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Better Training for Safer Food

Initiative

New technologies for a better spray application process

Precision farming to improve food quality

Jean – Paul DOUZALS
IRSTEA

Consumers, Health And Food Executive Agency

European Commission

Contents

low-volume spraying, variable application rate, sensors and other precision farming technologies

sensors for canopy characterization

new developments for drift reduction

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Challenges regarding to spray application techniques

Productivity – optimization (Cost vs. Gain Approach)
Food quality (input management, market requirements, residues)
Safety (Operator, Environment, Equipment)
Information – Feedback (traceability)

<u>Technologies providing potential answers</u>
Dosage - Volume/ha adjustment
GNSS based solutions (traceability, guiding)
Canopy detection and adjustment
Drift management

Every crop production industry has unique specifications

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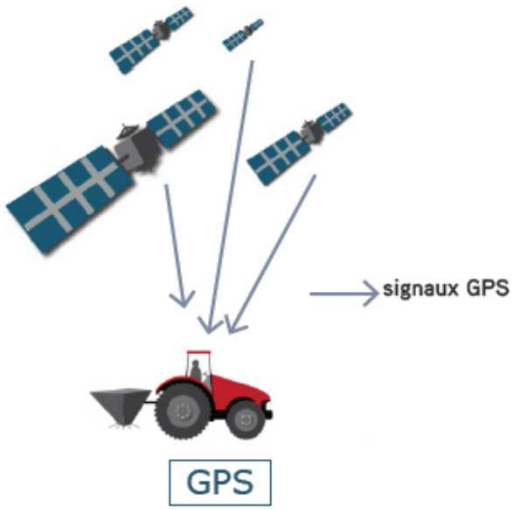
GNSS based solutions (traceability, guiding)

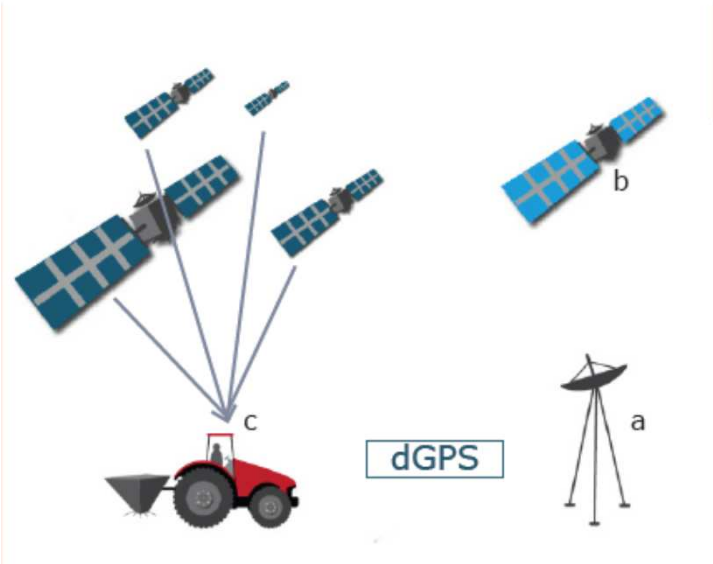


Source: CA N-PdC

Global Positioning System
or GLONASS or GALILEO (2020)
24 satellites – 20 000 km
Precision ± 5 m

Time of flight based system
Localization by multilateration
4 satellites min.
Not usable alone for agricultural purposes

GNSS based solutions (traceability, guiding)



Source: CA N-PdC

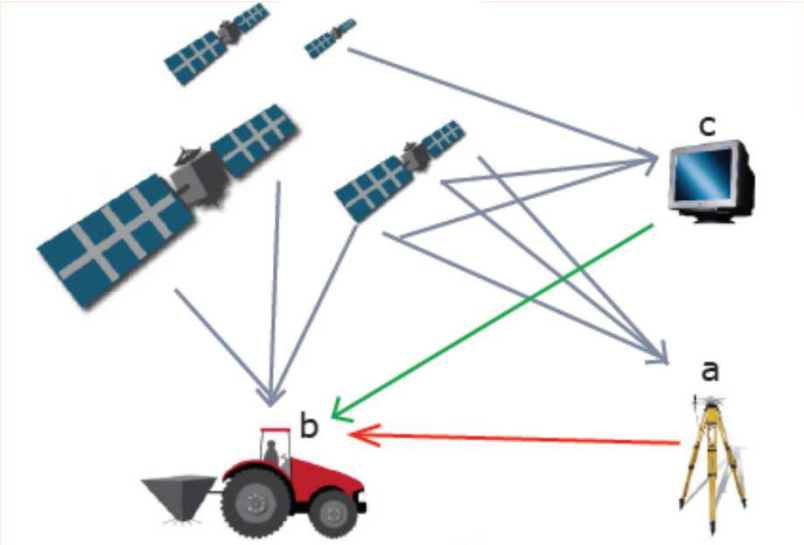
dGPS : differential GPS

Corrections are provided by ref stataion(s) and correction signal is sent via GPRS or GSM

EGNOS, StarFire, Omnistar
Precision ±5 – 50 cm

Compatible with tractor guiding
Sensitive to forest and relief

GNSS based solutions (traceability, guiding)



Source: CA N-PdC

GPS RTK

Precision ± 2cm
Use of Phase information
Ref stations – GSM transmission

Used for precision works (planting, sowing, hoeing)

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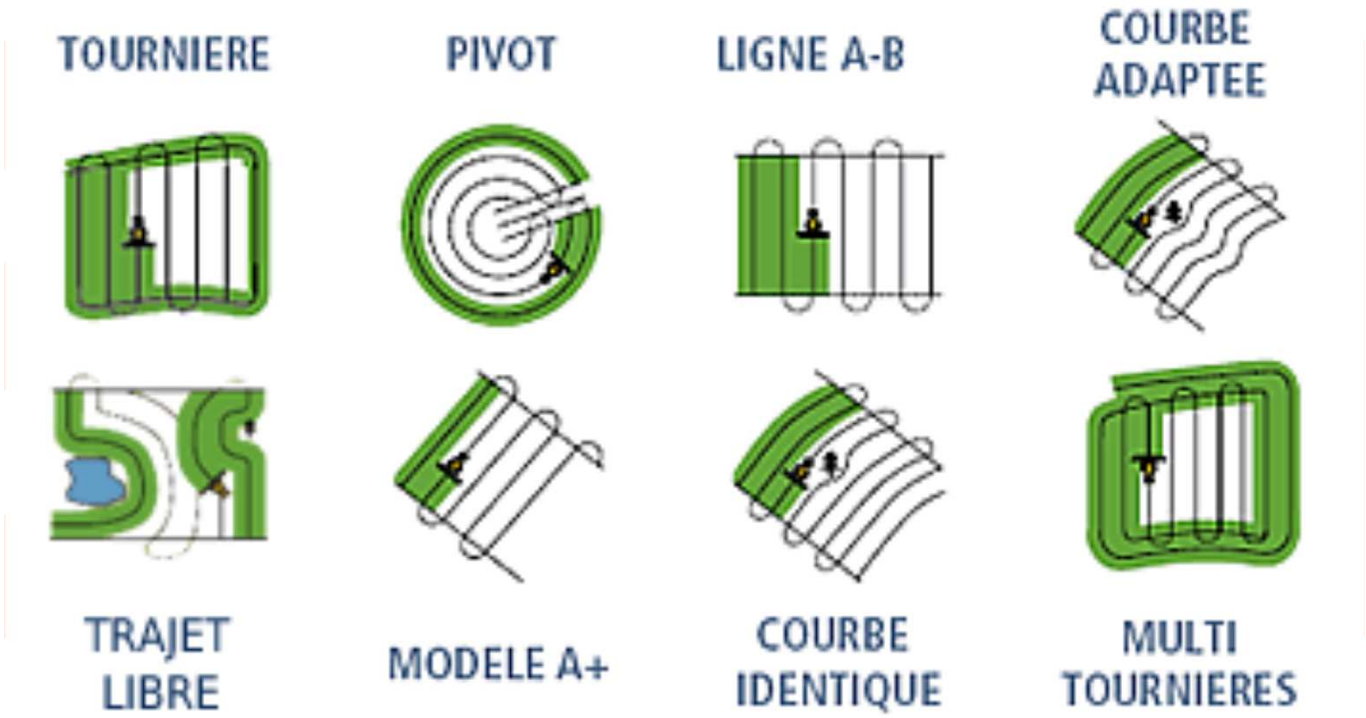
GNSS based solutions (traceability, guiding)

Guiding assistance systems
Auto guiding systems (autopilot)

Gains ~5-10 %

Guiding solutions



Source: geo-pro.fr

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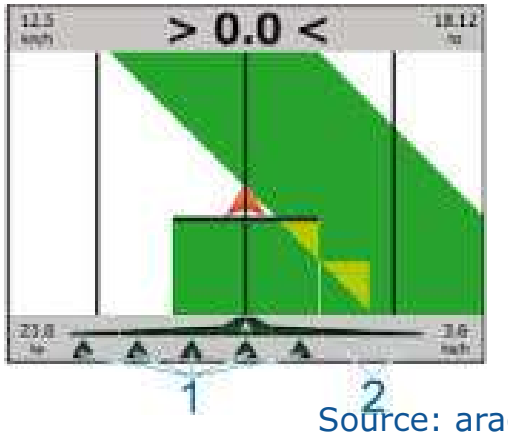
GNSS based solutions : Boom section control

Source: teejet.com



Source: arag

Gain depends on field geometry

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GNSS based solutions : Boom section control

Buffer zone management

Source : Amazone

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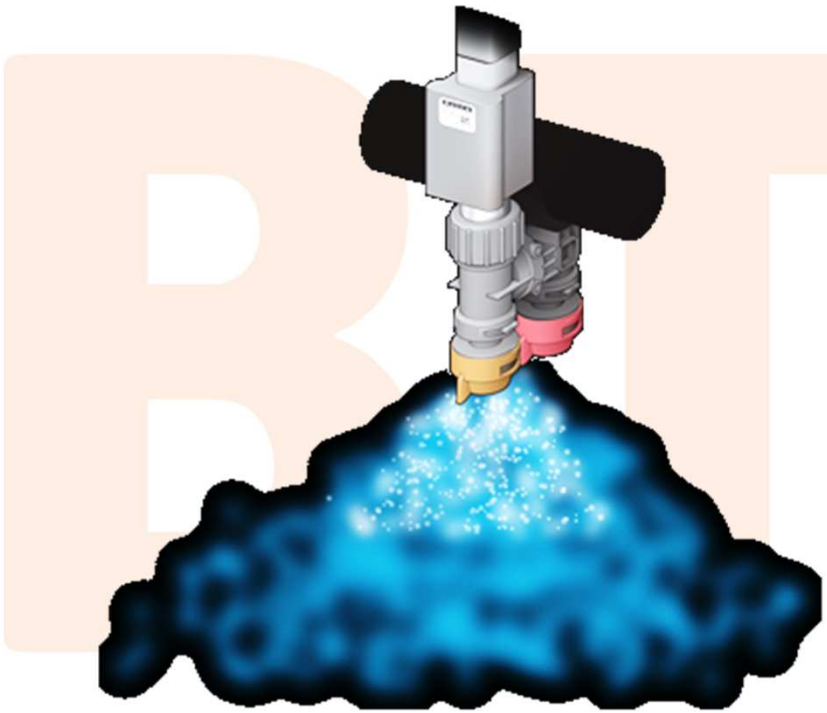
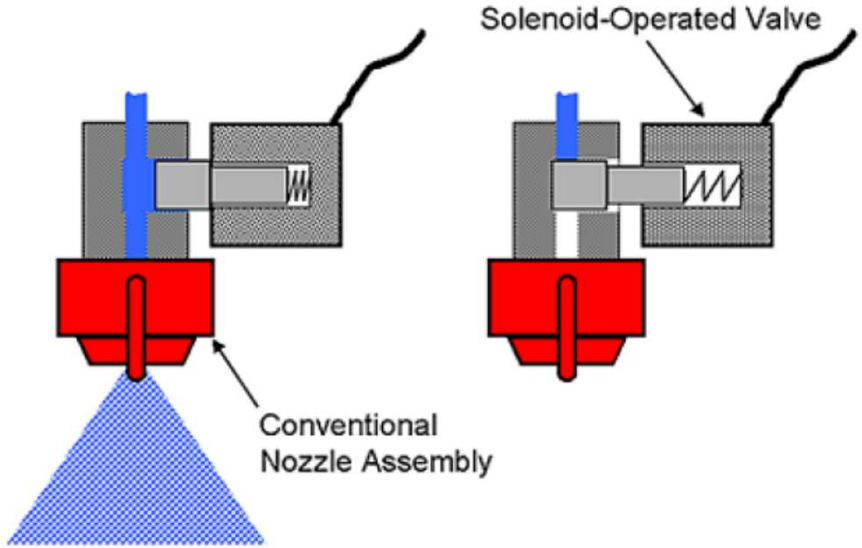
Boom section control systems can be used to prevent spray drift ?

- *NO anytime*
- *YES anytime*
- *YES if provided with nozzle switch technology*

GNSS based solutions : Single nozzle control

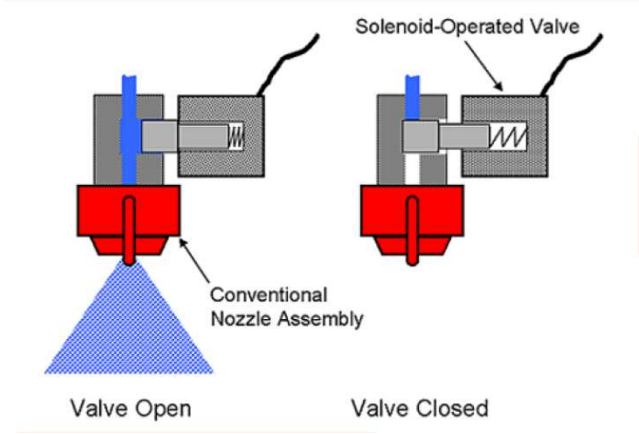


Source Raven



PWM control valve

Single nozzle control (ISS)



Pulse Width Modulation control valve (10 Hz)

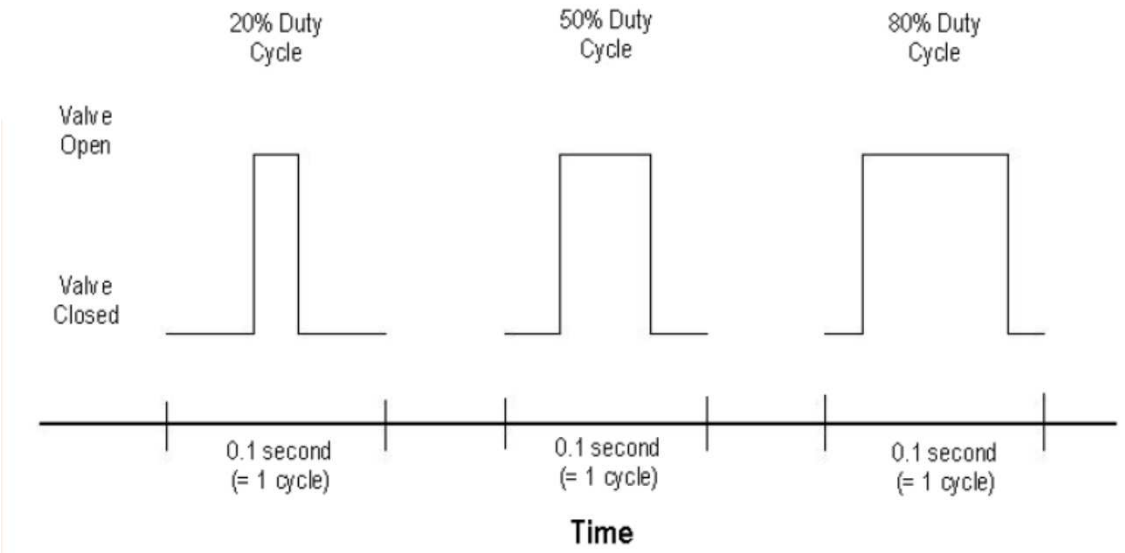


Figure 4. *Illustration of the electrical signal pattern used to control the operation of solenoid valves. (Note the varying duration of valve opening among the waves. This technique is referred to as* ***pulse width modulation****)*

Source Purdue Univ.

Source IRSTEA

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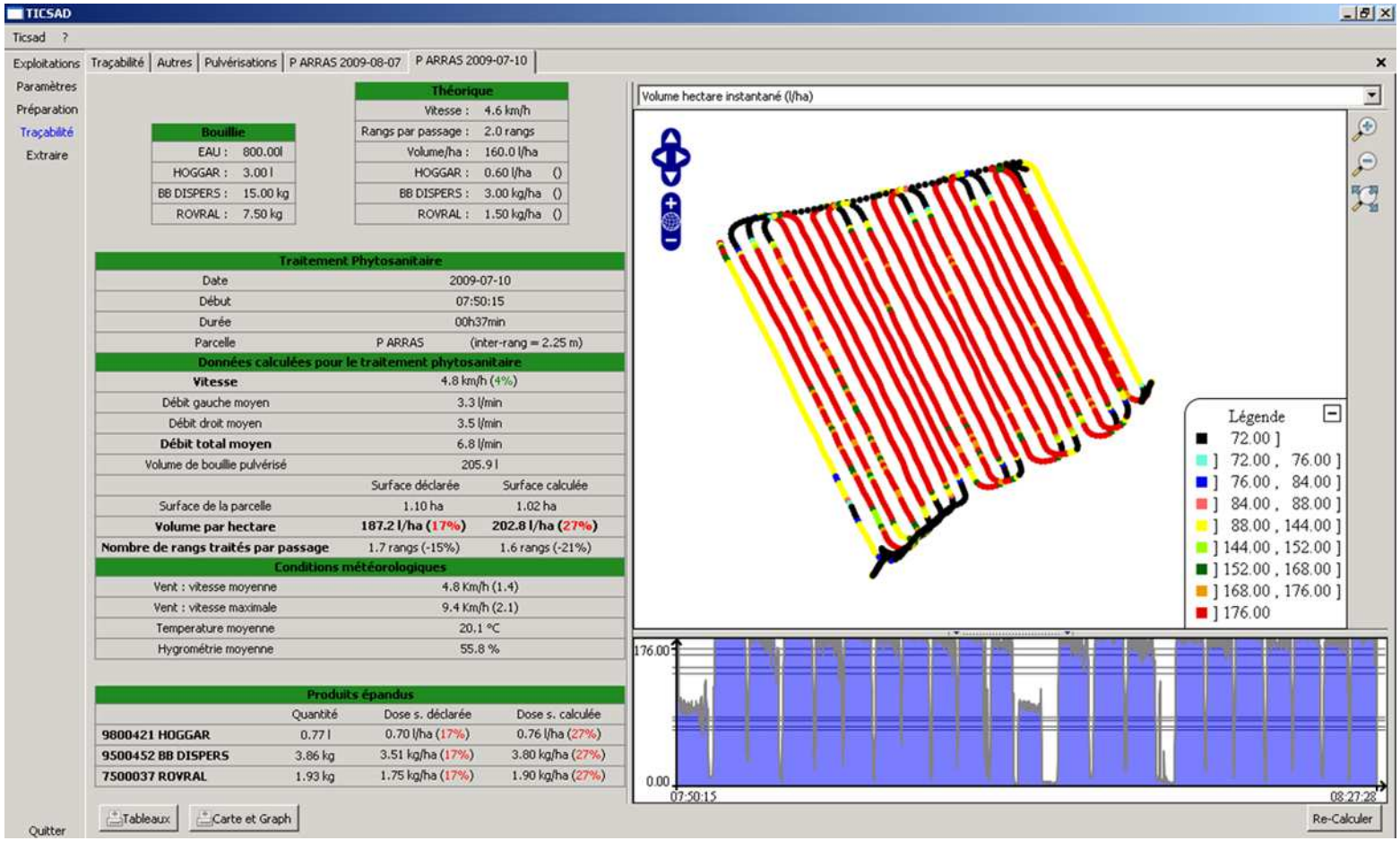
Results : Spray application mapping



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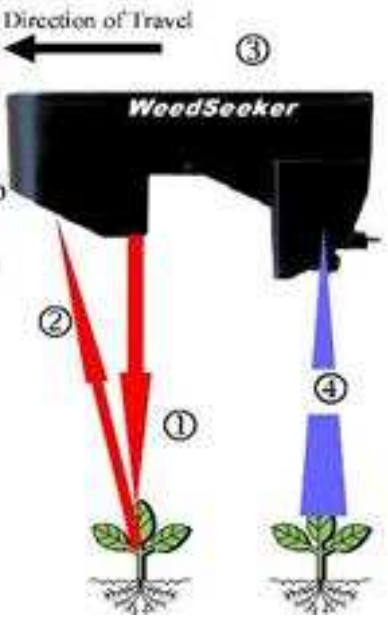
Vegetation detection for site specific applications

How a *WeedSeeker*® sensor works

1. "Light emitting diodes" (LEDs) produce a combination of invisible infrared and visible red light which is projected onto the target approximately 600 mm below the sensor.

2. The light reflected from the target is captured by a detector at the front of the sensor.



3. Sophisticated electronic circuits inside the sensor analyze the reflected light and determine when it matches the light reflected by green plants.

4. When green plant's reflectance is identified, the sensor waits until the plant is under the spray nozzle and then triggers a fast-fire solenoid valve which sprays the plant.

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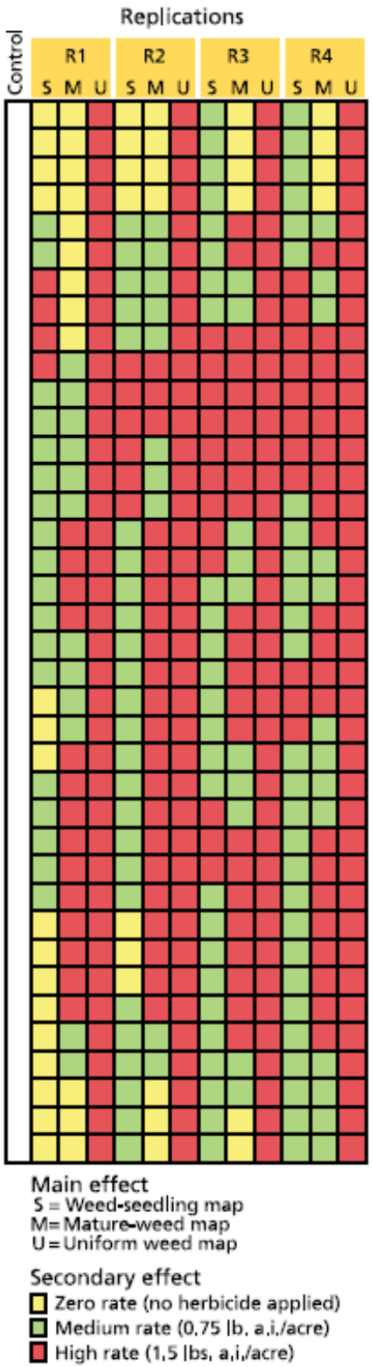
Gains of Weed Mapping & Patch Spraying

Herbicide application is the best example
Savings up to 90 %(1, 2)



M Koller and W.T. Lanini, 2005. Site-specific herbicide applications based on weed maps provide effective control., California Agriculture, 59 (3). 182-187.

Hamouz et al., 2013. Impact of site-specifc weed management on herbicide savings and winter wheat yield., *Plant Soil Env*., 59 (3), 101-107

Biomass detection/measurement

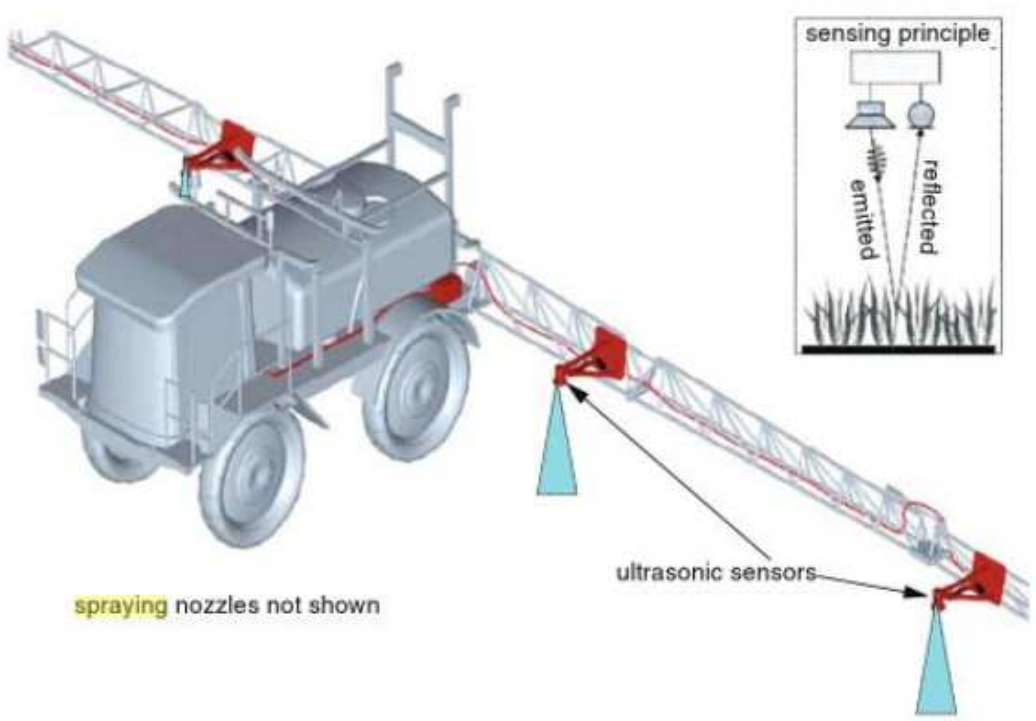


Fig. 11.1 Section control of a sprayer by ultrasonic sensing of biomass. The *insert* shows the sensing principle (From Reusch 2009 and Agri Con GmbH, Jahna, Germany, altered)

Precision in Crop Farming: Site Specific Concepts and Sensing Methods : Applications and results. 2013. H. J. Heege Ed. University of Kiel, Springer. 349p.

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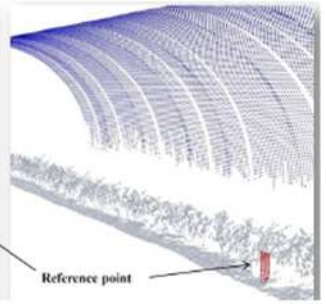
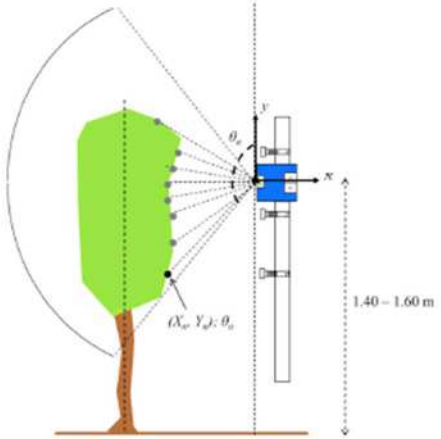
Crop detection

Electronic measurements for canopy characterization





Detection of missing plants
Adjustment of the application rate

Gil, E.; Llorens, J.; Llop, J.; Fàbregas, X.; Gallart, M. Use of a terrestrial lidar sensor for drift detection in vineyard spraying. *Sensors* **2013**, *13*, 516–534.

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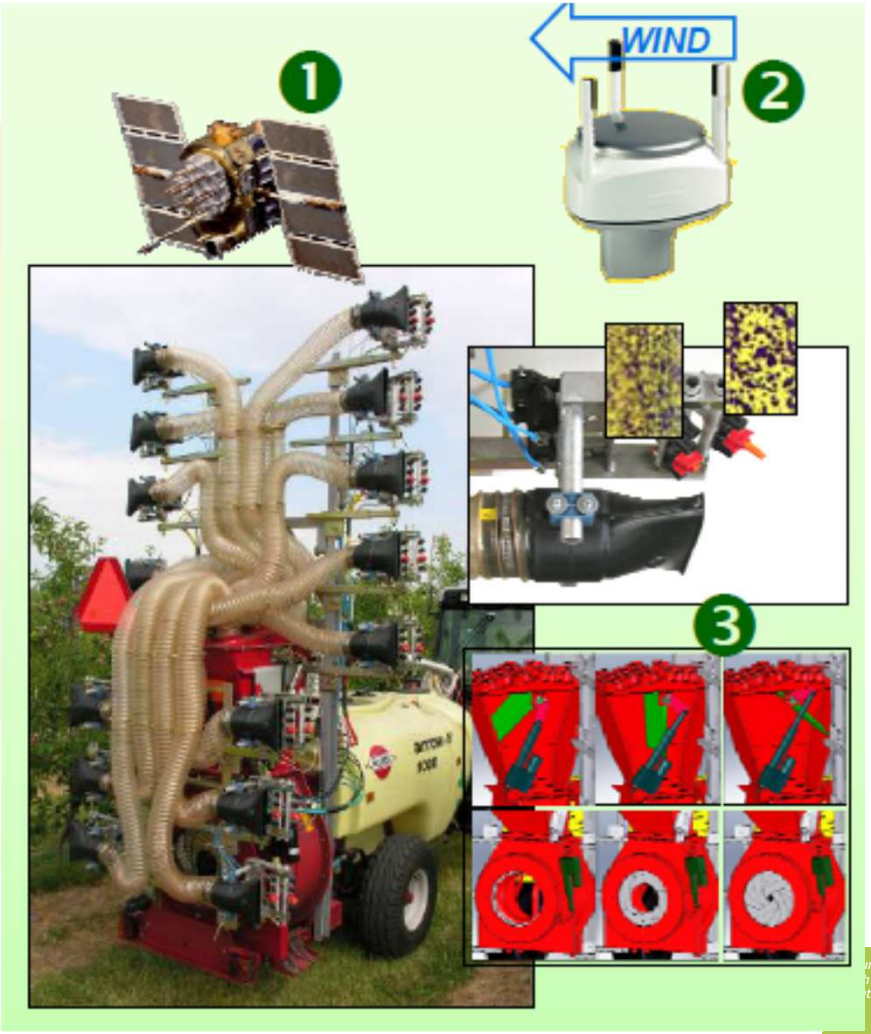
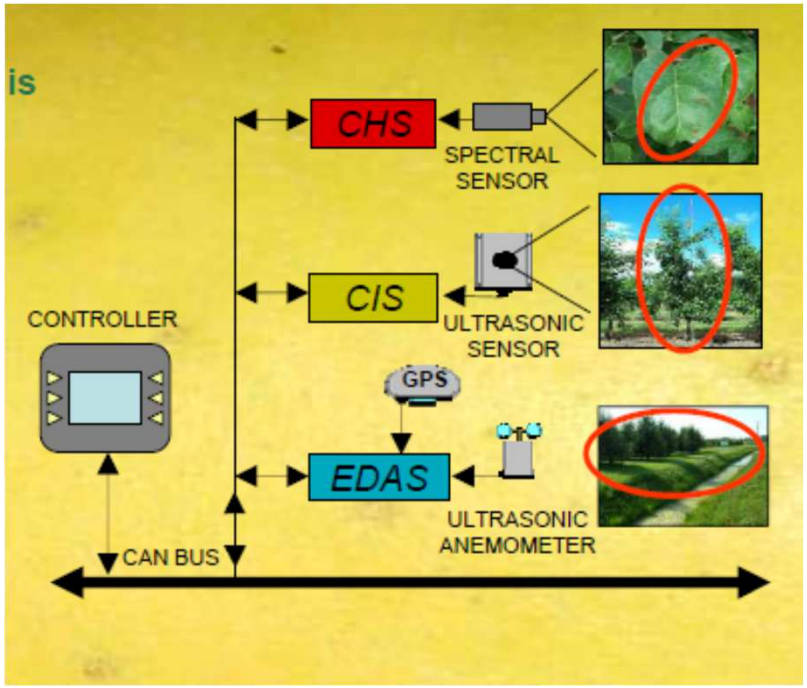
Crop detection and targeted application sprayers





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Crop detection systems :

Are used to detect missing vines or trees ?

May help to adapt the application volume to the crop volume ?

Can use ultrasonic sensors ?

Can use laser telemetry (Lidar) ?

Drift management (boom sprayers)

Air assisted boom sprayers

European database :
sdrt.-info.weebly.com

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Drift management (boom sprayers)

Shielded nozzle sprayers

Drift management (boom sprayers)

Source wingsprayer

Boom deflectors

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Drift management (bush and tree crop sprayers)

Conclusions

Current development of technologies to reduce the impact of pesticide application (dose adjustment, SSWM)

With the help of Precision Agriculture tools (GNSS, GIS) in order to keep a traceability of applications

Cost/gain approach is highly effective for weed management and gives promising results in the case of bush and tree crops applications

References

Guiding systems in Agriculture (in French) Agricultures et territoires – Chambre d'agriculture région Nord Pas de Calais Ed. 2013, 8p.

C. Debourdes, Mitigation of inputs in agriculture with GPS technologies (in French). Perspectives Agricoles, Feb 2012, 5p.

European database : sdrt.-info.weebly.com

Topps- AIM : http://topps-life.org/toppslife/sites/default/files/19%20-%20BR%20-%20AIM%20TEC%20Flyer.pdf

D. Ess, S.D. Parsons and C.R. Medlin, Implementing Site-Specific Management : Sprayer Technology – Controlling Application Rate and Droplet Size Distribution on the go. Purdue University SSM -5-W : https://www.extension.purdue.edu/extmedia/AE/SSM-5-W.pdf

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Thank you for your attention.

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European Commission
Consumers, Health and Food Executive Agency
DRB A3/042
L-2920 Luxembourg

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