



Searching for new tools for low-input agriculture

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CENTRO DE CIENCIAS MEDIAMBIENTALES



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Defining low-input agriculture

- Is it worthy wasting our time discussing definitions?
- Low-input agriculture = Organic agriculture?
- They may have different objectives and methods
- If they are not the same, their research needs may be different
- Introducing the LIA concept

Defining low-input agriculture

*“Low input farming systems seek:
to optimize the management and use of internal production inputs and
to minimize the use of external production inputs, such as purchased
fertilizers and pesticides, wherever and whenever feasible and
practicable,
to lower production costs, to avoid pollution of surface and
groundwater, to reduce pesticide residues in food, to reduce a
farmer’s overall risk, and to increase both short- and long-term farm
profitability”* (Parr et al., 1990)

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- Although low-input agriculture (LIA) is mainly focused on reducing the use of purchased agrochemicals, it does not exclude any type of input
- The technological toolbox for LIA may be much larger than for organic agriculture

Searching into the toolbox



Tools available:

- Global Positioning System (GPS)
- Geographic Information Systems (GIS)
- Remote and proximal sensing
- Variable Rate Technology (VRT)
- Information and Communication Techs (ICT)
- Modelling; Decision Support Systems (DSS)
- Robotics
- Biotechnology

Case study: Site-specific weed management

Weeds are generally patchy



Case study: Site-specific weed management

How patchy are weeds?

Percentages of the fields that are infested
with various weed species

Weed	Crop	Fields sample	% area infested	Range
<i>Alopecurus</i> (U K)	W heat	24	41	4-85
<i>Avena</i> (U K)	W heat	12	17	2-57
<i>Avena</i> (E)	Barley	31	22	3-97
<i>Cirsium</i> (U K)	W heat	4	23	9-37
<i>Sorghum</i> (E)	M a i z e	38	16	1-46
Total /		109	24	4-64
Average				

Case study: Site-specific weed management

How big are weed patches?

Size distribution of patches of *Avena sterilis*
in commercial barley fields

Patch size	n	Area infested (ha)	% n	% area
Small ($< 100 \text{ m}^2$)	406	1.7	58	3
Medium ($100 - 500 \text{ m}^2$)	209	4.8	30	9
Large ($500 - 5000 \text{ m}^2$)	64	9.1	9	17
Very large ($> 5000 \text{ m}^2$)	21	31.0	3	72

89%

Case study: Site-specific weed management

Patch detection is technically feasible

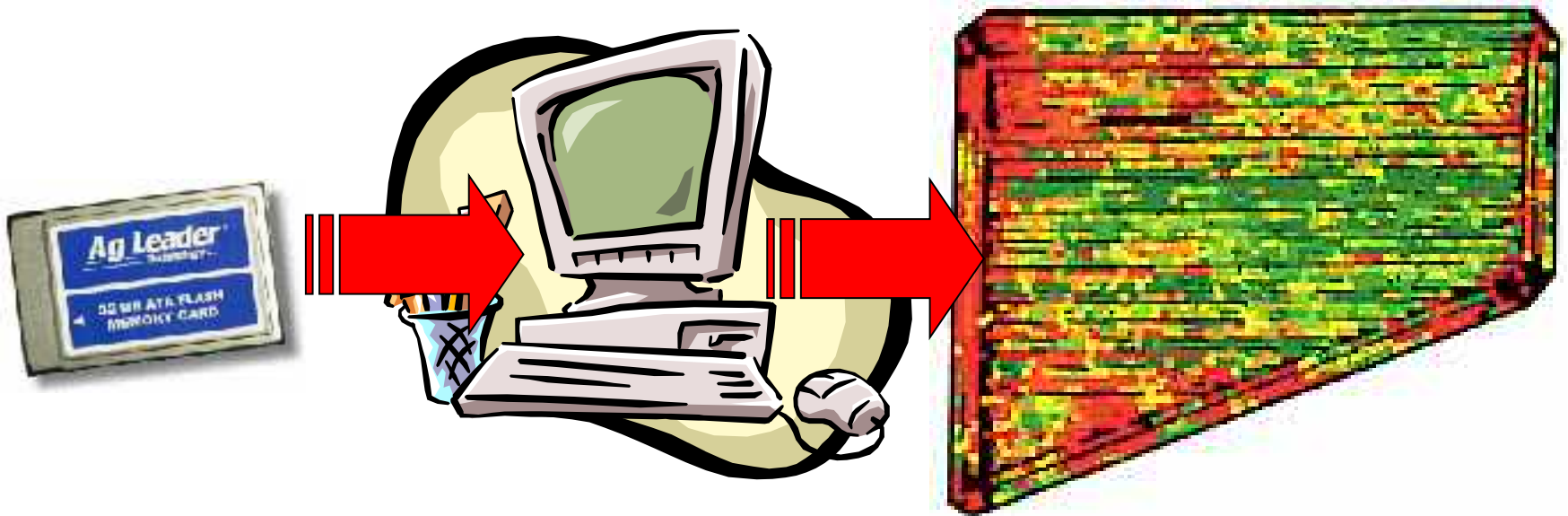
Ground based detection using bi-spectral cameras (Oebel & Gerhards, 2006)



Case study: Site-specific weed management

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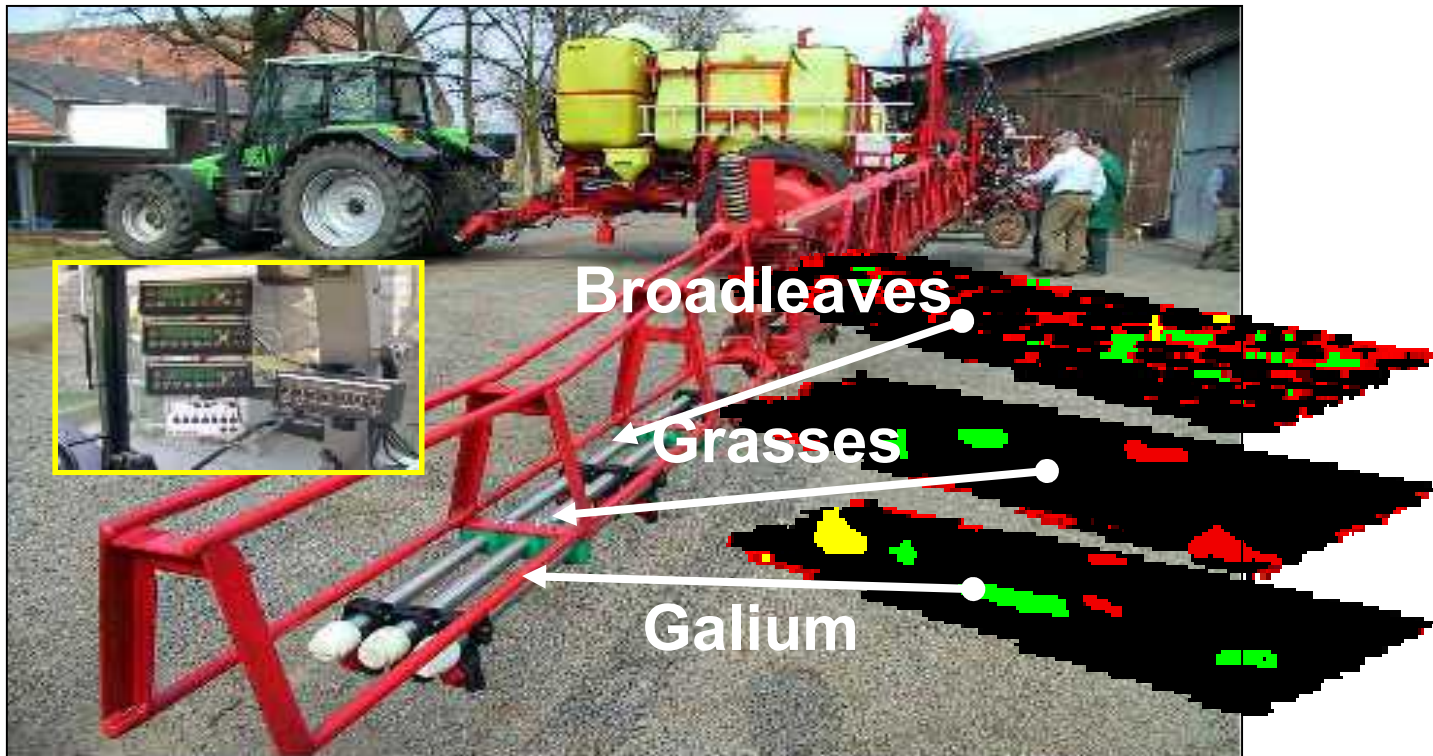
Generation of weed maps based on image analysis software that differentiates plants by shape (Oebel & Gerhards, 2006)



Case study: Site-specific weed management

Patch sprayers are already available

Experimental prototype patch sprayer that delivers 3 separate treatments (Gerhards & Oebel, 2006)



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Case study: Site-specific weed management

Patch spraying may be profitable economically

Average costs (€/ha) for weed control in various crops using uniform and site-specific treatments (Gerhards & Sokefeld, 2003)

Crop	Number of fields	Uniform	Site-specific 1	Site-specific 2
<i>Winter wheat/barley</i>	18	68	47	32
<i>Sugar beet</i>	21	148	151	69
<i>Maize</i>	7	103	113	95
<i>Average</i>		106	104	65

Site-specific 1 (3-section sprayer)... .. 14.8
€/ha

Site-specific 2 (direct injection sprayer)... .. 18.7 €/ha

Case study: Site-specific weed management

Patch spraying may save substantial herbicide volumes

Savings (%) for grass and broad-leaved herbicides using patch spraying (Gerhards & Oebel, 2006)

Crop	Fields size	Grasses	Broad-leaved
Spring barley	8.4	71	26
Spring barley	17.5	42	18
Winter wheat	20.0	65	58
Winter wheat	5.3	79	81
Sugar beet	5.8	46	57
Maize	4.6	6	46
Average	10.8	51.5	47.7

Other opportunities



- Minimizing the use of pesticides → Precision crop protection; GM crops
- Minimizing the use of fertilizers → Site-specific nutrient management
- Minimizing the use of fuel → Conservation tillage
- Minimizing the use of water → Drip irrigation; Precision water management

Other opportunities

Minimizing the use of pesticides: current research activities



- Spatial ecology of insects, plant pathogens and weeds
- Detection of pest organisms: remote sensing and ground sensors
- Site-specific spraying techniques
- Non chemical tactics: biological control, habitat manipulation, cultural and mechanical control, plant resistance
- IPM strategies
- Decision support systems

Need of a COST action

Although available technological tools can contribute significantly to minimize the use of external inputs, it is necessary:

- To integrate these tools into current and future low input systems
- To identify the gaps that exist in the development / commercial uptake of these systems
- To explore the opportunities to use these tools in organic agriculture
- To devise ICPS that tackle the overall problem rather than providing partial solutions

Thank you

