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Adapting cropping system to delay herbicide resistance. A simulation study

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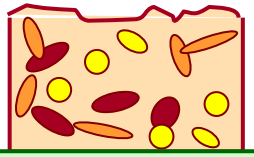
ALOMYSYS. Input variables

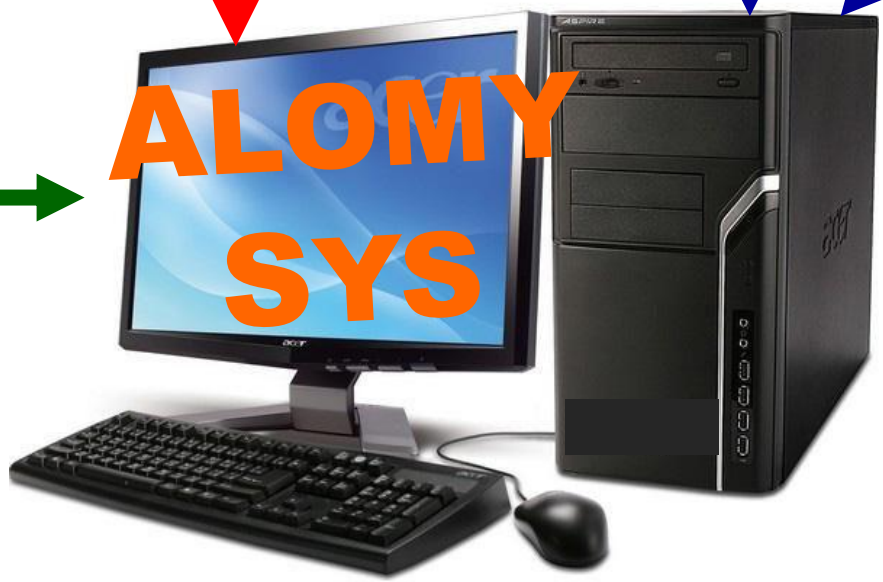
Cropping system

Weather

Soil texture



Initial weed population



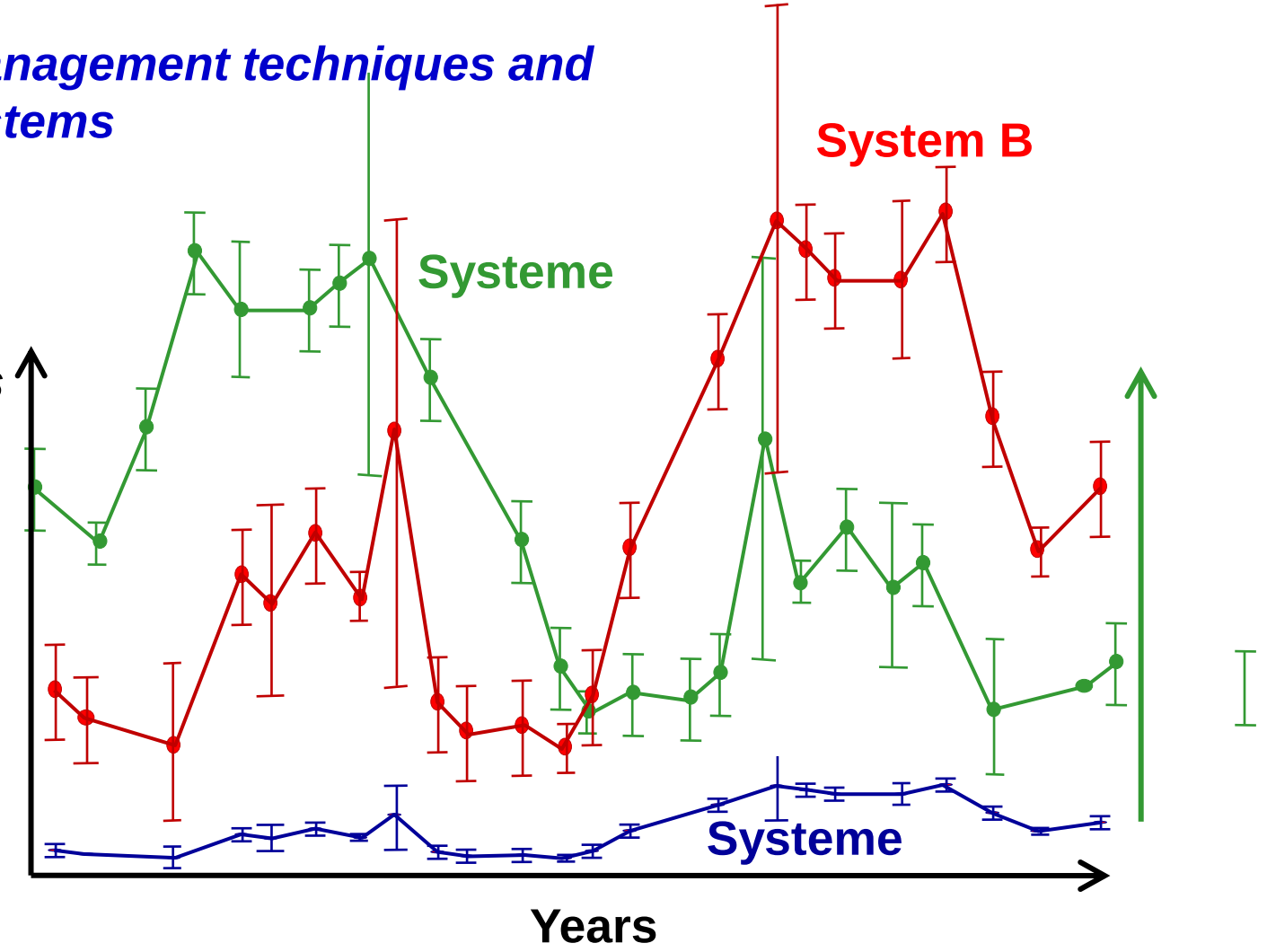
Colbach et al (2006a, 2006b, 2007, 2008)

ALOMYSYS. Output variables

➔ ***Compare management techniques and farming systems***

A. myosuroides **plants/m²**

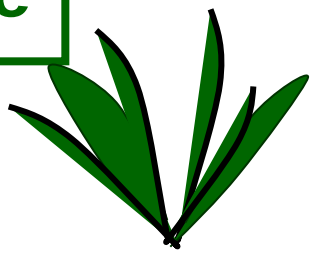
(per day/based simulations)



ALOMYSYS. Annual life-cycle

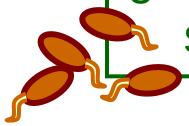
emerged seedlings

tillering

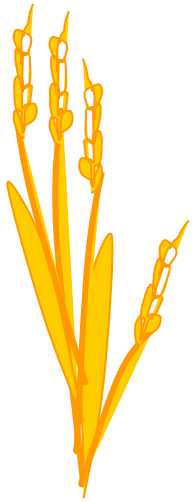


death

germinated seeds



Heading



	non-dormant	dormant
shallow		
…	seed bank	
deep		

Seed production

death

Colbach et al (2006, 2010) Eur J Agron,
Colbach et al (2007) Ecol Mod

ALOMYSYS effect of management techniques

Colbach et al (2006, 2010) Eur J Agron, Colbach et al (2007) Ecol Mod; Colbach et al. (2009) Eur J Agron

ALOMYSYS. The genetic submodel

- **21 genotypes / Fop resistance**

  Sensitivity and resistance to different herbicides

- **Mutations occurring during reproduction**

  Occurrence

- **Fitness costs/benefits**

  Effect of genotype on life-stage processes

Mutated alleles and herbicide resistance

- **Genotypes result from the combination of:**
  - 1 wild (W) and 5 mutated alleles (Leucine-1781, Cystein-2027, Asparagine-2041, Glycine-2078, Alanine-2096)

	Mutation				
	Alanine -2096 Ala	Asparagine -2041 Asn	Cystein -2027 Cys	Glycine -2078 Gly	Leucine -1781 Leu
Cycloxydim	S	S	S	R	R
Clethodim	r	S	S	R	S
Fenoxaprop	R	R	R	R	R
Clodinafop	R	R	R	R	R
Haloxyfop	R	R	R	R	R
Diclofop	R	R	R	R	R
Pinoxaden	S	r	R	R	R

(based on Délye et al., 2003; Délye et al., 2005; Délye et al., 2008; Petit et al., 2010)

S = 95-90% mortality
r = 0-70% mortality
R = 0% mortality

Mutation during seed production

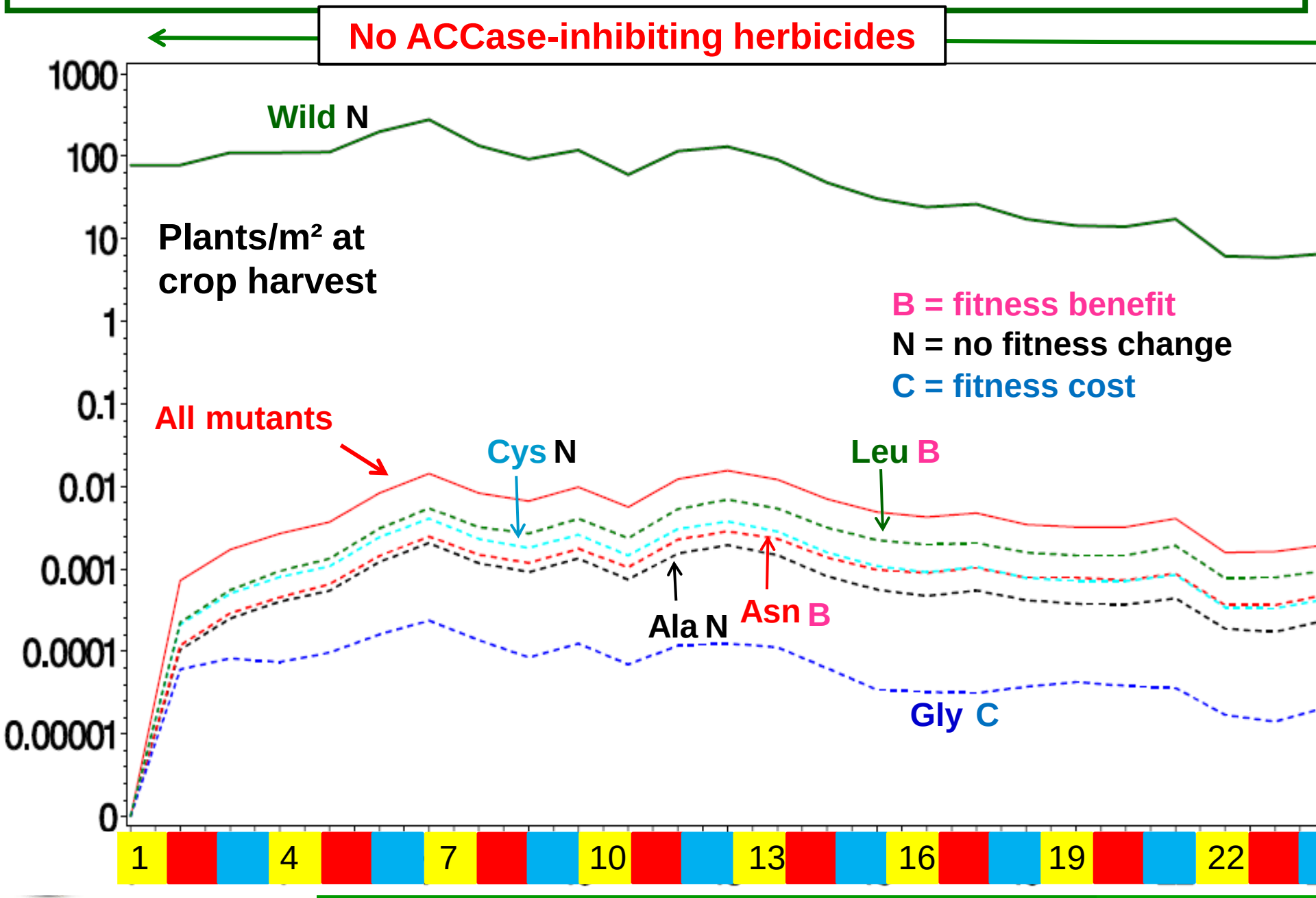
- **Number of mutated ovules and pollen grains depends on:**
  - Mutation rate = input variable chosen by user
  - Number of flowers producing pollen and ovules
  - Stochasticity
- **Genotype of mutated allele depends on:**
  - Stochasticity
  - Conversion rates

Fitness costs/benefits

	Mutation				
	Alanine -2096 Ala	Asparagine -2041 Asn	Cystein -2027 Cys	Glycine -2078 Gly	Leucine -1781 Leu
Germination speed					
Fresh seeds	No change	Slightly slower	No change	Faster	Slower
Old seeds	No change	Slower	No change	Slightly slower	Slightly faster
Fatal germination					
Fresh seeds	No change	No change	No change	More	Less
Old seeds	No change	Less	No change	No change	No change
Pre-emergent shoot length potential					
Fresh seeds	No change	No change	No change	No change	No change
Old seeds	No change	Longer	No change	Longer	No change
Pre-emergent root length potential					
Fresh seeds	No change	No change	No change	No change	No change
Old seeds	No change	Longer	No change	Longer	No change
Seed production	No change	No change	No change	Less	No change

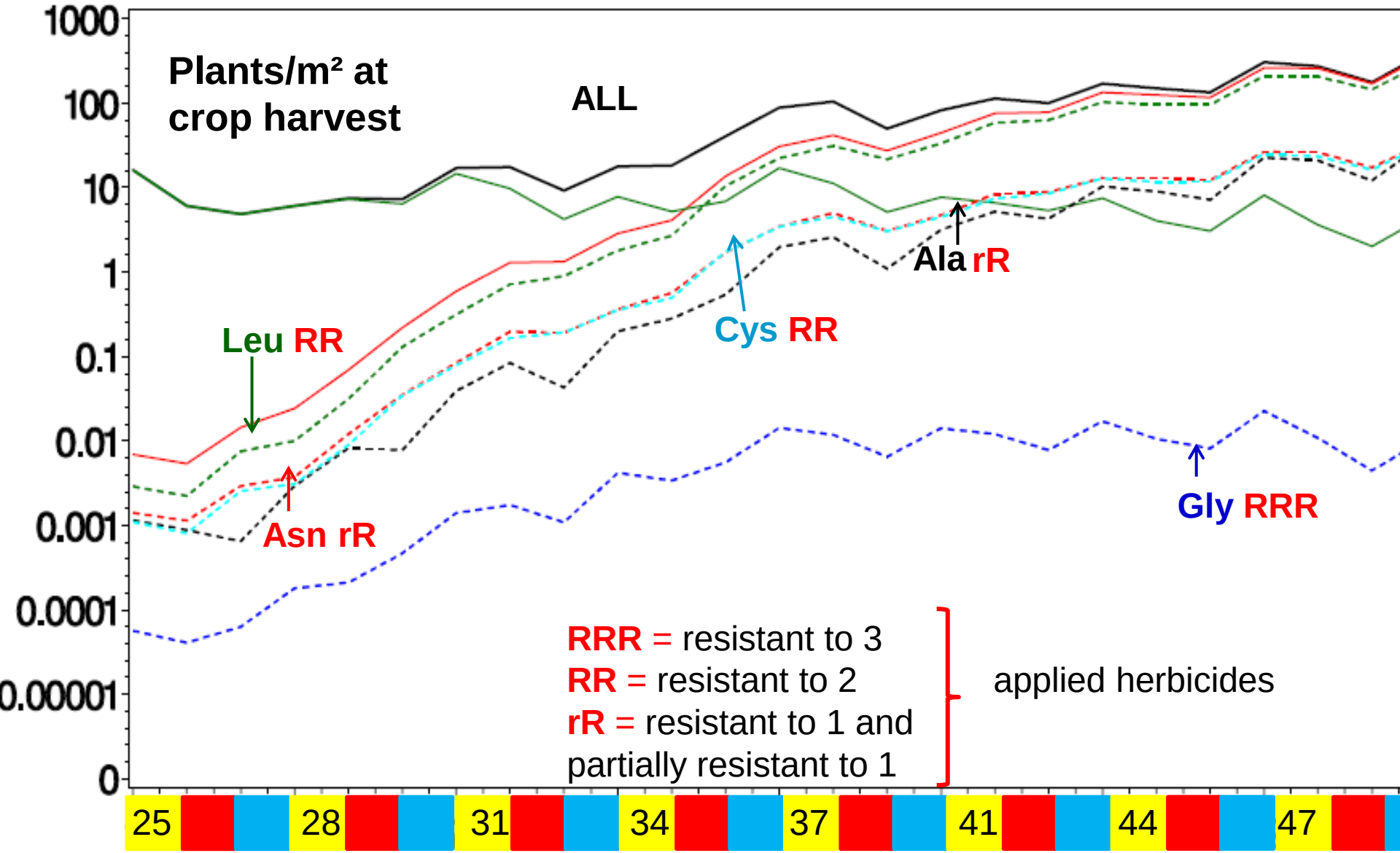
(based on Menchari *et al.*, 2008; Délye *et al.*, 2013)

Simulation. Initialisation without selection pressure

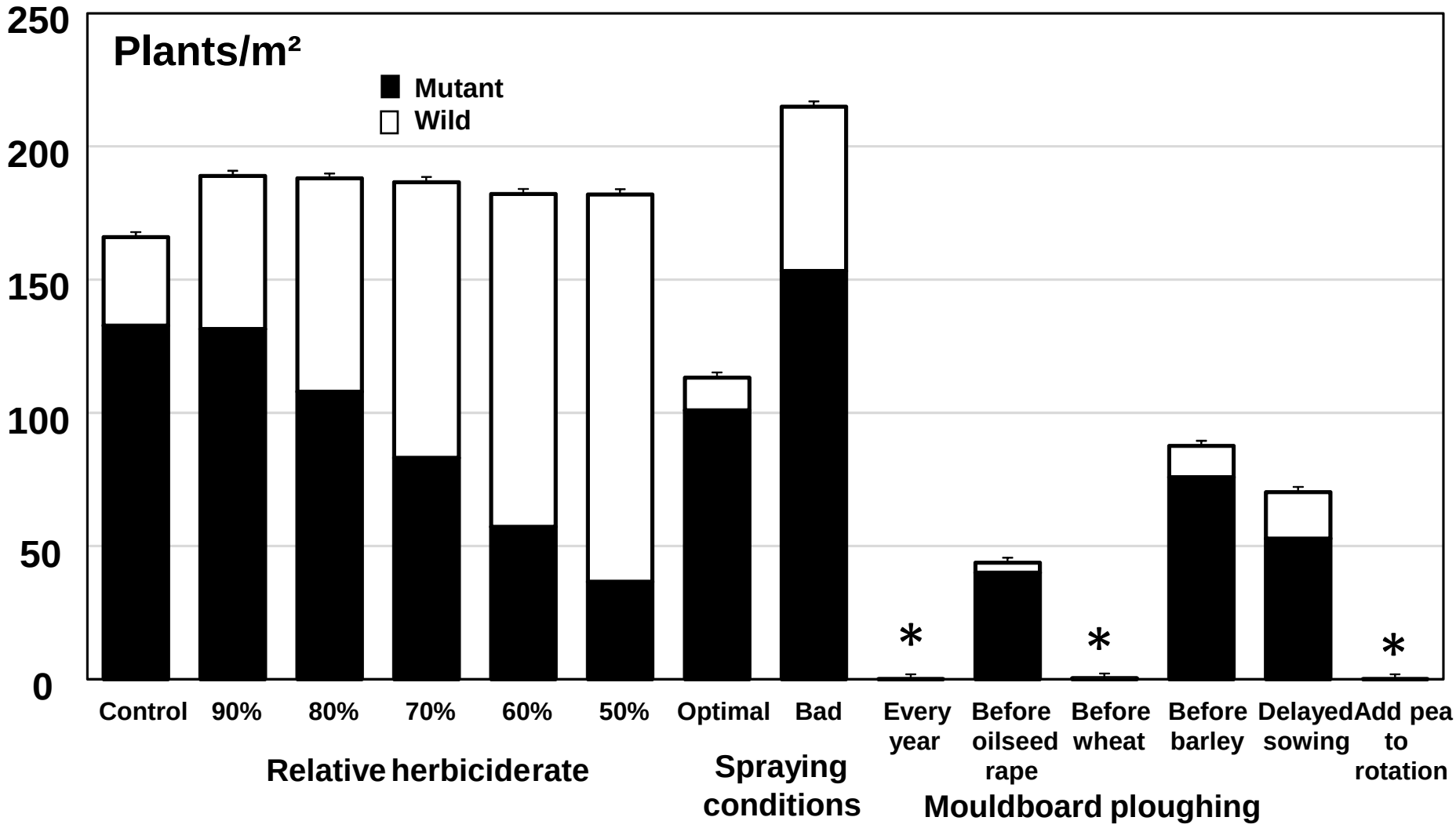


Simulation. Switching to selective herbicides

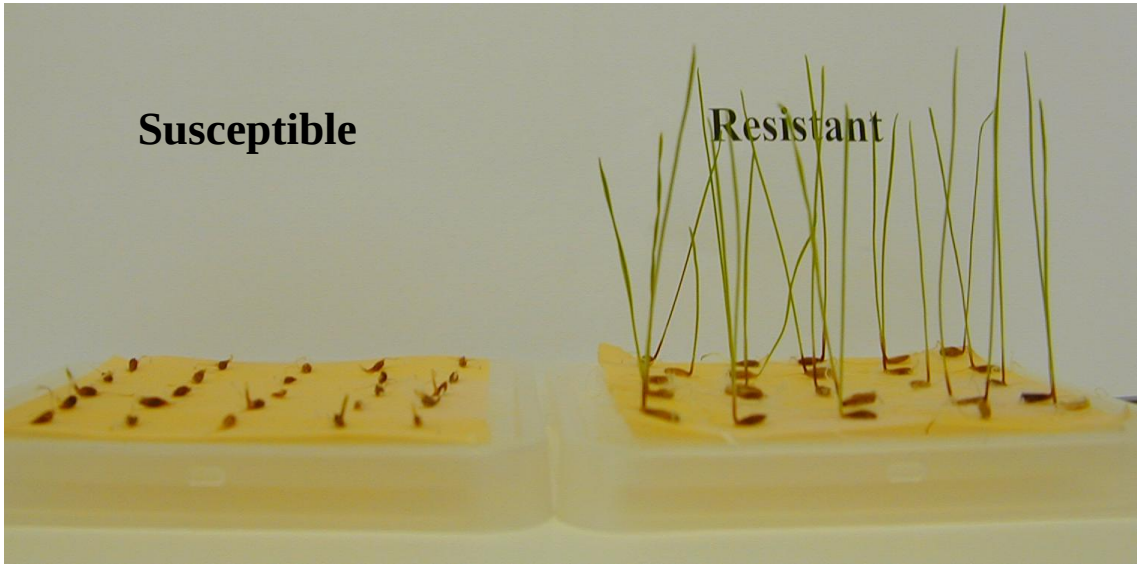
Many ACCase-inhibiting herbicides



Simulation. Effect of cropping system



Conclusion: please feed the model with long term studies … and tests !



All models are wrong but some can be useful