

Precision detection and spraying of volunteer potato plants in sugar beet fields

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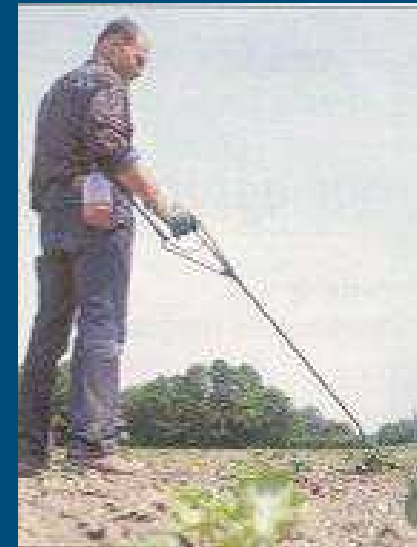


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Automated removal of volunteer potatoes

1. Volunteer potatoes are a severe weed
2. Detection using machine vision
3. Removal with spraying glyphosate
4. Conclusions and future perspectives



Problem

- Source of *Phytophthora infestans*
- Source of soil nematodes
- Serious weed problem in rotational crops
 - No effective control by herbicides
 - Manual control requires high labour input
 - These difficulties lead to incomplete control



Objectives

- Automate the detection of volunteer potatoes
- Design removal techniques
- Combine detection and removal on a platform

Detection

Removal

Prototype Machine



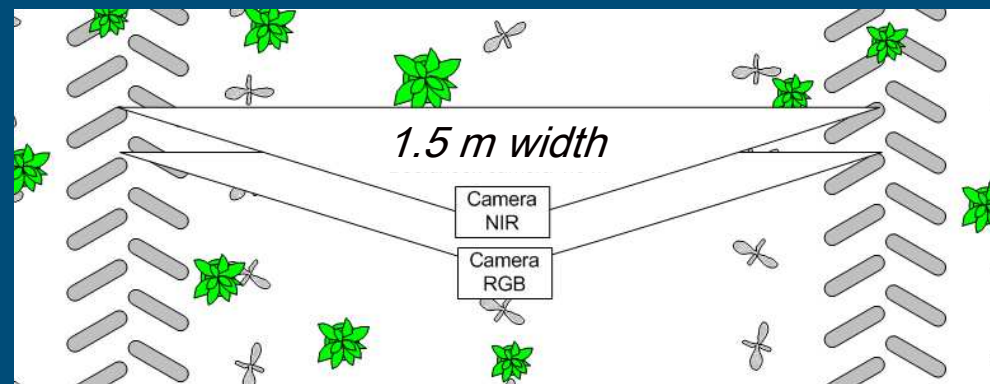
Objectives and system approach

- Detection
- Control
- Integration



Objective of detection

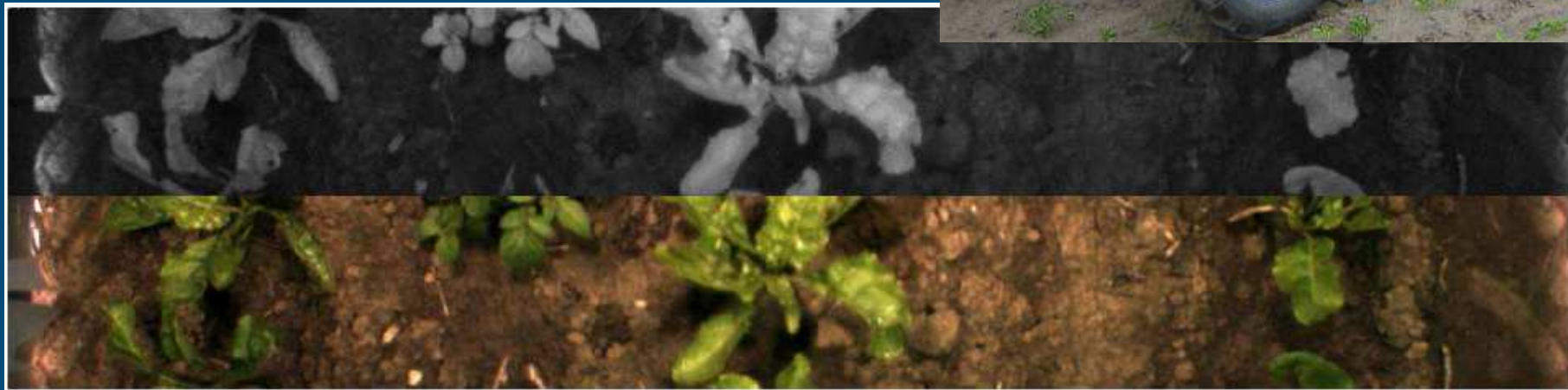
- Find volunteer potatoes automatically
- Extend vision based weed detection methods
 - Include more features → Increase classification rate
 - Include row detection for *online training*
 - Adaptive classification to *handle variability*



Detection – machine vision

■ Methods

- RGB and NIR camera
- Controlled light conditions

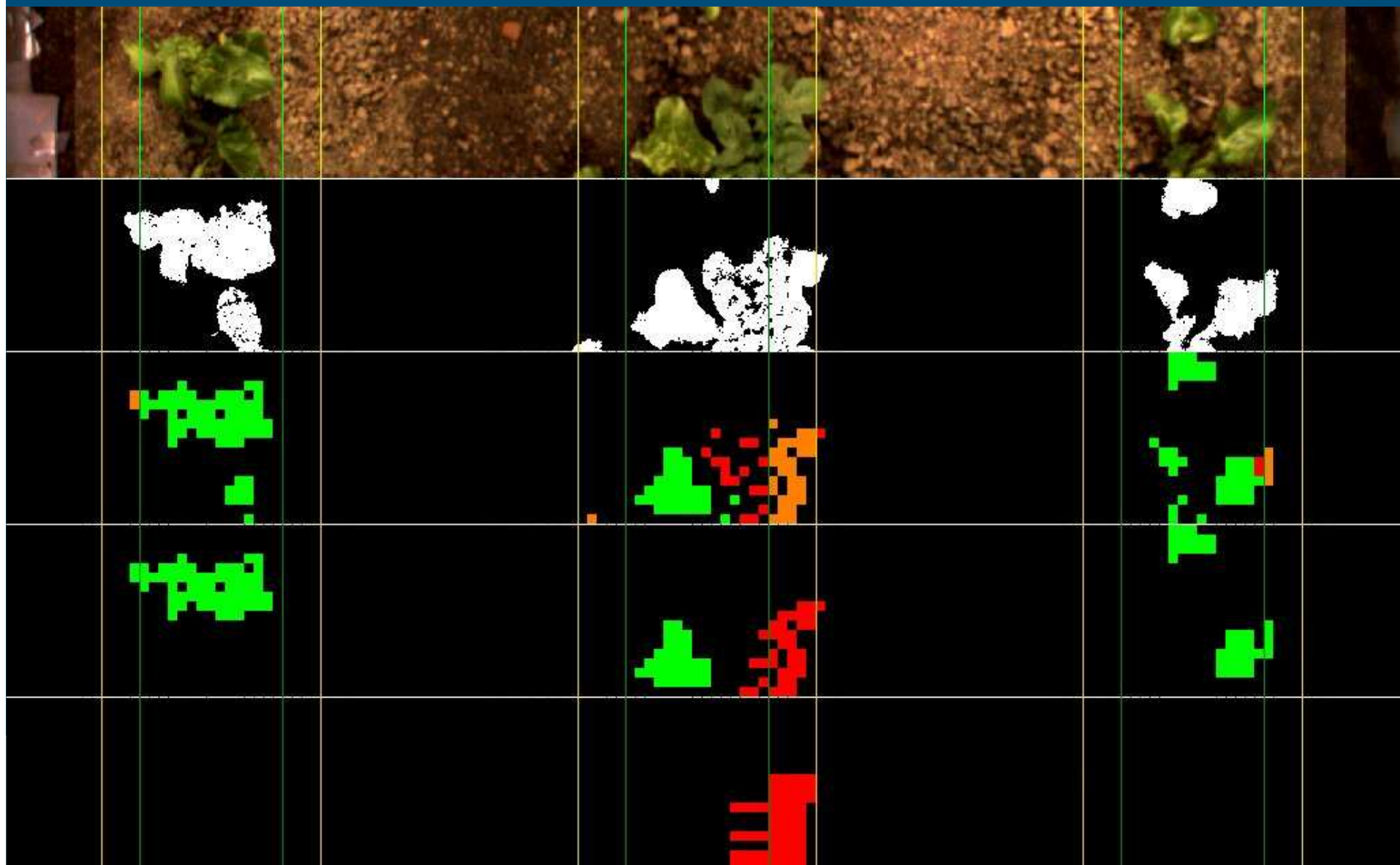


Detection – machine vision

- Methods → Multivariate Bayes classifier
- Adaptive crop and weed detection
- Learning based on crop row detection
- Vegetation grid cell features
 - Distance to crop row
 - Mean red value
 - Mean green value
 - Mean blue value
 - NDVI
 - Measure of texture



Detection – machine vision



Detection – machine vision

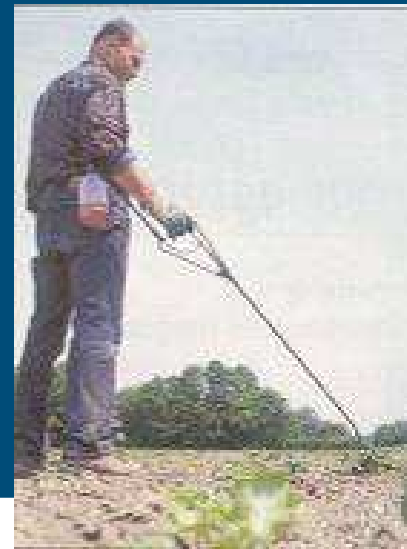
- Results from field experiment (300m²) October 2007

	N	Detected as:	
		Sugar beet	Volunteer potato
Sugar beet	263	92%	8%
Volunteer potato	29	3%	97%



Objective of removal

- Remove plants and kill tuber
- More than 90% control of volunteer plants
- Less than 5% sugar beet plants destroyed
- Driving speed between 5 and 7 km/h (1.5 - 2 m/s)



Removal – microsprayer

■ Methods

- Five needles in a row
- Glyphosate in gel
- Viscosity prevents splash
- Minimal drift



Removal – dose effect

■ Dose effect experiment

- 500 potato plants
- Effects of glyphosate in gel on volunteer potato plant
- 5 – 10 – 20 cm growth stage (I II III)

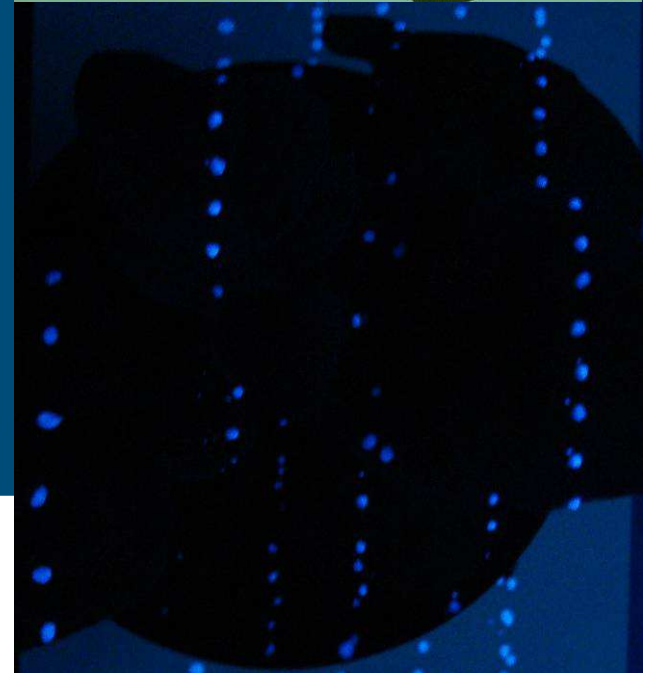
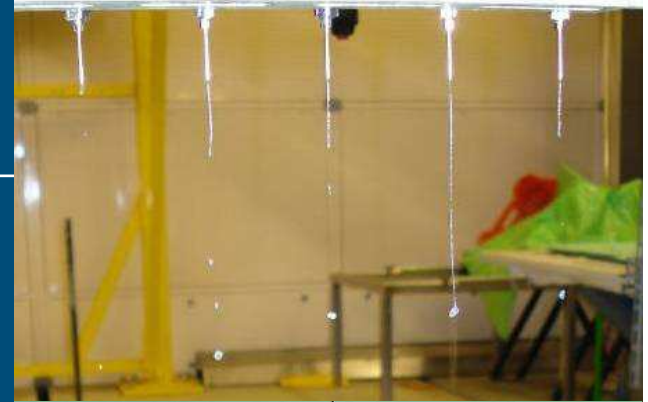
■ Effect parameters

- Photosynthesis activity
- New tuber production
- Regrowth



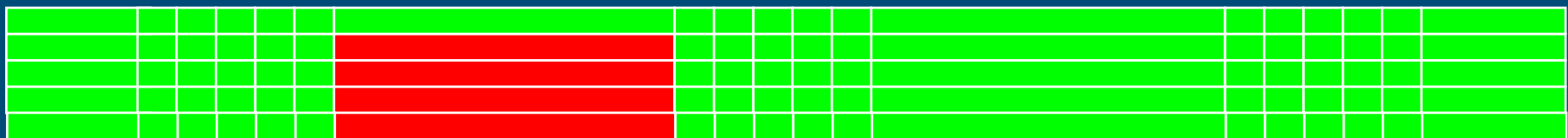
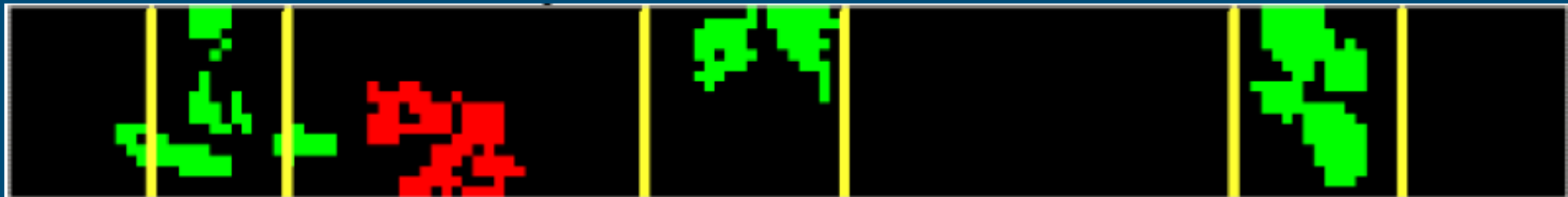
Removal – microsprayer

- Glyphosate in gel has same performance as glyphosate in water
- Fine droplet distribution gives the best control
- 3000 droplets / m² gives best control



Integration – functional model

- Detection and spraying combined
- Convert imaging to spraying
 - Within the row
 - Between the crop rows
 - Timing is crucial



Integration – field tests

- Performance of the system October 2008:
 - Volunteer potato control: 83 to 100 %
 - Sugar beet control: 0 to 1.4 %
 - Accuracy: ± 1.5 cm
 - Capacity: 2.5 hr / hectare
- System closely meets the requirements:
 - Velocity has to be increased



Integration – field tests

- Conclusions
- Real time detection feasible
- Positioning of droplets critical
- Micro-spraying feasible
- Glyphosate works



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Questions

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