Plant health for sustainable agriculture
CONFERENCE, 11 – 12 May 2015, Ljubljana, Slovenia

A generic Decision Support System (DSS) for Integrated Weed Management (IWM)

Plant health for sustainable agriculture (PHSA)

Ljubljana, 12th May 2015

Per Rydahl
IPM Consult Ltd., Denmark

Disposition

- Experience in DSS on IWM
- Demonstration
- Ideas and requirements
- ‘Decision engine’
- Integration of legal restrictions and IPM
- Customization for different countries
- IT system architecture
- Summary

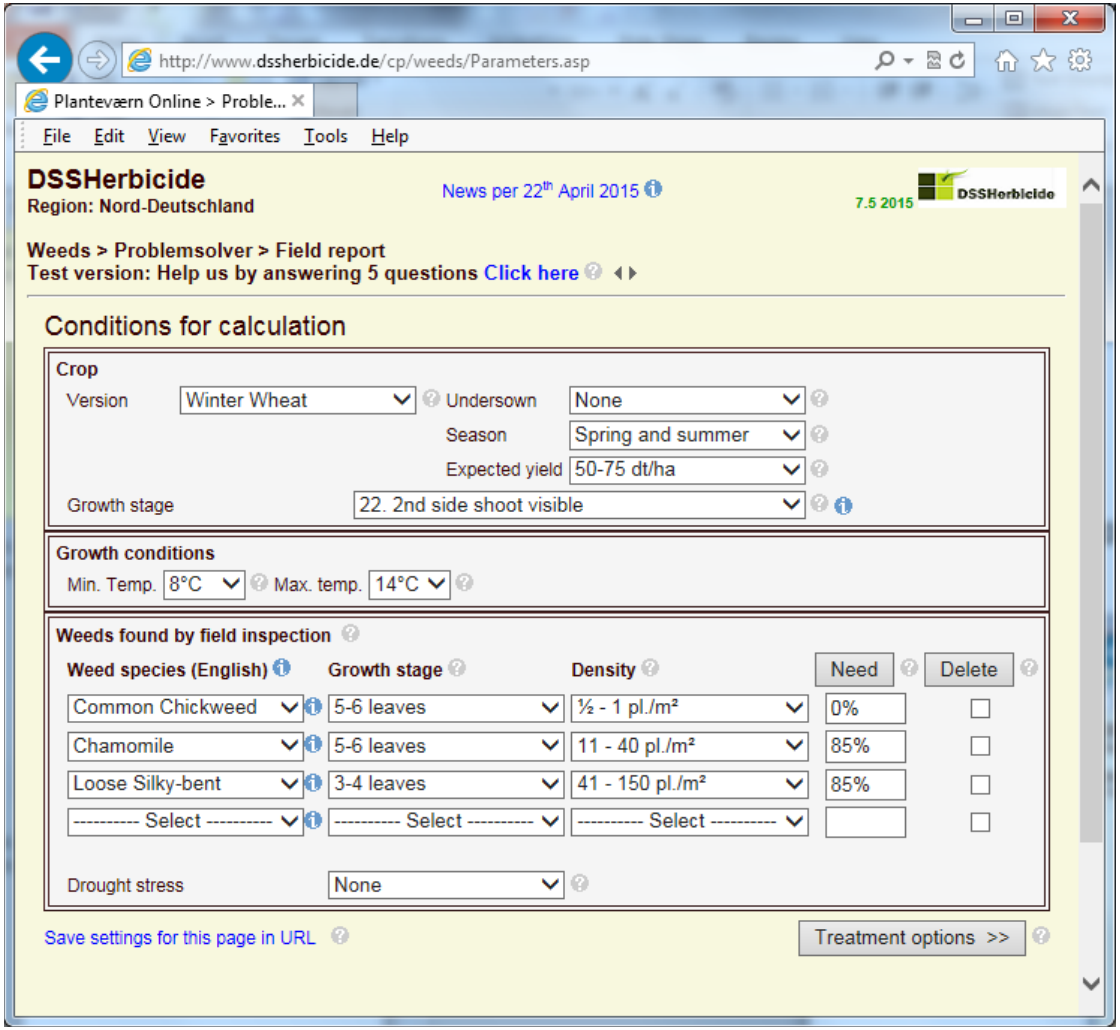
Experince in DSS on IWM

- 1989-2014:
  Aarhus University
  Design, test, export of DSS for IWM

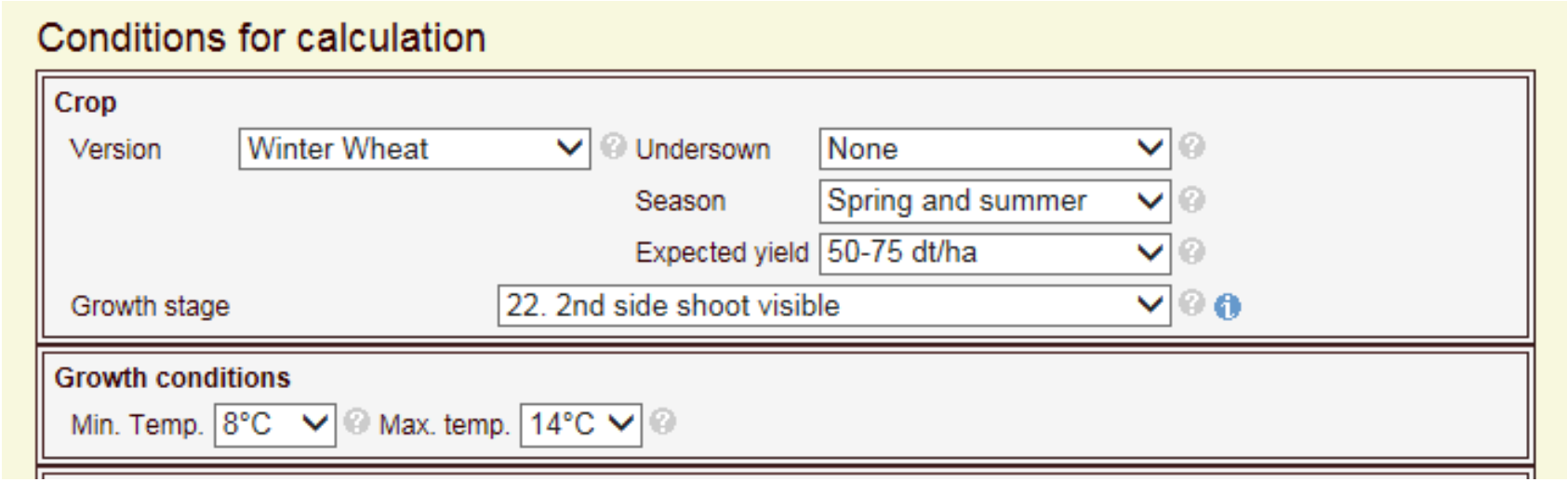
- Sept 2014 - :
  IPM Consult Ltd. (SME)
  Design, test export of DSS for IWM

Demonstration

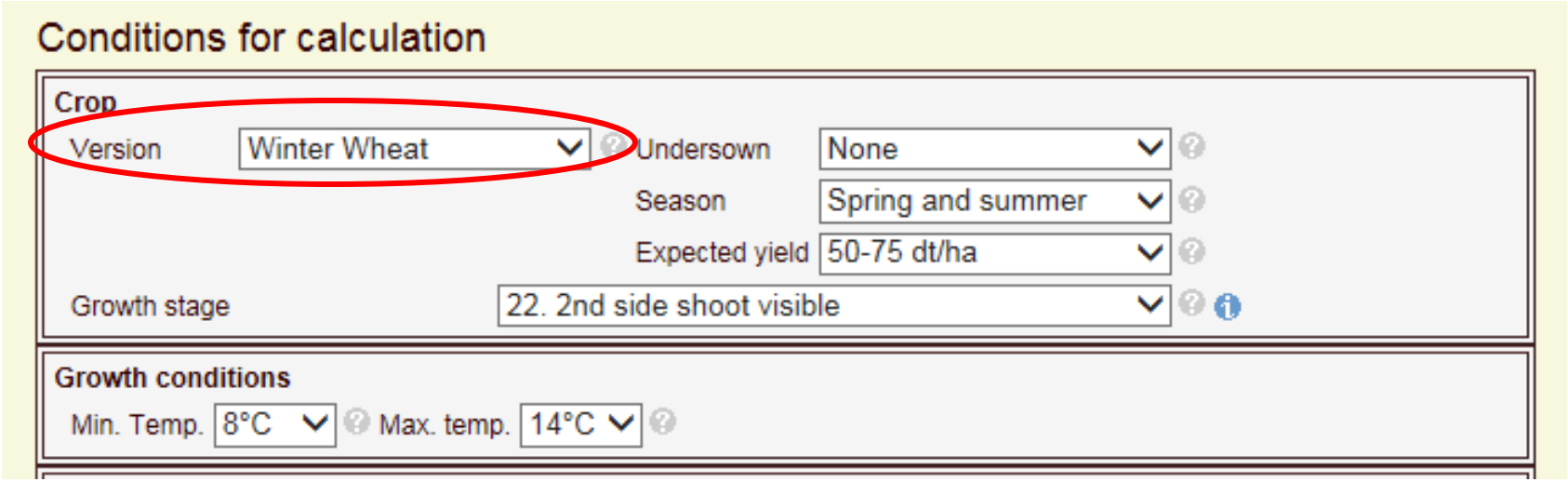
‘Problem solver’ – input of field report - prototype in Germany



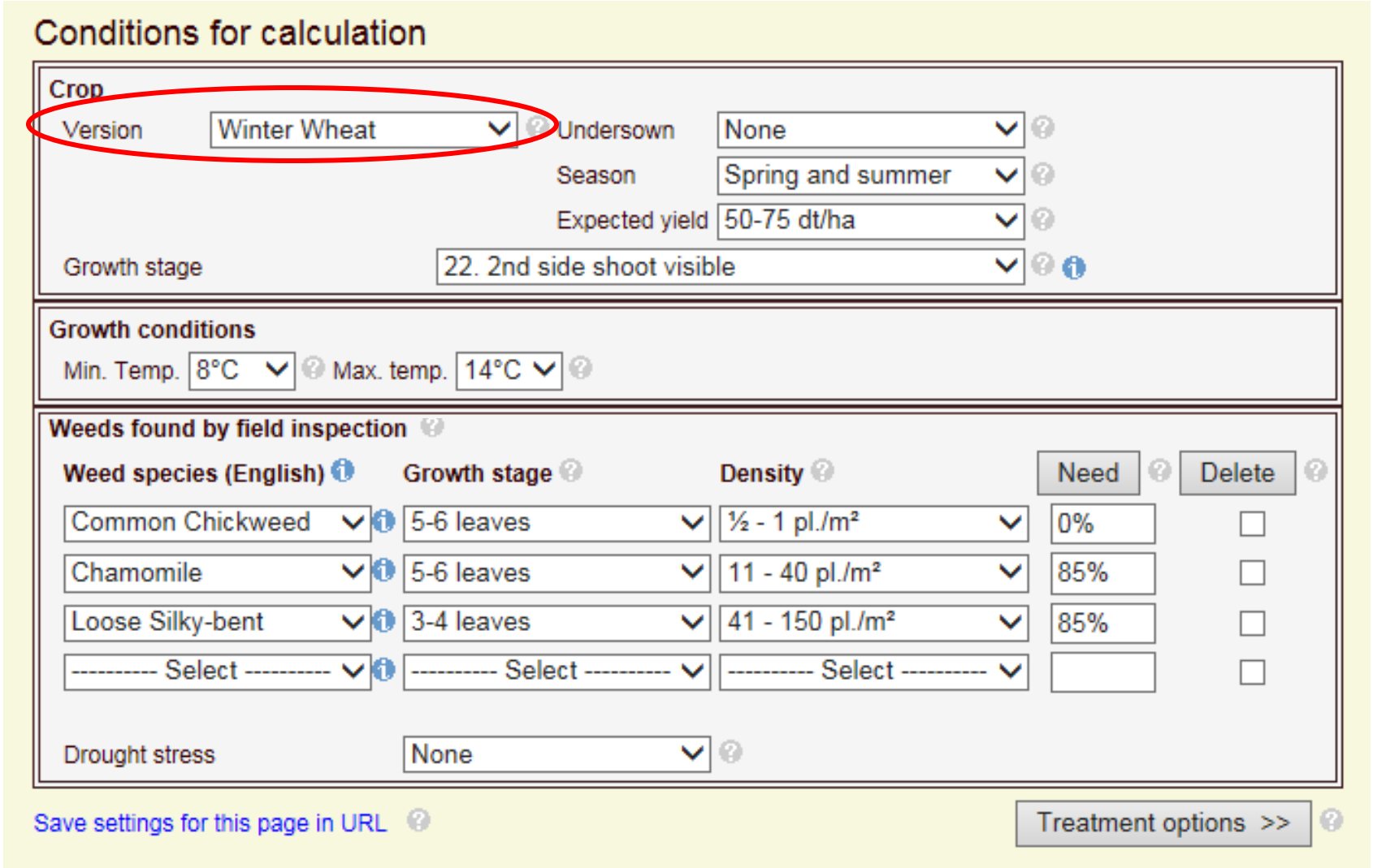
‘Problem solver’ - close-up



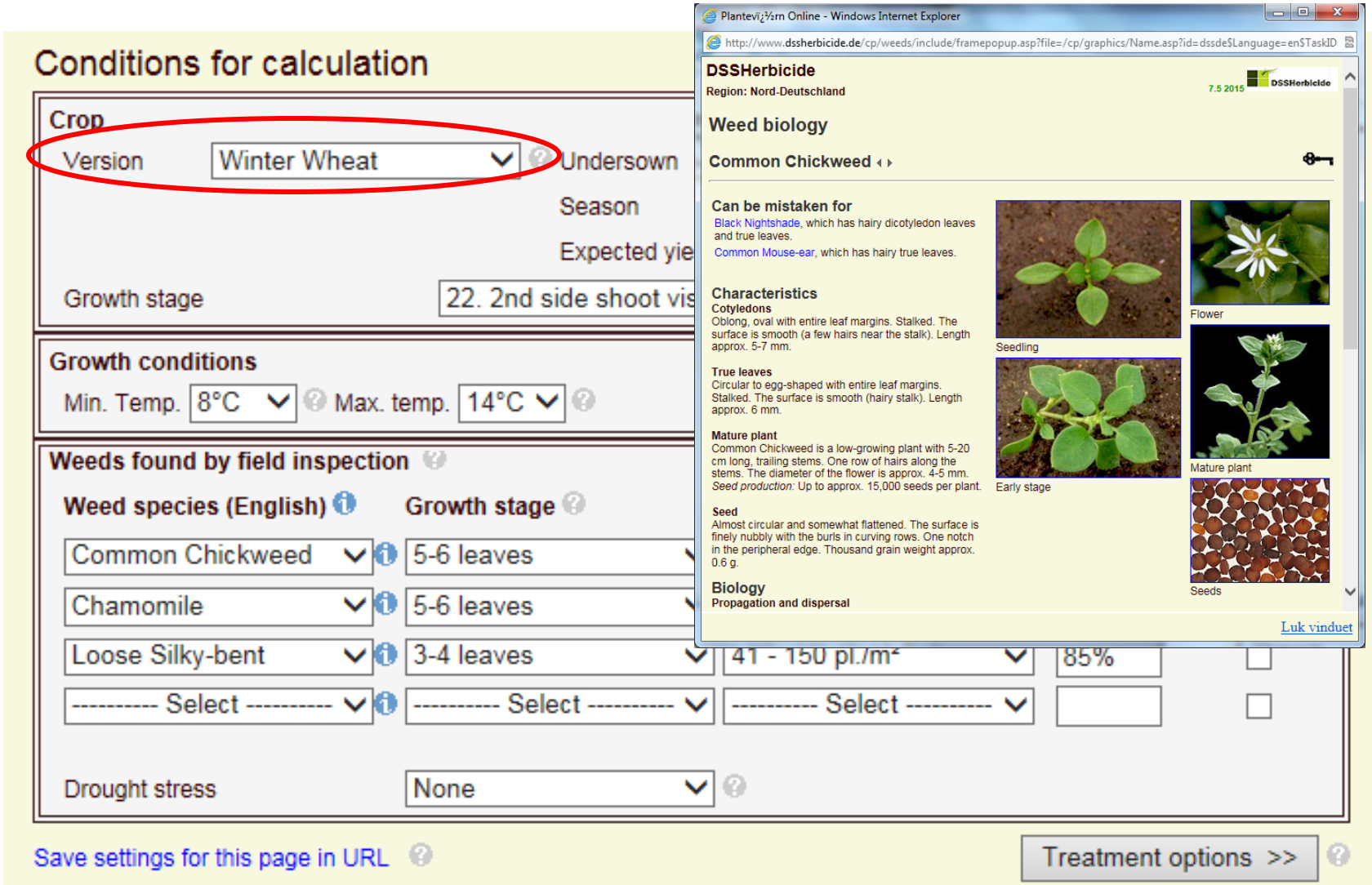
‘Problem solver’ - close-up



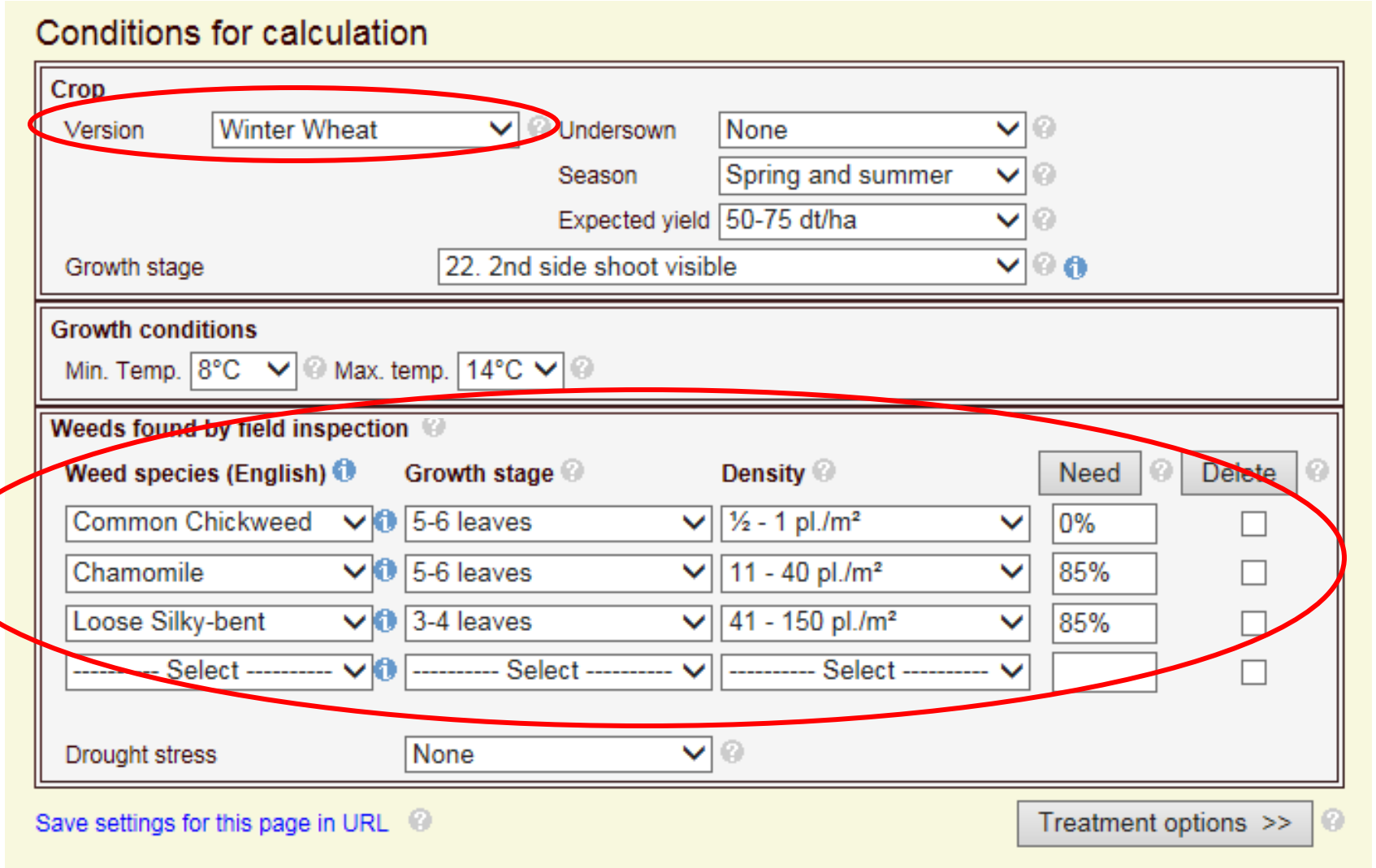
‘Problem solver’ - close-up



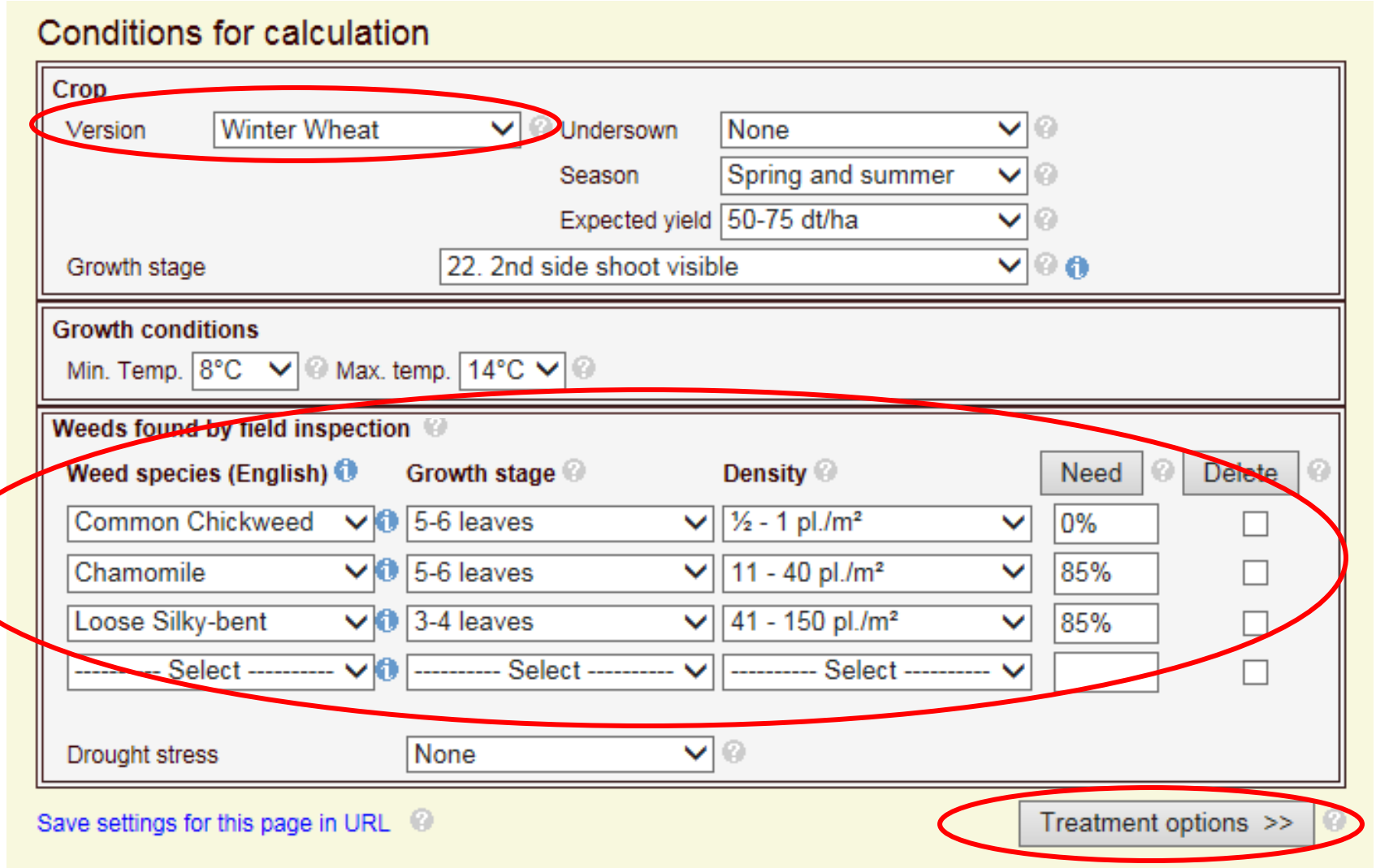
‘Problem solver’ - close-up



‘Problem solver’ - close-up



‘Problem solver’ - close-up



Output: treatment options, sorted for cost

Treatment options, sorted by Cost [< Go back] [Print] [Close]

No.	Trade names	Dosage (unit/ha) Actual	Dosage (unit/ha) Normal	Cost Euro/ha	Weed species	Efficacy Actual	Efficacy Target
1	Atlantis WG	0,149 kg	0,5 kg	6.6	Chamomile	85%	85%
	Genapol	0,6 l		0.6	Loose Silky-bent	98%	85%
	Totals			7.2			
	NW800: Must not be used at drained fields between 1. Nov. and 15. March						
2	Concert SX	8 g	150 g	1.4	Chamomile	86%	85%
	Monitor	5 g	25 g	7.4	Loose Silky-bent	86%	85%
	Monfast	0,4 l		0.4			
	Totals			9.2			
	NW800: Must not be used at drained fields between 1. Nov. and 15. March						

Output: treatment options, sorted for cost

Treatment options, sorted by Cost | < Go back | Print | Close

No.	Trade names	Dosage (unit/ha) Actual	Dosage (unit/ha) Normal	Cost Euro/ha	Weed species	Efficacy Actual	Efficacy Target
1	Atlantis WG	0,149 kg	0,5 kg	6.6	Chamomile	85%	85%
	Genapol	0,6 l		0.6	Loose Silky-bent	98%	85%
	Totals			7.2			
	NW800: Must not be used at drained fields between 1. Nov. and 15. March						
2	Concert SX	8 g	150 g	1.4	Chamomile	86%	85%
	Monitor	5 g	25 g	7.4	Loose Silky-bent	86%	85%
	Monfast	0,4 l		0.4			
	Totals			9.2			
	NW800: Must not be used at drained fields between 1. Nov. and 15. March						

Output: treatment options, sorted for cost

Treatment options, sorted by Cost | < Go back | Print | Close

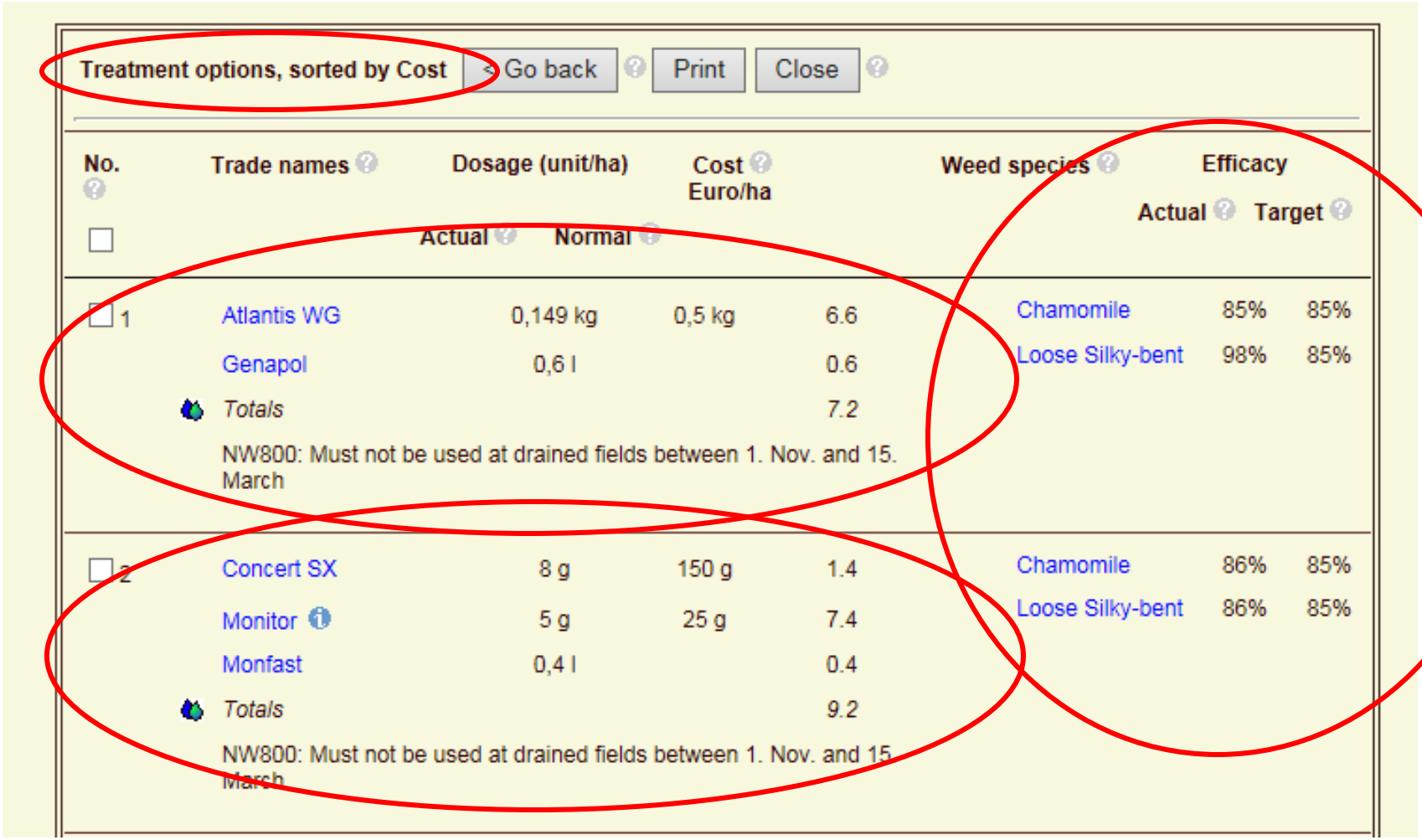
No.	Trade names	Dosage (unit/ha) Actual	Dosage (unit/ha) Normal	Cost Euro/ha	Weed species	Efficacy Actual	Efficacy Target
1	Atlantis WG	0,149 kg	0,5 kg	6.6	Chamomile	85%	85%
	Genapol	0,6 l		0.6	Loose Silky-bent	98%	85%
	Totals			7.2			
	NW800: Must not be used at drained fields between 1. Nov. and 15. March						
2	Concert SX	8 g	150 g	1.4	Chamomile	86%	85%
	Monitor	5 g	25 g	7.4	Loose Silky-bent	86%	85%
	Monfast	0,4 l		0.4			
	Totals			9.2			
	NW800: Must not be used at drained fields between 1. Nov. and 15. March						

Output: treatment options, sorted for cost

Treatment options, sorted by Cost | < Go back | Print | Close

No.	Trade names	Dosage (unit/ha) Actual	Dosage (unit/ha) Normal	Cost Euro/ha	Weed species	Efficacy Actual	Efficacy Target
1	Atlantis WG	0,149 kg	0,5 kg	6.6	Chamomile	85%	85%
	Genapol	0,6 l		0.6	Loose Silky-bent	98%	85%
	Totals			7.2			
	NW800: Must not be used at drained fields between 1. Nov. and 15. March						
2	Concert SX	8 g	150 g	1.4	Chamomile	86%	85%
	Monitor	5 g	25 g	7.4	Loose Silky-bent	86%	85%
	Monfast	0,4 l		0.4			
	Totals			9.2			
	NW800: Must not be used at drained fields between 1. Nov. and 15. March						

Output: treatment options, sorted for cost



Treatment options, sorted by Cost < Go back | Print | Close

No.	Trade names	Dosage (unit/ha) Actual	Dosage (unit/ha) Normal	Cost Euro/ha	Weed species	Efficacy Actual	Efficacy Target
1	Atlantis WG	0,149 kg	0,5 kg	6.6	Chamomile	85%	85%
	Genapol	0,6 l		0.6	Loose Silky-bent	98%	85%
	Totals			7.2			
	NW800: Must not be used at drained fields between 1. Nov. and 15. March						
2	Concert SX	8 g	150 g	1.4	Chamomile	86%	85%
	Monitor	5 g	25 g	7.4	Loose Silky-bent	86%	85%
	Monfast	0,4 l		0.4			
	Totals			9.2			
	NW800: Must not be used at drained fields between 1. Nov. and 15. March						

‘Efficacy profile’
Prototype in Slovenia

Conditions for calculation

Crop

Version: SLO Maize, TE reliable

Undersown: None

Expected yield: 8-10 ton/ha

Growth stage: 12. 2 leaves

Weeds

Growth stage: 3-4 leaves

Treatment options (max. Dose)

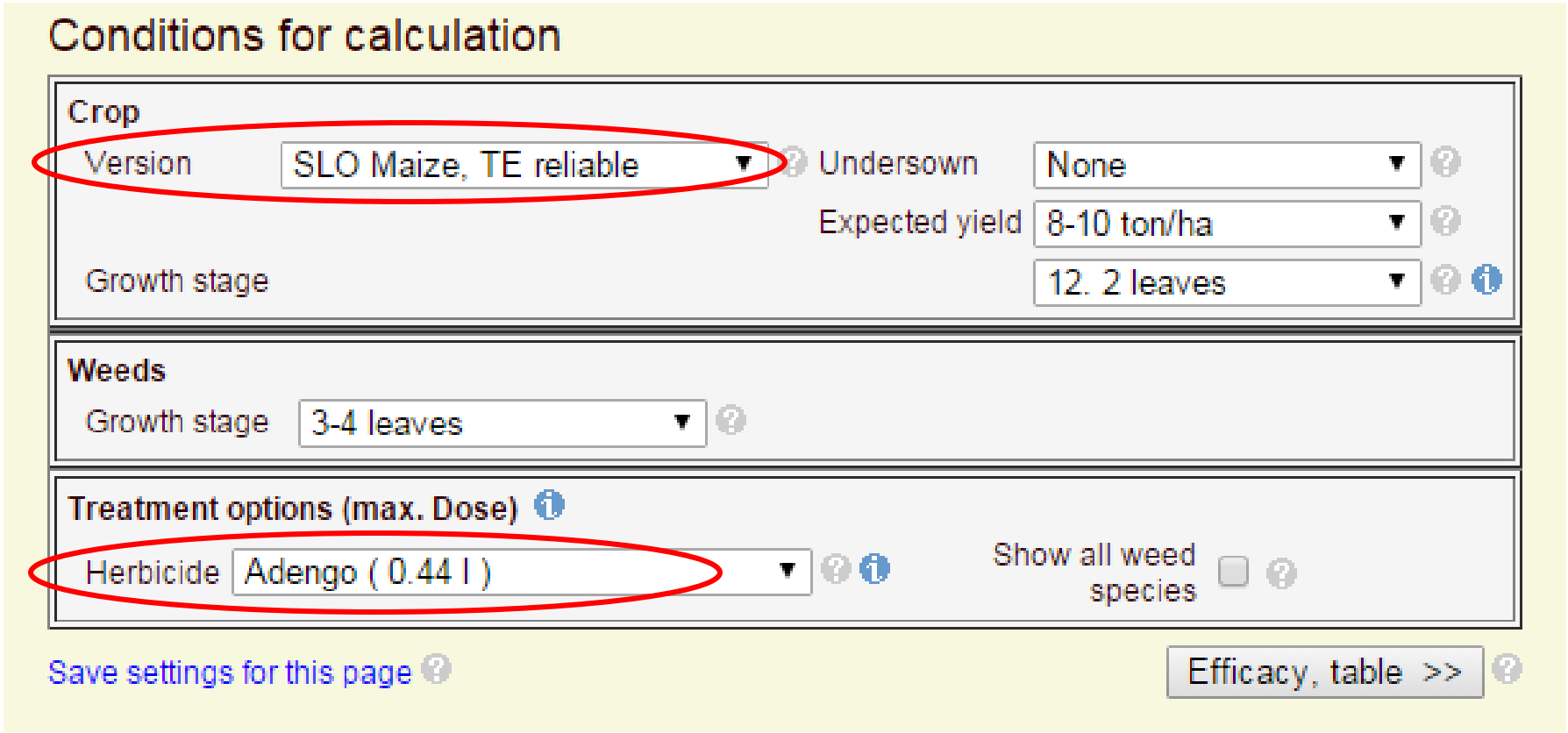
Herbicide: Adengo (0.44 l)

Show all weed species

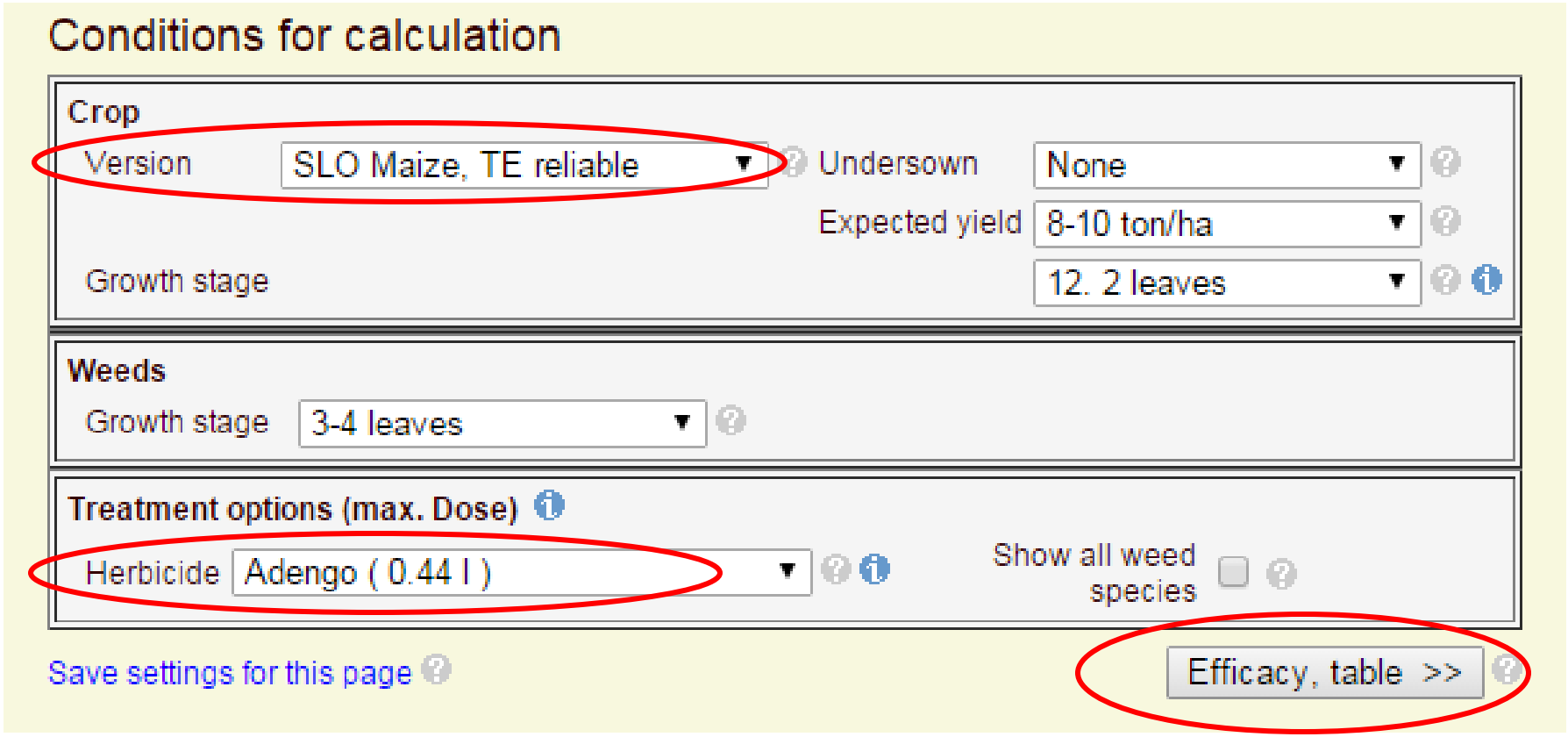
Save settings for this page

Efficacy, table >>

‘Efficacy profile’
Prototype in Slovenia



‘Efficacy profile’
Prototype in Slovenia



Output: efficacy and dose rates

Herbicide : Adengo
Max. dose : 0.44 l / ha
Adjuvant : Not relevant

Weed growth stage: 3-4 leaves

Print

Weed species	Calculated efficacy (%) of four dosages (l /ha)				Rec. Level of control (%) Recommended / Modify (plants/m²)					Calculated dose (l /ha) at these efficacies (plants/m²)				
	0,11	0,22	0,44	0,88	1	10	40	150	...	1	10	40	150	...
Amaranthus retroflexus	26	69	93	99	80	90	96	97	97	0.28	0,38	0,55	0,62	0,62
Chenopodium album	30	72	94	99	80	92	97	98	98	0,26	0,39	0,58	0,68	0,68
Chenopodium polyspermu	30	72	94	99	80	90	96	97	97	0,26	0,36	0,52	0,58	0,58
Cirsium arvense	5	23	65	92	80	92	97	98	98	0,59	0,89	1,32	1,54	1,54
Convolvulus arvensis	11	43	82	97	80	90	95	96	96	0,42	0,57	0,76	0,83	0,83
Digitaria sanguinalis	12	46	84	97	80	90	95	96	96	0,4	0,54	0,72	0,79	0,79
Echinochloa crus-galli	14	50	86	97	80	92	97	98	98	0,37	0,56	0,83	0,98	0,98
Elymus repens	5	23	65	92	80	92	97	98	98	0,59	0,89	1,32	1,54	1,54
Galinsoga sp	39	80	96	99	60	85	92	94	94	0,15	0,25	0,33	0,37	0,37
Lamium sp	47	84	97	99	50	80	90	94	94	0,12	0,2	0,27	0,33	0,33

Output: efficacy and dose rates

Herbicide : Adengo
Max. dose : 0.44 l / ha
Adjuvant : Not relevant

Weed growth stage: 3-4 leaves

Print

Weed species	Calculated efficacy (%) of four dosages (l /ha)				Rec. Level of control (%) Recommended / Modify (plants/m²)					Calculated dose (l /ha) at these efficacies (plants/m²)				
	0,11	0,22	0,44	0,88	1	10	40	150	...	1	10	40	150	...
Amaranthus retroflexus	26	69	93	99	80	90	96	97	97	0.28	0,38	0,55	0,62	0,62
Chenopodium album	30	72	94	99	80	92	97	98	98	0,26	0,39	0,58	0,68	0,68
Chenopodium polyspermu	30	72	94	99	80	90	96	97	97	0,26	0,36	0,52	0,58	0,58
Cirsium arvense	5	23	65	92	80	92	97	98	98	0,59	0,89	1,32	1,54	1,54
Convolvulus arvensis	11	43	82	97	80	90	95	96	96	0,42	0,57	0,76	0,83	0,83
Digitaria sanguinalis	12	46	84	97	80	90	95	96	96	0,4	0,54	0,72	0,79	0,79
Echinochloa crus-galli	14	50	86	97	80	92	97	98	98	0,37	0,56	0,83	0,98	0,98
Elymus repens	5	23	65	92	80	92	97	98	98	0,59	0,89	1,32	1,54	1,54
Galinsoga sp	39	80	96	99	60	85	92	94	94	0,15	0,25	0,33	0,37	0,37
Lamium sp	47	84	97	99	50	80	90	94	94	0,12	0,2	0,27	0,33	0,33

Output: efficacy and dose rates

Herbicide : Adengo
Max. dose : 0.44 l / ha
Adjuvant : Not relevant

Weed growth stage: 3-4 leaves

Print

Weed species	Calculated efficacy (%) of four dosages (l /ha)				Rec. Level of control (%) Recommended / Modify (plants/m²)					Calculated dose (l /ha) at these efficacies (plants/m²)				
	0,11	0,22	0,44	0,88	1	10	40	150	...	1	10	40	150	...
Amaranthus retroflexus	26	69	93	99	80	90	96	97	97	0.28	0,38	0,55	0,62	0,62
Chenopodium album	30	72	94	99	80	92	97	98	98	0,26	0,39	0,58	0,68	0,68
Chenopodium polyspermu	30	72	94	99	80	90	96	97	97	0,26	0,36	0,52	0,58	0,58
Cirsium arvense	5	23	65	92	80	92	97	98	98	0,59	0,89	1,32	1,54	1,54
Convolvulus arvensis	11	43	82	97	80	90	95	96	96	0,42	0,57	0,76	0,83	0,83
Digitaria sanguinalis	12	46	84	97	80	90	95	96	96	0,4	0,54	0,72	0,79	0,79
Echinochloa crus-galli	14	50	86	97	80	92	97	98	98	0,37	0,56	0,83	0,98	0,98
Elymus repens	5	23	65	92	80	92	97	98	98	0,59	0,89	1,32	1,54	1,54
Galinsoga sp	39	80	96	99	60	85	92	94	94	0,15	0,25	0,33	0,37	0,37
Lamium sp	47	84	97	99	50	80	90	94	94	0,12	0,2	0,27	0,33	0,33

Output: efficacy and dose rates

Herbicide : Adengo
Max. dose : 0.44 l / ha
Adjuvant : Not relevant

Weed growth stage: 3-4 leaves

Print

Weed species	Calculated efficacy (%) of four dosages (l /ha)				Rec. Level of control (%) Recommended / Modify (plants/m²)					Calculated dose (l /ha) at these efficacies (plants/m²)				
	0,11	0,22	0,44	0,88	1	10	40	150	...	1	10	40	150	...
Amaranthus retroflexus	26	69	93	99	80	90	96	97	97	0.28	0,38	0,55	0,62	0,62
Chenopodium album	30	72	94	99	80	92	97	98	98	0,26	0,39	0,58	0,68	0,68
Chenopodium polyspermu	30	72	94	99	80	90	96	97	97	0,26	0,36	0,52	0,58	0,58
Cirsium arvense	5	23	65	92	80	92	97	98	98	0,59	0,89	1,32	1,54	1,54
Convolvulus arvensis	11	43	82	97	80	90	95	96	96	0,42	0,57	0,76	0,83	0,83
Digitaria sanguinalis	12	46	84	97	80	90	95	96	96	0,4	0,54	0,72	0,79	0,79
Echinochloa crus-galli	14	50	86	97	80	92	97	98	98	0,37	0,56	0,83	0,98	0,98
Elymus repens	5	23	65	92	80	92	97	98	98	0,59	0,89	1,32	1,54	1,54
Galinsoga sp	39	80	96	99	60	85	92	94	94	0,15	0,25	0,33	0,37	0,37
Lamium sp	47	84	97	99	50	80	90	94	94	0,12	0,2	0,27	0,33	0,33

Output: efficacy and dose rates

Herbicide : Adengo
Max. dose : 0.44 l / ha
Adjuvant : Not relevant

Weed growth stage: 3-4 leaves

Print

Weed species	Calculated efficacy (%) of four dosages (l /ha)				Rec. Level of control (%) Recommended / Modify (plants/m²)					Calculated dose (l /ha) at these efficacies (plants/m²)				
	0,11	0,22	0,44	0,88	1	10	40	150	...	1	10	40	150	...
Amaranthus retroflexus	26	69	93	99	80	90	96	97	97	0.28	0,38	0,55	0,62	0,62
Chenopodium album	30	72	94	99	80	92	97	98	98	0,26	0,39	0,58	0,68	0,68
Chenopodium polyspermu	30	72	94	99	80	90	96	97	97	0,26	0,36	0,52	0,58	0,58
Cirsium arvense	5	23	65	92	80	92	97	98	98	0,59	0,89	1,32	1,54	1,54
Convolvulus arvensis	11	43	82	97	80	90	95	96	96	0,42	0,57	0,76	0,83	0,83
Digitaria sanguinalis	12	46	84	97	80	90	95	96	96	0,4	0,54	0,72	0,79	0,79
Echinochloa crus-galli	14	50	86	97	80	92	97	98	98	0,37	0,56	0,83	0,98	0,98
Elymus repens	5	23	65	92	80	92	97	98	98	0,59	0,89	1,32	1,54	1,54
Galinsoga sp	39	80	96	99	60	85	92	94	94	0,15	0,25	0,33	0,37	0,37
Lamium sp	47	84	97	99	50	80	90	94	94	0,12	0,2	0,27	0,33	0,33

Output: efficacy and dose rates

Herbicide : Adengo
Max. dose : 0.44 l / ha
Adjuvant : Not relevant

Weed growth stage: 3-4 leaves

Print

Weed species	Calculated efficacy (%) of four dosages (l /ha)				Rec. Level of control (%) Recommended / Modify (plants/m²)					Calculated dose (l /ha) at these efficacies (plants/m²)				
	0,11	0,22	0,44	0,88	1	10	40	150	...	1	10	40	150	...
Amaranthus retroflexus	26	69	93	99	80	90	96	97	97	0.28	0,38	0,55	0,62	0,62
Chenopodium album	30	72	94	99	80	92	97	98	98	0,26	0,36	0,52	0,58	0,58
Chenopodium polyspermu	30	72	94	99	80	90	96	97	97	0,26	0,36	0,52	0,58	0,58
Cirsium arvense	5	23	65	92	80	92	97	98	98	0,59	0,89	1,32	1,54	1,54
Convolvulus arvensis	11	43	82	97	80	90	95	96	96	0,42	0,57	0,76	0,83	0,83
Digitaria sanguinalis	12	46	84	97	80	90	95	96	96	0,4	0,54	0,72	0,79	0,79
Echinochloa crus-galli	14	50	86	97	80	92	97	98	98	0,37	0,56	0,83	0,98	0,98
Elymus repens	5	23	65	92	80	92	97	98	98	0,59	0,89	1,32	1,54	1,54
Galinsoga sp	39	80	96	99	60	85	92	94	94	0,15	0,25	0,33	0,37	0,37
Lamium sp	47	84	97	99	50	80	90	94	94	0,12	0,2	0,27	0,33	0,33

Ideas and requirements

Ideas

Ideas

- Weeds:
  - are inhomogeneous distributed
  - different species cause different losses
  - different species are differently susceptible to different control measures

Ideas

- Weeds:
  - are inhomogeneous distributed
  - different species cause different losses
  - different species are differently susceptible to different control measures
- Legal restrictions:
  - still more complex
  - EU cross-compliance -> subsidies for farmers!

Ideas

- Weeds:
  - are inhomogeneous distributed
  - different species cause different losses
  - different species are differently susceptible to different control measures
- Legal restrictions:
  - still more complex
  - EU cross-compliance -> subsidies for farmers!
- So,
  - rational and legal weed management is complex!
  - farmers need assistance
  - a DSS may be helpful

Identified requirements

Identified requirements

- EU-project ‘ENDURE’ (2007-2010):
  - 70 European DSS for crop protection were analysed
  - 9 included IWM

Identified requirements

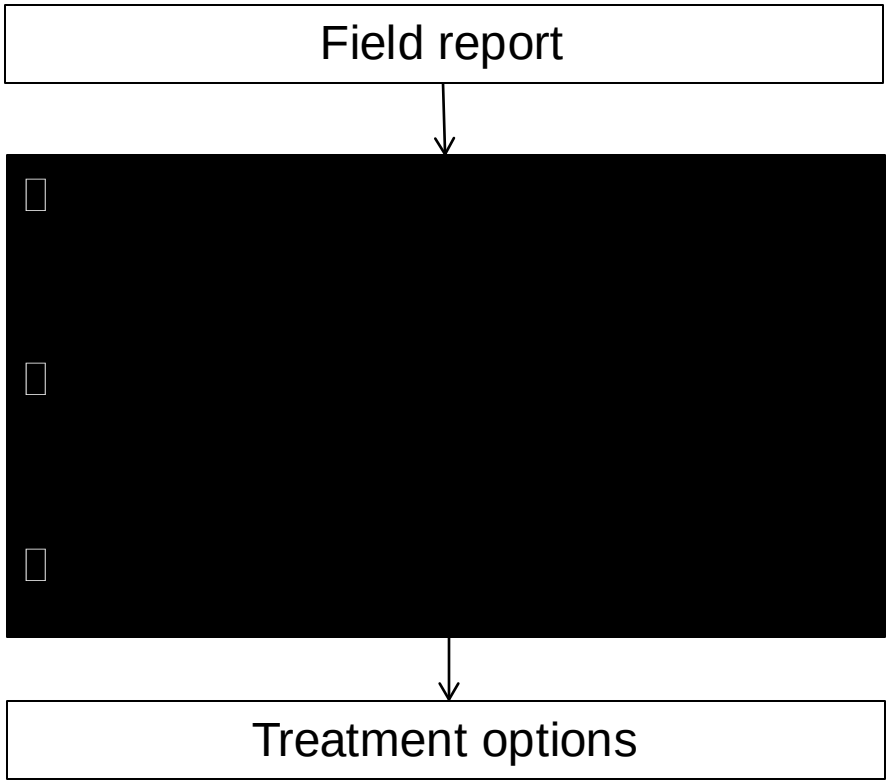
- EU-project ‘ENDURE’ (2007-2010):
  - 70 European DSS for crop protection were analysed
  - 9 included IWM
- DSSs must be robust:
  - low risks for end-users
  - more robust than advisors?

Identified requirements

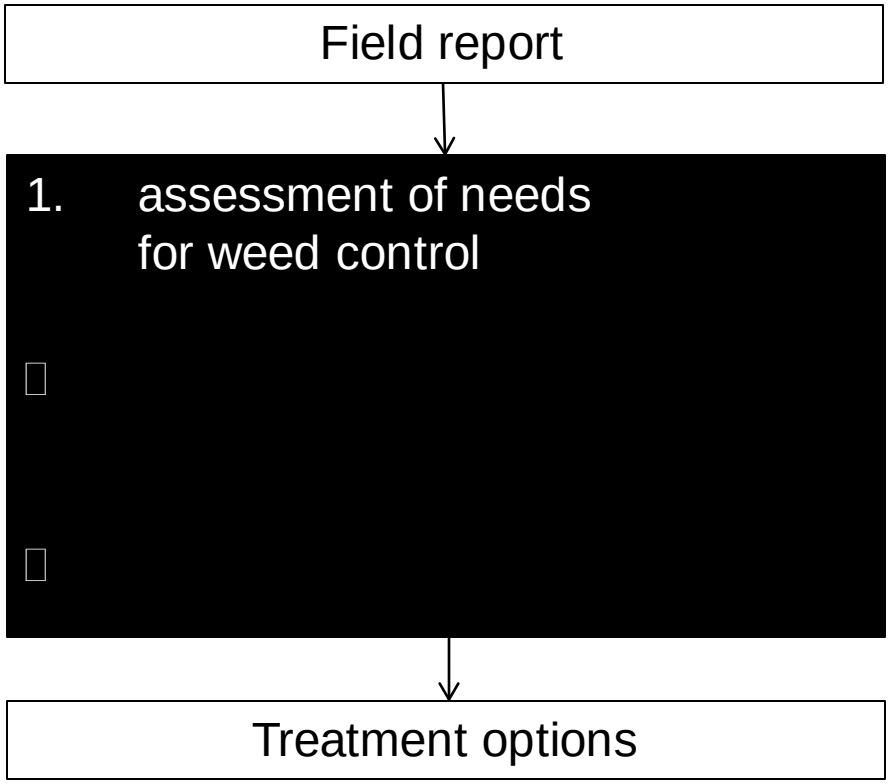
- EU-project ‘ENDURE’ (2007-2010):
  - 70 European DSS for crop protection were analysed
  - 9 included IWM
- DSSs must be robust:
  - low risks for end-users
  - more robust than advisors?
- DSSs must be potent:
  - reduce cost
  - reduce ‘environmental load’ (indexes)
  - ensure legal use of herbicides

‘Decision engine’

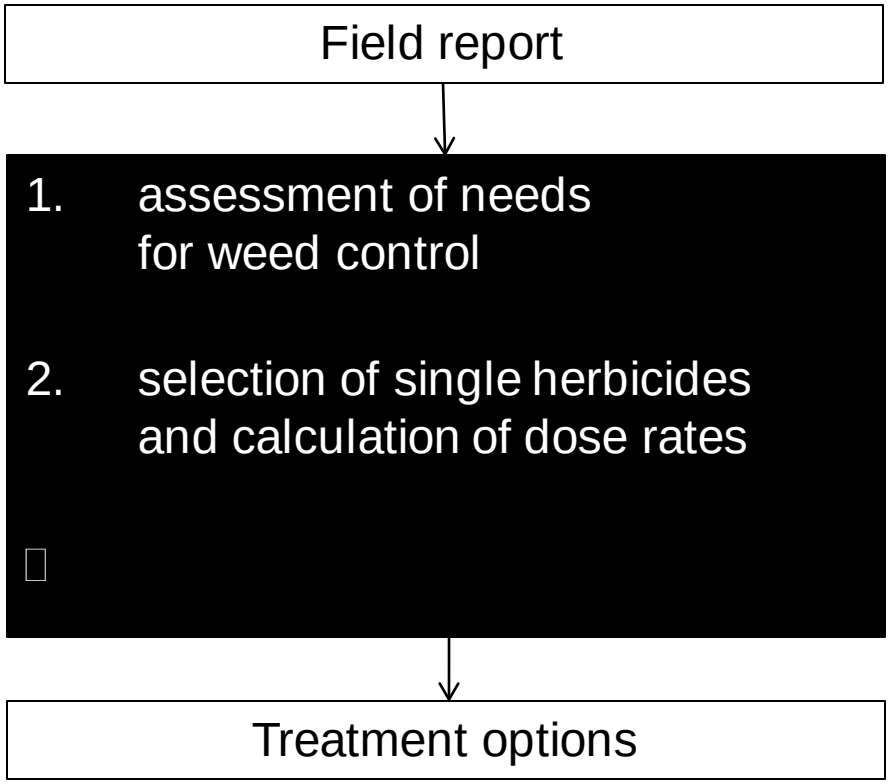
‘Decision engine’
3-step mechanism



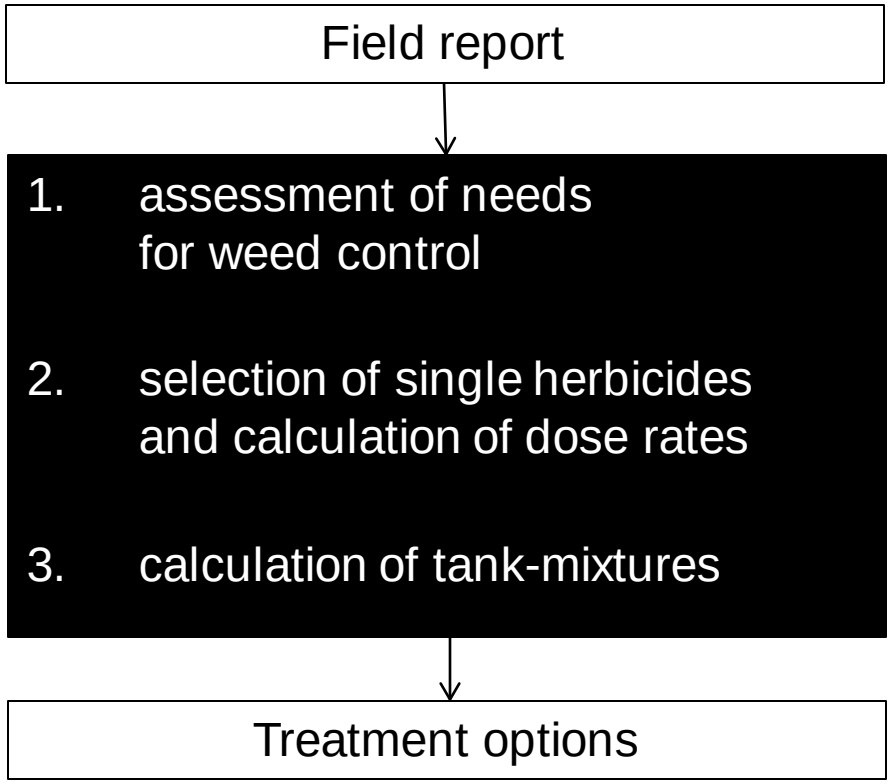
‘Decision engine’
3-step mechanism



‘Decision engine’
3-step mechanism



‘Decision engine’
3-step mechanism



Step 1/3:

Assessment of needs for control

Target efficacy

Target efficacy

- Integrates:
  - yield potentials
  - weed propagation
  - practical complications
  - etc.

Target efficacy

- Integrates:
  - yield potentials
  - weed propagation
  - practical complications
  - etc.
- Based on literature and expert knowledge

Target efficacy

- Integrates:
  - yield potentials
  - weed propagation
  - practical complications
  - etc.
- Based on literature and expert knowledge
- Actual levels determined in interative proces of design and field tests

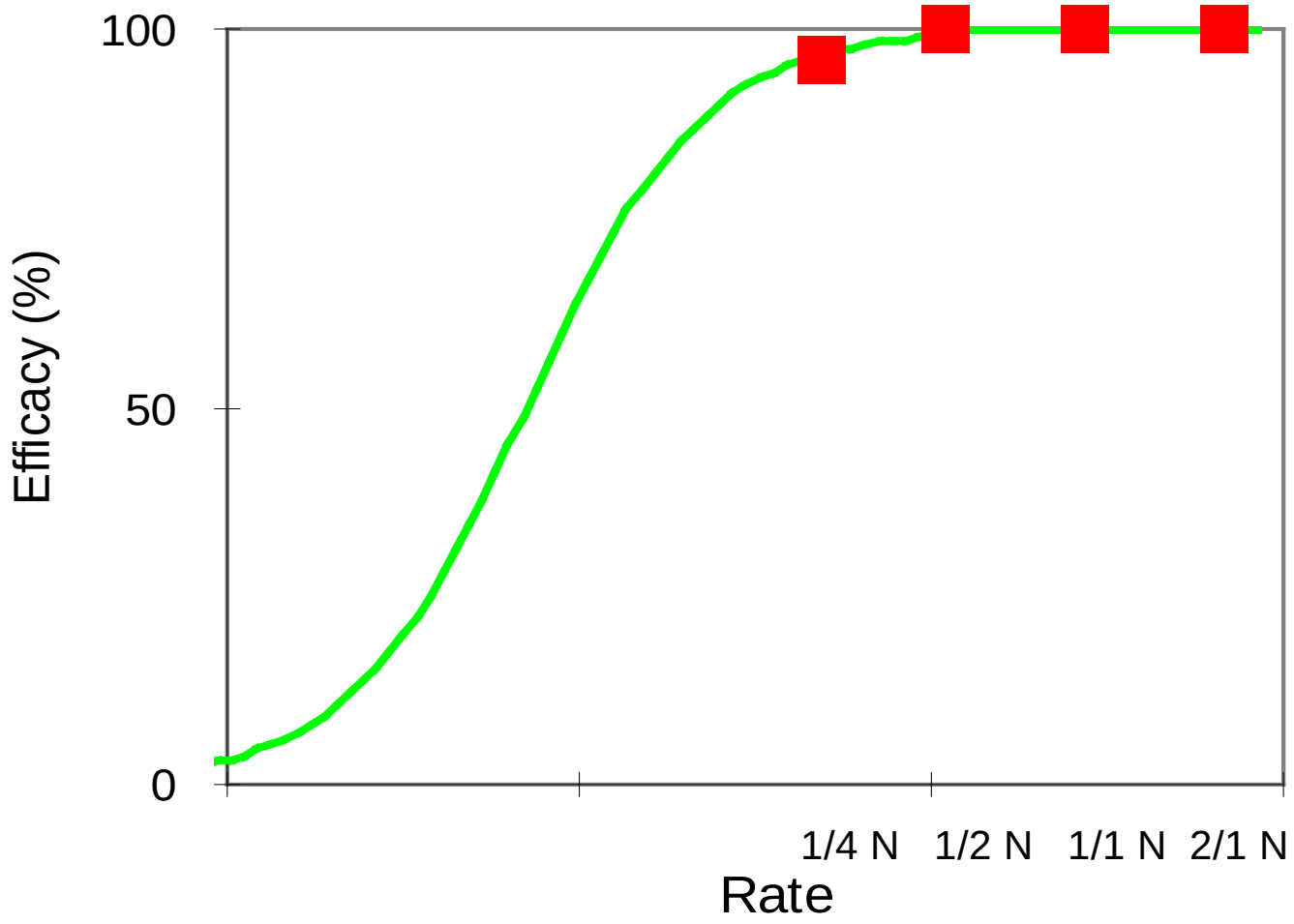
Target efficacy

- Integrates:
  - yield potentials
  - weed propagation
  - practical complications
  - etc.
- Based on literature and expert knowledge
- Actual levels determined in interative proces of design and field tests
- Output:
  - need for control on weed biomass (0-97%)

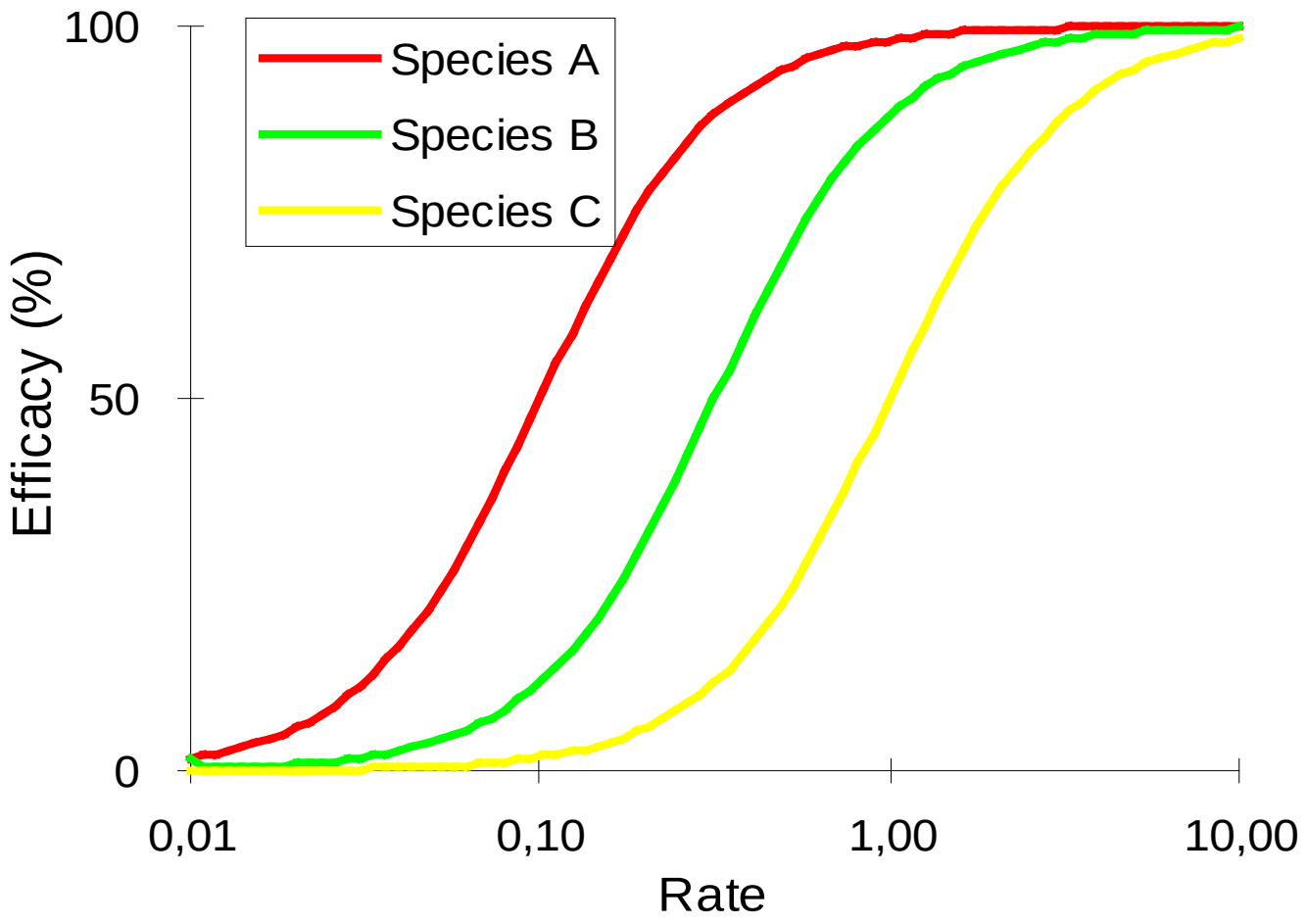
Step 2/3:

Herbicide dose-response functions

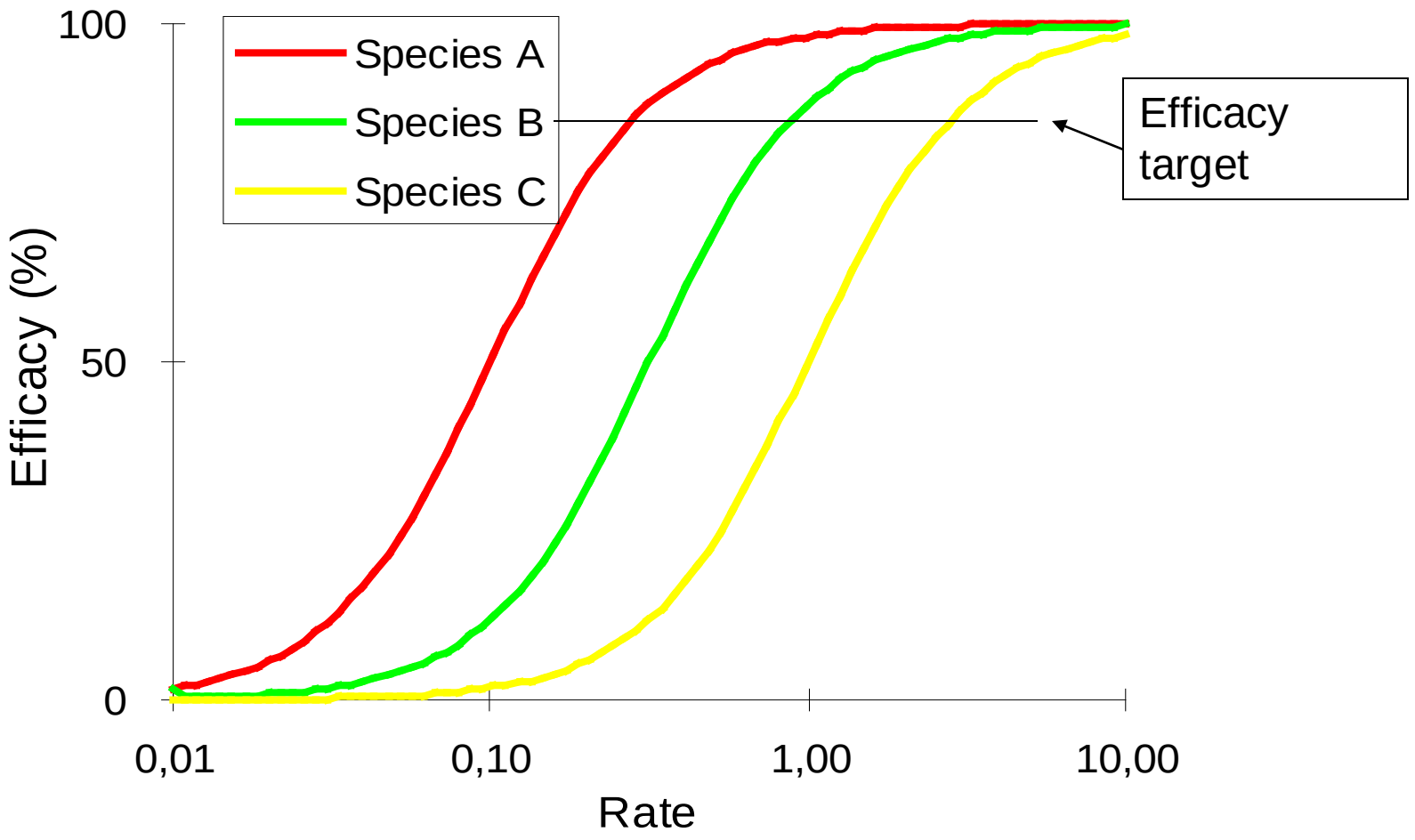
Example:
1 herbicide, 1 weed



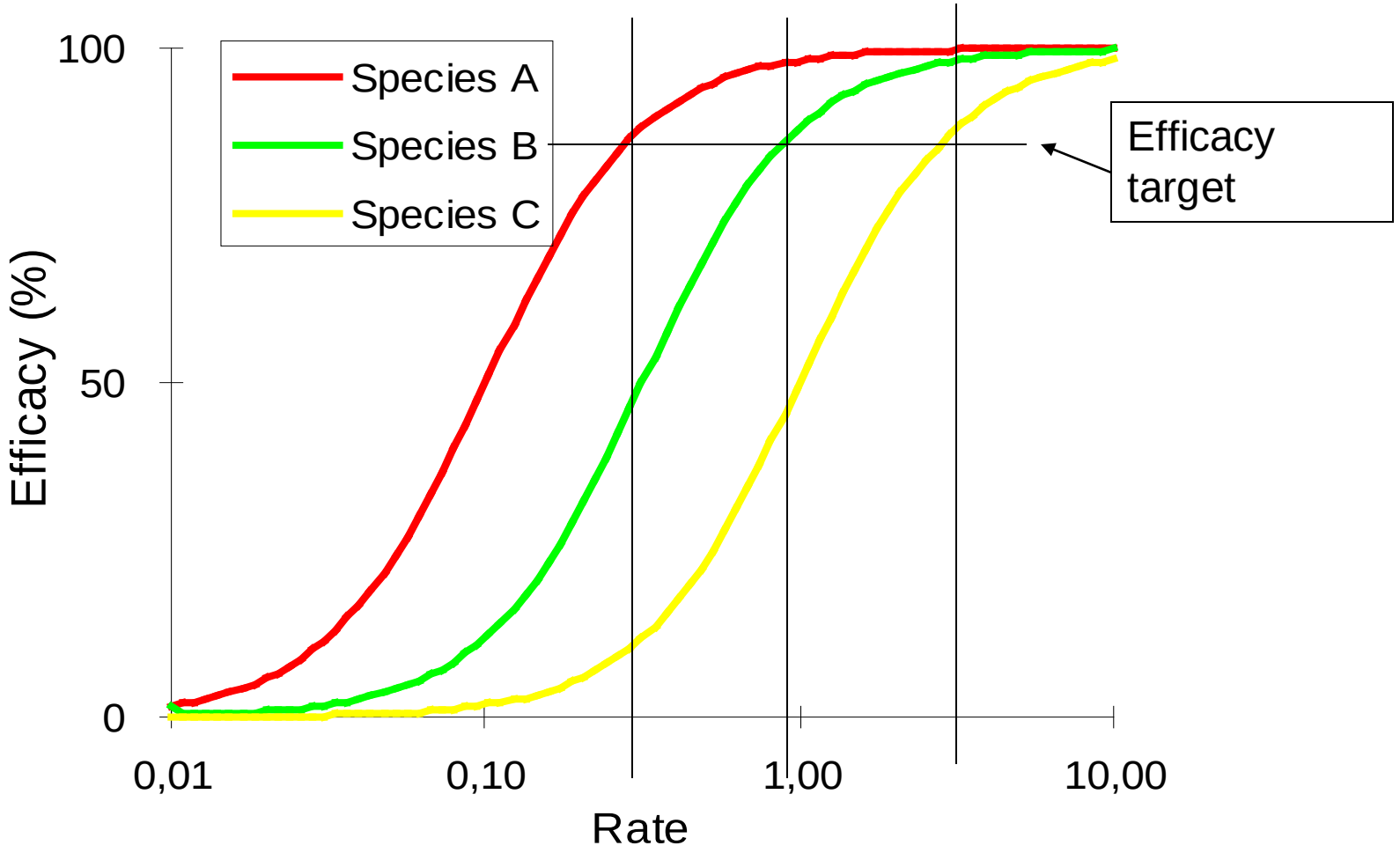
Example:
1 herbicide, 3 weeds



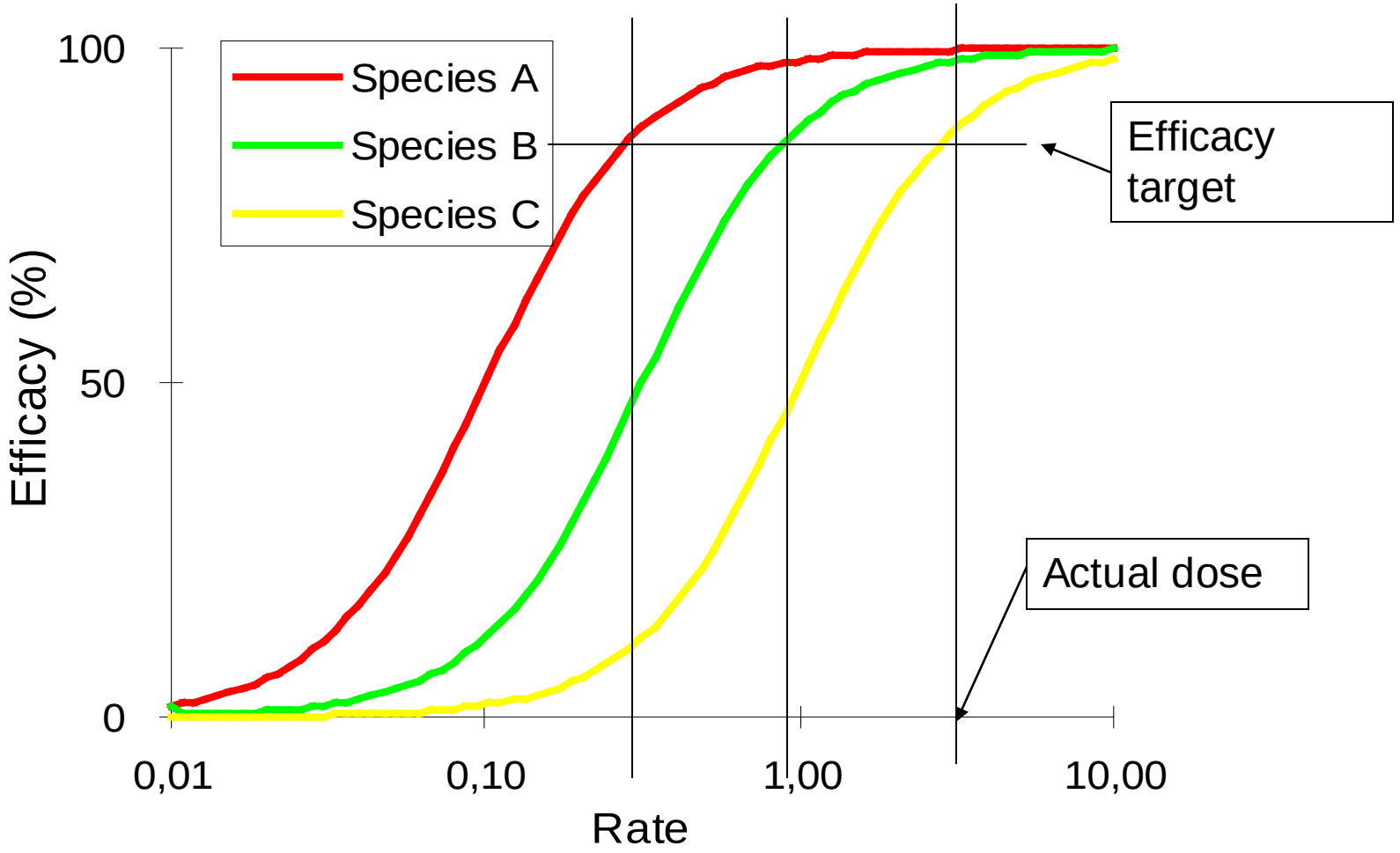
Example:
1 herbicide, 3 weeds



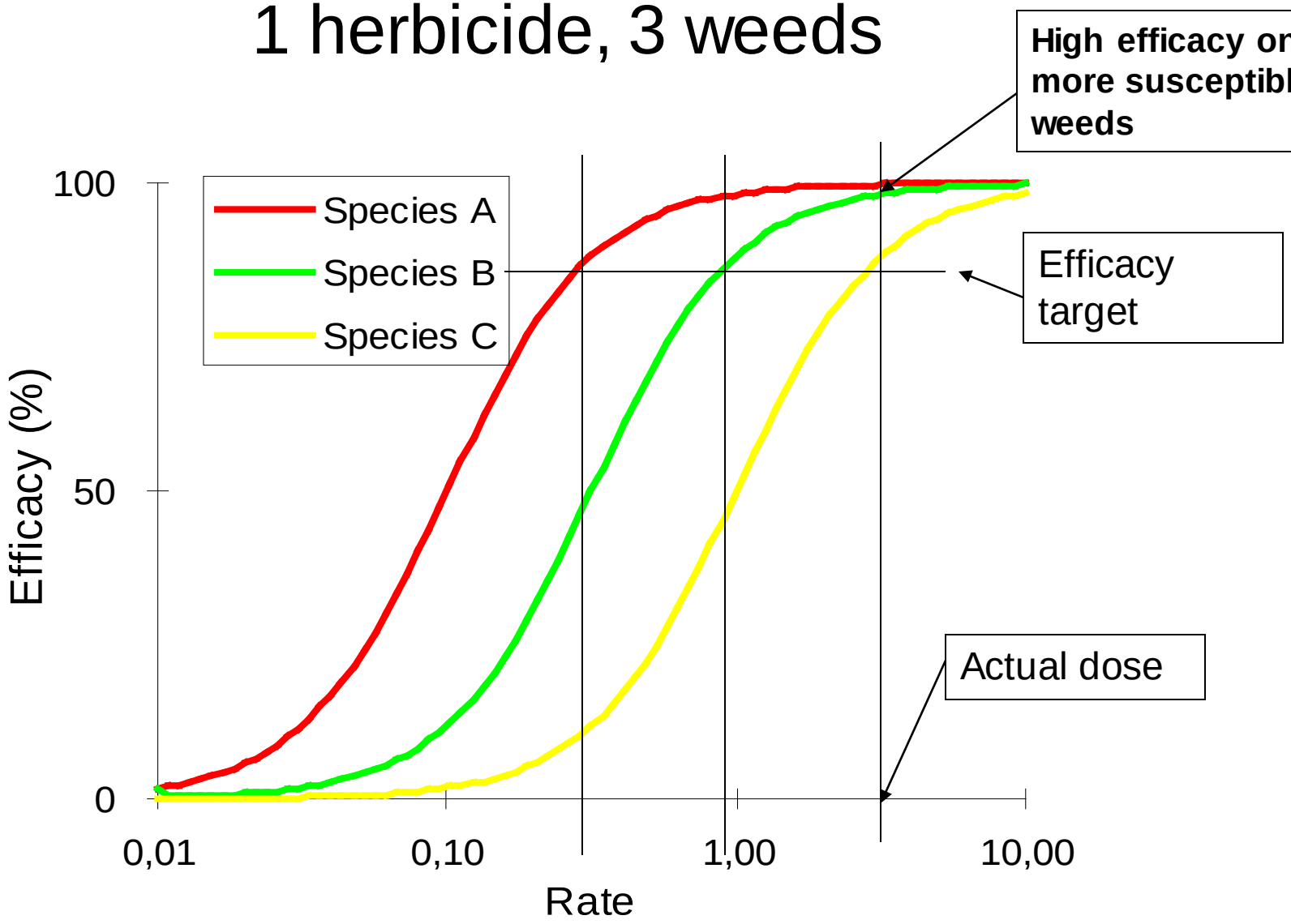
Example:
1 herbicide, 3 weeds



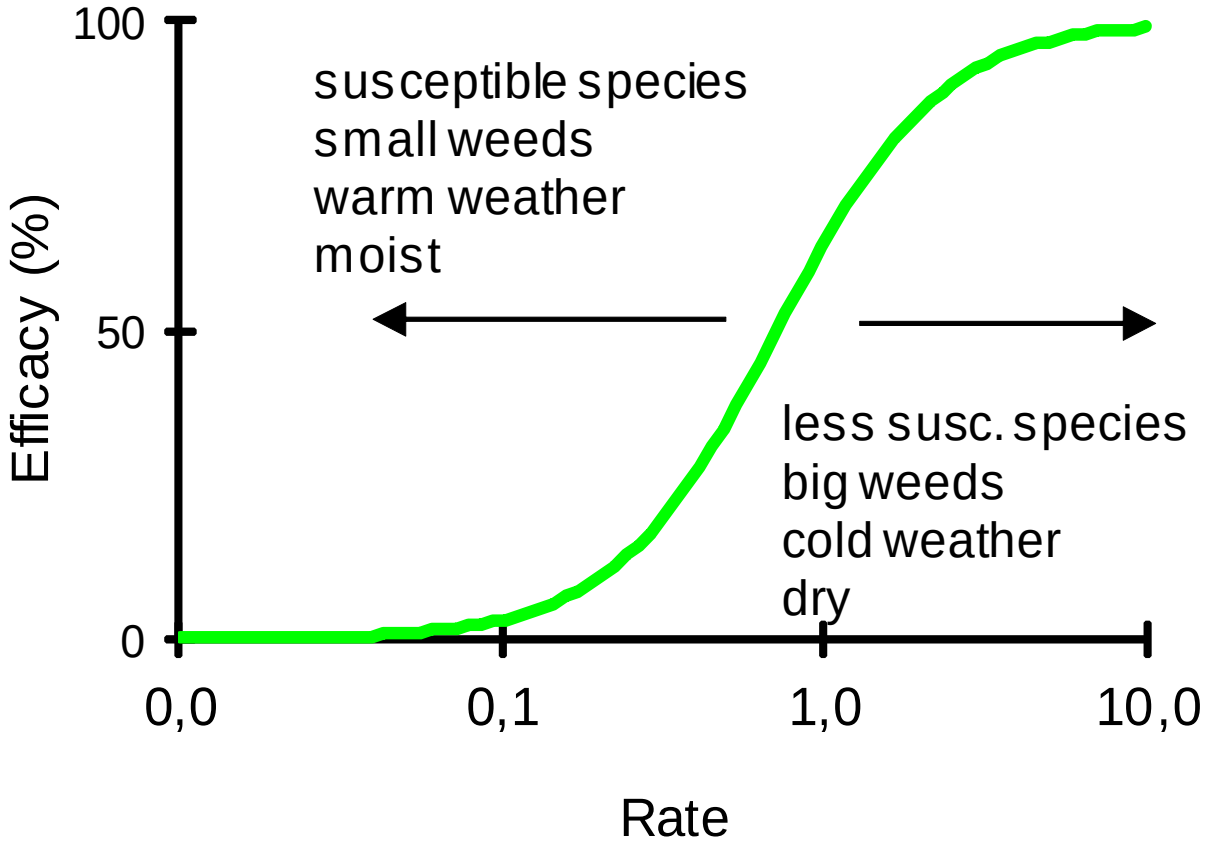
Example:
1 herbicide, 3 weeds



Example:
1 herbicide, 3 weeds



General attributes



Source: Per Kudsk, Aarhus University

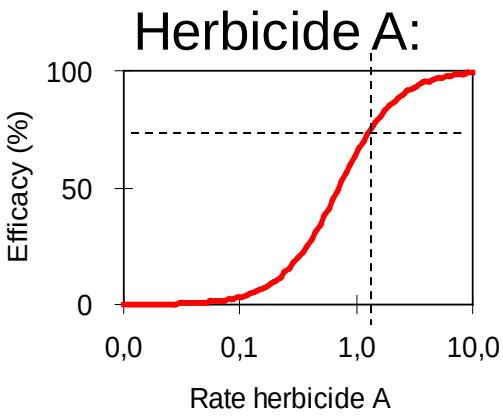
Step 3/3:

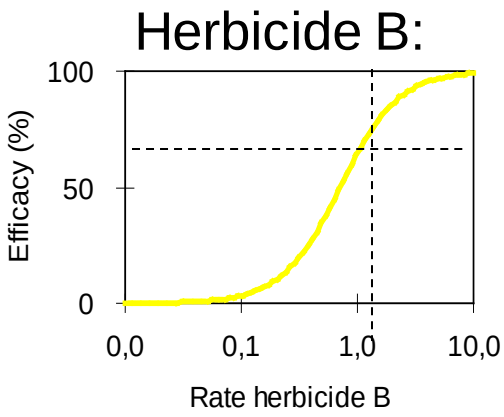
Optimizing herbicide tank-mixtures

Motivation for ‘tank-mixes’

- Extend weed spectrum
- Reduce input of herbicides (cost / index)
- Reduce risk of herbicide resistance

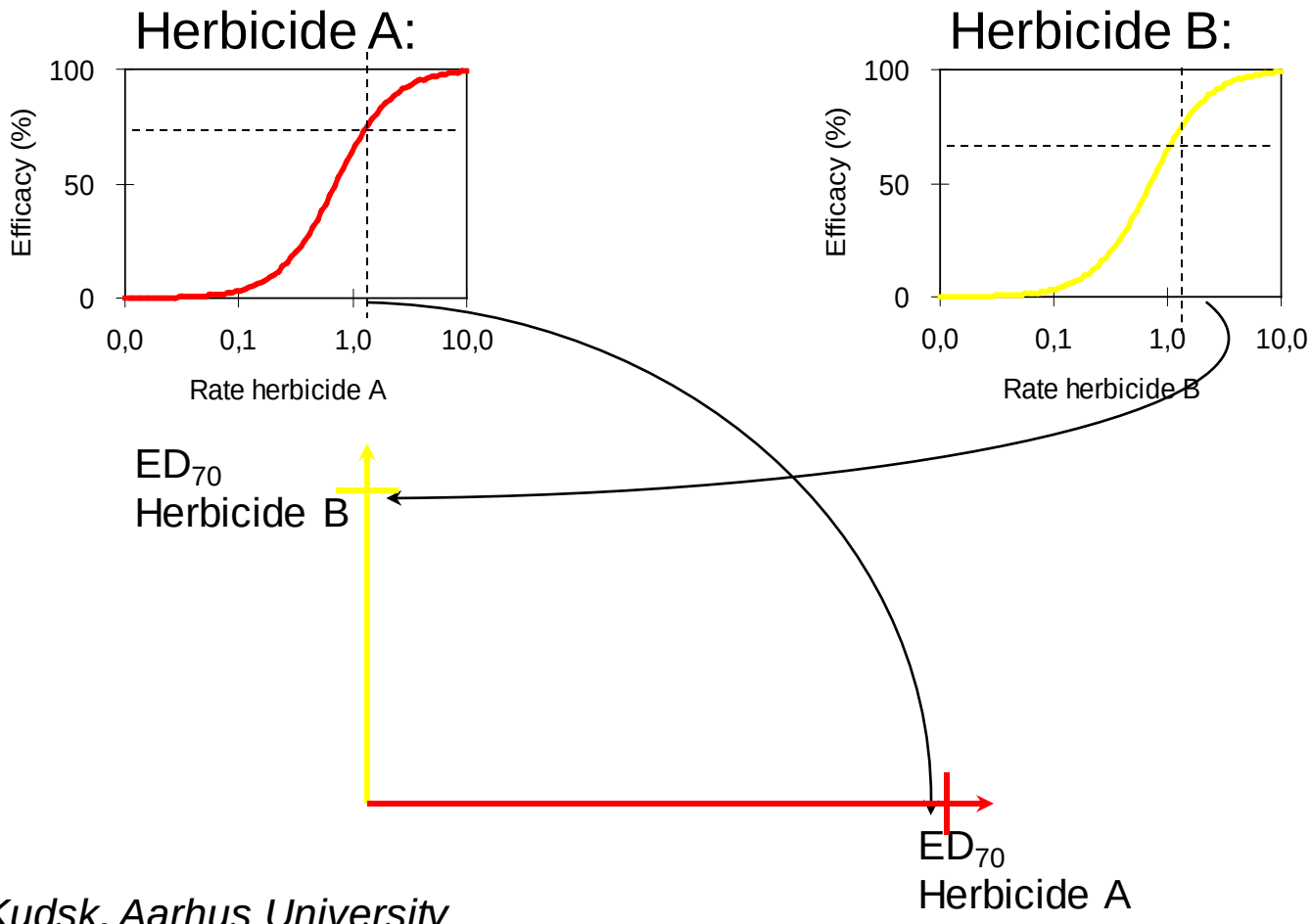
Calculations





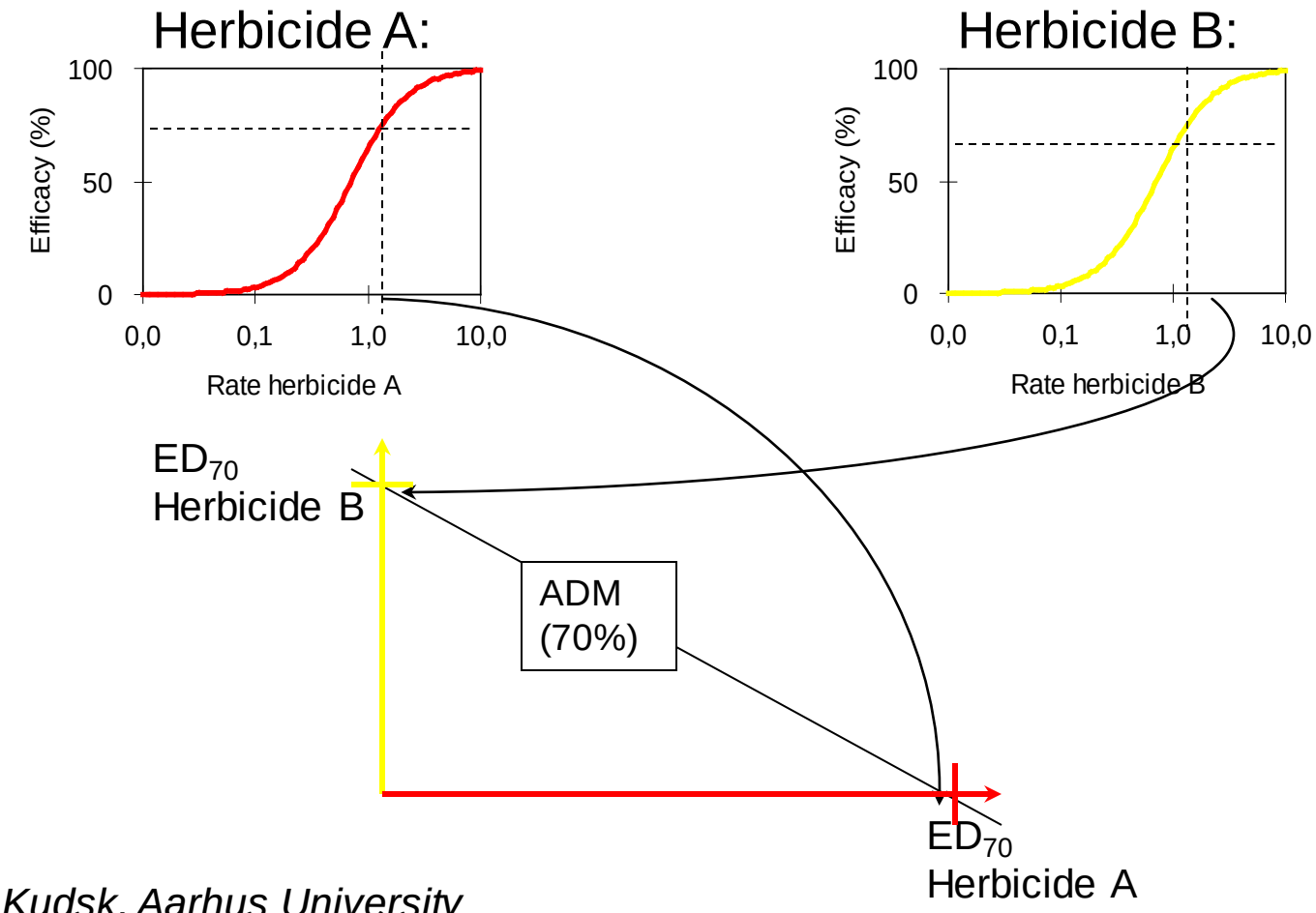
Source: Per Kudsk, Aarhus University

Calculations



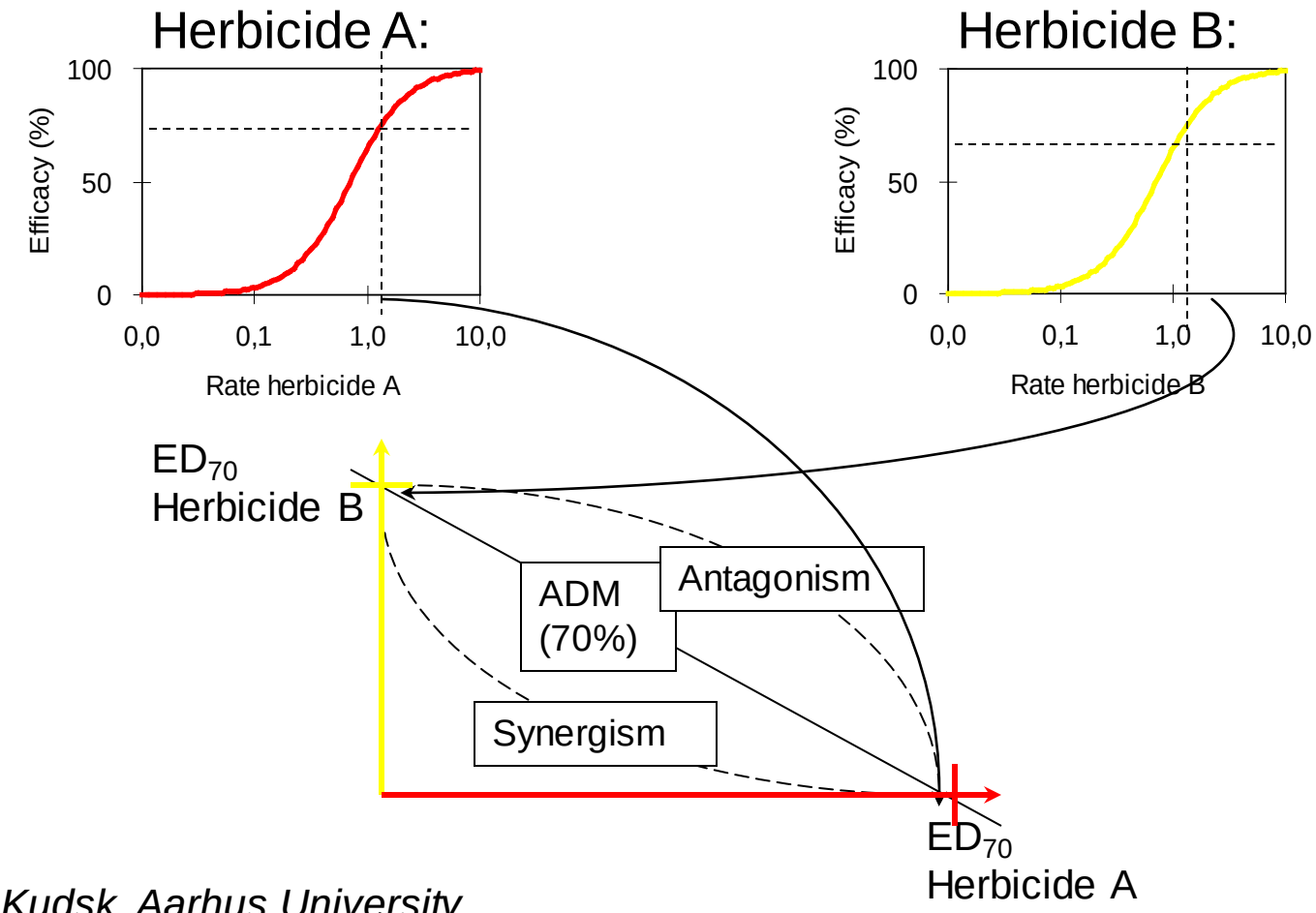
Source: Per Kudsk, Aarhus University

Calculations



Source: Per Kudsk, Aarhus University

Calculations

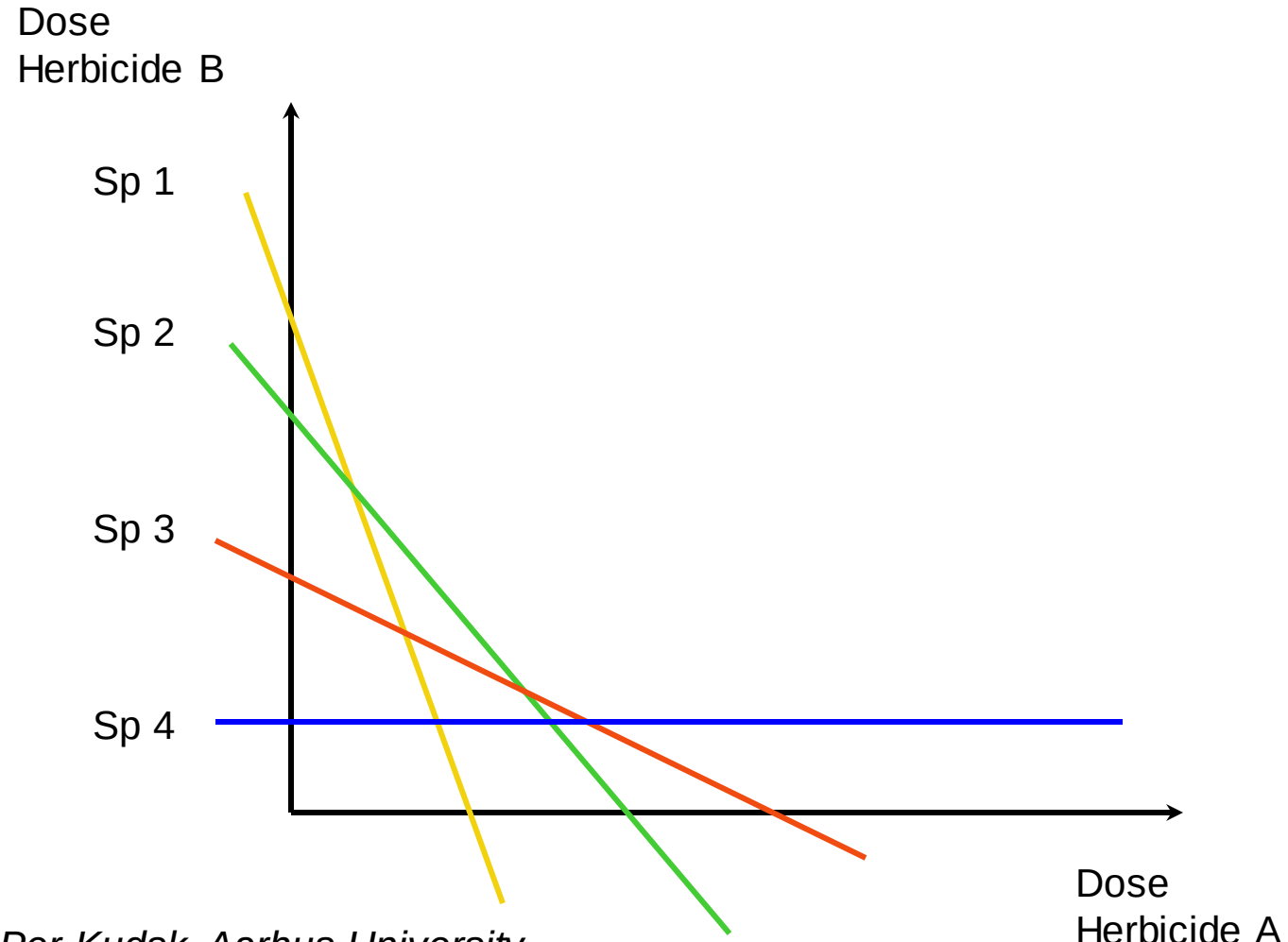


Source: Per Kudsk, Aarhus University

Optimization, example:
2 herbicides, 4 weeds

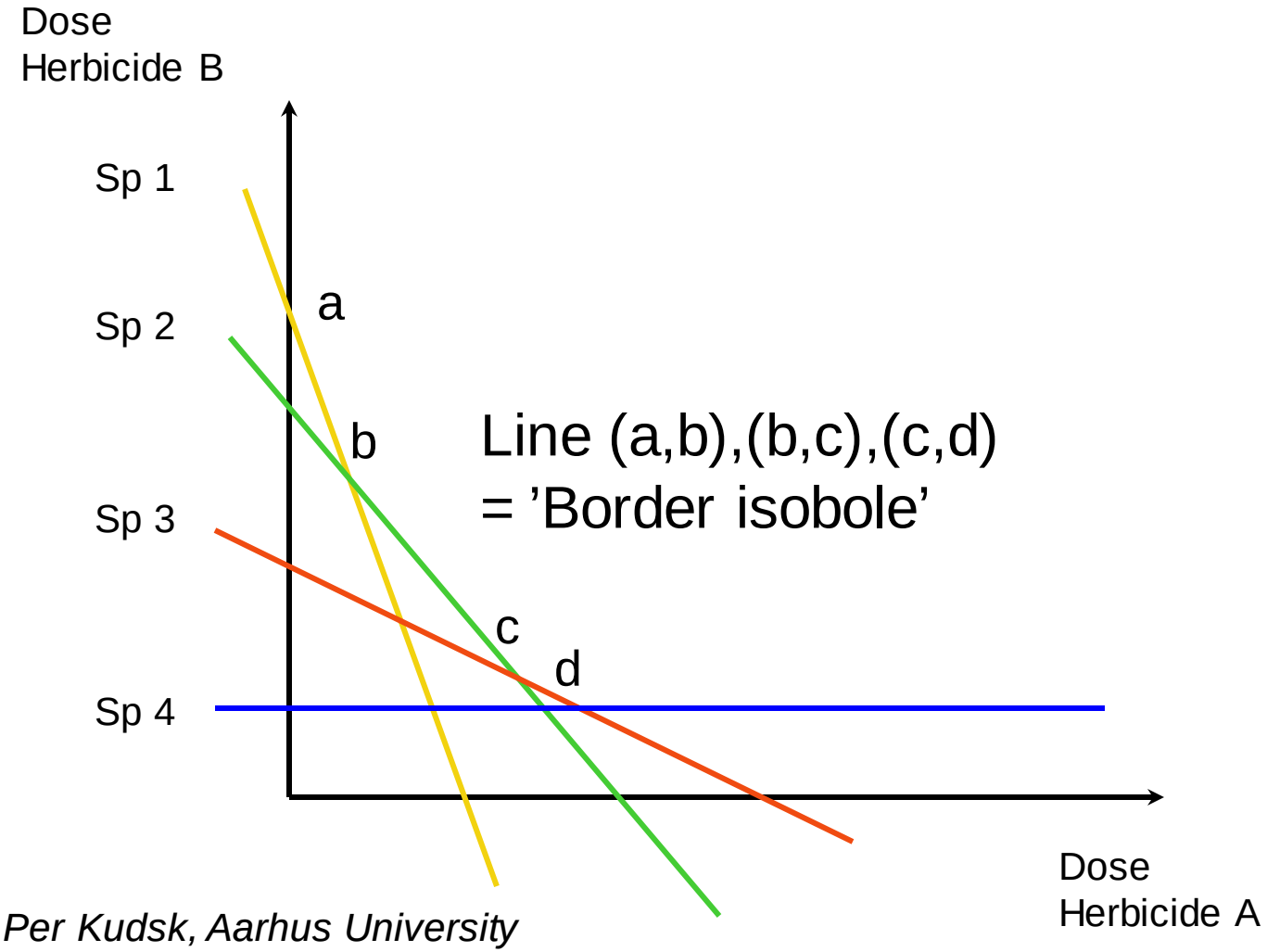
Source: Per Kudsk, Aarhus University

Optimization, example:
2 herbicides, 4 weeds



Source: Per Kudsk, Aarhus University

Optimization, example:
2 herbicides, 4 weeds



Source: Per Kudsk, Aarhus University

Integration of legal restrictions and IPM

Legal restrictions

Legal restrictions

- Herbicide product labels

Legal restrictions

- Herbicide product labels
- Main focus:
  ‘EU-cross compliance’ -> subsidies for farmers

Legal restrictions

- Herbicide product labels
- Main focus:
  ‘EU-cross compliance’ -> subsidies for farmers
- Examples:
  - maximum dose rates per season
  - distance to fresh waters
  - etc.

IPM principles
(benchmarks)

No.	Principle	DSS?
1	Crop rotation, soil cultivation, fertilisation, etc.	No
2	Monitoring of weeds	Yes
3	Use of thresholds to identify needs for control	Yes
4	Preference of non-chemical methods	(Yes)
5	Targeted use herbicides	Yes
6	Herbicide use on necessacary levels	Yes
7	Anti-resistance strategies	(Yes)
8	Evaluate success of applied control measures	Yes

Source: Directive 2009/128/EC, Annex III, 8 general principles

Customization for different countries

Denmark
- customization and users

Denmark
- customization and users

- Customization:
  - 32 crops (80% of arable land)
  - all relevant weed species (105)
  - all registered herbicides
  - about 2,8 mio. dose-response scenarios of single herbicides (much more, when also tank-mixtures are considered)

Denmark
- customization and users

- Customization:
  - 32 crops (80% of arable land)
  - all relevant weed species (105)
  - all registered herbicides
  - about 2,8 mio. dose-response scenarios of single herbicides (much more, when also tank-mixtures are considered)

- Users:
  - first release in 1991
  - 350 regional advisors (100%)
  - 700 farmers (3%)
  - schools (young farmers, BSc, MSc)

Denmark
- customization and users

- Customization:
  - 32 crops (80% of arable land)
  - all relevant weed species (105)
  - all registered herbicides
  - about 2,8 mio. dose-response scenarios of single herbicides (much more, when also tank-mixtures are considered)

- Users:
  - first release in 1991
  - 350 regional advisors (100%)
  - 700 farmers (3%)
  - schools (young farmers, BSc, MSc)

- In this context, this DSS constitutes a professional point of reference

Denmark
- results from field tests

Source:

- *Joergensen et al. (2007). Report from Danish EPA, no. 115, 2007, 247 pp (in Danish, summary in English)*
- *Sonderskov et al. (2014). Decision Support System for Optimized Herbicide Dose in Spring Barley. Weed Technolology, Vol. 28, no. 1, pp.19-27*

Denmark
- results from field tests

- >2,000 field tests: different crops, versions

Source:

- *Joergensen et al. (2007). Report from Danish EPA, no. 115, 2007, 247 pp (in Danish, summary in English)*
- *Sonderskov et al. (2014). Decision Support System for Optimized Herbicide Dose in Spring Barley. Weed Technolology, Vol. 28, no. 1, pp.19-27*

Denmark
- results from field tests

- >2,000 field tests: different crops, versions
- Robust weed management

Source:

- *Joergensen et al. (2007). Report from Danish EPA, no. 115, 2007, 247 pp (in Danish, summary in English)*
- *Sonderskov et al. (2014). Decision Support System for Optimized Herbicide Dose in Spring Barley. Weed Technolology, Vol. 28, no. 1, pp.19-27*

Denmark
- results from field tests

- >2,000 field tests: different crops, versions
- Robust weed management
- Range of herbicide input on field level:
  - from 5% of a registered dose of 1 herbicide
  - to 100% of registered doses of 4 herbicides (tank-mix)
  - control options available in simple and complex infestations

Source:

- *Joergensen et al. (2007). Report from Danish EPA, no. 115, 2007, 247 pp (in Danish, summary in English)*
- *Sonderskov et al. (2014). Decision Support System for Optimized Herbicide Dose in Spring Barley. Weed Technolology, Vol. 28, no. 1, pp.19-27*

Denmark
- results from field tests

- >2,000 field tests: different crops, versions
- Robust weed management
- Range of herbicide input on field level:
  - from 5% of a registered dose of 1 herbicide
  - to 100% of registered doses of 4 herbicides (tank-mix)
  - control options available in simple and complex infestations
- Reduction of herbicide input:
  - about 45% in cereals
  - about 20% in 'open' crops (peas, beets, maize)

Source:

- *Joergensen et al. (2007). Report from Danish EPA, no. 115, 2007, 247 pp (in Danish, summary in English)*
- *Sonderskov et al. (2014). Decision Support System for Optimized Herbicide Dose in Spring Barley. Weed Technolology, Vol. 28, no. 1, pp.19-27*

Norway

Source: Tørresen K S et al. (2004), Grøn kunskap 8 (2)

Norway

- Customization:
  - 4 cereal crops
  - 35 weeds
  - all registered herbicides

Source: Tørresen K S et al. (2004), Grøn kunskap 8 (2)

Norway

- Customization:
  - 4 cereal crops
  - 35 weeds
  - all registered herbicides
- First release 2005

Source: Tørresen K S et al. (2004), Grøn kunskap 8 (2)

Norway

- Customization:
  - 4 cereal crops
  - 35 weeds
  - all registered herbicides
- First release 2005
- Results from field tests:
  - robust weed management
  - about 40% reduction of herbicide input
  - professional point of reference

Source: Tørresen K S et al. (2004), Grøn kunskap 8 (2)

North Germany and North Poland

Source: Mol, F de et al. (2014). 26. Deutsche Arbeitsbesprechung über Fragen der Unkrautbiologie und –bekämpfung, 11.-13. Marts 2014 in Braunschweig

North Germany and North Poland

- Customization:
  - winter wheat
  - selected weeds
  - selected herbicides

Source: Mol, F de et al. (2014). 26. Deutsche Arbeitsbesprechung über Fragen der Unkrautbiologie und –bekämpfung, 11.-13. Marts 2014 in Braunschweig

North Germany and North Poland

- Customization:
  - winter wheat
  - selected weeds
  - selected herbicides
- Provisional results from field tests:
  - robust weed management
  - about 20-30% reduction of input of herbicides,
  - compared to local ‘best practice’
  - need for integration of more herbicides and weeds

Source: Mol, F de et al. (2014). 26. Deutsche Arbeitsbesprechung über Fragen der Unkrautbiologie und –bekämpfung, 11.-13. Marts 2014 in Braunschweig

Central Germany, North Italy, Slovenia

Source: Rydahl et al., 2015, A generic decision support system for integrated weed managemement, Abstract for PURE conference in Poznan, 2015

Central Germany, North Italy, Slovenia

- Customization:
  - maize
  - selected weeds
  - selected herbicides

Source: Rydahl et al., 2015, A generic decision support system for integrated weed managemement, Abstract for PURE conference in Poznan, 2015

Central Germany, North Italy, Slovenia

- Customization:
  - maize
  - selected weeds
  - selected herbicides
- Results from field tests:
  - robust weed management
  - additional field tests planned for 2015
  - need for integration of more herbicides and weeds

Source: Rydahl et al., 2015, A generic decision support system for integrated weed managemement, Abstract for PURE conference in Poznan, 2015

Spain

Source: Montull J M et al. (2014), Crop Protection 64,110-114

Spain

- Customization:
  - winter wheat
  - selected weeds
  - selected herbicides

Source: Montull J M et al. (2014), Crop Protection 64,110-114

Spain

- Customization:
  - winter wheat
  - selected weeds
  - selected herbicides
- Special conditions:
  - warm and dry summers
  - multi-herbicide-resistant weed biotypes (ALS, fop/dim, 2-4 D)

Source: Montull J M et al. (2014), Crop Protection 64,110-114

Spain

- Customization:
  - winter wheat
  - selected weeds
  - selected herbicides
- Special conditions:
  - warm and dry summers
  - multi-herbicide-resistant weed biotypes (ALS, fop/dim, 2-4 D)
- Results from field tests:
  - robust weed management
  - about 30% reduction of herbicide use, compared to local ‘best practice’

Source: Montull J M et al. (2014), Crop Protection 64,110-114

IT system architecture

IT System Architecture

IT System Architecture

- ‘CPO-weeds’ (as demonstrated) is owned jointly by Aarhus University and SEGES, Denmark

IT System Architecture

- ‘CPO-weeds’ (as demonstrated) is owned jointly by Aarhus University and SEGES, Denmark

- New IT system architecture (‘IPMCs DSS’) is developed and owned by IPM Consult Ltd., Denmark

IT System Architecture

- ‘CPO-weeds’ (as demonstrated) is owned jointly by Aarhus University and SEGES, Denmark

- New IT system architecture (‘IPMCs DSS’) is developed and owned by IPM Consult Ltd., Denmark

- IPMCs DSS includes:
  - new, faster and more efficient code and database structure
  - new math, new parameterization based on publicly available data
  - many new facilities
  - technically validated proof-of-concept
  - user-interface now in design-phase

Summary

Summary

- DSS has been customized and validated:
  - in 9 countries including different:
    crops, herbicides, weeds, environmental conditions
  - focus on ‘low-hanging fruits’ (robustness and potential)

Summary

- DSS has been customized and validated:
  - in 9 countries including different:
    crops, herbicides, weeds, environmental conditions
  - focus on ‘low-hanging fruits’ (robustness and potential)
- DSS has proven generic in terms of
  models supporting decision making and IT

Summary

- DSS has been customized and validated:
  - in 9 countries including different:
    crops, herbicides, weeds, environmental conditions
  - focus on ‘low-hanging fruits’ (robustness and potential)
- DSS has proven generic in terms of
  models supporting decision making and IT
- DSS has proven to be potent - why?
  - some weeds can be controlled by 5-10% of a registered dose
  - ‘best practice’ (=reference) -> often adjusted to worst-case conditions

Summary

- DSS has been customized and validated:
  - in 9 countries including different:
    crops, herbicides, weeds, environmental conditions
  - focus on ‘low-hanging fruits’ (robustness and potential)
- DSS has proven generic in terms of
  models supporting decision making and IT
- DSS has proven to be potent - why?
  - some weeds can be controlled by 5-10% of a registered dose
  - ‘best practice’ (=reference) -> often adjusted to worst-case conditions
- DSS has proven to be robust - why?
  - conservative methods of parameterization
  - iterative process of adjustments and field tests
  - no court cases yet ☺

Summary

- DSS has been customized and validated:
  - in 9 countries including different:
    crops, herbicides, weeds, environmental conditions
  - focus on 'low-hanging fruits' (robustness and potential)
- DSS has proven generic in terms of
  models supporting decision making and IT
- DSS has proven to be potent - why?
  - some weeds can be controlled by 5-10% of a registered dose
  - 'best practice' (=reference) -> often adjusted to worst-case conditions
- DSS has proven to be robust - why?
  - conservative methods of parameterization
  - iterative process of adjustments and field tests
  - no court cases yet ☺
- International collaboration is welcomed ☺

Thank you!