Perspectives for site specific application of soil herbicides in arable farming

KNPV 26 November 2013

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Outline

- Soil herbicides in Dutch agriculture
- Advantages & disadvantages
- Interactions between soil herbicides and soil
- Developing and testing DSR's
    - Greenhouse, model, field
- From soil map to taskfile
- Issues to tackle
- Outlook

Soil herbicides in Dutch agriculture

- Soil herbicides
  - Applied around crop emergence
  - Kill germinating weeds

Crop	Soil herbicides (a.i.)
Wheat, winter	diflufenican/isoproturon, aclonifen, pendimethalin, prosulfocarb
Sugar beet	clomazone, chloridazon/quinmerac, metamitron *
Potato	prosulfocarb, metazachloor, aclonifen, clomazone, metribuzin, pendimethalin, linuron *
Onion	pendimethalin, chloridazon *
Maize	isoxaflutole, s-metolachlor, dimethenamid-P, terbutylazine *
	* also used in post-emergence herbicide mixtures

Advantages & disadvantages

- Environmental and Agronomic
  - - Emission (Persistence, leaching etc), (eco)toxicity, phytotoxicity, carry-over
  - + Early season head start of crop, less post-emergence control, resistance management
- Need for smart usage

Source: http://www.ag.ndsu.edu/cpr/weeds/what-are-the-advantages-of-using-foundation-soil-applied-herbicides-5-3-12ine 3

Interaction with the soil

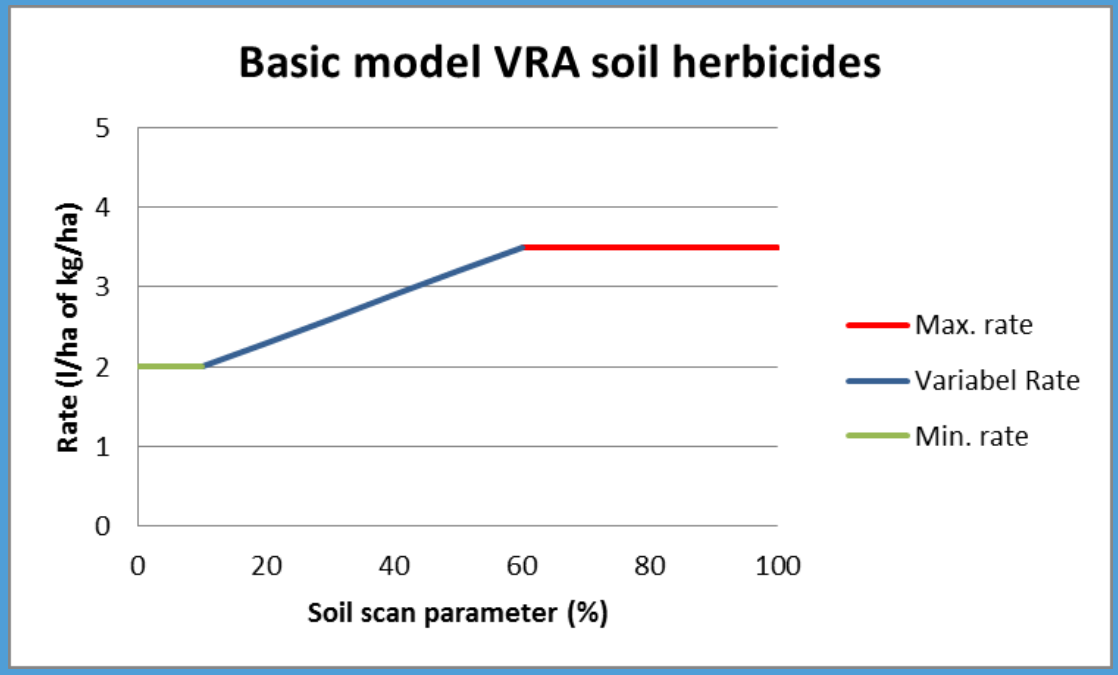
- Sorption to soil determined by:
  - Physico-chemical properties of herbicide
  - Weather conditions
  - Soil characteristics: SOM, clay, pH, soil moisture
- If sorbed: not available for killing germinating weeds.
- Within field spatial variation -> DSR -> Variable Rate Application of soil herbicides

Developing & testing DSR's

- Literature, label
- Greenhouse experiments
- Model
- On farm research to test DSR in practice

Decision Support Rules

- Basic model for soil herbicides

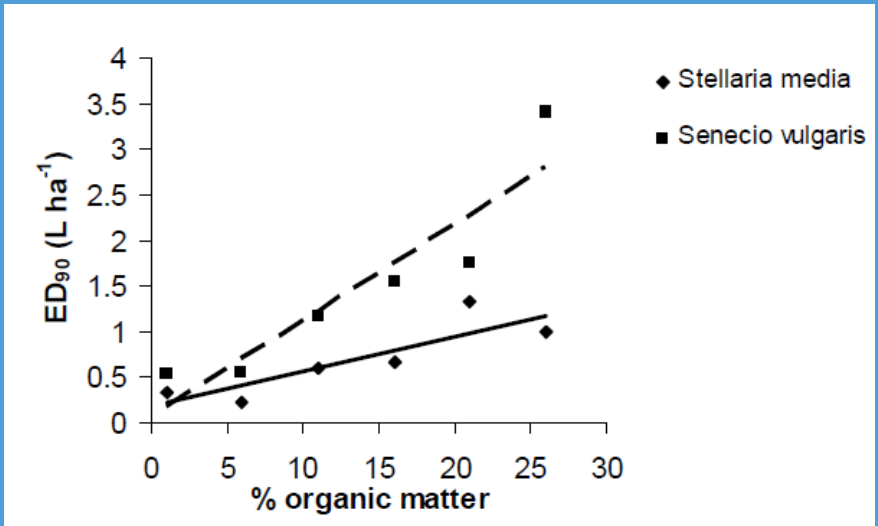


Source: Kempenaar et al., 2013

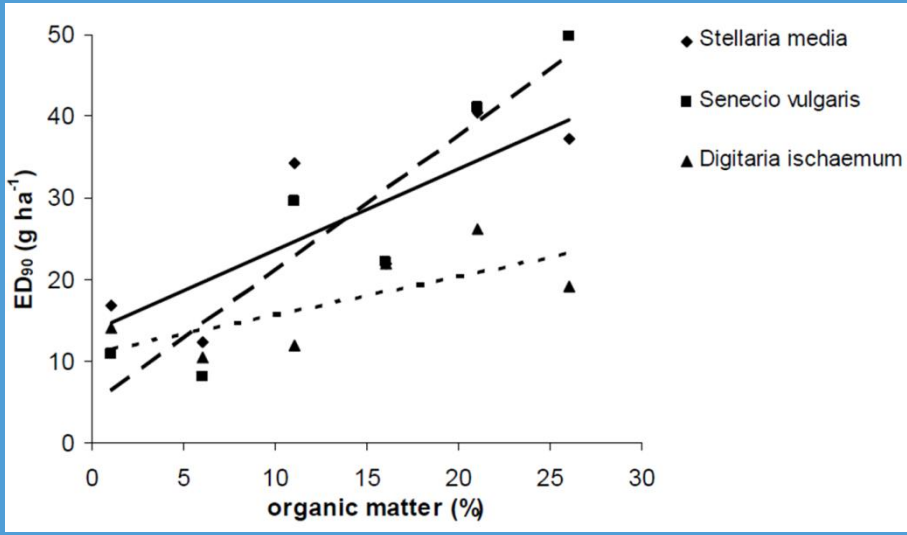
Greenhouse experiment (Tielen, 2010)

- Isoxaflutole, dimethenamid-P
- Soil of varying OM content
- Weed species : Common Groundsel (*Senecio vulgaris)*, Chickweed (*Stellaria media)*, Smooth crab grass (*Digitaria ischaemum)*

Dimethenamid-P



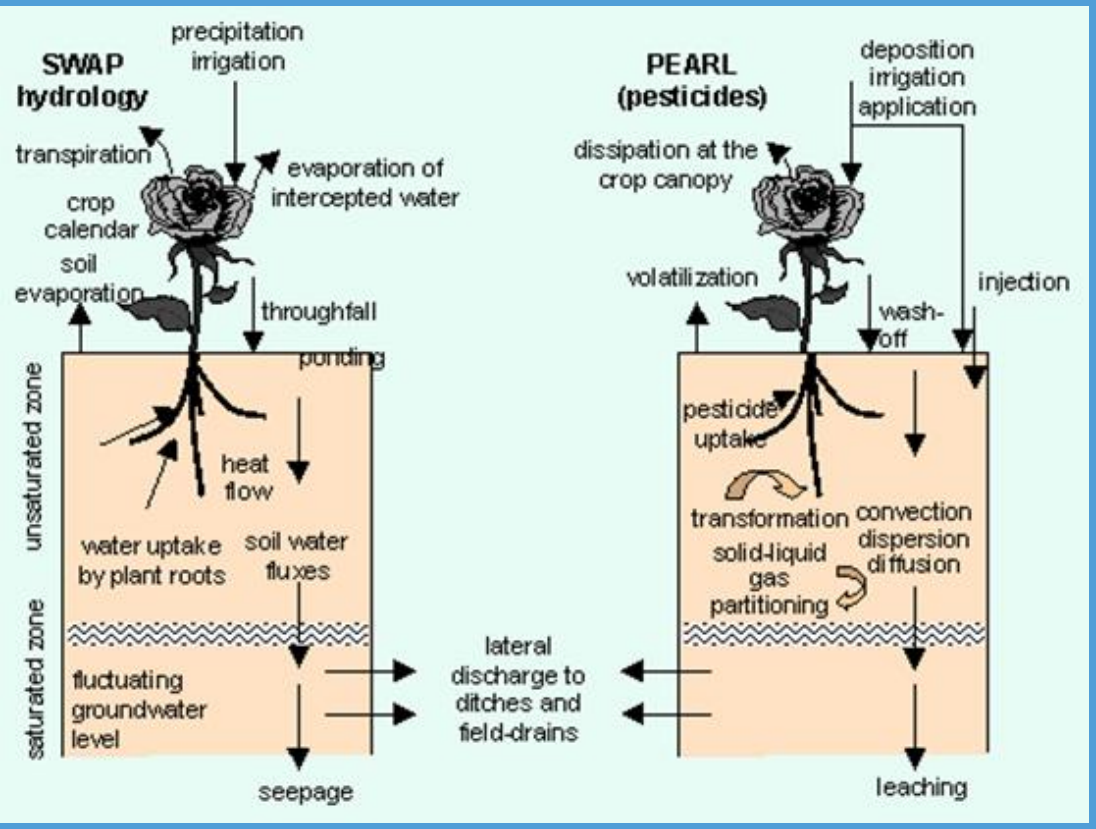
Isoxaflutole



The ED90 indicates a fresh weight reduction of 90%

- ED_{90} : shows relation between OM and efficacy.
- Differences between weed species.

Interaction with the soil: PEARL



- PEARL is an acronym of *Pesticide Emission Assessment at Regional and Local Scales*. PEARL comprises two parts: a soil water model SWAP (Soil, Water, Atmosphere and Plant) and PEARL to determine the pesticide fate.

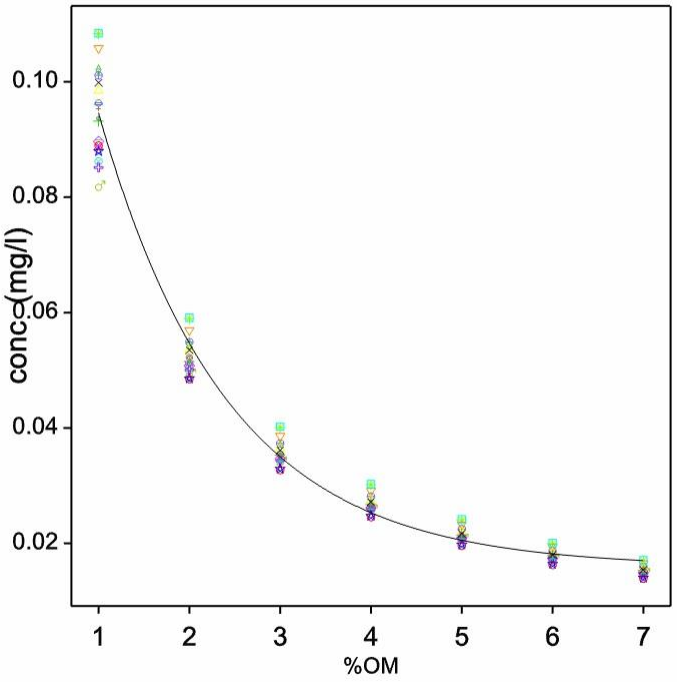
Figure 1 Overview of processes included in the PEARL model. (Source: (Tiktak et al., 2002) and http://www.pearl.pesticidemodels.eu/pdf/pearlman.pdf)

Model study PEARL

- Aim: Determine bioavailability of Dimethenamid-P and isoxaflutole in relation to SOM content in sandy soil using PEARL
- Crop: Maize
- Run for 20 years of weather data

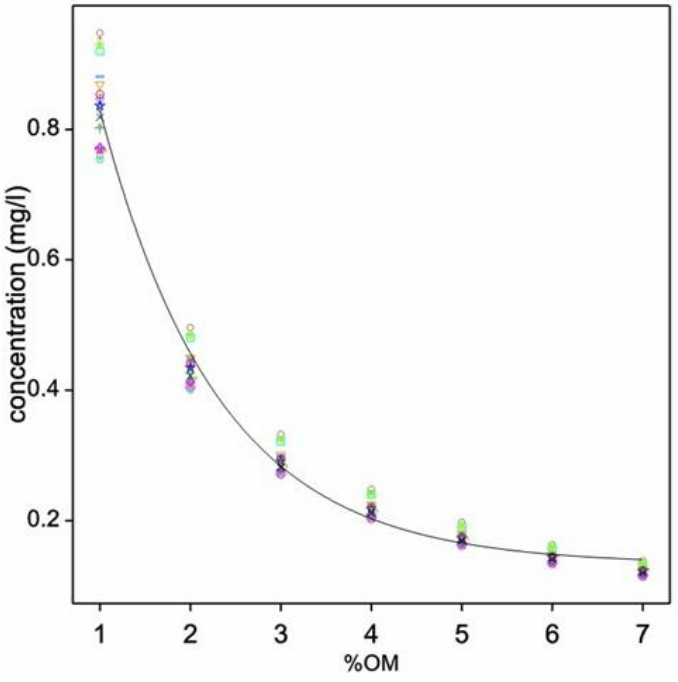
Source: Heijting et al., 2012

Isoxaflutole -> DKN



Fitted general model to DKN concentration at t=7 days after application

Dimethenamid-P

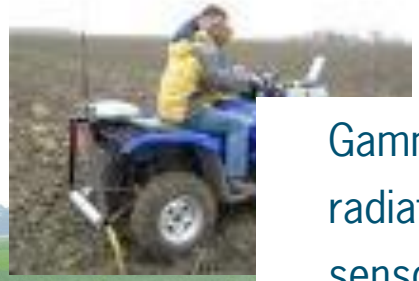


Fitted general model to DIMP concentration at t=7 days after application

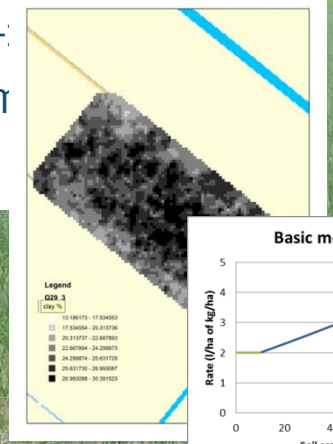
Follow up should focus on

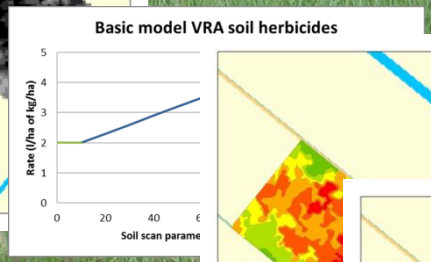
- Optimizing time of application to weather circumstances
- Establishing relation between concentration in soil and efficacy
- Studying behaviour in soils with both OM and clay, also for other active ingredients

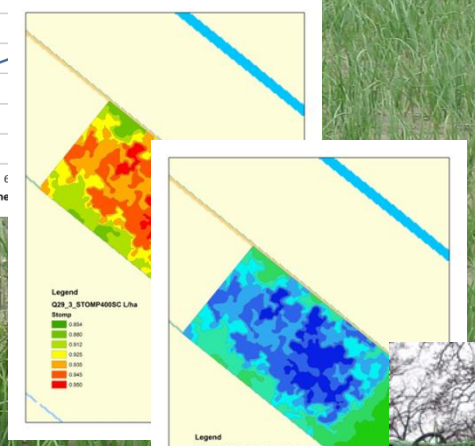
From soil map to taskfile



Gamma radiation sensor - texture m (clay)



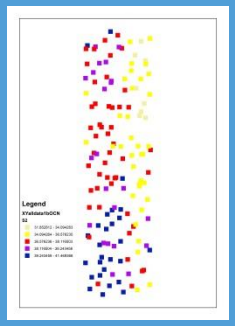


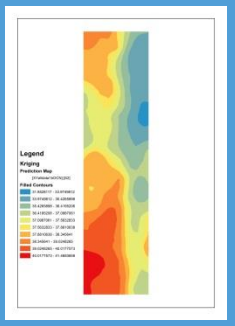


Stomp (pendimethalin) in onion

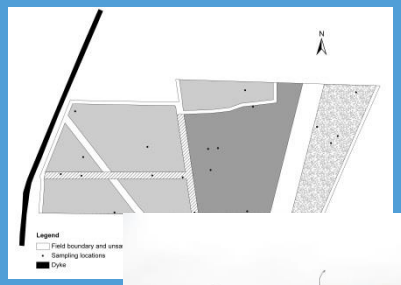
Mapping within-field variation:

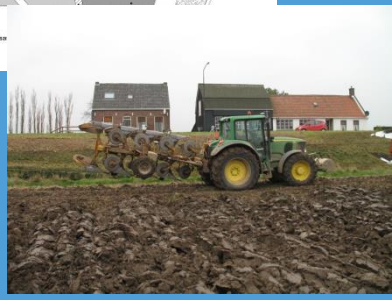
- Sampling+geostatistical interpolation





- Stratifying fields in zones -> sampling

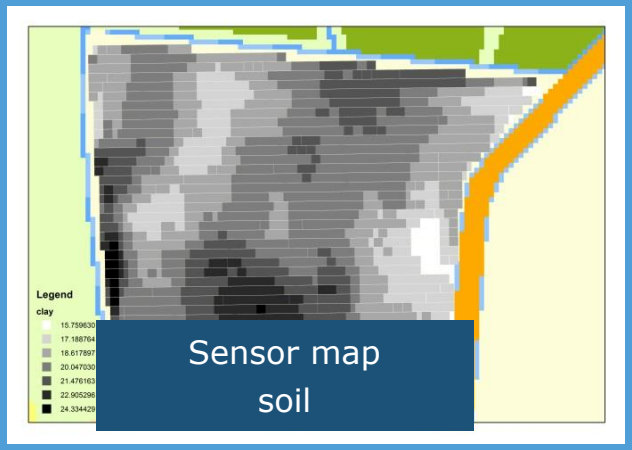




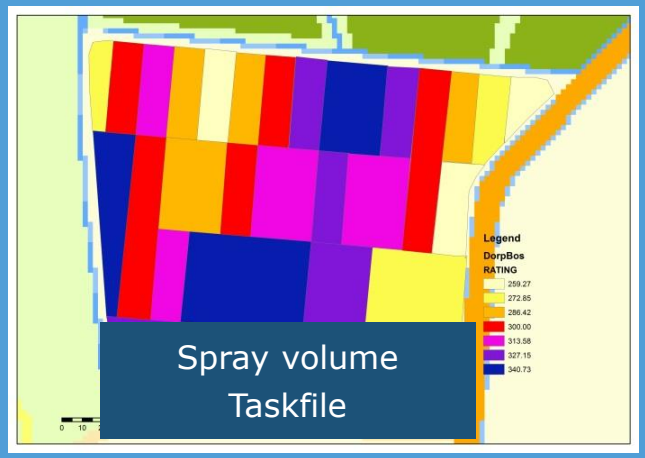
- Sensing

Sources: Heijting et al., 2007 & 2011

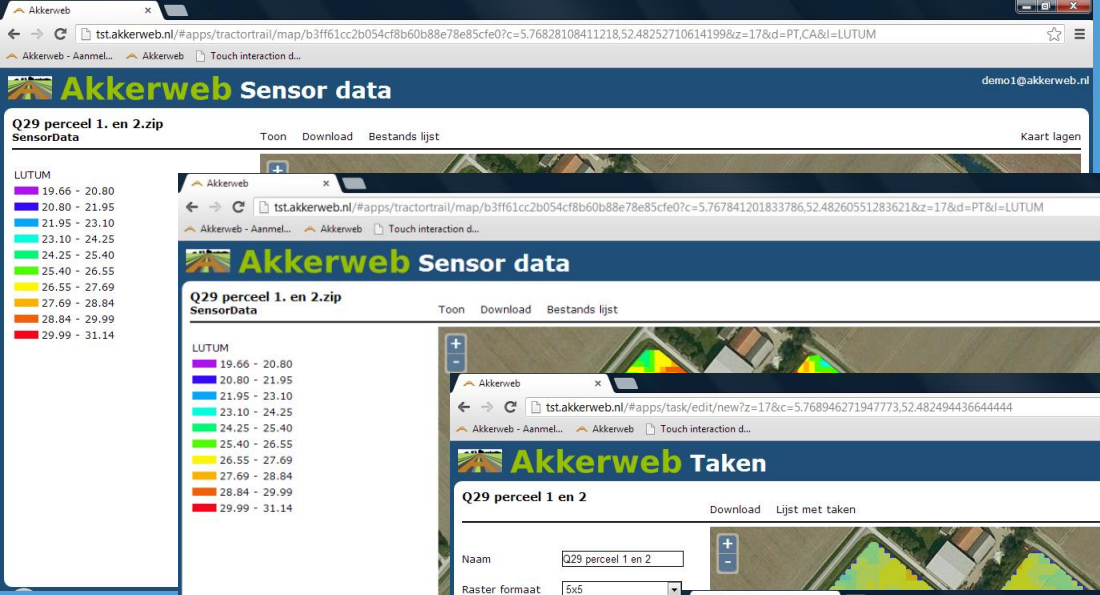
Javelin (diflufenican/isoproturon) in winterwheat

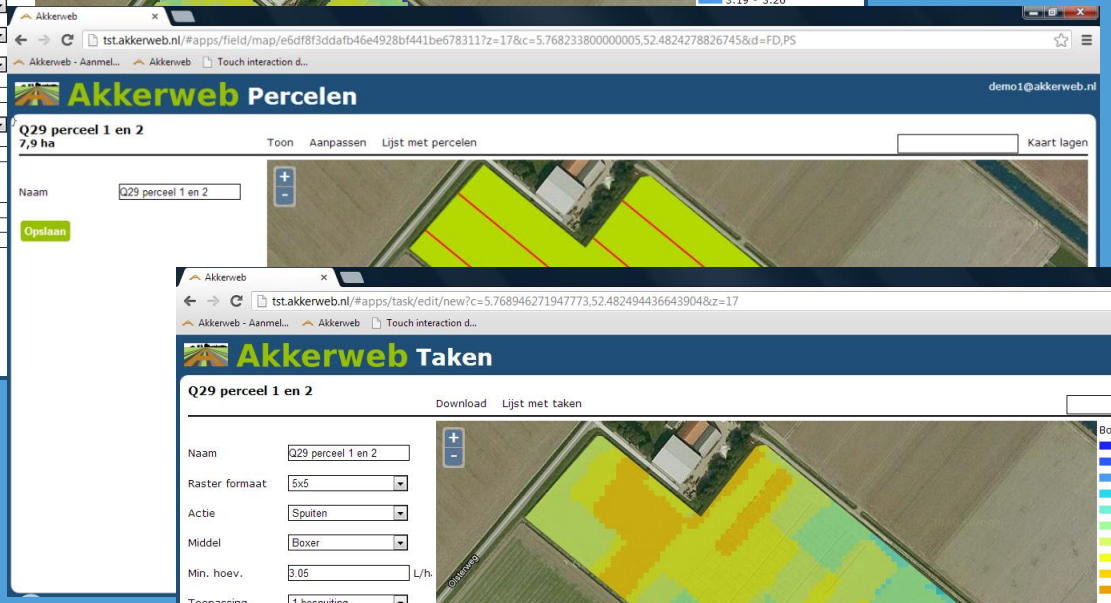


- DSR
- Sprayboom width
- Routing
- Reponse time
- Spray volume if uniformly applied



Boxer (prosulfocarb)





From soil map to taskfile

In general reduction depends on:

- Basic DSR and range
- Spatial pattern and variation of soil
- Spray equipment
- Routing (size and shape of field)
- Efficacy

Overall expected reduction 20-30%

Issues to tackle

- Validation of soil scans
- Efficacy testing in practice
- Technical hiccups
- Spatial variation of weed patterns
- Further testing needed

Outlook

- Technically possible to apply VRA
- Expected reduction in use 20-30%
- Less phytotoxicity -> positive effect on yield
- Increasing amount and availability of soil scans
- Advances in DSR development
- Discussion on label prescription

Thank you for your attention

With the kind co-operation of Harold Zondag, Jean- Marie Michielsen, Jos Tielen, Gabriella Fait, Han Kemink, Anselm Claassen, Wim van de Slikke, Simon de Lange, Willem Dantuma and many others.

IJKakker

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