Innovative IPM in pome fruit and strategies for implementation

Innovative crop protection for sustainable agriculture

Bart Heijne, Aude Alaphilippe, Vittorio Rossi, Imre Holb, Tito Caffi, Gabriele Fortino, Sylvaine Simon, Jan Buurma, Wil Hennen, Jörn Strassemeyer, Martina Mayus

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Overview of the presentation

- introduction of PURE
  - Pesticide Use-and-risk Reduction in European farming systems with Integrated Pest Management
  - FP7, March 2011 – March 2015
- Françoise Lescourret, INRA, France
- first results Innovative pome fruit
- stakeholder interactions

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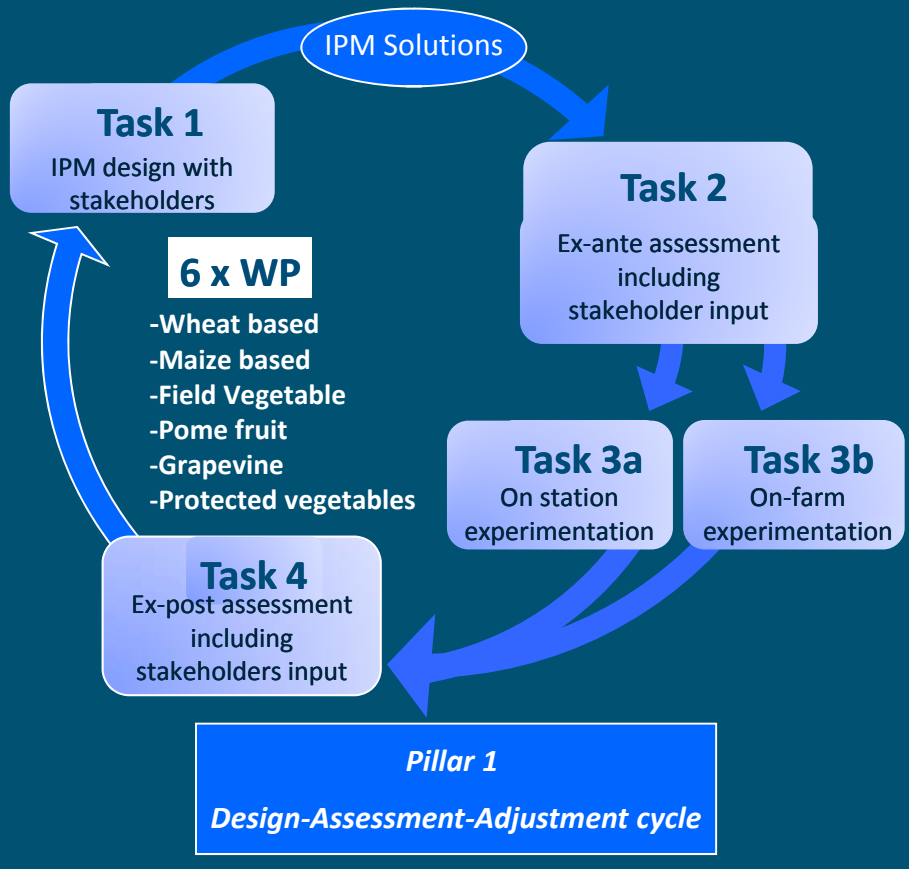
PURE objectives

- scientific knowledge to design future solutions
  - based on innovative research in challenging fields
- toolbox of approaches, methods and tools for implementing efficient IPM solutions (flexibility)
- provide practical IPM solutions to reduce dependence on pesticides (farming system-specific)
  - design and test in real conditions
  - goal: robustness

Guiding principles

- solutions concretising the « Integrated» of IPM
  - solutions = combinations of tactics and strategies
  - systems approach
- design-evaluation-adjustment process

Pure dynamics



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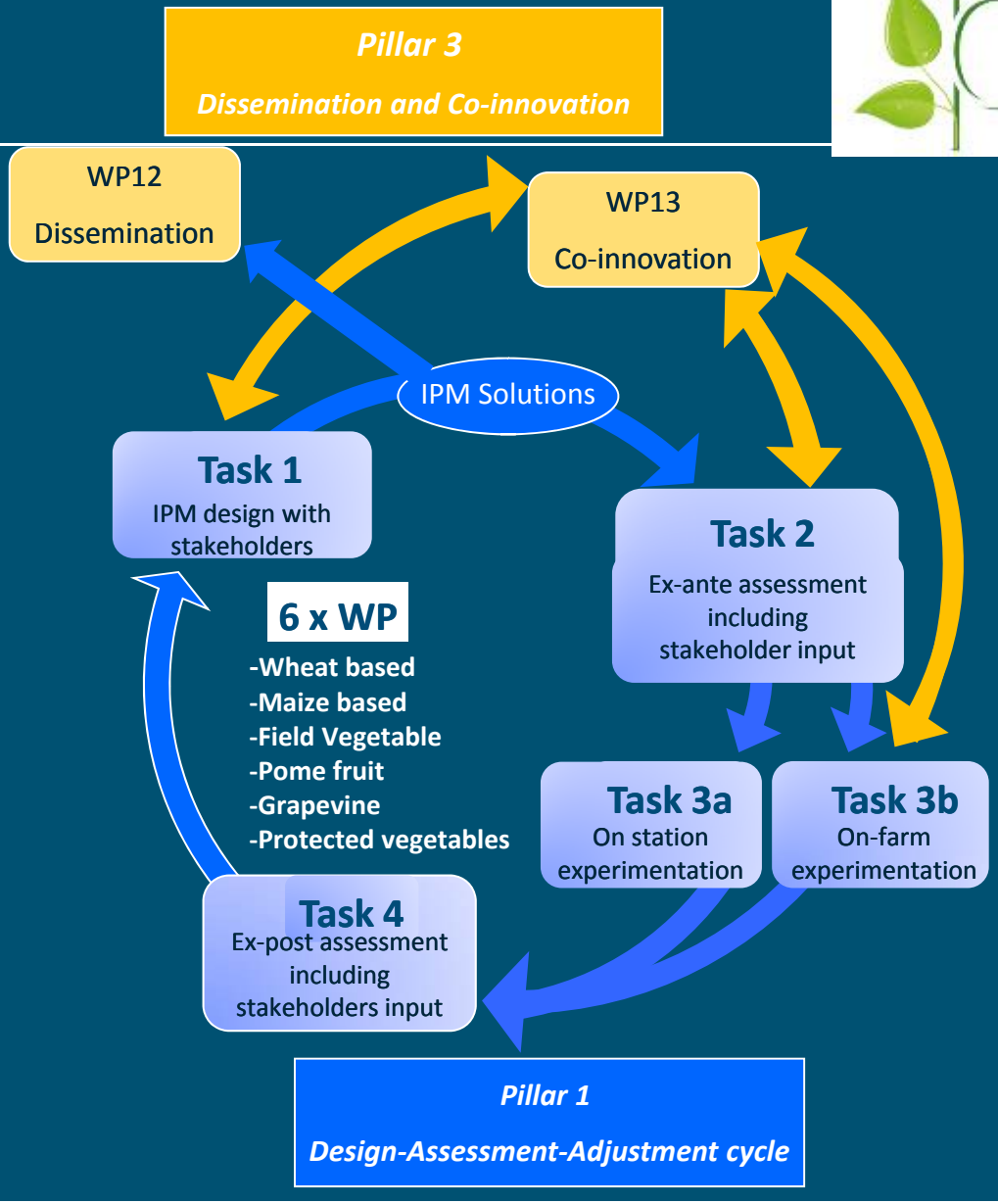
Pure dynamics



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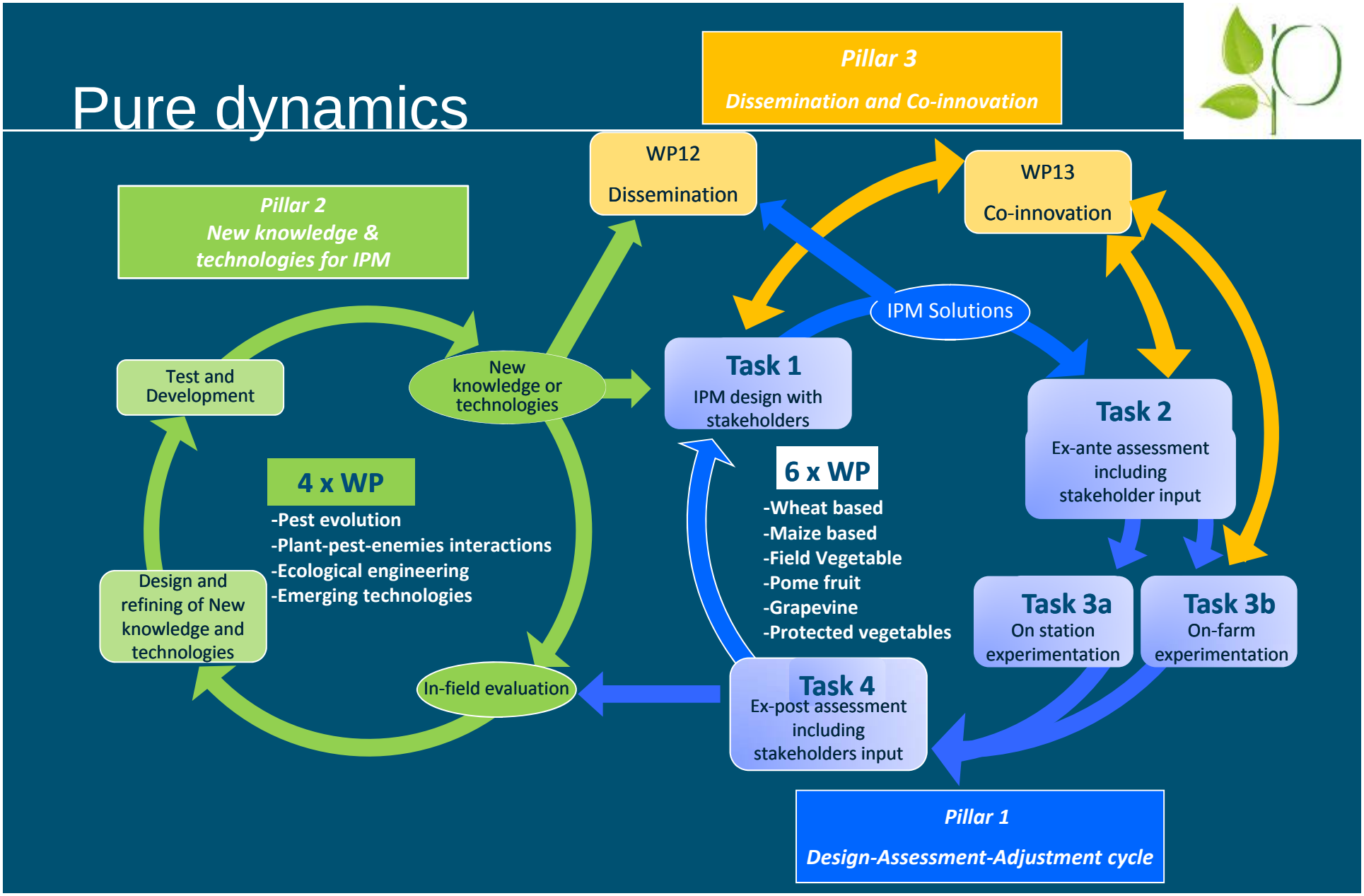

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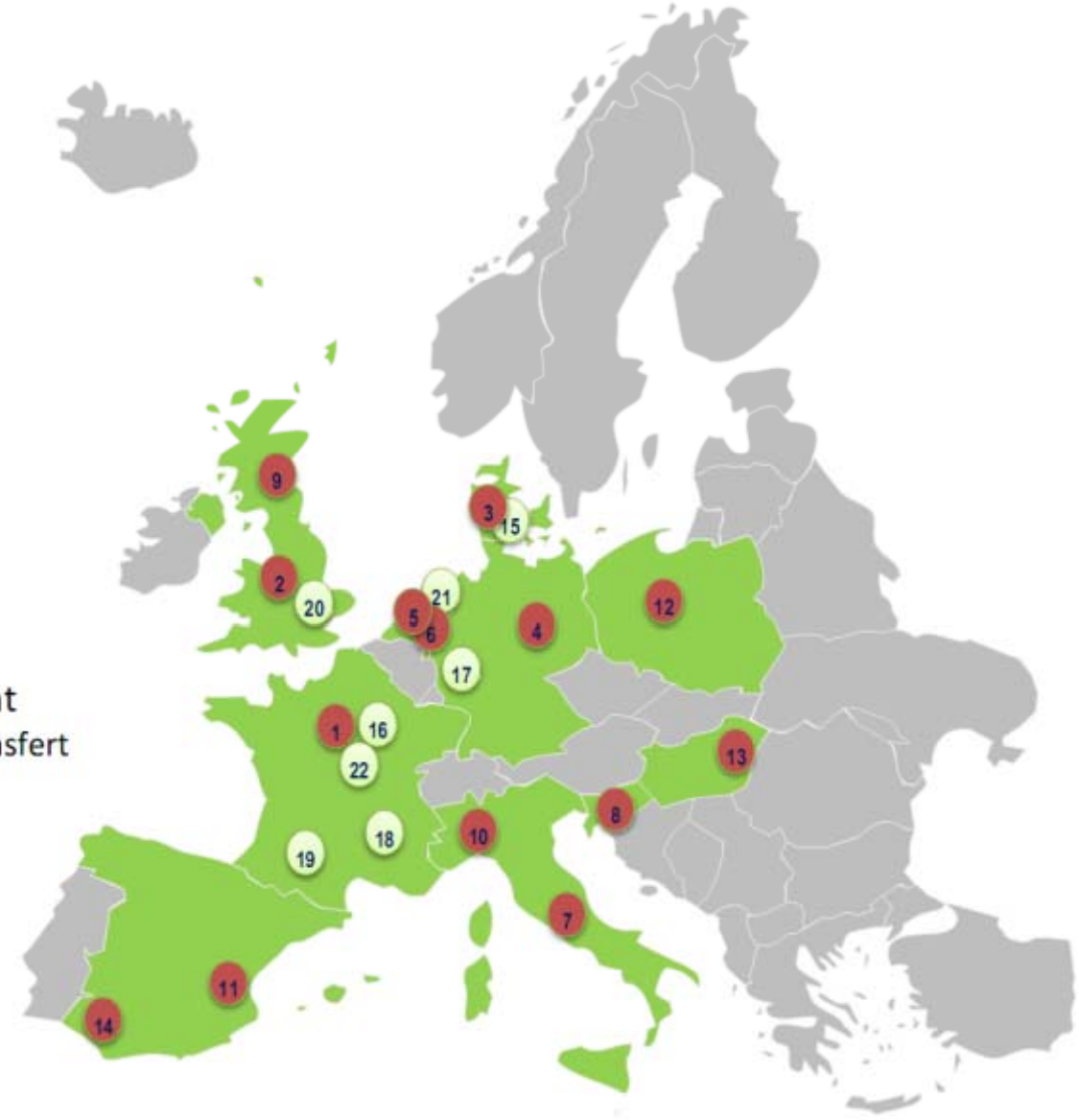
Research
1 - INRA
2 - RRES
3 - AU
4 - JKI
5 - Stichting DLO
6 - WUR
7 - CNR
8 - KIS
9 - SCRI
10 - FEM
11 - IVIA
12 - IOR
13 - UDCAS
14 - JRC-IPTS

Extension
15 - DAAS
16 - ACTA

Industry
17 - BCS
18 - Biotop
19 - NPP
20 - Burkard
21 - Blgg

Management
22 - INRA Transfert



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Work Package 5

- Innovative IPM pome fruit systems
- implement an innovative system (multipest)
  - initially focus on key pests
  - ultimately aiming at integration innovative IPM tools into system strategies
- repetitive cyle
  - design IPM strategy, testing, assessing, redesign
- ex-ante and ex-post assessement of IPM strategies
  - over-all, economic, environmental & health risks
- stakeholder interaction

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WP 5 pome fruit subjects

- scab – apple: Imre Holb - Hongary
- codling moth – apple: Aude Alaphillipe - France
- brown spot – pear: Vittorio Rossi - Italy
- pear psylla – pear: Herman Helsen – Netherlands

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ex-ante, ex-post evaluation

- overall assessment – DEXiPM
  - Gabriele Fortino – INRA, France
- environment - SYNOPS
  - Jörn Strassemeyer - JKI, Germany
- economic - PREMISE
  - Wil Hennen – LEI, Netherlands
  - Jan Buurma – LEI, Netherlands

Integrated apple scab management

- sanitation measurements
  - urea, Vinasse at leaf fall
  - leaf shredding
- antagonists: reduction inoculum winter
  - *Athelia*
  - *Microsphaeropsis*
- environmental friendly products
  - plant extracts
  - potassium bicarbonate

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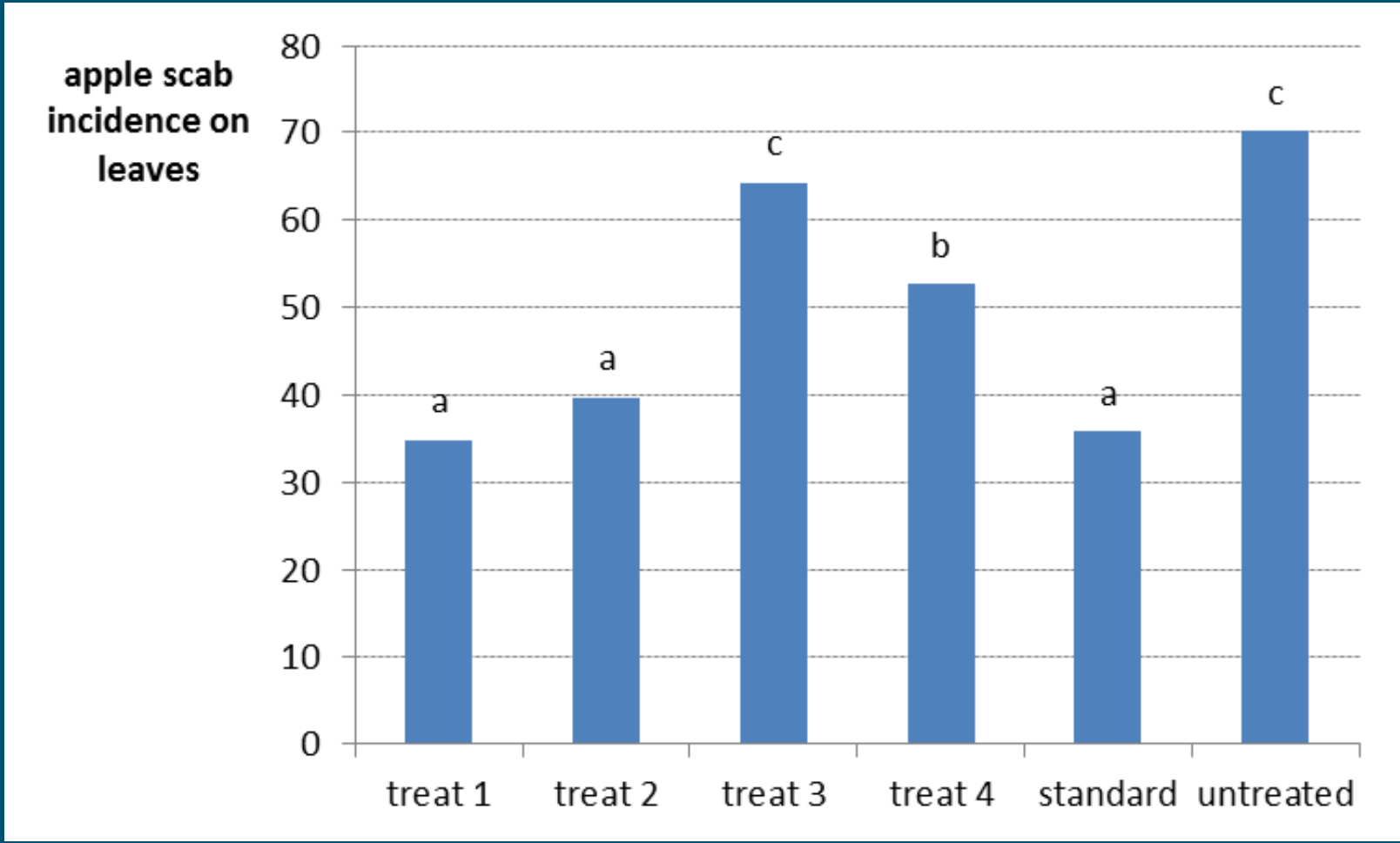
Efficacy of H39 on apple scab



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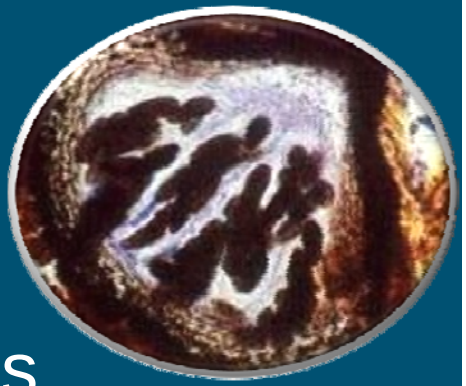
Innovative management brown spot of pear

- *Stemphylium vesicarium – Pleospora allii*
- leaf infestation – leaf drop
- fruit infestation – fruit rot
- severe damage Italy, Spain
  incidental damage Belgium, Netherlands



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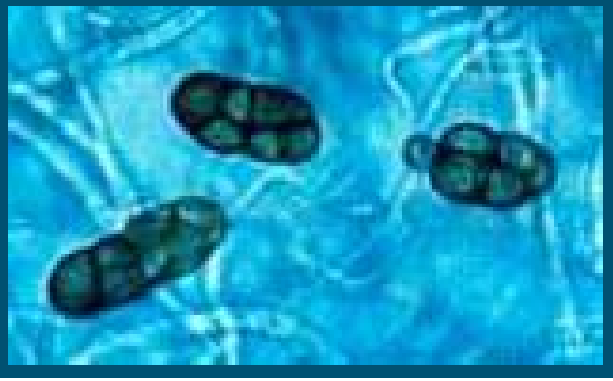
Non-chemical methods to reduce the inoculum of *Stemphylium vesicarium*

- Conference leaves collected at leaf fall from pear orchard not affected by brown spot (autumn)
- autoclaved & inoculated with *S. vesicarium*
- 2-days incubation
- treated



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- leaves exposed outdoor a grass
- randomised block design 3 replicates

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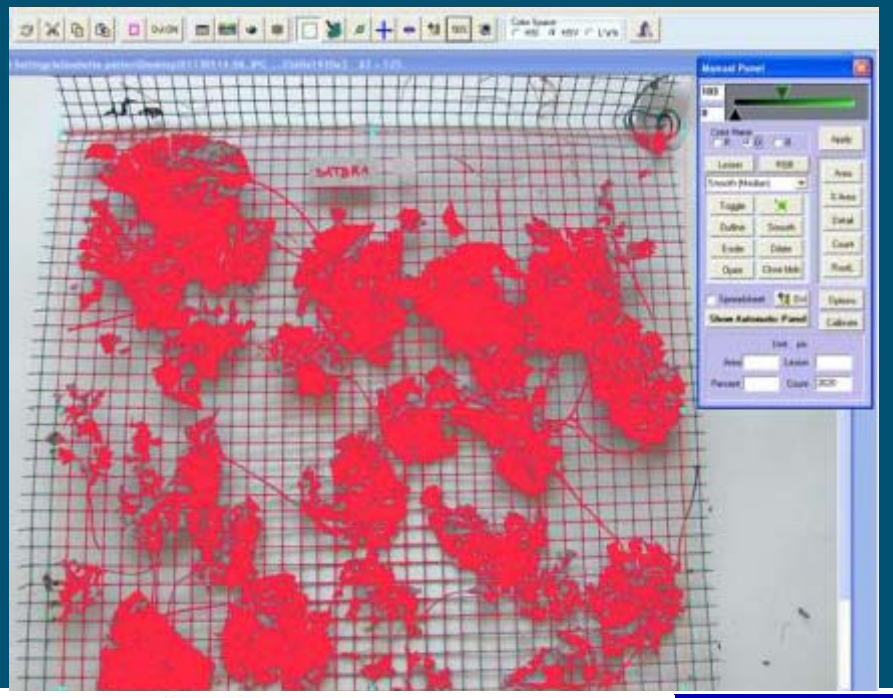
Leaf degradation

- Degradation leaf litter
  - periodically: from leaf fall
  - to complete degradation in the summer



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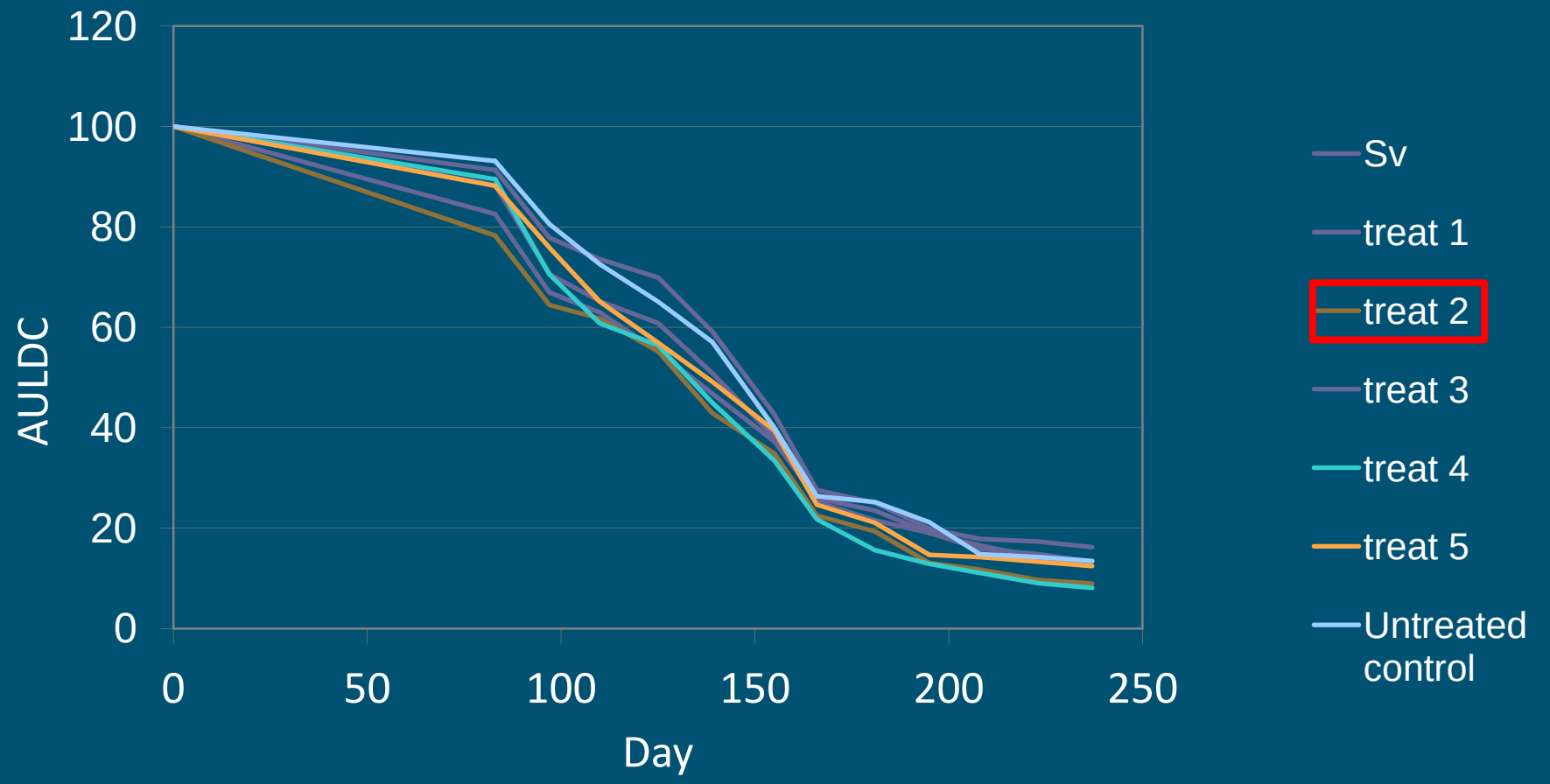
Leaf degradation in time



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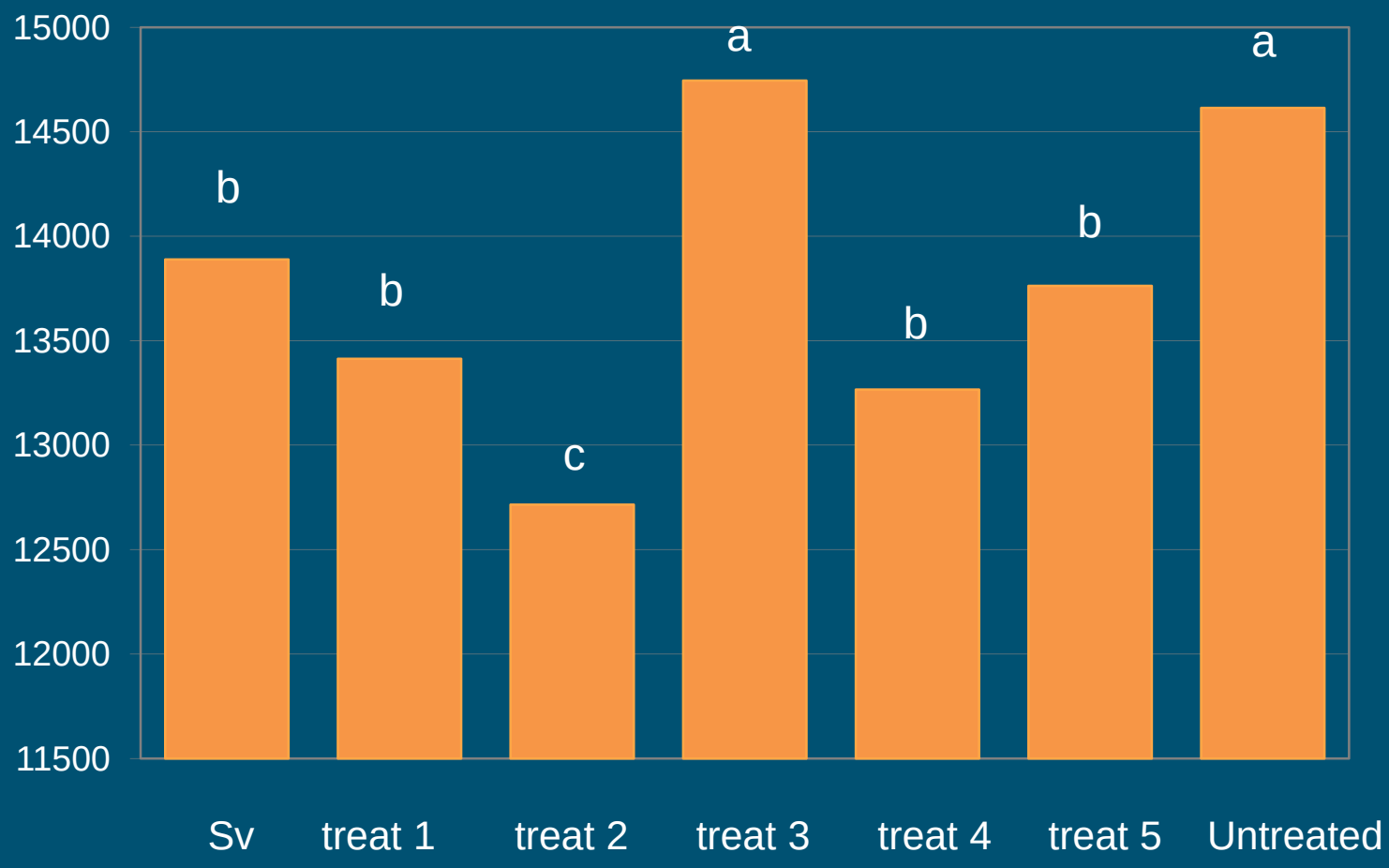
total AULDC (Area Under Leaf Degradation Curve)



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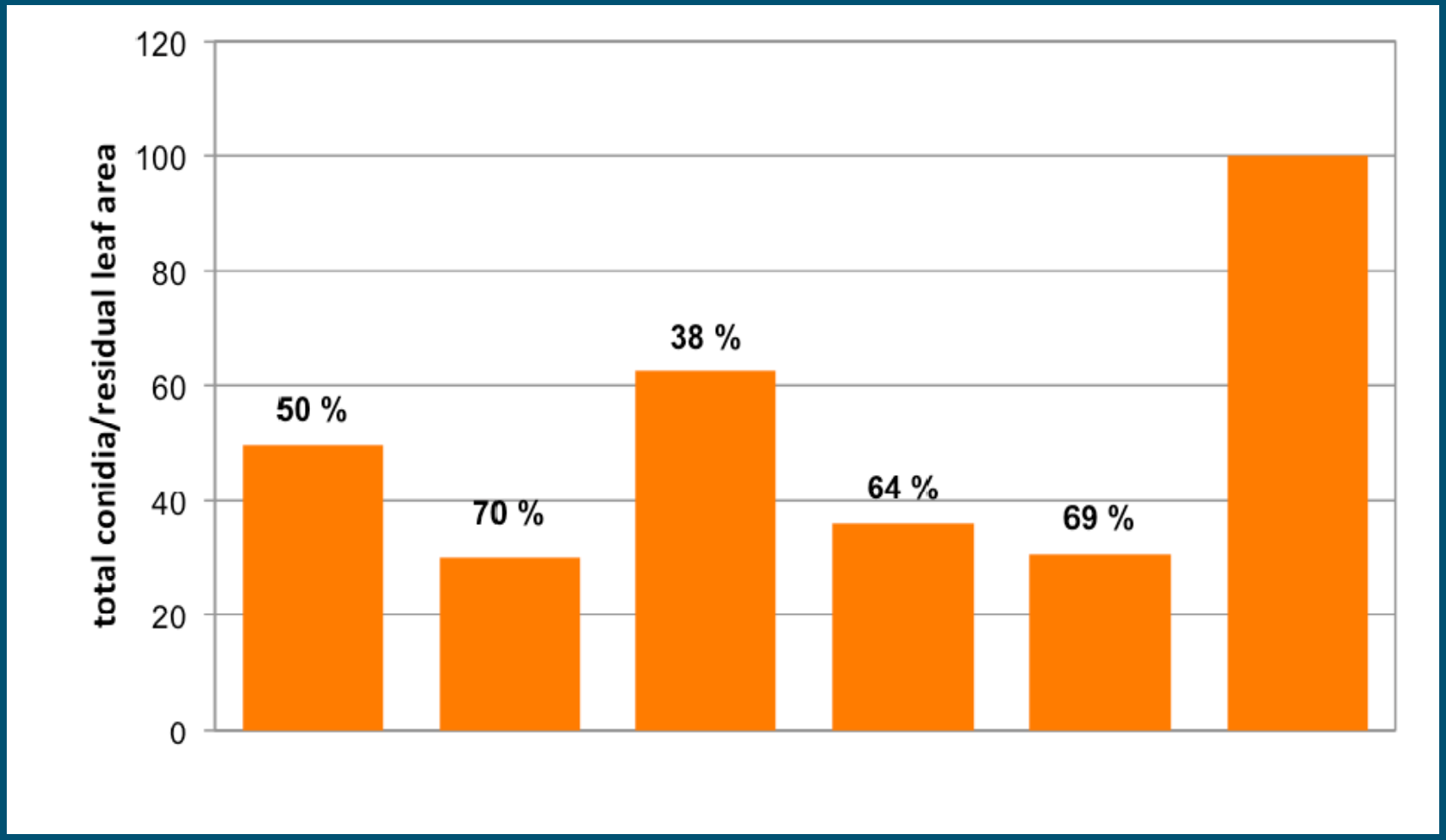
Total conidia of *Stemphylium* vesicarium



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Effects of codling moth exclusion netting

- efficacy on codling moth
- effect on rosy apple aphid
- effect on beneficials (natural enemies predating in rosy apple aphid colonies, predation and parasitism on eggs of codling moth)

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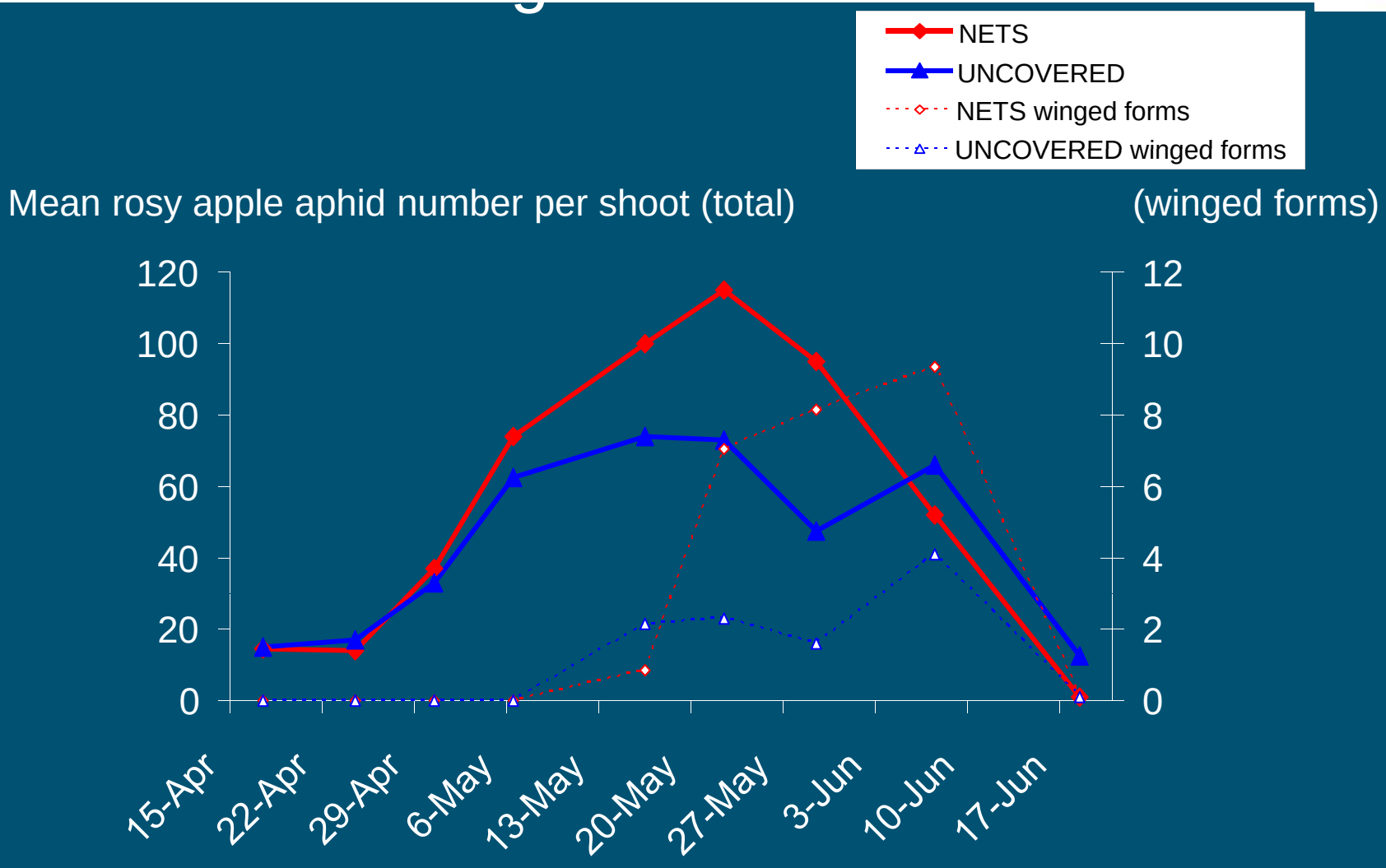
Exclusion netting: on station



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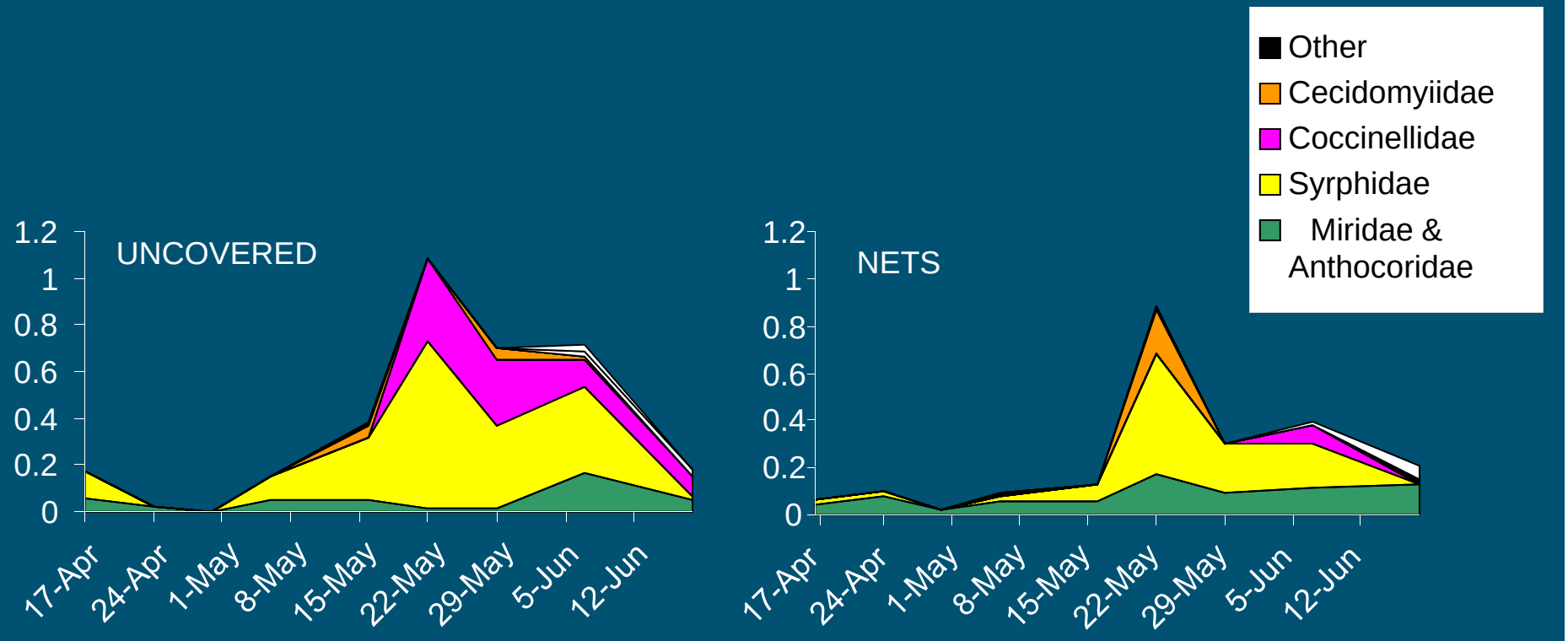
Exclusion netting: on station

mean number of natural enemies of rosy apple aphid per shoot



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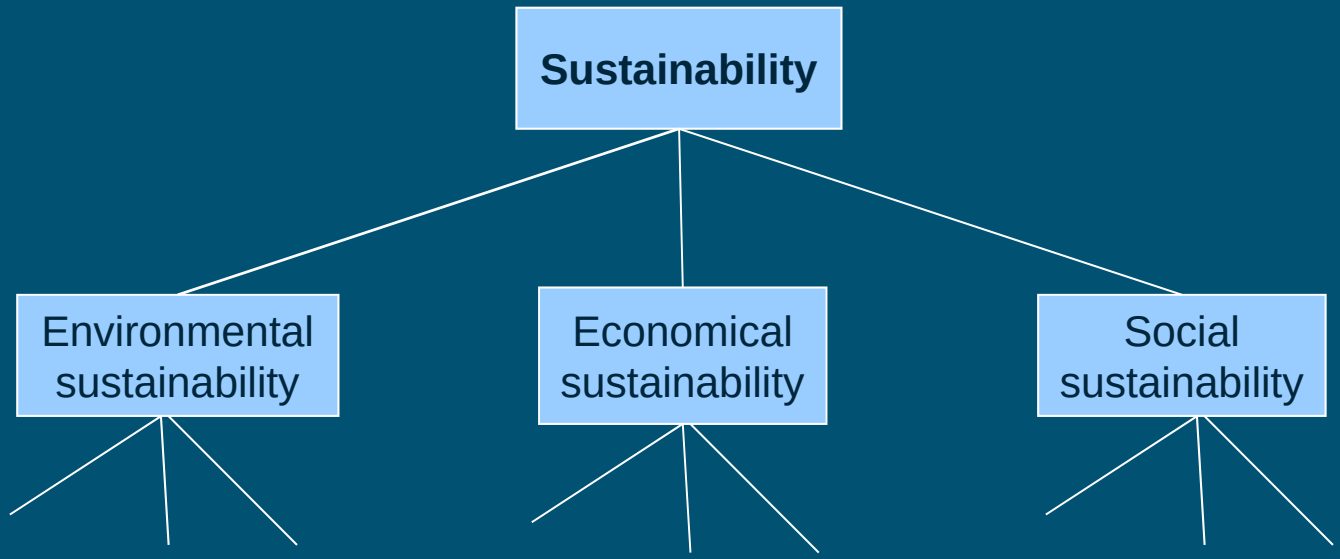
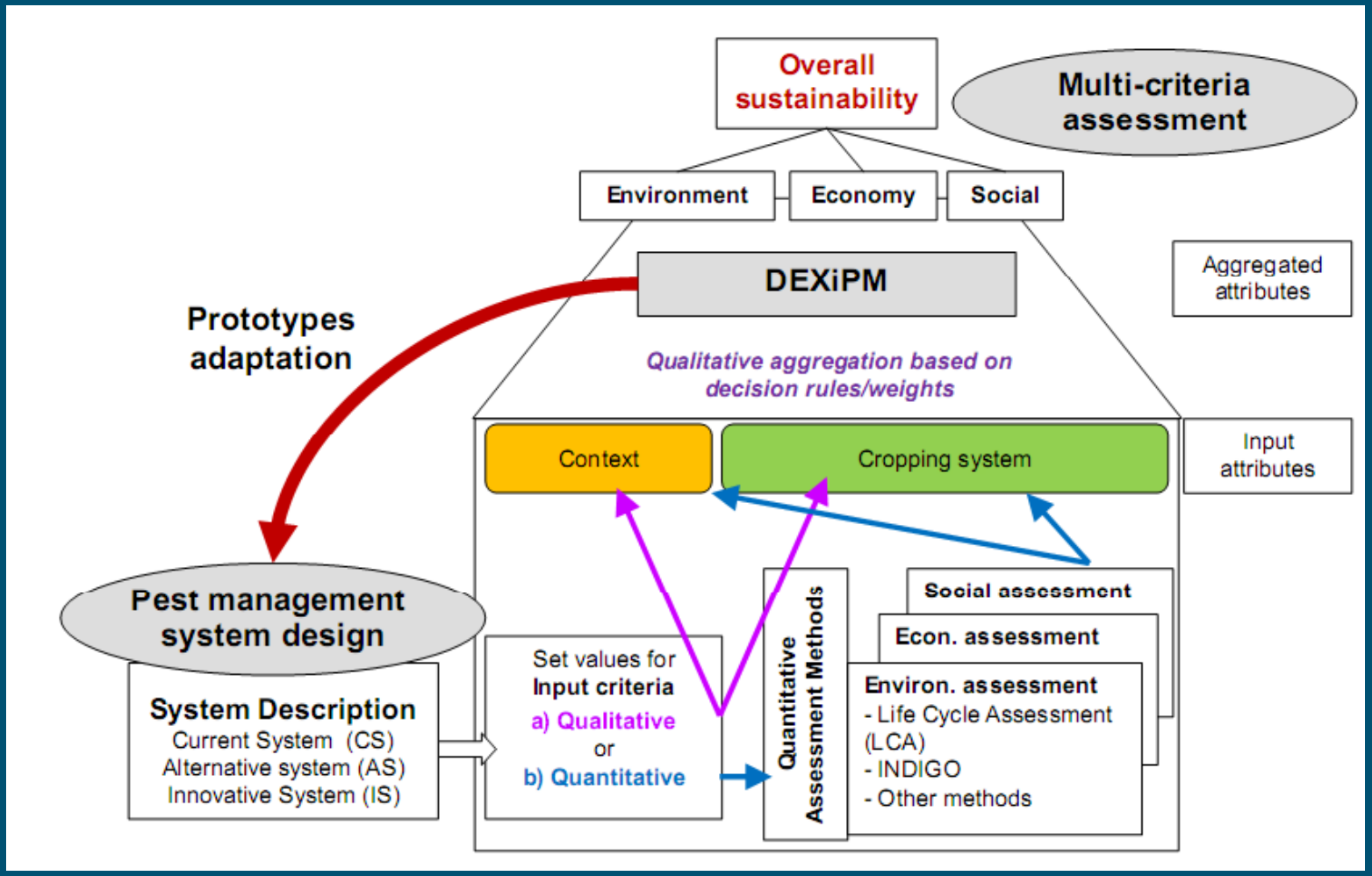
DEXi software (1)

- Allows analysing a complex decision problem breaking it into smaller thematic attributes organised hierarchically in a decision tree



assessment tool DEXiPM



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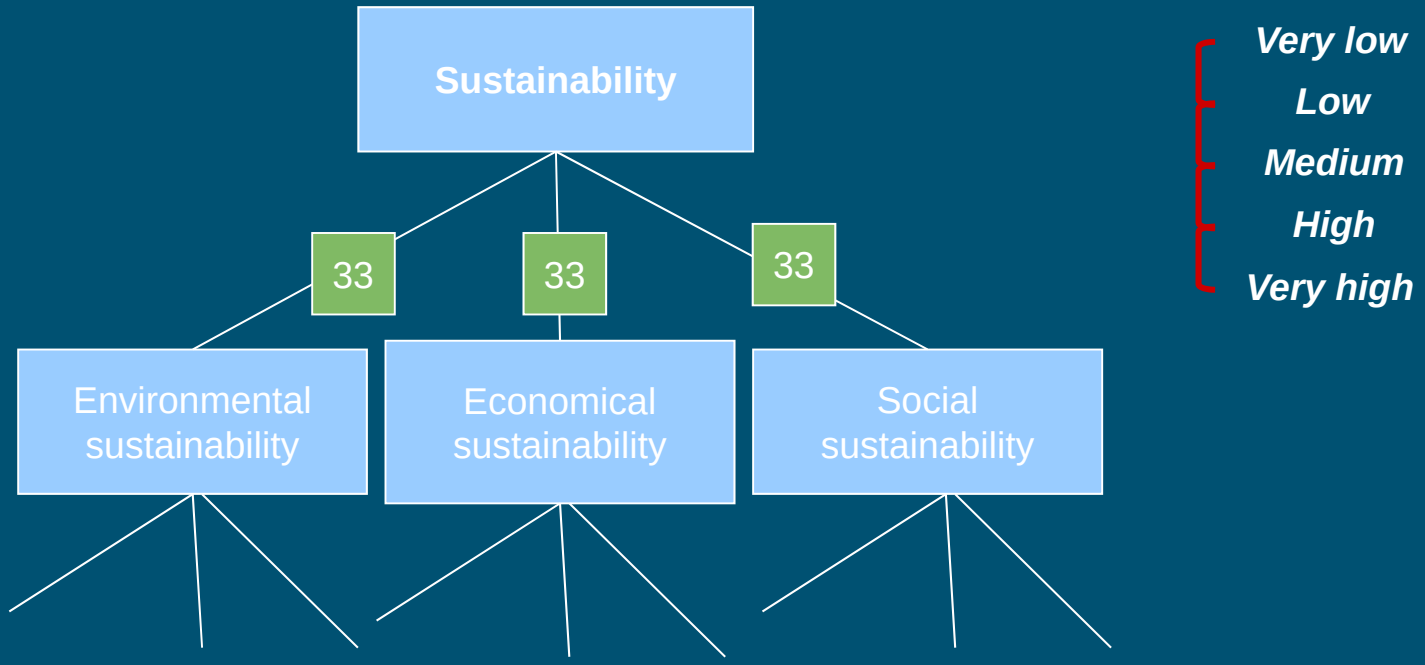
Lay-out DEXi

- attributes scored: qualitative (high, medium, low)
- aggregated through utility functions (if-then qualitative rules): weight of attribute on upper one



Decision rules

Economical sustainability 33%	Social sustainability 33%	Environmental sustainability 33%	Overall sustainability
Very low	Very low	Very low	Very low
Low	Medium	Very low	Low
Medium	Very high	Low	Medium
Medium	High	Very high	High
Very high	High	Very high	Very high

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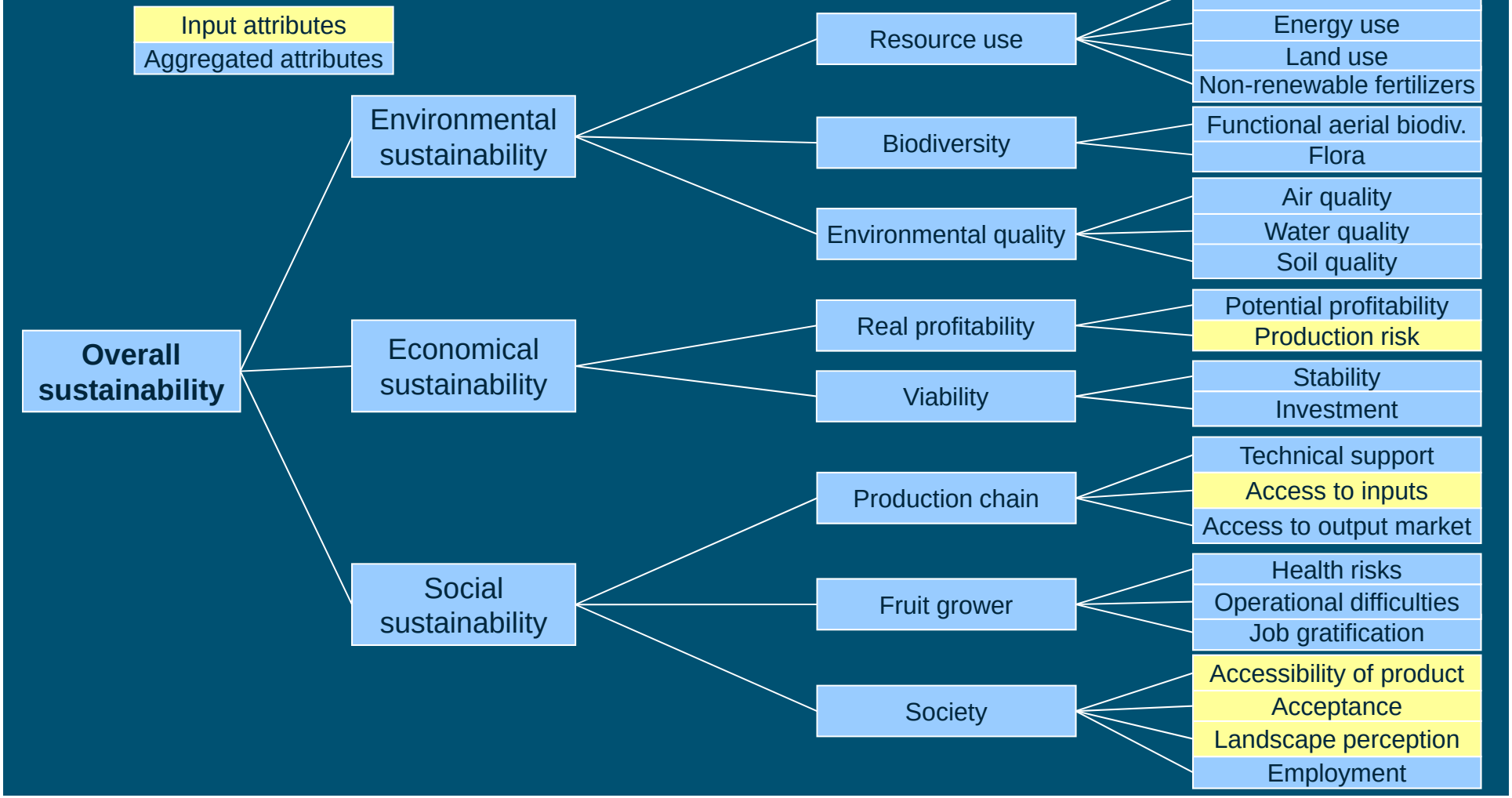
DEXi Pomefruit overview



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Conclusion and perspective DEXi fruit

- model is a research tool: continuously improved
- 1st version transferred to specialist
- to be tested and used as an assessment tool
- structure, criteria, aggregation rules, etc. feedback
- further improvements will be implemented spring-summer 2013

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PREMISE; economic model for ex-ante assessment

- goal: ex-ante evaluation IPM solutions orchards
- start prototype; case scab in apples NL
- PREMISE is a chain risk model with 3 stages:
- link epidemiology to economy
  - quiescence (saprophytic)
  - ascospore (primary)
  - conidia (secondary)
- situation on farm: conditions and measures

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Specification: 3 types of variables

Conditions
(fixed variables)

- Climate (infection periods)
- Cultivars (susceptibility)
- Planting density (shadow)
- Grower skills (including decision support systems)
- Soil activity (earth worms, soil microflora, manure use)
- Inoculum (ascospores, leaf infection, fruit infection)

Regional road

Measures
(control variables)

- Leaf shredding
- Urea / vinasse
- Antagonist
- Fungicide A + features
- Fungicide B + features
- Fungicide C + features

Driver

Linkages with Synops

Indicators
(result variables)

- Infestation level
- Infected fruits
- Labour costs
- Machine costs
- DSS/advisory costs
- Number of sprays
- Kinds of fungicides
- Risk potential
  - environment
  - workers
  - consumers
- Orchard stars

Dashboard

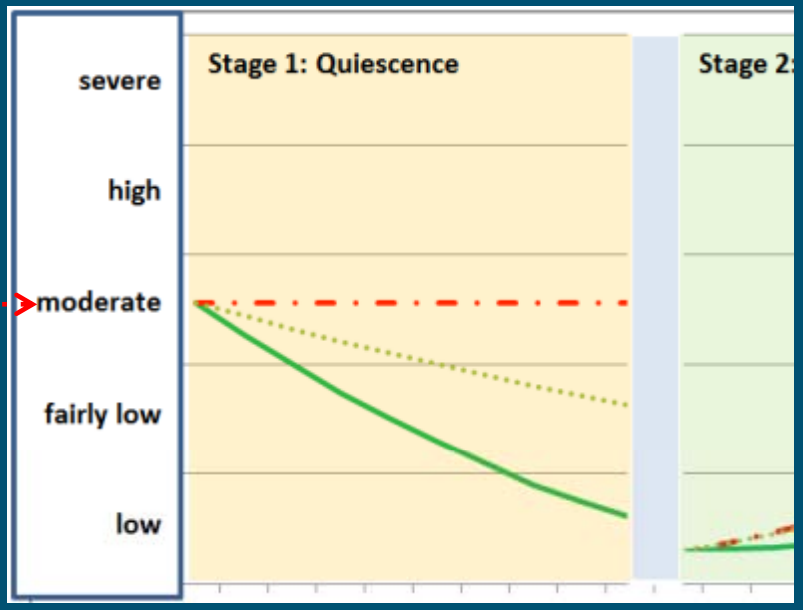
Dashboard data provide basis for ex-ante comparison

PREMISE: Example 1st stage

CONDITIONS

Stage 1: Quiescence

# leaf litter wetness days winter	< 30
soil activity (%org.matter topsoil)	<1%
# sprays after harvest in last seasc	1
PAD from last season	medium (201-1000)



Three lines

- Reference : worst case, conditions have worst value

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PREMISE: Example 1st stage

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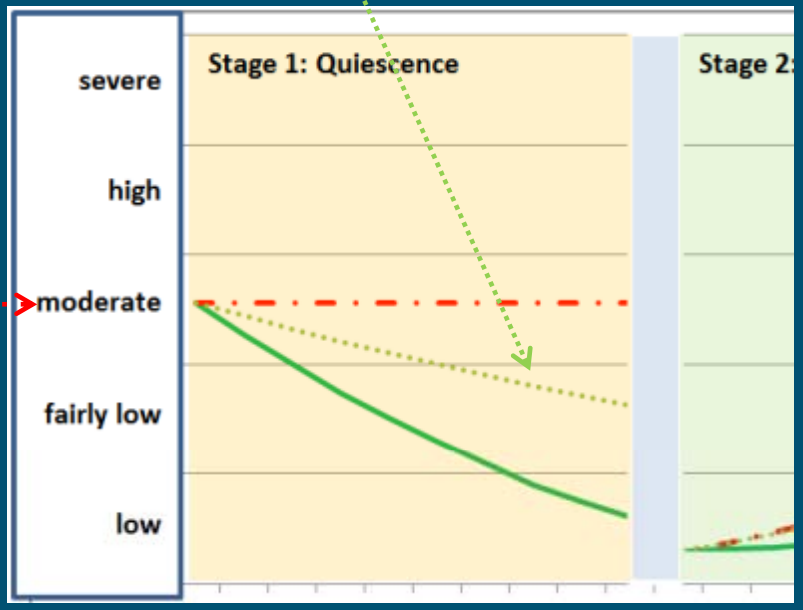

Three lines

- Reference : worst case, conditions have worst value
- Conditions only : actual condition value

PREMISE: Example 1st stage

CONDITIONS

Stage 1: Quiescence

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PAD from last season	medium (201-1000)

MEASURES

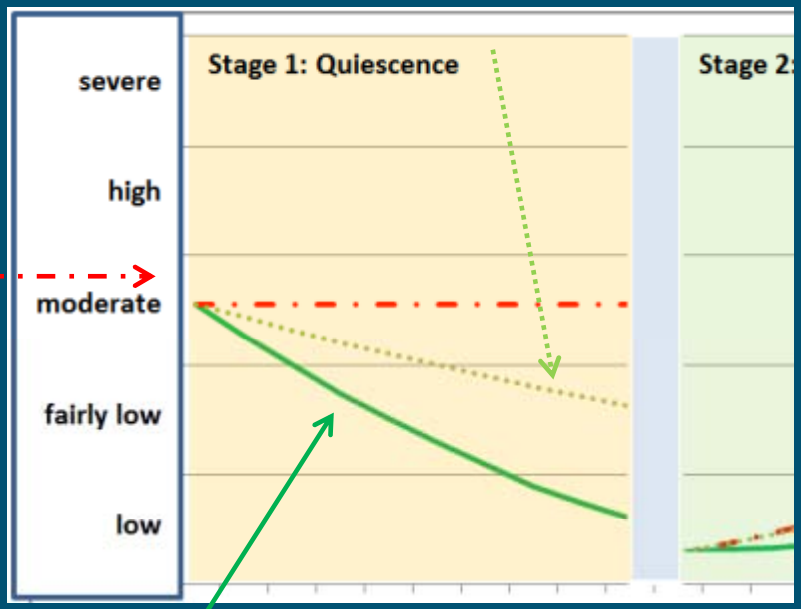
☐ Leaf shredding

#Urea	2
#Vinasse	1

☐ Leaf removal

#Antagonist	0

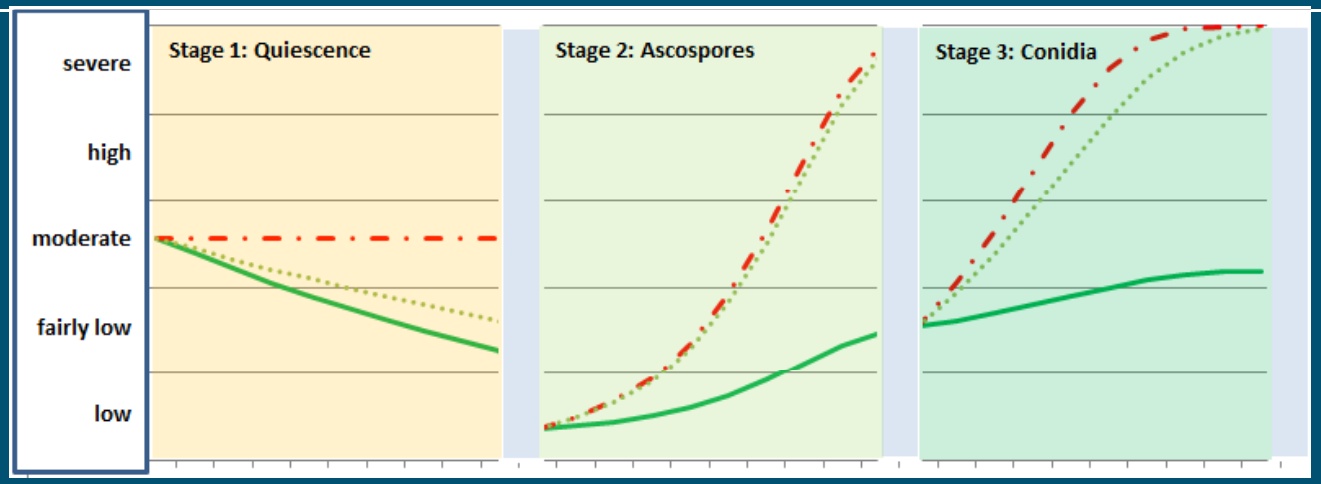
Fungicides [all stages!]

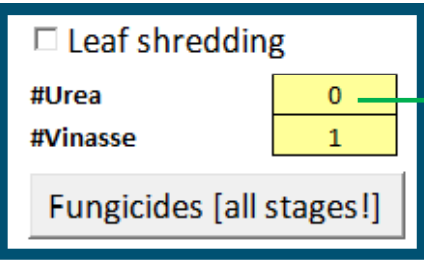


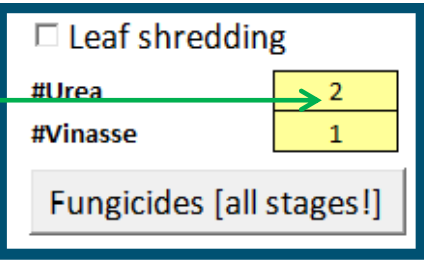
Three lines

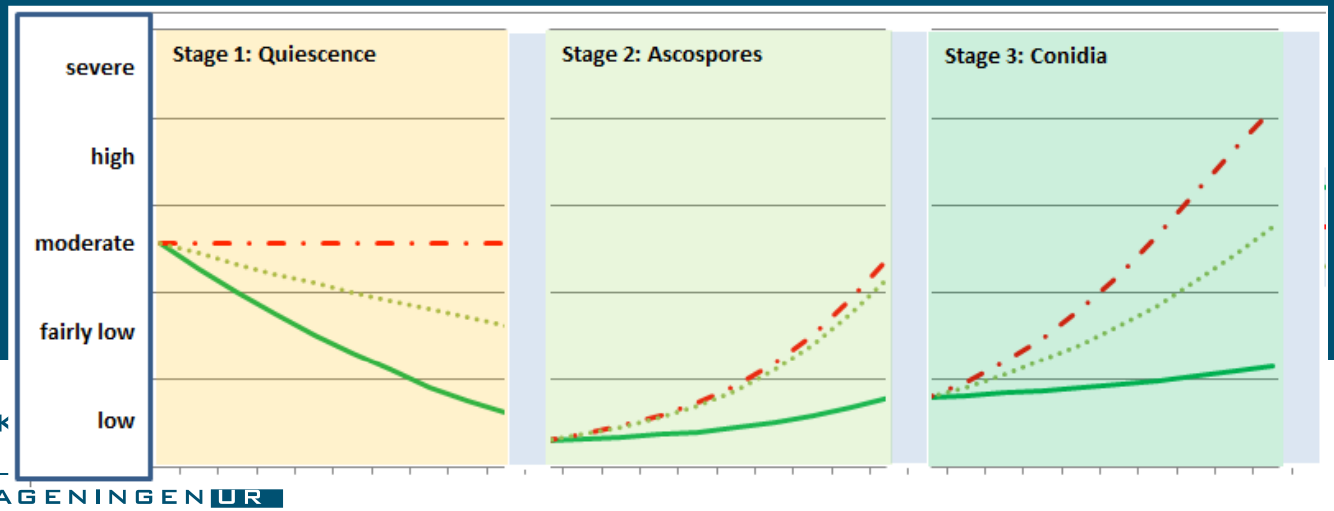
- Reference : worst case, conditions have worst value
- Conditions only : actual condition value (below ref.)
- Effect : measures improve situation at condition

PREMISE: Effect of measures









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PREMISE: Outcome

Expect % scab infected	2%	used as reference (returns,
Requirements retailer (Stars)	Very low requirements	

Price (€/100 kg)		
- Quality Class 1	59.0	96.0%
- Quality Class 2	30.0	3.0%
- Quality Class 3	15.0	1.0%

INDICATORS

	Reference	End Stage3	Difference	
Returns	27114	27245	131	Euro/ha
Fixed costs		0		
Variable costs		994		
labour sorting	3200			
labour fungicides	140			
labour other	200	+		
Labour Total		3540	+	
Total costs of measures and sorting			4534	
Environmental impact			Low	
Number of fungicide applications			7	
#Stars			***	[extra price=4%]

Uncertainty

not 1 outcome-class but membership value (%) for more classes -- fuzzy sets

Economic effect (comp. reference)	**no stars**	**stars*** **
very good		
good		
fairly good		
slightly good		
no effect		
slightly bad		58%
fairly bad		39%
bad	39%	3%
very bad	61%	

Precentages represent class membership (fuzzy sets)

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PREMISE: cost-benefit analysis

Questions PREMISE may answer:

- Is application of measure X cost-effective?
- Does investment for measure X pay off?
- IPM solution A compared to IPM solution B?

Stakeholder interaction

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- my co-authors

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Thank you for your attention

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