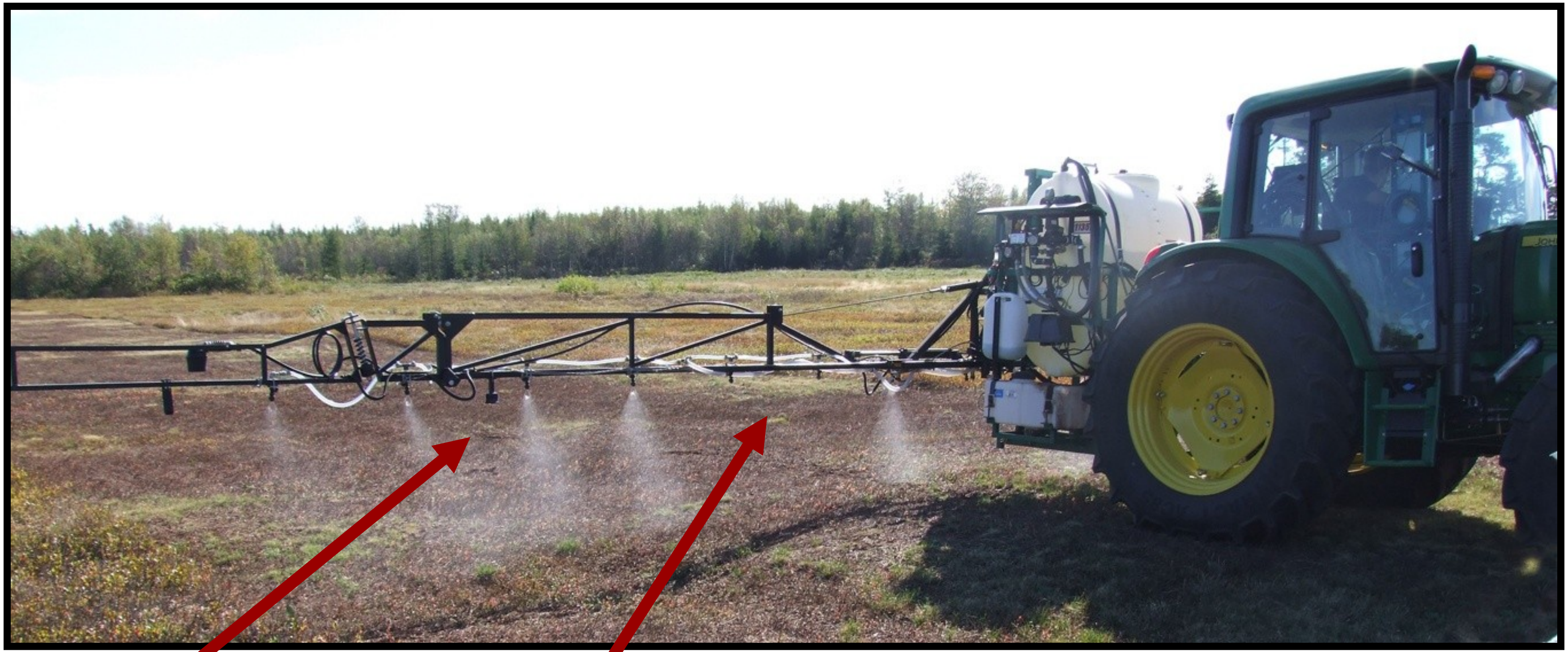
Controllers

Solenoid Valve & Nozzle

Height Sensor

Camera

# Commercial Prototype VR Sprayer during Field Operation



Nozzle activated

Nozzle deactivated

# Commercial Prototype VR Sprayer - Video

# Spot-Application of Kerb-Commercial Prototype VR Sprayer

Total area = 6.13 Acres

Total required (UA)@20 Gal/ac= 122.5 Gal.

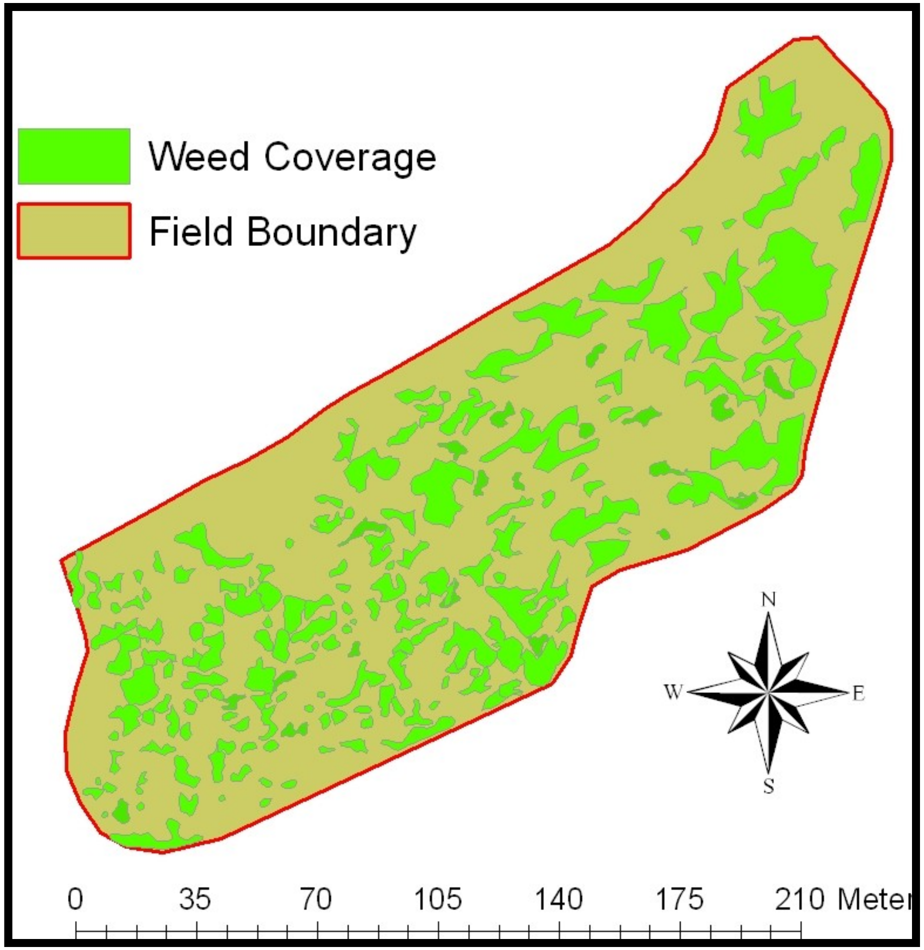
Weed coverage = 1.7ac (27.7% of field area)

Coverage (10" buffer before/after) = 2.0 ac

Saving with SA using GIS = 67.4 %

Actual chemical applied (DJ) = 37.5 Gal.

Saving with SA (DJ Controller) = 69%



# Cost Analysis- Conventional vs Spot-Application (for one application only)

- Target: Sheep Sorrel
- Chemical: Kerb
- Area sprayed = 300 acres
- Assume weed cover = 25%
- Application cost = $180/acre
- Total cost (Uniform application) = 300 X 180 = $54,000
- Cost of Spot- application = $13,500
- Chemical cost saving with Spot- application = $40,500

- Fewer trips to set water for sprayer
- Saves time (10 hours) + fuel, and labor
- Less impact on ENVIROMENT

## Additional cost of converting commercial to VR sprayer:

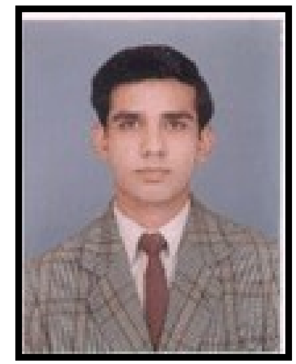
- Computerized variable rate 8-channel controller (Controller + Sensors/Cameras + GPS) = $4,000.00
- Dickey John *Land Manager II* controller
- (Controller + GPS + linear flow control valve, flow meter) = $2,600.00
- Wiring etc. = $400.00
- Total initial cost: (Prototype Sprayer) = $7,000.00
- **Commercial Prototype Sprayer** = $14,000.00

# Precision Agriculture Research Team - HQP







# ACKNOWLEDGEMENTS


Bragg Lumber Company Limited OXFORD

Nova Scotia's Provincial Berry
the Wild Blueberry
Wild Blueberry Producers Association of Nova Scotia

Agri-Futures Nova Scotia's ACAAF Council
Advancing Canadian Agriculture and Agri-Food
Agriculture and Agri-Food Canada Agriculture et Agroalimentaire Canada Canada

NOVA SCOTIA Agriculture

Agriculture and Agri-Food Canada Agriculture et Agroalimentaire Canada
Hort. Cluster

New Brunswick Nouveau Brunswick CANADA
Agriculture and Aquaculture

Natural Sciences and Engineering Research Council of Canada

Canada Foundation for Innovation

Atlantic Canada Opportunities Agency Agence de promotion économique du Canada atlantique

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