

# Automated Prototype Variable Rate Sprayer for Spot Application of Agrochemicals

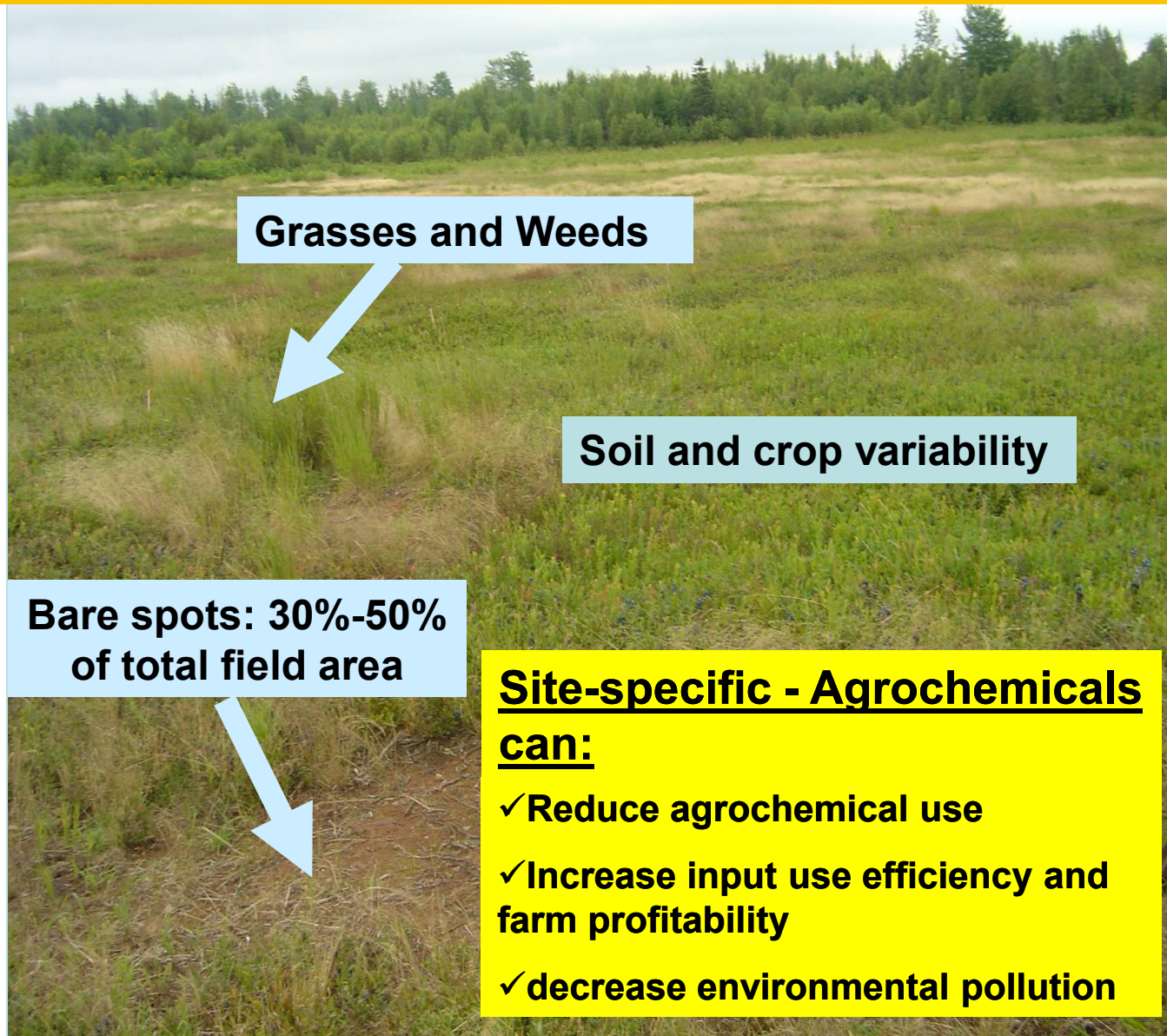
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Associate Professor and Machinery Systems Research Chair  
Engineering Department



Nova Scotia  
Agricultural  
College

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



**Grasses and Weeds**

**Soil and crop variability**

**Bare spots: 30%-50%  
of total field area**

**Site-specific - Agrochemicals  
can:**

- ✓ **Reduce agrochemical use**
- ✓ **Increase input use efficiency and farm profitability**
- ✓ **decrease environmental pollution**

# Our solution – A variable rate sprayer

- Technology that automatically senses weeds
  - Activates specific nozzles only when necessary
  - Real-time detection versus GIS and prescription maps
  - Work developed with wild blueberry industry but many possible applications

# 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



# Look-Ahead Feature



# Look-Ahead Delay Time Calculations

<b>Trial</b>	<b>Weed sensing time</b>	<b>Nozzle open time</b>	<b>Difference</b>	<b>Average look- ahead delay time (sec.)</b>
1	6.30	6.33	.033	
2	10.033	10.10	.067	
3	13.866	13.933	.067	0.054 sec.
4	17.33	17.366	.033	
5	20.466	20.533	.067	

# Flow Rate Measurements (Dickey John *Land Manager II*)



# Flow Rate Measurements (Dickey John *Land Manager II*)

## DJ Settings @ 20 gal/acre

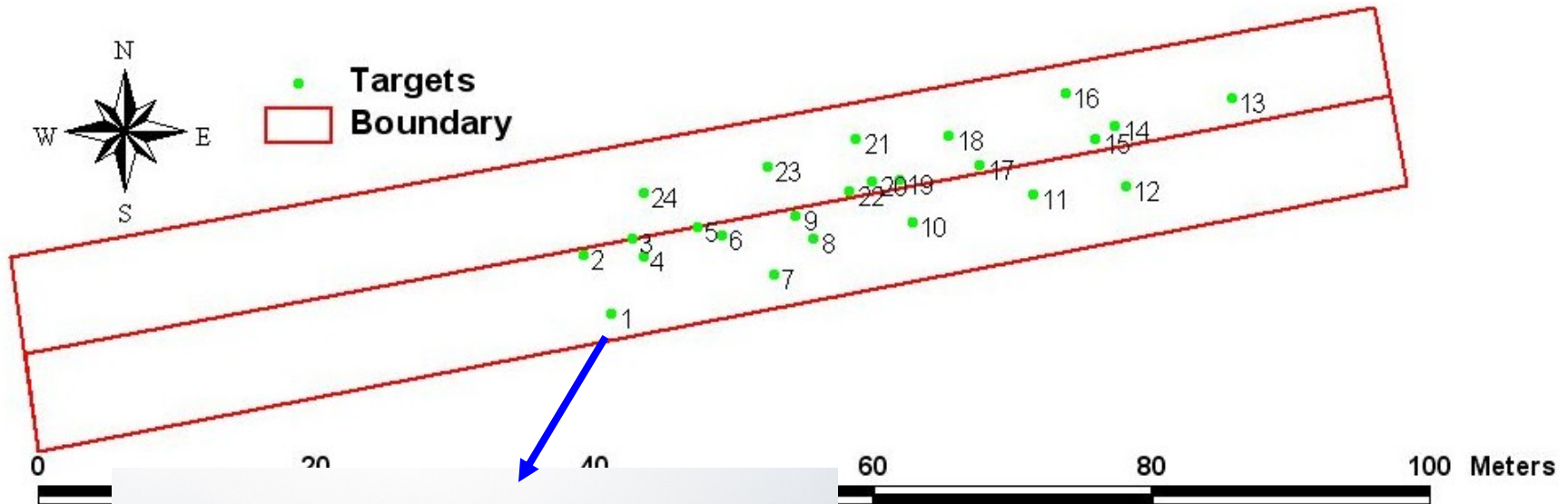
	Number of Nozzles							
Flow rate (litre)	All 8	1	1,2	1,2,3	1,2,3,4	1,2,3,4,5	1,2,3,4,5,6	1,2,3,4,5,6,7
Measured	36.9	12.0	13.3	14.9	18.6	18.9	18.9	18.6
DJ Controller	37.4	11.7	13.3	15.2	19.0	19.4	19.6	19.0
Difference (%)	1.4	2.5	0	2.0	2.1	2.0	1.5	2.1



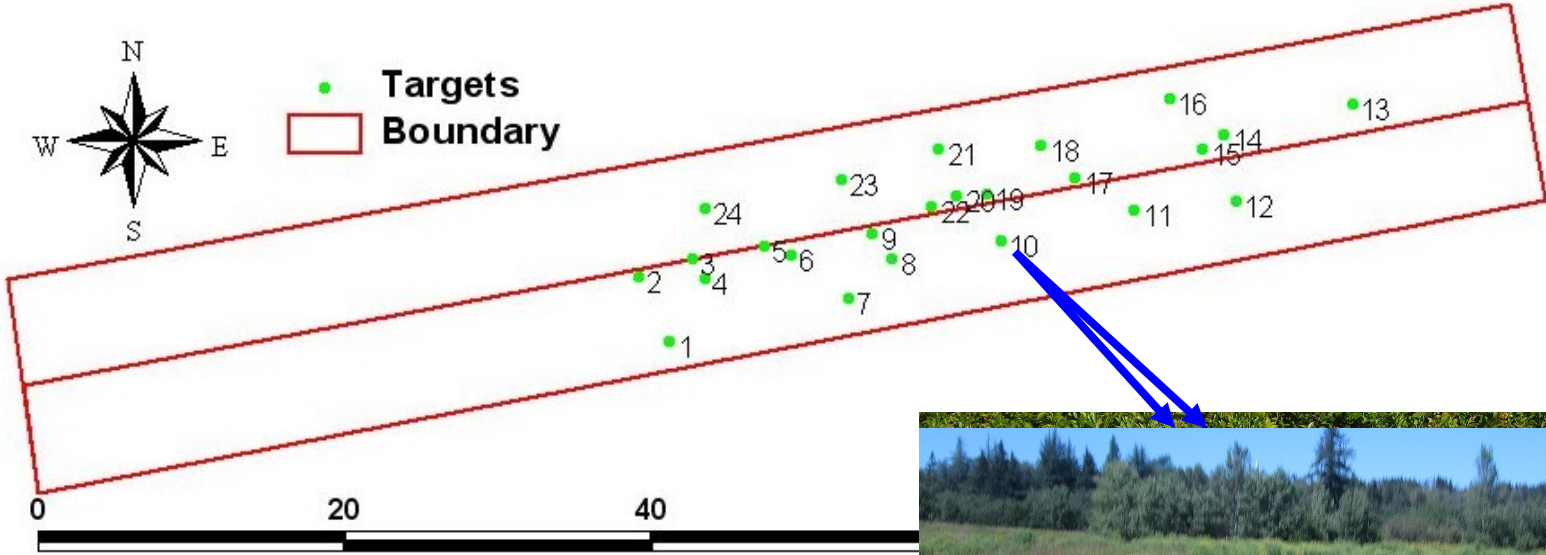
# Video- VR Sprayer Testing in Hay Field



# VR Sprayer Evaluation in a WBB Field (Goldenrod)



# VR Sprayer Evaluation Using Water Sensitive Papers in a WBB Field (Goldenrod)







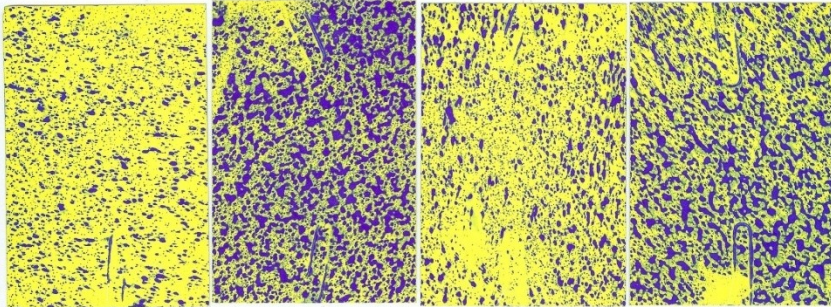
# Water Sensitive Papers in Uniform and VR side of the field

UN-13

UN-14

UN-15

UN-16

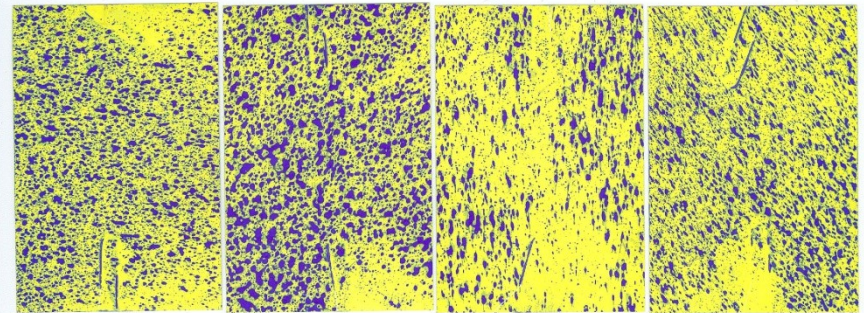


VR-13

VR-14

VR-15

VR-16

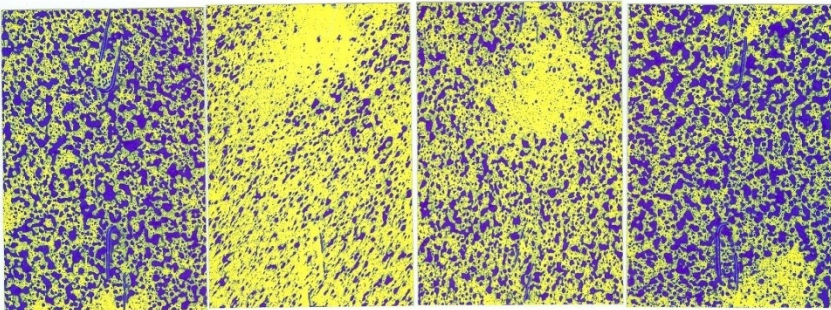


UN-17

UN-18

UN-19

UN-20

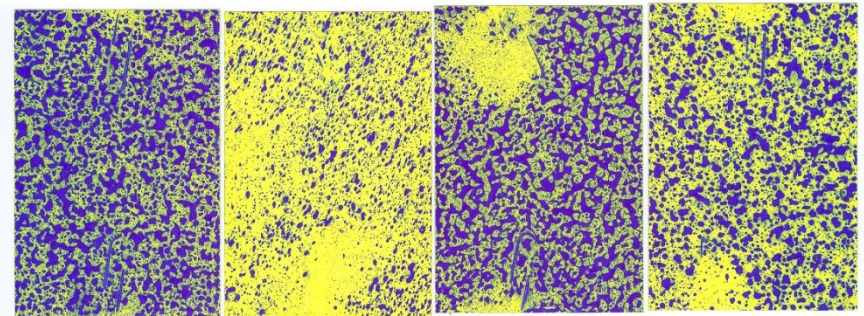


VR-17

VR-18

VR-19

VR-20

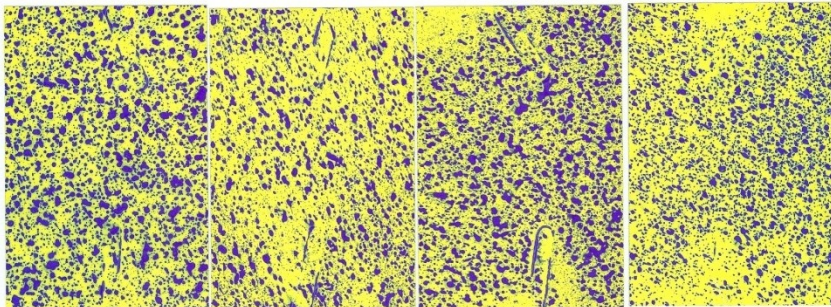


UN-21

UN-22

UN-23

UN-24

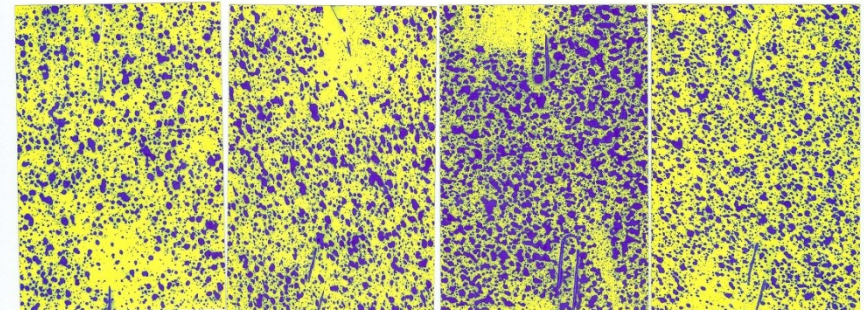


VR-21

VR-22

VR-23

VR-24



# Real-Time Kinematic-DGPS

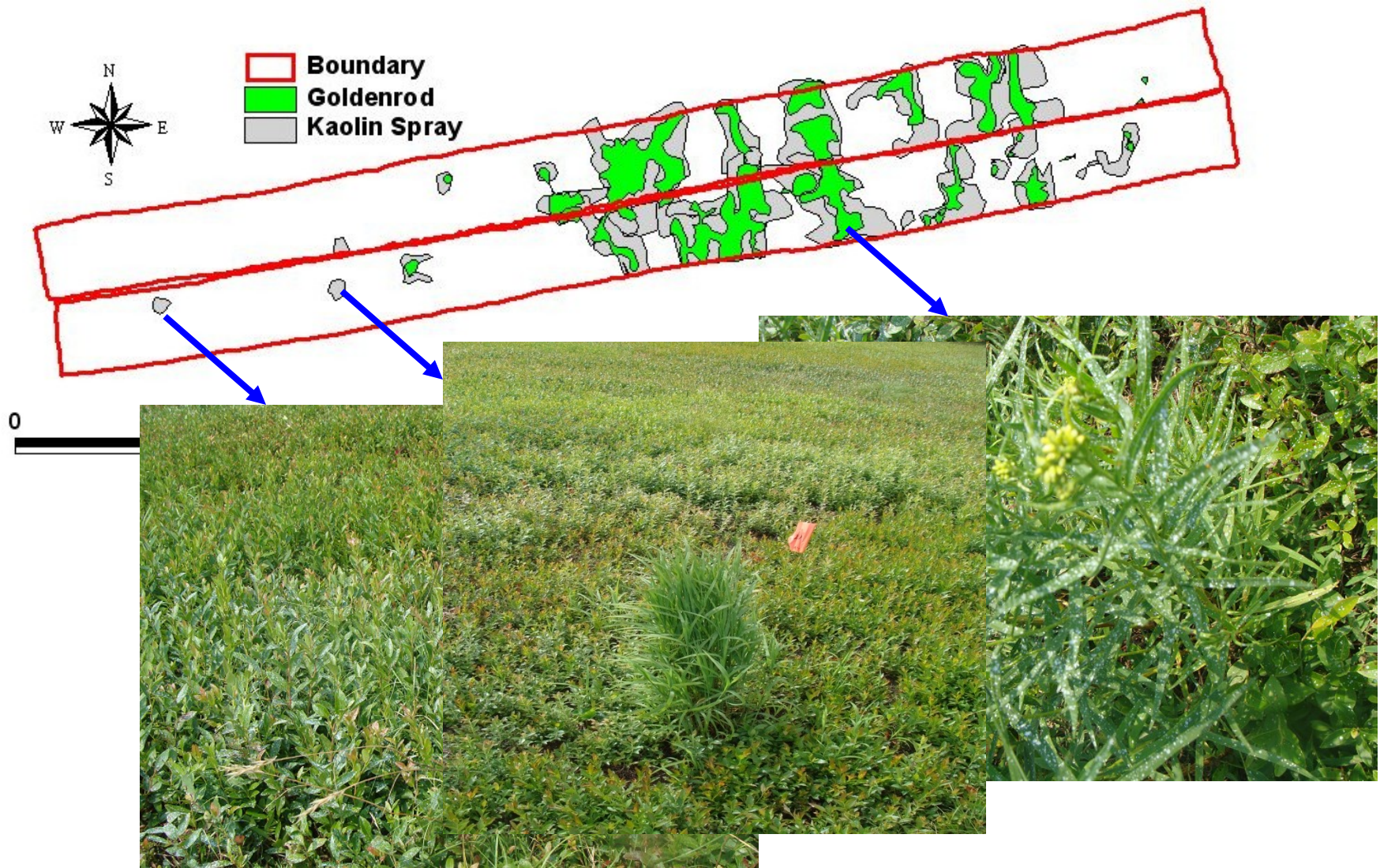


Base Station



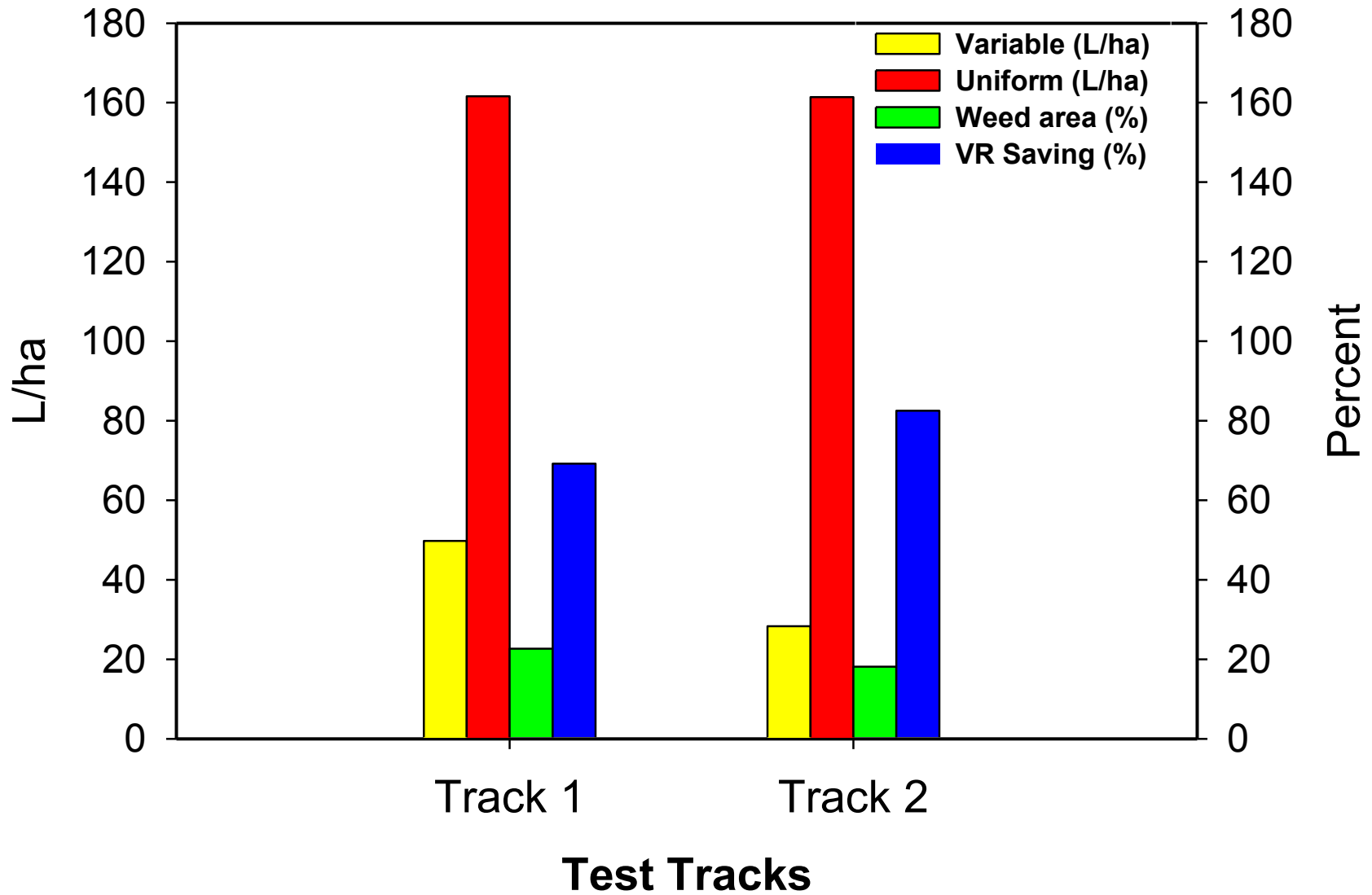
DGPS Rover

# Weed and Spray maps (Goldenrod)





# Chemical Saving with Spot-Application



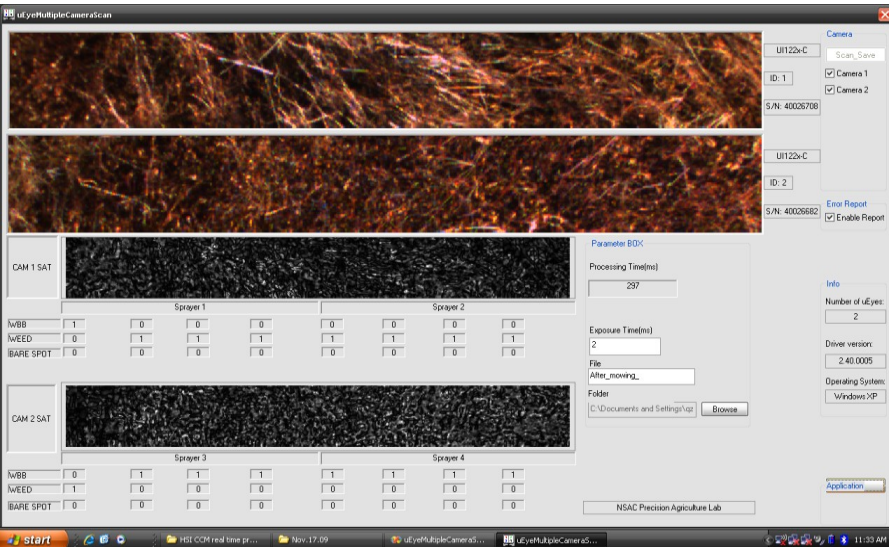
May



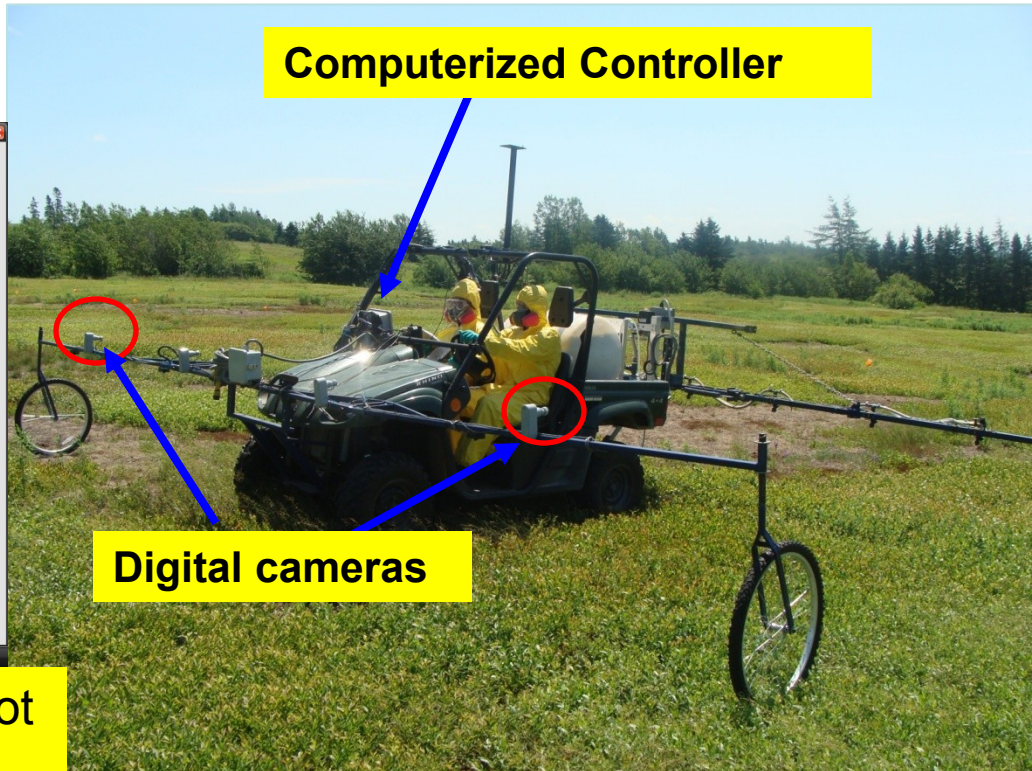
June



Early July



Computerized Controller

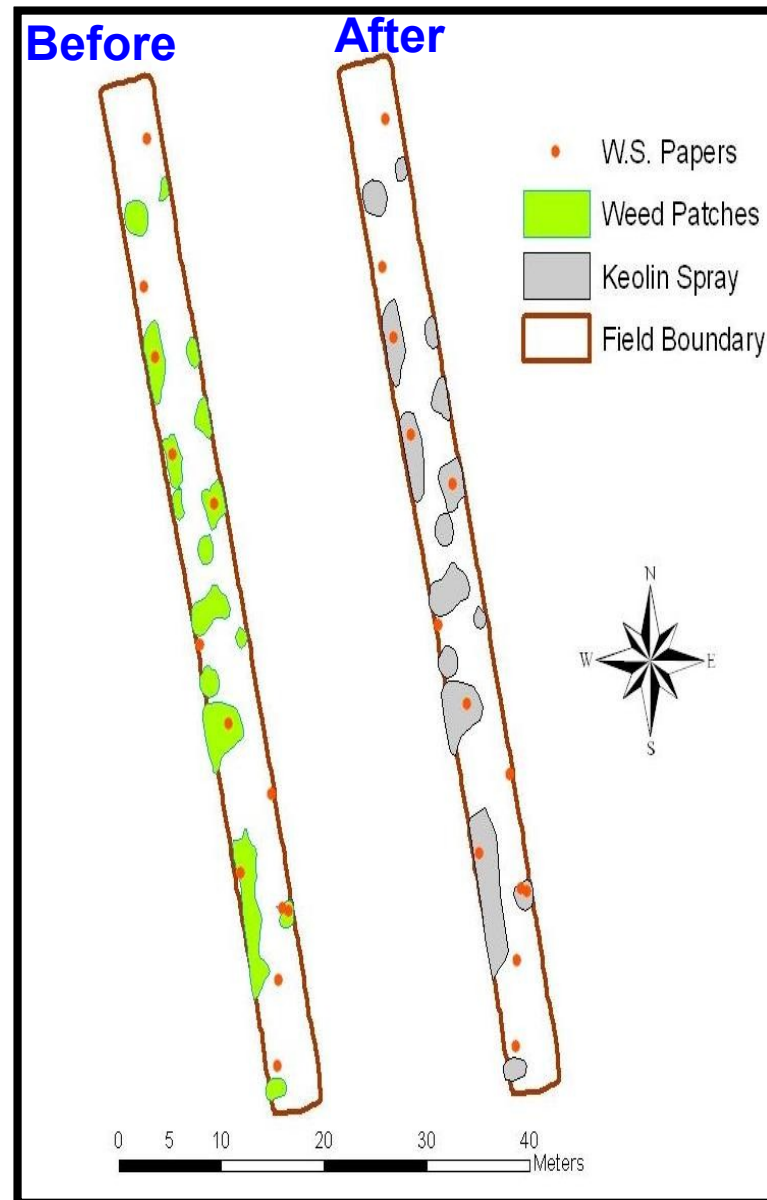


Digital cameras

Customized Software for Weed, Bare Spot and Plant Detection

Up to this point, all work was done with ultrasonics to prove the controller. All new work is with imaging technology

# Sheep sorrel, Fescue Grasses, Moss and Spray Maps





# Commercial Sprayer Prototype



John Deere 6430 Tractor and MS P1135E Sprayer

# Commercial Sprayer Prototype



# Commercial Sprayer Prototype



Nozzle activated

Nozzle deactivated



# Cost Analysis- Conventional vs Spot-Specific

(for one application only)

- Target: **Sheep Sorrel**
- Chemical: **Kerb**
- Area sprayed = **300 acres**
- Assume weed cover = **20%**
- Application cost = **\$180/acre**
- Total cost (Uniform application) = **300 X 180 = \$54,000**
- Cost of Spot- application = **\$10,800**
- Chemical cost saving with spot- application = **\$43,200** or **\$144/acre**
- **Currently about 100,000 acres in production**
  - **savings of \$14.4 million per application**

## Benefits

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





# VR Sprayer Costs

## Additional cost of converting to VR sprayer (4 wheeler prototype):

- Computerized variable rate 8-channel controller  
(Controller + Sensors/Cameras + GPS) = \$3,700
- Dickey John *Land Manager II* controller  
(Controller + GPS + linear flow control valve, flow meter) = 3,500
- Wiring, etc. = 300
- Total cost = **\$7,500.00**

## Tractor prototype:

Commercial sprayer (\$11,000) + VR modifications (**\$15,000**) = \$26,000



# Technology advantages

- Easy user-friendly setup on a touch screen- no complicated switches.
- Wireless convenience- setup is possible some distance from the controller.
- Automatic compensation for changing ground speed – no need to manually readjust sensors.
- Manual speed input is possible in case there is GPS signal outage.
- Adjustable front and back buffers for precise overlapping of agrochemical applications on targets.
- Accurate placement of agrochemical.
- Cost-Effective – (Topcon, Green seekers, Holland Scientific)

# Technology Benefits

- Precise application of pesticides reduces agrochemical use
- Lowers pressure on environment
- Reduces operating costs to producers
- Open new markets as only spraying the weeds
  - MRL (Maximum Residue Limits) is very important in many markets (e.g. Japan and Germany)
  - The technology sprays the weeds and not the fruit

## Next Steps

- Identify the products we have
  - Software, consulting, design/redesign, customization
- Identify market potential – multiple uses
- Identify potential licensees
  - Doug Bragg Enterprises and Bragg Lumber is very interested
- Identify method of commercialization
- Other? – help from Innovacorp to commercialize

# ACKNOWLEDGEMENTS



## Bragg Lumber Company Limited

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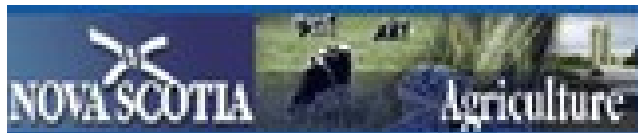
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## Nova Scotia Agricultural College



## Nova Scotia's ACAAF Council Advancing Canadian Agriculture and Agri-Food



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