IPM 2.0
Towards future-proof crop protection in Europe

A generic DSS for weed control

Per Rydahl
Aarhus University, Denmark

EFPP
EUROPEAN FOUNDATION FOR PLANT PATHOLOGY

EU-project 'ENDURE' 2007-2010
– survey on DSS for crop protection

- 70 DSS analysed
- Report on www.endure-network.eu, 128 pp
- 9 DSS on weed control
- In context of reducing use of herbicides, 'best parts' were identified i 3 DSS:
  - DecidHerb INRA,France
  - CPOWeeds AU, Denmark
  - GestInf CNR, Italy

EU-project PURE 2011-2014
- new DSS integrating best parts from 3 DSS

Based on a field report:

1. DecidHerb or CPOWeeds:
   - assess target efficacy on single weed species

2. CPOWeeds:
   - select single herbicides
   - calculate dose rates
   - optimize tank-mixtures

3. GestInf:
   - calculate expected economic net return of alternative treatments

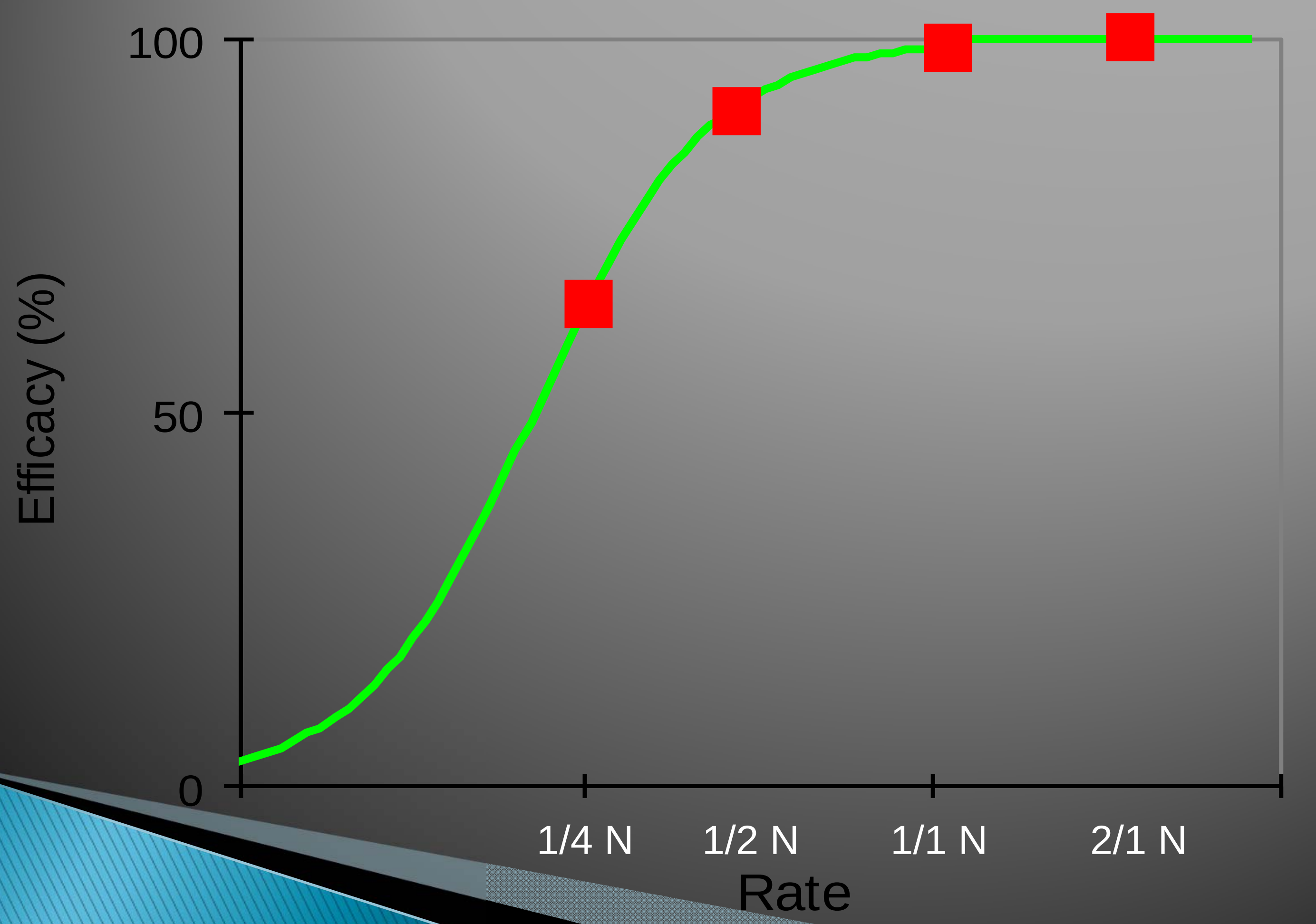
Step 1: target efficacy (DecidHerb)

- Short term needs for control of multi-species weed infestations
- Algorithams based on fuzzy sets (fuzzy logic)
- Output:
  percent control needed on biomass of single weeds after treatment

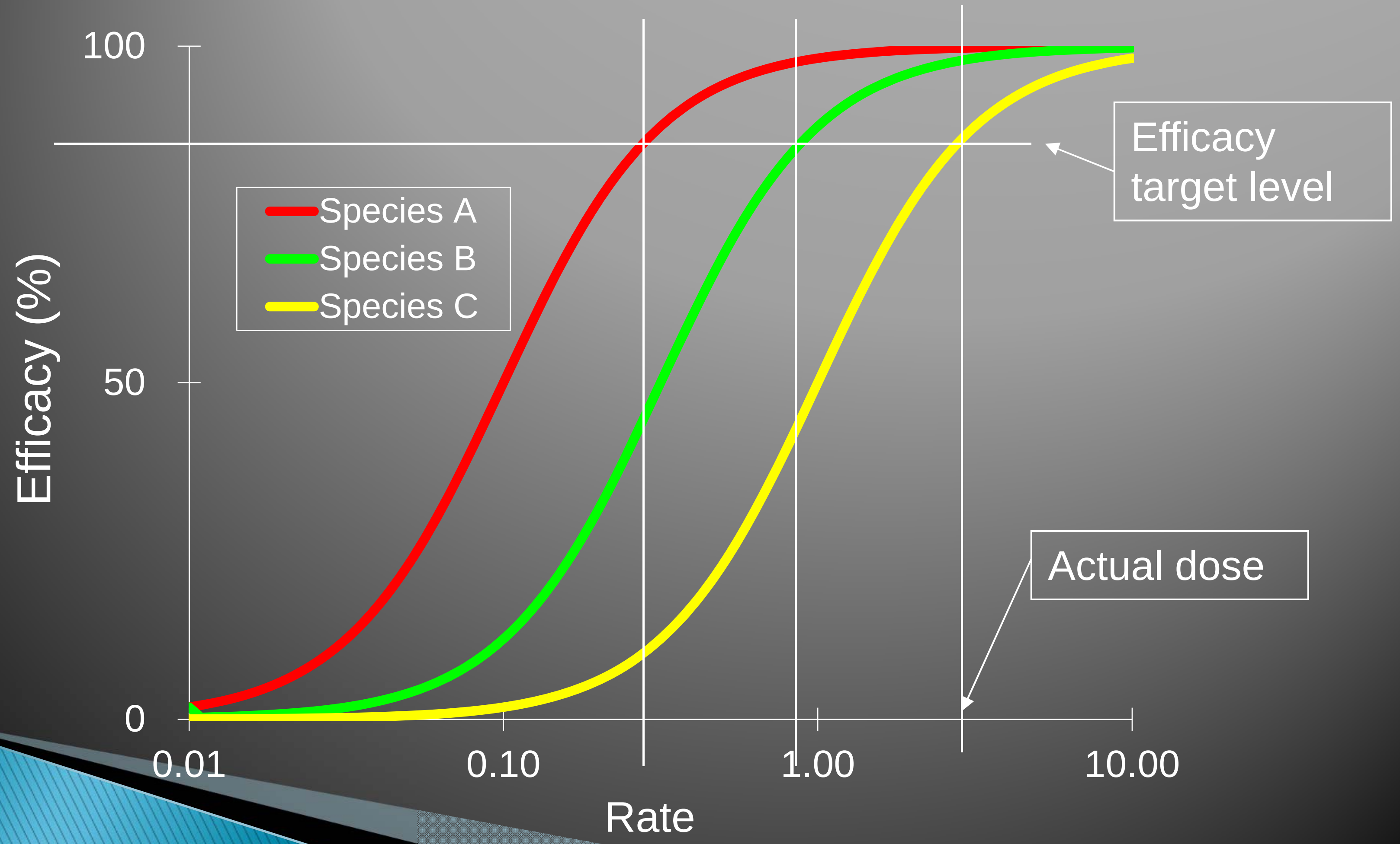
Step 1: target efficacy (CPOWeeds)

- Multispecies weed infestations
- Integrates aspects, which farmers consider important:
  - potentials for yield quantity and quality
  - weed propagation
  - cosmetic aspects
- No objective models yet
  – algorithms based on expert knowledge and literature
- Output:
  percent control needed on biomass of single weeds after treatment

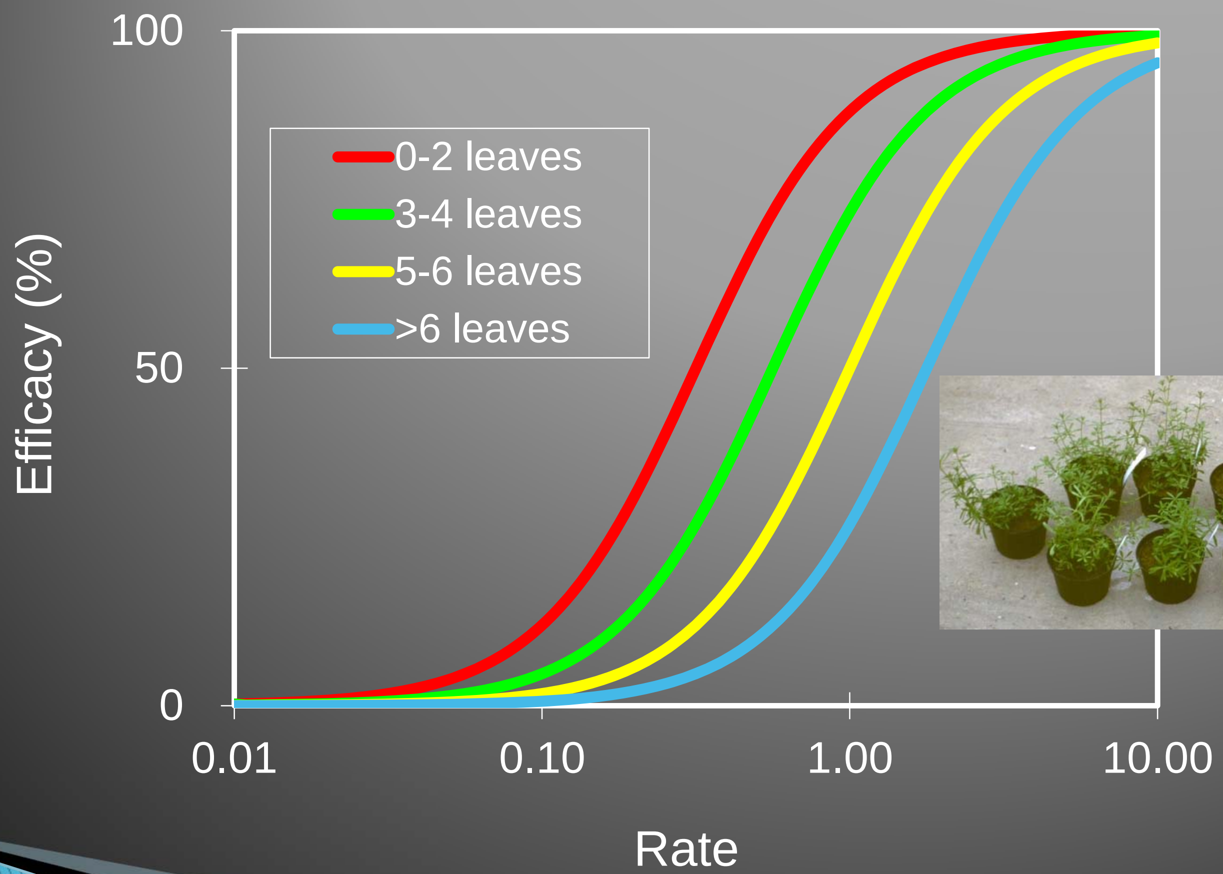
Step 2: herbicide dose response function for 1 weed



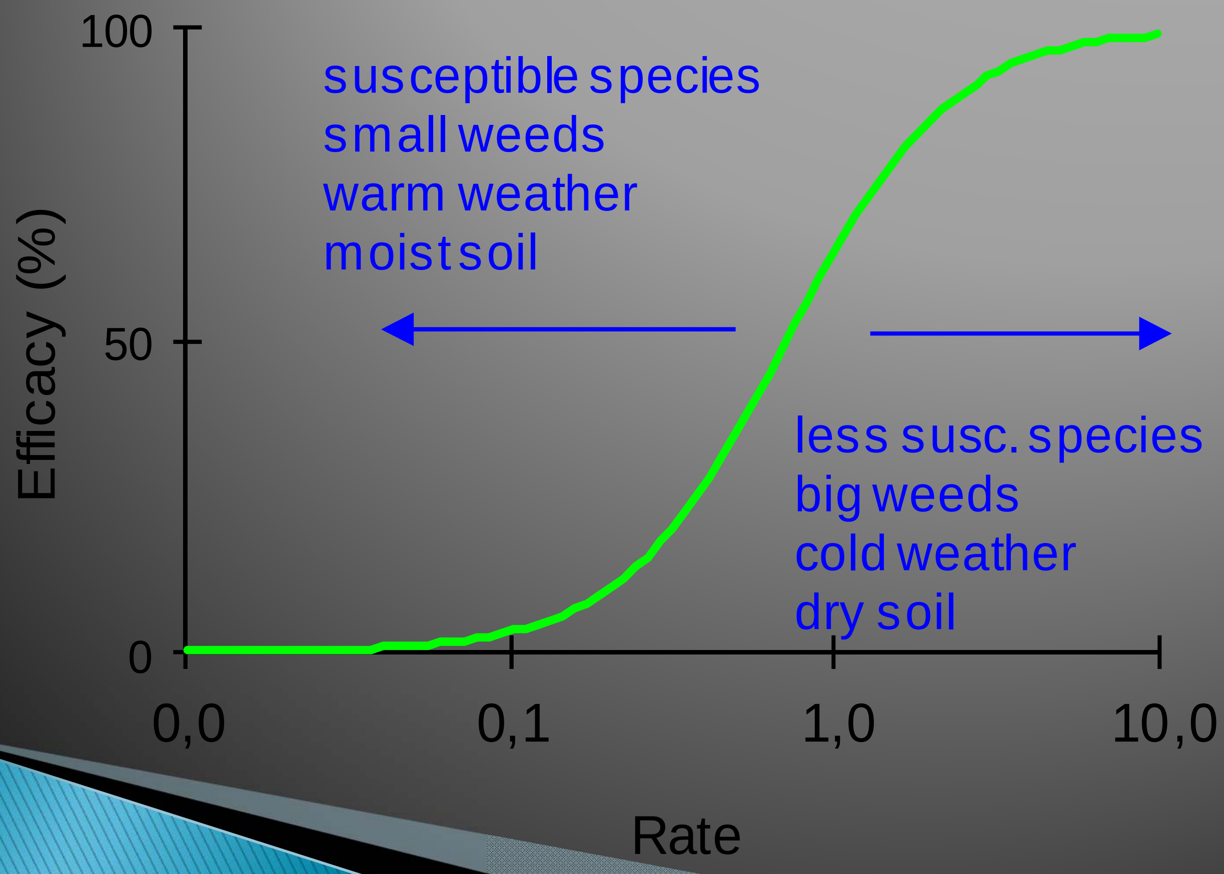
Step 2: 1 herbicide, 3 weeds



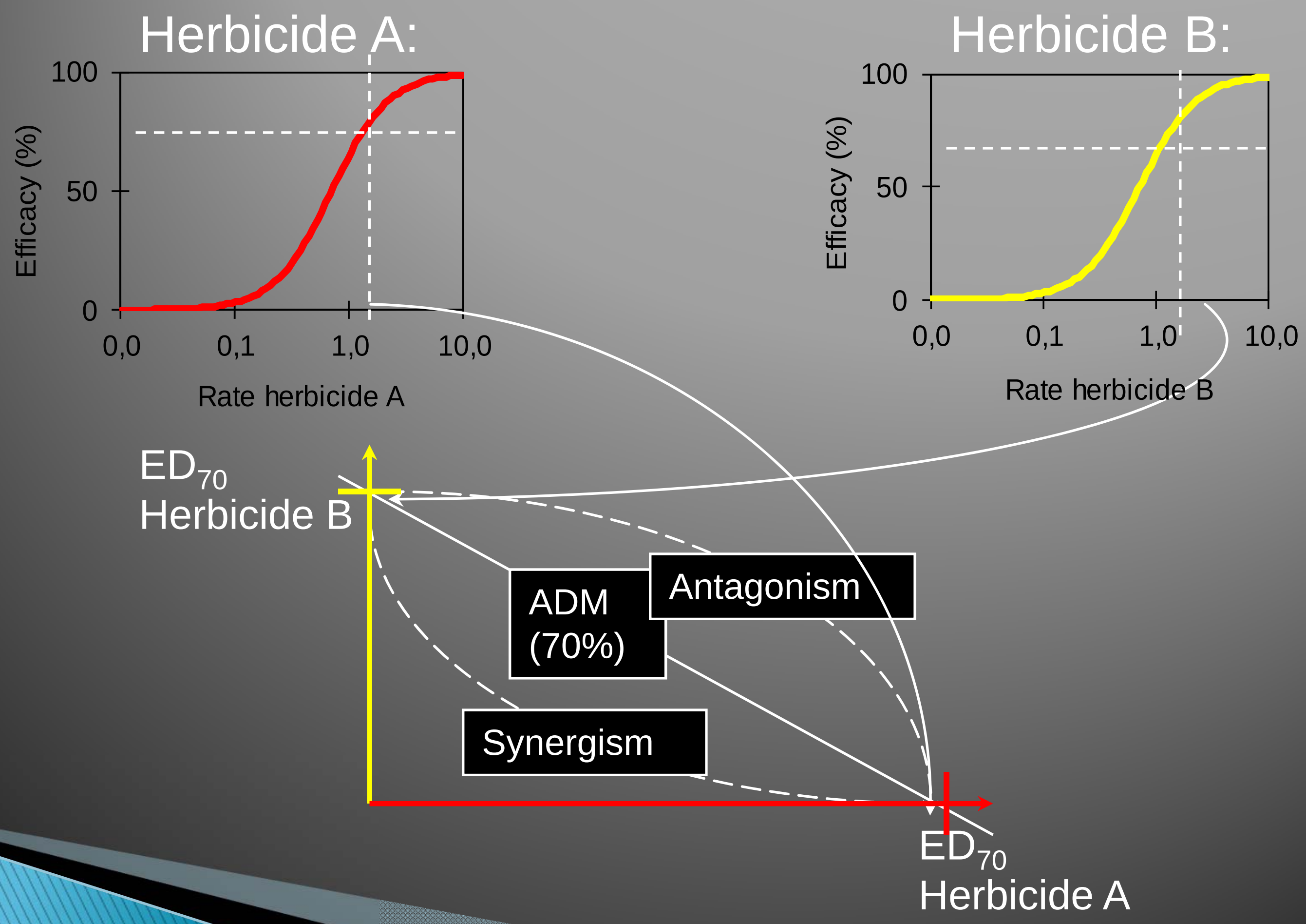
Step 2: 1 herbicide, 1 weed, 4 growth stages



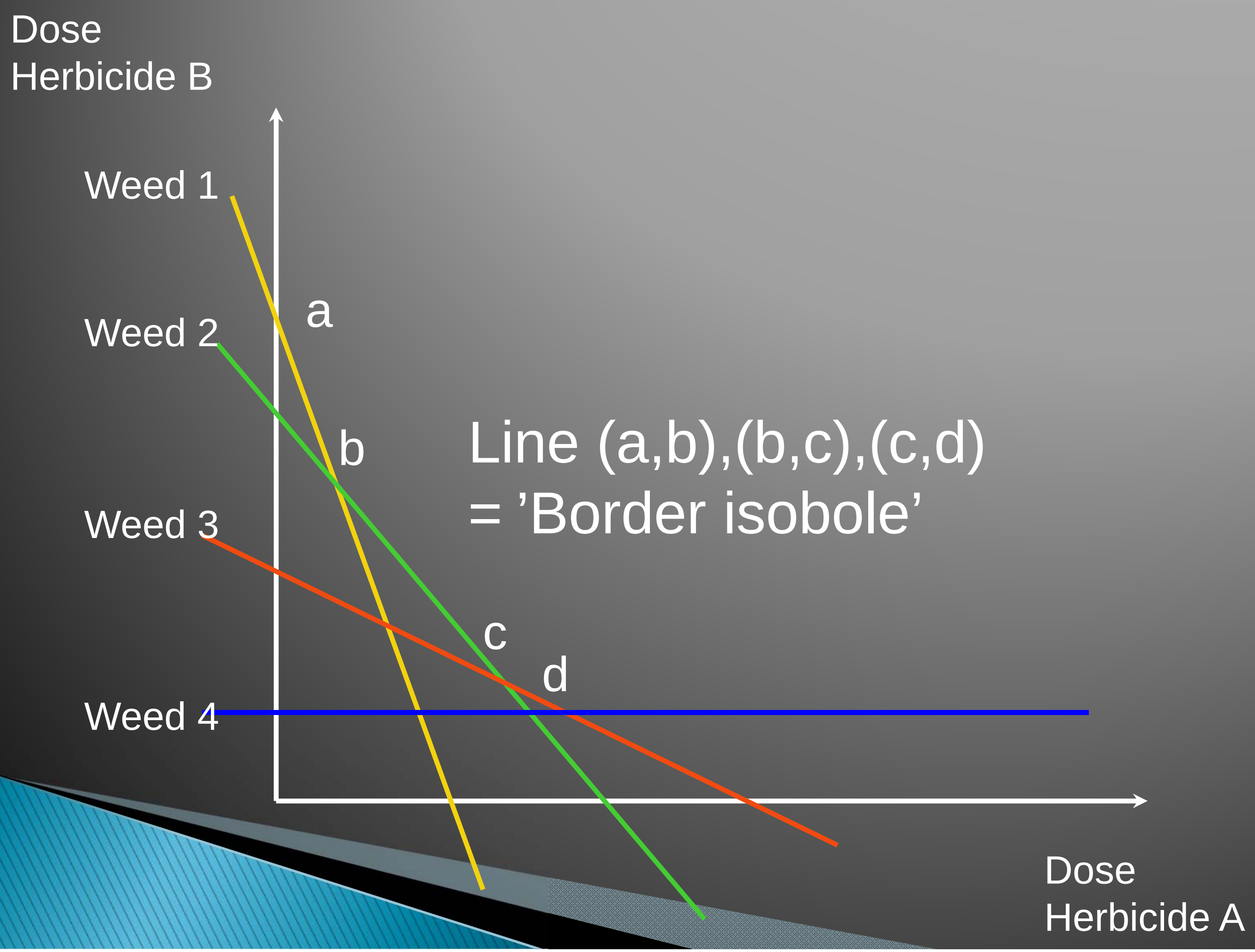
Step 2: general attributes
(now 2,1 mio. scenarios in DK)



Step 2: Optimization of tank-mixes by Additive Dose Model (ADM)



Step 2: Optimization for arbitrary constant relating to dose rates
Example: 2 herbicides, 4 weeds



Step 3: Calc. of expected economic net return

- GestInf:
  - Prediction of yield loss from mixed weed infestations
  - Predicted efficacy of a treatment will reduce yield loss
  - Using prices of crop and herbicides, net economic net return will be calculated

Implementation
– DecidHerb and GestInf

- DecidHerb:
    - Released in France
    - Main crops, weeds and herbicides in France
    - No field validation tests
    - Not so many users
- GestInf:
    - Prototypes in Italy
    - Wheat and maize, selected herbicides and weeds
    - Few field validation tests

Implementation
– CPOWeeds

- Denmark, released
  - 32 crops, all herbicides,105 weeds
  - about 1,300 subscribers
  - > 2,000 field validation tests, robust weed control, 20–40% reduction of TFI
- Norway, released
  - 4 crops, all herbicides, 35 weeds
  - 3 years field validation tests:
    robust weed control, 20–30% reduction of cost of herbicides
- Spain, prototype
  - wheat, selected weeds and herbicides
  - 3 years field validation tests:
    robust weed control, 30% reduction of cost of herbicides
- China, prototype
  - paddy rice
  - selected weeds and herbicides
  - field validation test started in 2012, prelimenary results are promising

Implementation
– by integration of different DSSs

- Germany, Italy and Slovenia: prototype
  - EU-project 'PURE'
  - CPOWeeds, DecidHerb and GestInf
  - maize, selected herbcides and weeds
  - field validation test start March 2013

- Denmark, Germany and Poland: prototype
  - EU-project 'DSSHerbicide'
  - Integration of CPOWeeds and CeBrUs (University of Rostock)
  - wheat, selected weeds and herbicides
  - field validation tests, 1st years results:
    robust weed control, reduced input of herbicides

New DSS features in EU-project 'PURE'

- Control of already resistant weeds:
  - Documentation is solid
  - Resistant biotypes of weeds = 'new' weed species
  - high target efficacy on resistant biotypes
  - Herbicide dose-response functions:
    - low effect on resistant biotypes of same herbicide MOA
    - normal effect of alternative MOAs
- Prevention of new resistance development:
  - Documentation is poor
  - Focus on efficacy!
  - Identification of risky MOAs, which shall be recommended max. every second generation of weeds
  - Focus on summer- and winter-annual weeds
- Integration of mechanical weed control

Generic aspects – CPOWeeds

DSS now been implemented and validated in:

- Different climates:
  - Denmark/Norway: temperate, moist
  - Spain: sub-tropical, arid
  - China: sub-tropical, moist
- Different crops, weeds, herbicides and interactions
- Robust control of weeds and potentials for reduction of herbicide use have been demonstrated in all scenarios
- Generic IT system architecture

User interfaces

Pros & Cons

- Pros:
  - Optimization of treatments on a field or farm level
  - Robust recommendations
  - Potentials for reduction of herbicide use
  - May be customized for 'low- or high-hanging fruits'
  - A point of reference regarding needs for control and efficacy of herbicides
  - Colaborations on design of DSS and herbicide efficacy testing will be win/win
  - Many requirements in Directive 2009/128/EC are met
- Cons:
  - Field tests of herbicides: 3-4 dose rates (weed species)
  - Semi-field test of herbicides: 6-8 dose rates (weed growth stages, climatic conditions, ADM)
  - Construction and field test of DSS prototypes
  - Advisors and agrochemical industry may no

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