Can we have user friendly DSS, especially for weed control?

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Survey on existing DSS

- **Planned and executed by participants from 8 countries**
- **27 EU-countries + Switzerland was included**
- **Data was collected on 70 DSS**
- **Analyses revealed a rich collection of:**
  - crop x pest systems
  - decisions, which are supported
  - modelling approaches
  - levels of validation
  - levels of implementation
  - … and much more …

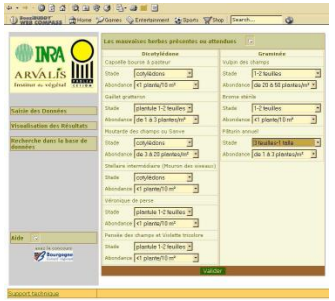
Results from survey

- **In a context of reducing the use of pesticides, 'best parts' were identified in 4 major crop x pest groups:**
  - diseases in horticultural crops (18 DSS)
  - diseases in agricultural crops (37 DSS)
  - pests (18 DSS)
  - weeds (9 DSS)

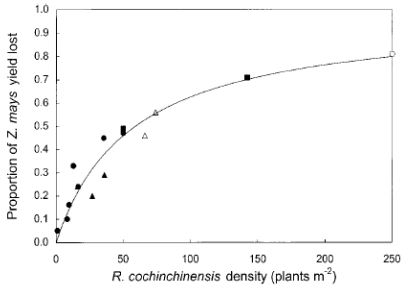
- **Report (140 pages) was published on ENDURE Workspace and endure-network.eu**

‘Best parts’ for weed control

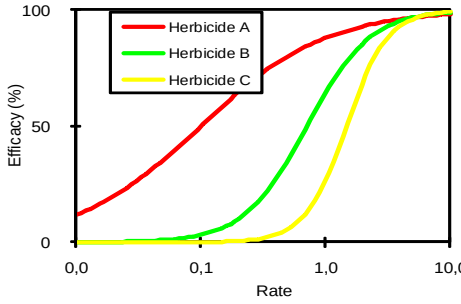
- **’DecidHerb’, France**
  - ’fuzzy logic’ to quantify needs for weed control
  - multicriteria assessment of alternative treatments options



- **’GestInf’, Italy**
  - yield-loss functions and expected economic net return of alternative treatment options



- **’CPOWeeds’, Denmark**
  - herbicide dose-response functions
  - linear optimization of herbicide mixes, e.g. for cost or Treatment Frequency Index (TFI)



endure diversifying crop protection

New DSS
- decisions on different points of time

1. **Before a growing season:**
   1. read updated field weed map
   2. consult DSS
   3. order relevant herbicides x quantities

2. **During a growing season:**
   1. follow time plan (when, what)
   2. inspect field
   3. consult DSS
   4. treat if needed
   5. evaluate
   6. inspect field again …

3. **After a growing season:**
   1. return surplus of herbicides to the dealer

Decisions on the day of treatment

Field report

Quantify needs for control:

1) DecidHerb:
   WPT (fuzzy logic)
2) Alternative:
   Manual input

Identify treatments:

1) CPOWeeds:
   Dose-response functions
   (species, size, clim. cond.)
   + ADM-optimization
   for cost or for TFI
2) Alternative:
   Rec. from handbooks

Ranking of treatments:

1) GestInf:
   Economic net return
2) DecidHerb:
   Ipest index
   Multicriteria assessment
3) CPOWeeds:
   TFI
   Cost

Recommendations

Target efficacy (%) on single weed species

Single herbicides and mixes in adequate dose rates

System architecture

- **Microsoft Excel (2007/2010)**
- **A ‘modelling platform’, customizable for:**
  - arbitrary combinations of country x crop x weed species x herbicides x ‘conditions’
  - complexity of algorithms and calculation functions
- **Operational DSS and documentation is publicly available in the ENDURE Virtual Laboratory**

Initial parameterisation

- **To test functional integrity:**
  - 1 crop, 3 weeds, 3 herbicides
- **Estimates of algorithms and functions:**
  - Weed Potential Threat (WPT): INRA, France
  - Herbicide dose-response functions: AU, Denmark
  - Yield loss functions and economic net return: CNR, Italy
- **Recommendations from this parameterisation should not be followed in real fields! ☺**

User-interface

Generic DSS for weed control, ver. 1.0

Constructors: INRA, France / UCPH, Denmark / AU, Denmark / CNR, Italy

endure diversifying crop protection

Actual treatment no. 1

status 1,00

obj 3,00

Find optimal dose for treatment

Field report

Maize growth stage	Crop vigor	Yield (weed free) - hkg/ha
2-3 leaves	Strong, even canopy	110 - 130
3	2	3

Grain price - €/hkg
17 - 20
3

Weed	Weed growth stage	Density group
Capsella bursa-pastoris	1-2 leaves	3 - 20 pl/m²

Calculated values

Optimize for: Costs €/ha

Actual value 0,5643906

Cost model	Costs €/ha	TFI	g a.i.	Net margin €/ha
0,56439064	0,5643906	0,03	0,444	-12,4

Harm	WPT	Target efficacy WPT-con.	Man	Result	Expected eff. ADM
0,198	0,170523416	34%		34%	34%
-	-	-		-	-
-	-	-		-	-
-	-	-		-	-
-	-	-		-	-
-	-	-		-	-
-	-	-		-	-
-	-	-		-	-

Find all treatment options

Recommendations for control

4% of N!

	Costs €/ha	Costs €/ha	TFI	g a.i.	Net margin €/ha
0,444 Harmony SX;	0,564	0,564	0,03	0,444	-12,4
3,93 Maister;	1,17	1,17	0,026	3,93	-13,0

2 weeds, small, low density

Field report

Maize growth stage	Crop vigor	Yield (weed free) - kg/ha
2-3 leaves	Strong, even canopy	110 - 130
3	2	3

Grain price - €/hkg
17 - 20
3

Weed	Weed growth stage	Density group
Capsella bursa-pastoris	1-2 leaves	3 - 20 pl/m²
Galium aparine	1-2 leaves	3 - 20 pl/m²

Calculated values

Optimize for: Costs €/ha

Actual value: 5,7407408

Cost model	Costs €/ha	TFI	g a.i.	Net margin €/ha
5,740740806	5,7407408	0,129	19,31	5,3

Harm	WPT	Target efficacy WPT-con.	Man	Result	Expected eff. ADM
0,198	0,170523416	34%		34%	89%
0,668	0,260382514	52%		52%	52%
-	-	-		-	-
-	-	-		-	-
-	-	-		-	-
-	-	-		-	-
-	-	-		-	-
-	-	-		-	-

Recommendations for control

13% of N!

19,3 Maister;
0,327 Callisto;

Find all treatment options

Costs €/ha
5,74
16,8

Costs €/ha	TFI	g a.i.	Net margin €/ha
5,74	0,128	19,3	5,3
16,8	0,218	0,327	-5,9

3 weeds, larger, high density

Field report

Maize growth stage	Crop vigor	Yield (weed free) - hkg/ha
2-3 leaves	Strong, even canopy	110 - 110
3	2	3

Grain price - €/hkg
17 - 20
3

Weed	Weed growth stage	Density group
Capsella bursa-pastoris	3-4 leaves	> 50 pl/m²
Galium aparine	3-4 leaves	> 50 pl/m²
Setaria viridis	3-4 leaves	> 50 pl/m²

Calculated values

Optimize for:	Actual value
Costs €/ha	58,885135

Cost model	Costs €/ha	TFI	g a.i.	Net margin €/ha
58,88513514	58,885135	1,75	161,3	699,4

Harm	WPT	Target efficacy WPT-con.	Man	Result	Expected eff. ADM
0,256	0,330192308	66%		66%	100%
0,795	0,815909091	95%		95%	97%
0,507	0,556428571	95%		95%	95%
-	-	-		-	-
-	-	-		-	-
-	-	-		-	-
-	-	-		-	-
-	-	-		-	-

Find all treatment options

Recommendations for control

2 x N!

	Costs €/ha	Costs €/ha	TFI	g a.i.	Net margin €/ha
150 Maister; 11,2 Harmony SX;	58,8	58,8	1,75	161	699,0
150 Maister; 0,61 Callisto; 11,2 Harmony SX;	90,2	90,2	2,15	161	705,0
150 Maister; 1,5 Callisto;	121	121	2	151	699,0

First question

- Can we have user-friendly DSS, especially for weed control?
- What do you think?
- Please visit DSS demo stand at this conference

Expected benefits

- **A central point of reference for:**
  - economic thresholds for treatment
  - target efficacy
  - herbicide efficacy
  - optimized treatments on a field level
  - anti-resistance strategies (preventive, curative)

- **A potential for reduction of herbicide use:**
  - depends on the extent of herbicide efficacy data accessible
  - if efficacy data from 2-3 dose rates is accessible: 20-50% reduction as compared to ‘best practices’
  - low risk for farmers – only ‘low-hanging fruits’ are picked (=only safe reductions are recommended)

Requirements for construction

- **Qualification required for construction (parameterization) of DSS:**
  - insigth in interactions between: crops x weeds x herbicides x ‘conditions’
- **A general problem:**
  - limited access to data on efficacy of herbicides in reduced dose rates
- **A general solution: Adjust EU-legislation on pesticides:**
  - data on pesticide efficacy should be publicly accessible!
  - more data on efficacy of reduced dose rates of pesticides should be submitted for registration of pesticides!
  - such actions also support the implementation of Directive 2009/128/EC (IPM) in 2014

Requirements to end-users

- **Field inspections:**
  - advisors cannot overcome this task (but support)
  - low economic incentives for farmers
  - farmers are reluctant

- **Danish questionnaire survey, 2004, 600 farmers:**
  - user-interface (similar to new DSS): no problem!
  - differentiated treatments on a field level: no problem!
  - field inspections before treatments: big problem!

Future plans

- **Excel tool will be used as an outline for construction of web-applications and web-services**
- **Parameterisation for more regions x crops x weeds x herbicides x conditions**
- **Integration of Ipest index and 'multicriteria assessment'**
- **Integration of more requirements in Directive 2009/128/EC (IPM):**
  - non-chemical control measures
  - 'guidelines' for specific combinations of nation/region x crop x pest type