# Managing weeds without herbicides?


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100years 1918 — 2018

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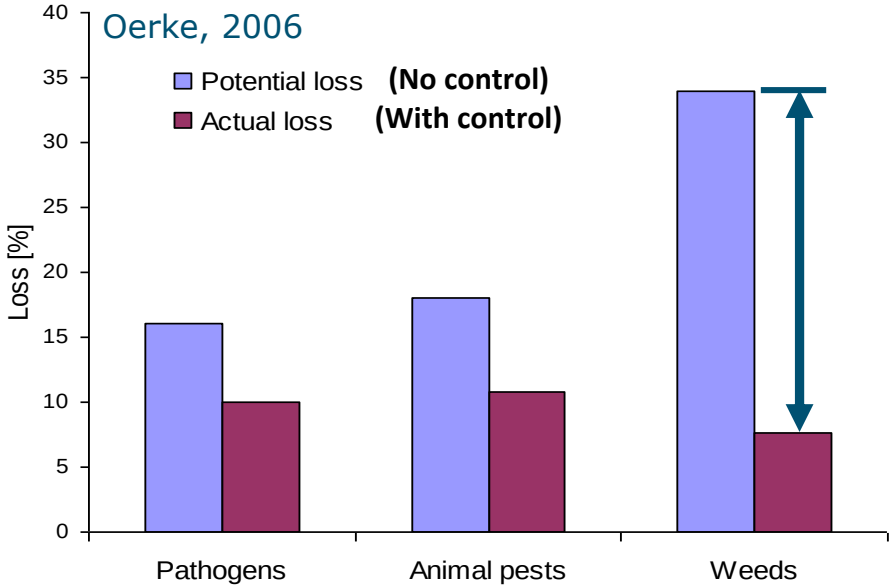
# Agricultural ecosystems and weeds

- **Agricultural** fields characterized by
  - Low levels of ***stress***
  - High levels of ***disturbance***
- Creating favourable conditions for **ruderal** / **pioneer** plant species
  - rapid early growth
  - short vegetative period
  - high seed production rate
  - seed dormancy mechanism

# The weed problem at a global level





- Large gap between potential and actual yield loss
  → Need for **durability** of weed control measures

# Current weed control

- Weeds are endemic
- Control measures often routinely taken
    - Tillage (e.g. ploughing)
    - Herbicides (*kg of active substance*)
    - 2017: 2.901.786 (NL) ; 126.470.823 (EU28)
    - 2016: 2.971.284 ; 125.211.962
    - 2015: 2.881.015 ; 128.683.389

**A strong reliance on herbicidal control**

# Concerns regarding herbicides

- **Environment**

Mentions of surface- and groundwater contaminated with herbicidal compounds

Grondwater besmet met bestrijdingsmiddelen

Gisteren, 22:44

**DEN HAAG - Een kwart van de grondwaterwinlocaties kennen (potentiële) problemen met gewasbeschermingsmiddelen. Het gaat om 52 locaties. Dat blijkt uit onderzoek van het RIVM. In drinkwater worden de stoffen niet aangetroffen.**

In het grondwater worden vooral herbiciden (onkruidverdelgers) of afbraakproducten hiervan aangetroffen. Zes van de elf meest aangetroffen stoffen zijn inmiddels niet meer toegelaten. Dat hoeft niet te betekenen dat deze stoffen nog worden gebruikt; het kan vele jaren na gebruik nog zichtbaar zijn in grondwater.

- **Human health related**

Monsanto's landbouwgif glyfosaat is wel/niet kankerverwekkend

Ideaal bestrijdingsmiddel voor de een, sluipend milieugevaar volgens de ander

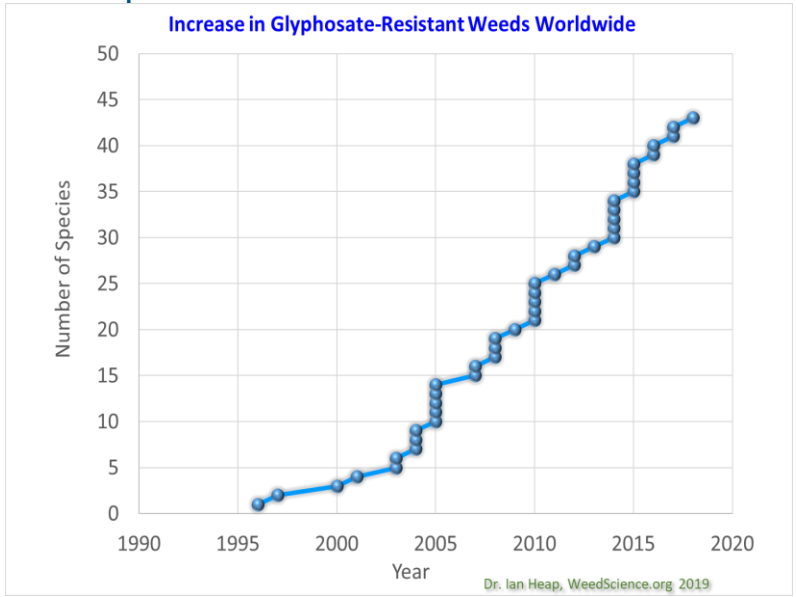
Classifications differ:

- IACR – likely to be carcinogenic
- EFSA – unlikely to be carcinogenic

# Concerns regarding herbicides - agronomic

- **Durability**

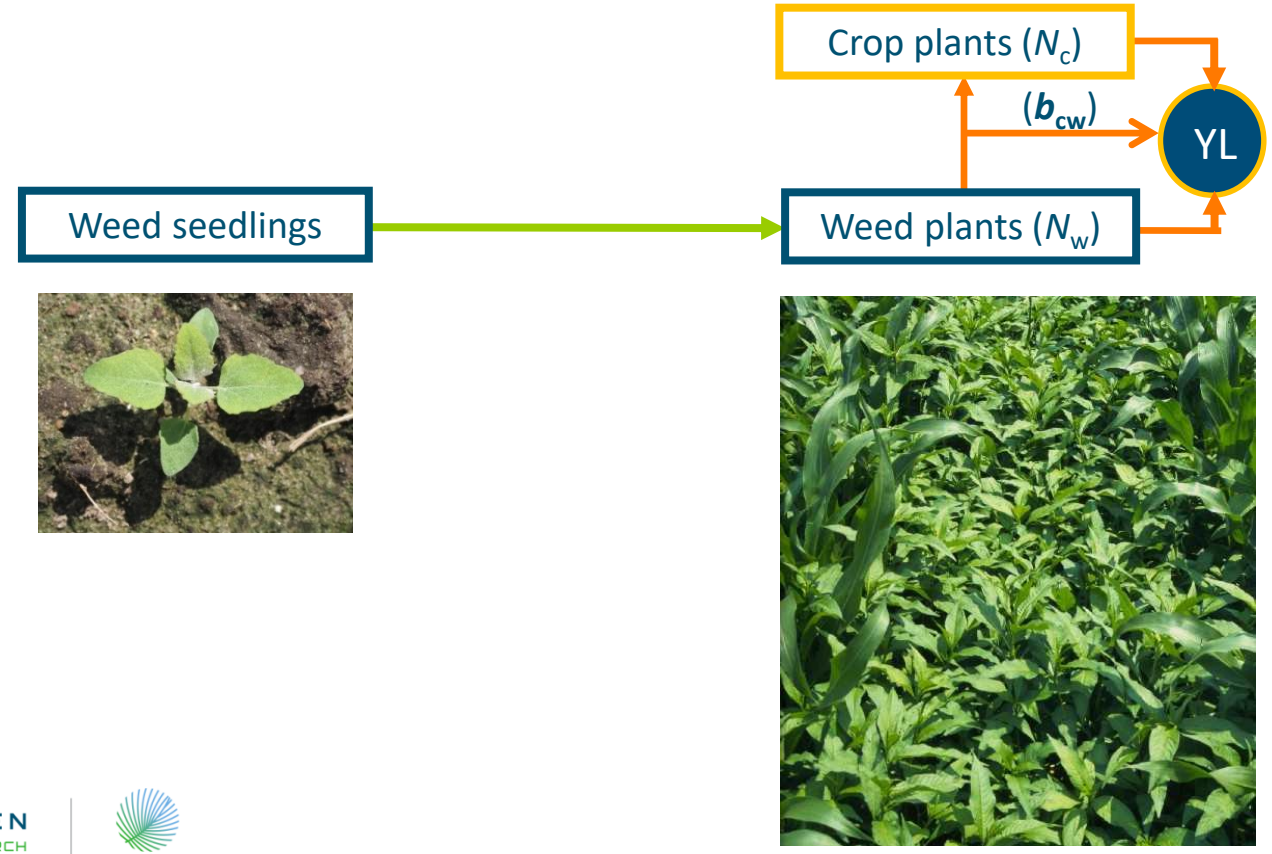
One-sided, frequent, use selects for rapid development of herbicide resistance.



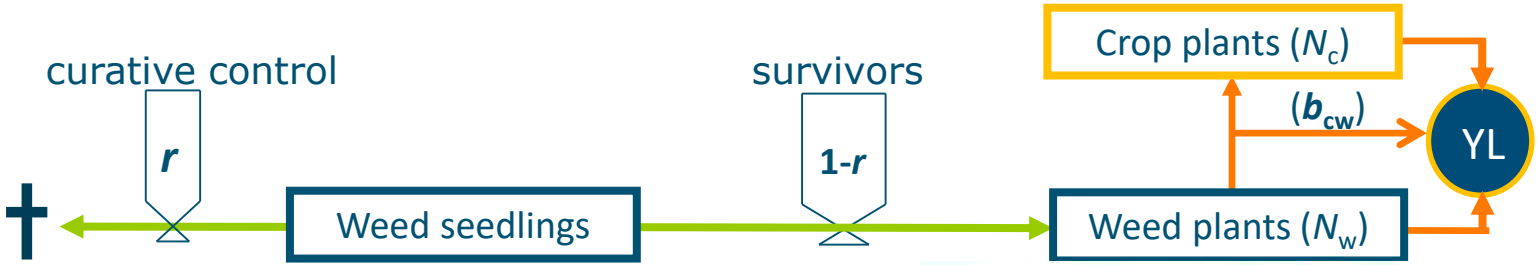

- **Rigid**

Not just the highly competitive species are killed, but nearly all plants, resulting in a serious decline in biodiversity

# At field level – competition



# At field level – curative control

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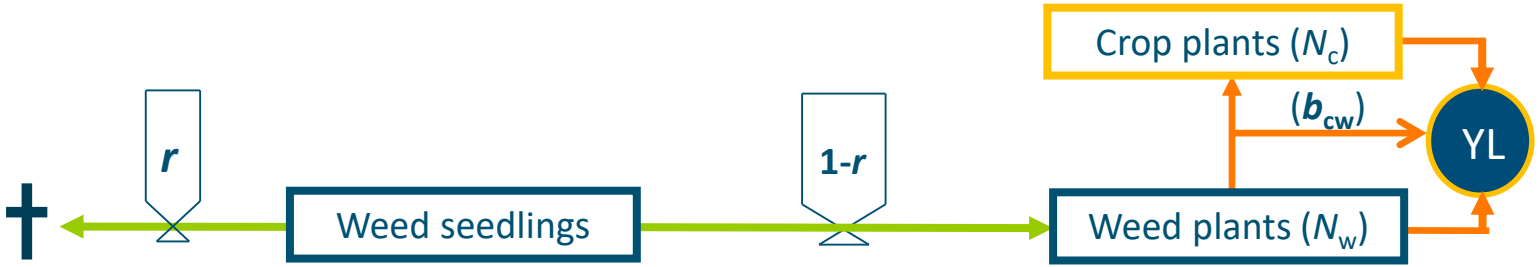
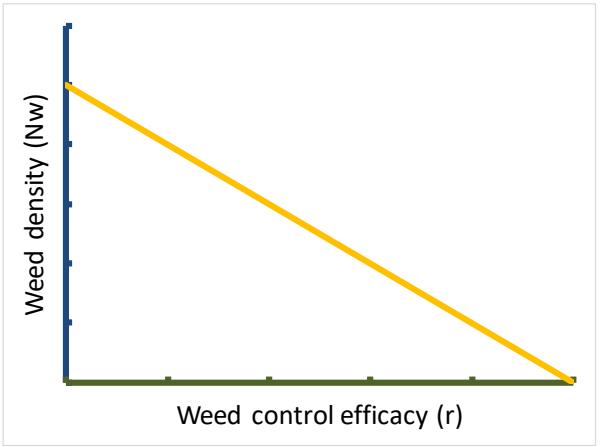
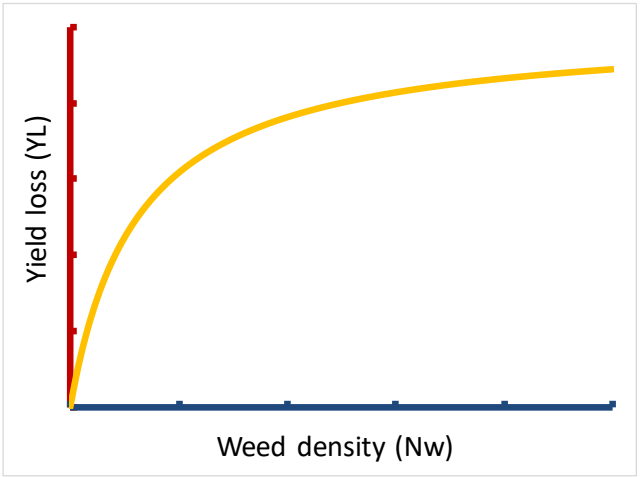
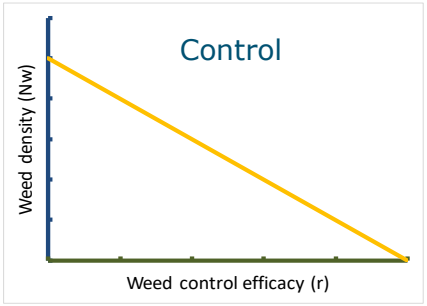
# At field level - schemetically

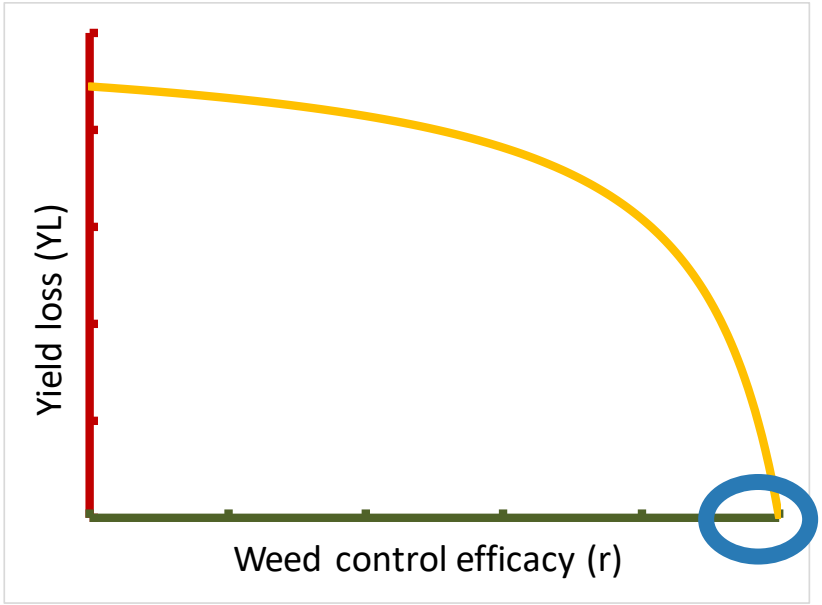


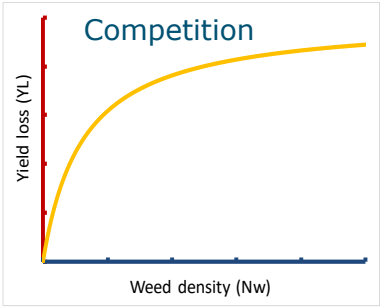



# At field level: yield loss – weed control relation




- High level of control needed to avoid serious yield loss
- Different from a-biotic stresses (e.g. nitrogen): **law of diminishing returns**

# Aspects of weeds that matter

## Damage
'an unwanted plant'

## Control
'aimed at minimizing yield loss'

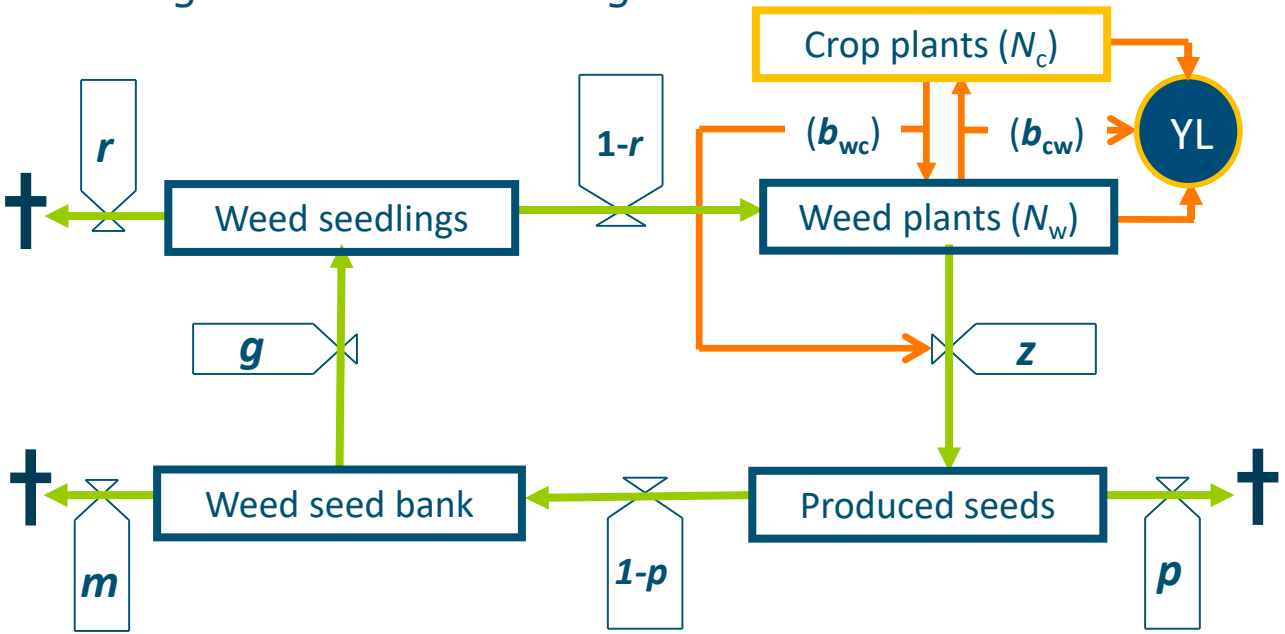
## Adaptation
'control measures select for difficult to control weed species'

## Persistence
'despite control, the weed problem remains'

This calls for **diverse** systems, focused at an **extended time horizon**

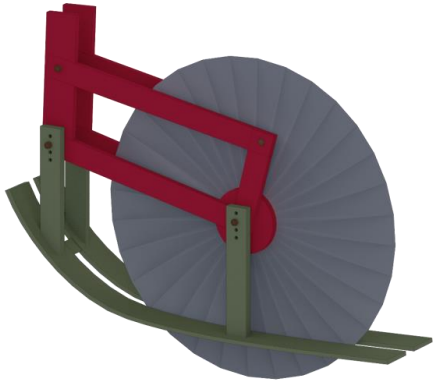
# From weed control to population management

- Weed life cycle in the center, not just the weed seedling stage
- Many more stages can serve as target



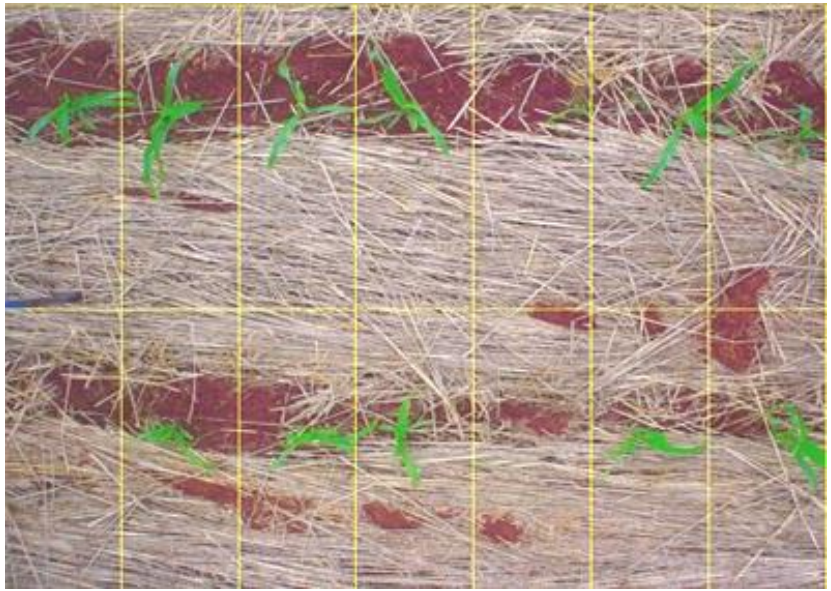
# Diversification of weed management

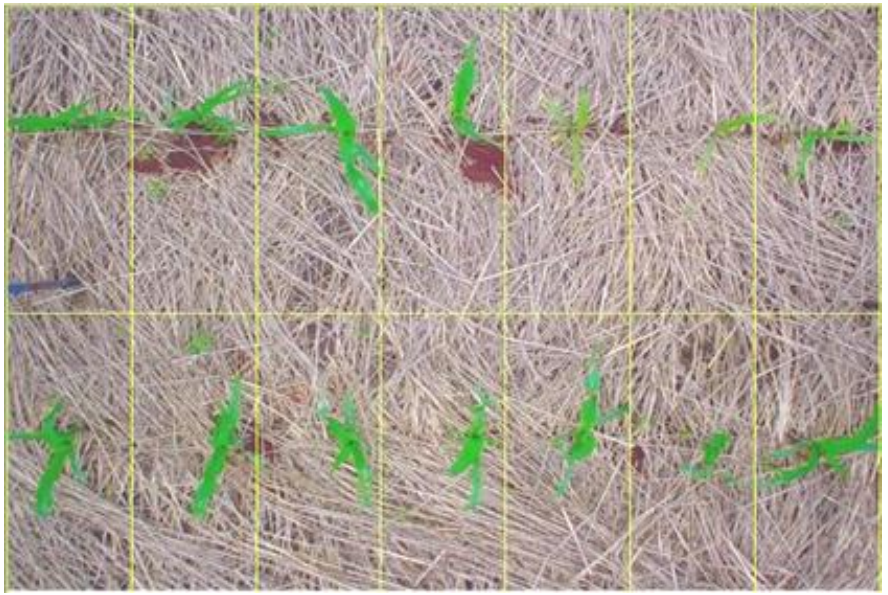
- **Preventing seedling establishment** → mulch, seeder, light control



# Small modifications can have a major impact

- Preventing seedling establishment





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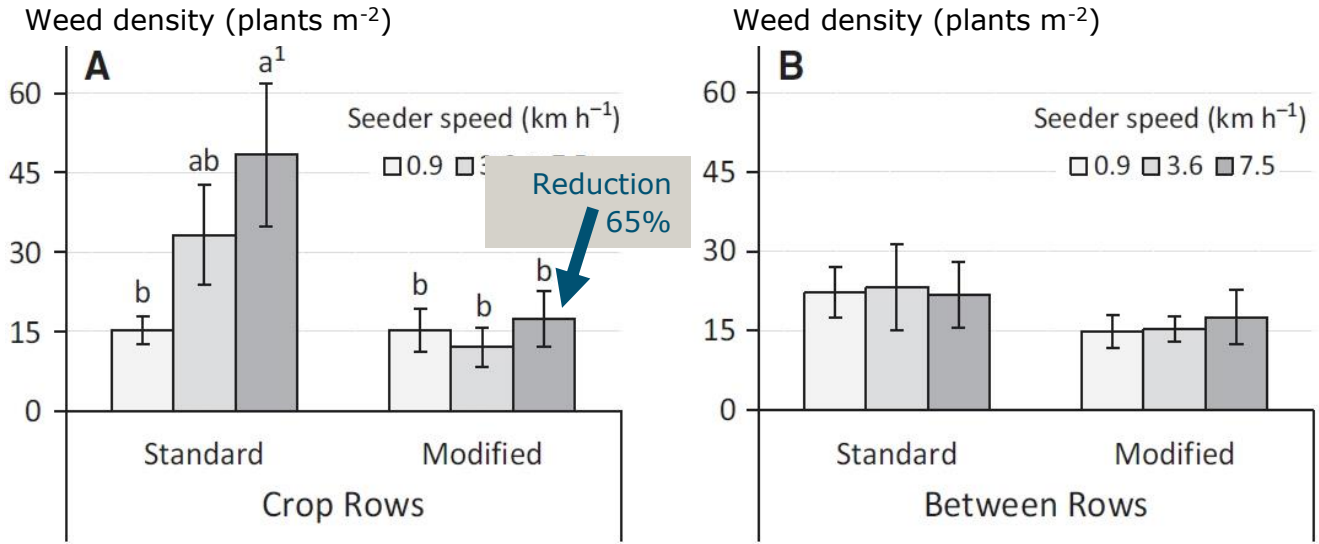
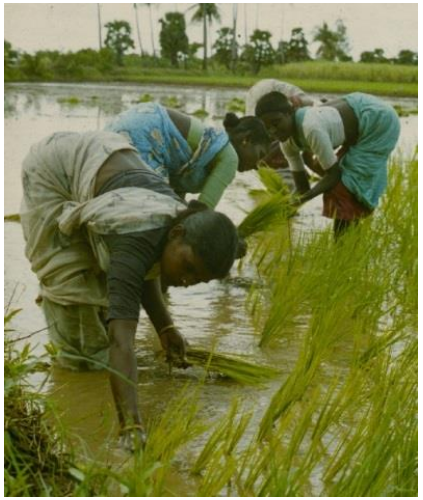
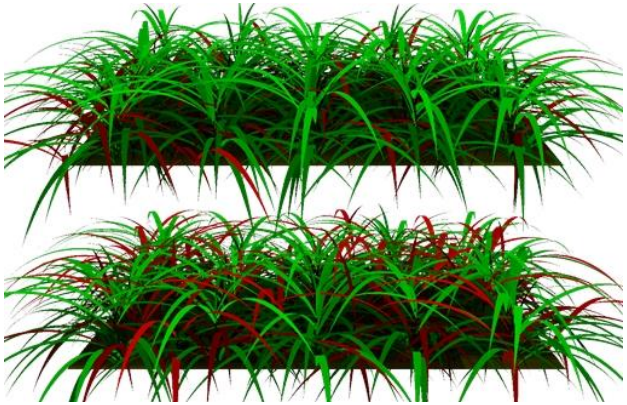


# Diversification of weed management

- Preventing seedling establishment
- **Increased crop competitiveness** → transplanting, competitive cultivars, seeding rate, spatial pattern





# Diversification of weed management

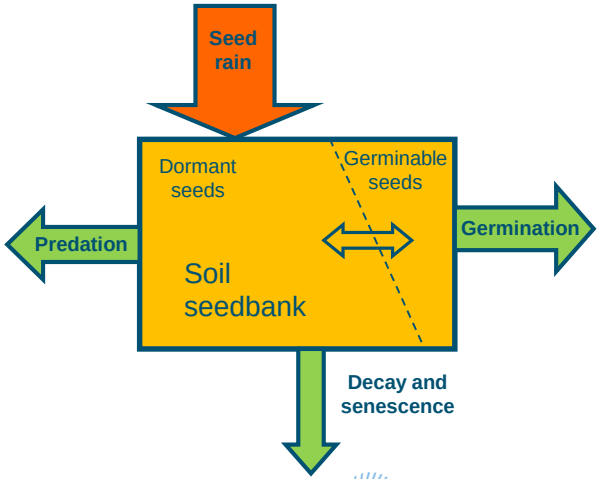
- Preventing seedling establishment
- Increased crop competitiveness
- **Removal of fresh weed seeds** → predation, mechanical seed catch/destruction


Seed collection at harvest

Seed predation

# Diversification of weed management

- Preventing seedling establishment
- Increased crop competitiveness
- Removal of fresh weed seeds
- **Reducing seed bank size** → increased seed mortality




Incorporation of cover crop residues: 'allelopathy'

# Diversification of weed management

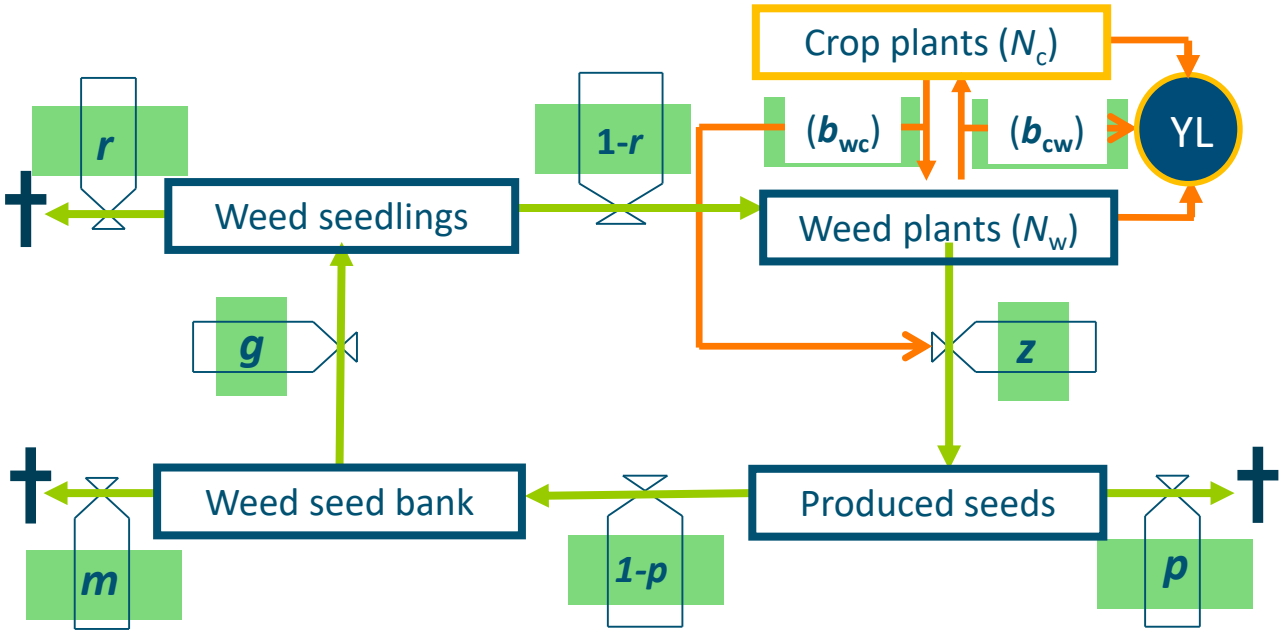
- **Removal of weed seedlings** → alternative curative control



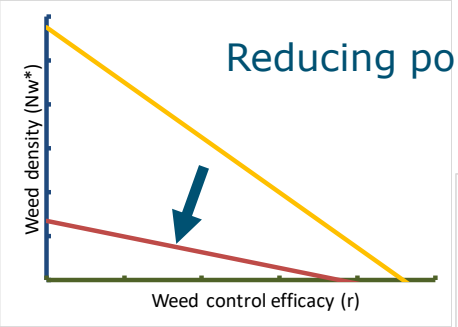



# From weed control to population management

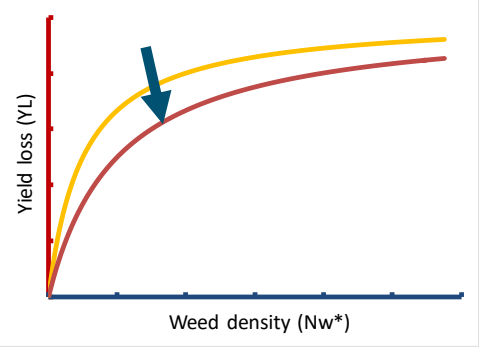
- Tackling weeds in various life cycle stages



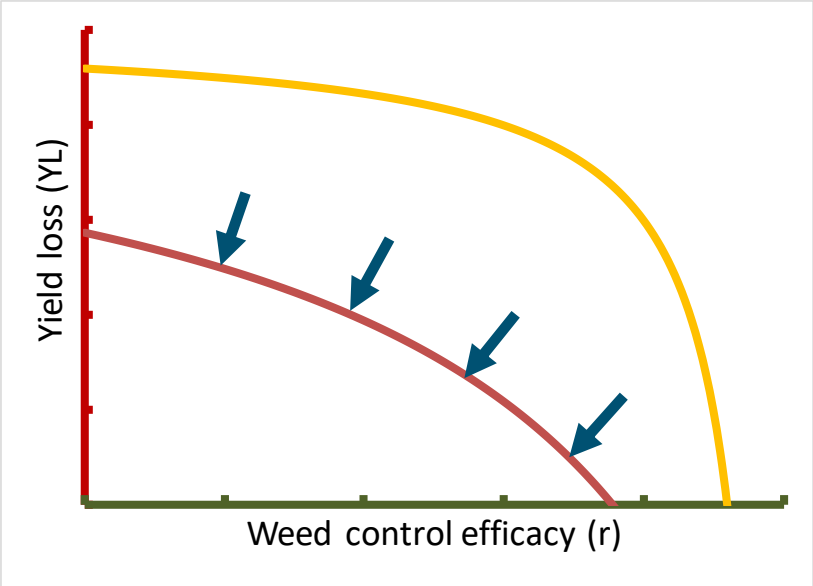
# Moving the yield loss - weed control relationship




Reducing population size - Minimizing damage




Measures combined are required to create a sufficient shift: '*many little hammers*'



# Crop rotation: another important tool

- The crop strongly influences which weed species will flourish:
  - Timing (sowing / harvest)
  - Competitiveness
  - Control options that fit with the crop

- **Monocultures** select for few difficult to control weed species
- **Crop rotations** create further options for **diversification**
  - Results in a more diverse weed community
  - Avoids dominance of few extremely harmful weed species

# Personal impression

- No single measure can do the job as effective as herbicides, but ...
- Weed management systems without herbicides or with a lesser reliance on herbicides are feasible.
- Combinations of measures are needed, usually including curative control.
- Diversification of weed control measures (crop rotation) safeguards durability.
- It is better to be pro-active then to wait untill herbicide resistance has evolved.

Thank you for your attention!