Using a fleet of robots for patch spraying

C. Fernandez-Quintanilla
1. **Context**
   - Weed distribution
   - SSWM (Site specific weed management)
   - Robots
1. **Context**
   - Weed distribution
   - Site Specific Weed Management
   - Robots

2. **RHEA Project**
   - Concept
   - Equipment
   - Demo
The challenge

Very often, weeds are aggregated in patches
Weed distribution may be due to various factors.
What can be done?

Site-specific weed management: the old style

L. Barrau
A changing scenery

1940 - Typical scenery in Central Spain

Workforce

[Image of a map with labeled points A, B, and C, and a group of people in traditional attire]
A changing scenery

2015 - Typical scenery in Central Spain

Workforce
What can be done?

Site-specific weed management: *high-tech style*

Hohenheim University

Supervision  Actuation  Decision making
Ground supervision

Optoelectronic sensors in maize

Institute of Agricultural Sciences, CSIC
Ground supervision

LIDAR sensors in poplars

Institute of Agricultural Sciences, CSIC
Ground supervision

Video + Image analysis in maize

Hohenheim University
Aerial supervision

Hyperspectral radiometer in maize

Institute of Agricultural Sciences, CSIC
Aerial supervision

Multispectral cameras in maize

Institute of Sustainable Agriculture, CSIC
Decision making

AgLeader
State of the art

Automobile vector

Agricultural vector

Delphi

John Deere
State of the art

Weed control sector

Hortibot
Aarhus University

BoniRob
Amazone
RHEA: Robot Fleets for Highly Efficient Agriculture and Forestry Management
NMP2-LA-2010-245986

8 countries
3 Research centres
4 Universities
7 SMEs
1 Large company
Two options?

Macro-spraying vs. Micro-spraying
Our choice: a fleet of medium sized robots

Harper Adams University
RHEA Project

**CONCEPT**

- Inspection
- Weed map
- Decision making
- Control

**EQUIPMENT**

- Actuation

**DEMO**

- Inspection
- Weed map
- Actuation

**Inspection**

- Drone
- Computer

**Weed map**

- Drone
- Computer

**Actuation**

- Tractors
RHEA Project

Inspection

Data base: Historical weed infestation

Previous season

May

Current season

July

February
Actuation

Prescription map
**Base station:** control and communication systems for a fleet with 3 ground mobil units and 2 aerial units

**Decision making / Control**
The air platform:

- Model: Air Robot 200
- Mass: 6.3 kg (with battery)
- Maximum payload: 3 kg
- Flight duration: 40 min
- GPS accuracy: ±2.5 m
**The ground platform:**

- **Model:** CNHI Boomer 3050-CVT
- **Weight:** 1.83 ton
- **Engine power:** 51hp
- **Length:** 3.1 m

**Actuation**

- Communication antenna
- Vision system
- Safety controller antenna
- GPS antenna
- Solar panel 200W

**CNHI**

**Fuel cell 1200 W**
The smart sprayer: 2 tanks: \( \text{H}_2\text{O} \) (200 l), herbicide (15 l)

Central Direct Injection system

Solenoid nozzles
The physical control implement:

- Inter-rows: mechanical
- Within-rows: thermal
RHEA Project

**Actuation**

- **Row detection**
- **Weed detection**

University of Madrid
La Poveda Research Station, Arganda, January 2014
Actuation

Weed patch
RHEA Project

Institute of Sustainable Agriculture, CSIC / IRSTEA
>95% targets sprayed
<2% non-targets sprayed
Working as a fleet
Project impact

• More precise operations
• Saving herbicides / propane
• Lower farmer exposure to herbicides
• Lower side effects on the environment
• Lower hand labor ........
• ......(but more qualified!)
Looking back

ECPA 2001

Third European Conference on Precision Agriculture

Montpellier
Thanks to....

.... and to all of you for listening