Approcci e metodi quantitativi a supporto della valutazione e gestione del rischio associato agli organismi da quarantena.

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UNIVERSITÀ DEGLI STUDI DI BRESCIA

1. Problemi metodologici nella valutazione del rischio associato alle IAS
2. Il ruolo di EFSA
3. L'approccio quantitativo di EFSA al Pest Risk Assessment
4. Esempi di "Second tier"
5. Priority pest

1. Problemi metodologici nella valutazione del rischio associato alle IAS

Environmental changes
- Global warming
- Atmospheric and ocean circulation
- Loss of biodiversity
- Ecosystem processes and services

→

- Improved winter survival
- Increased fecundity
- Accelerated pest population growth
- Increase in the number of generations
- Raised virulence
- Reduced dormancy
- Enlarged geographical range
- Increased crop susceptibility

Agricultural changes
- Production systems
- Freshwater depletion
- Agro-biodiversity loss
- Land degradation and desertification

→

- Lack of pests' natural enemies
- Increased crop stress
- Breakdown of resistance mechanisms (including ecosystem resistance and resilience)

Societal changes
- Trades and human migration
- Human population growth
- Land use
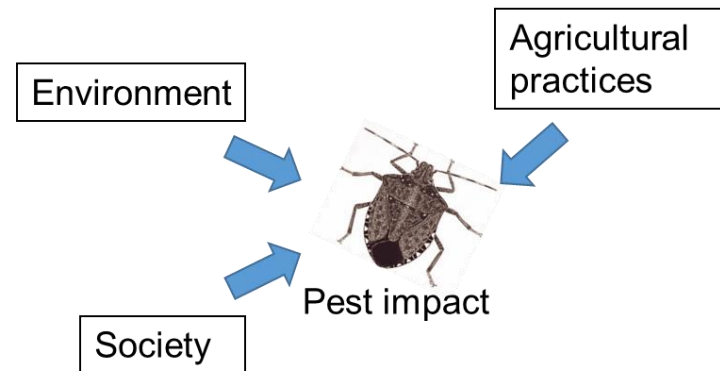- Urban intensification
- Pollutants emission

→

- Potential for pests entry, establishment spread and impact in new areas

- **Multi-dimensional effects**

  Heterogeneity in drivers and processes involved

Environment

Agricultural practices
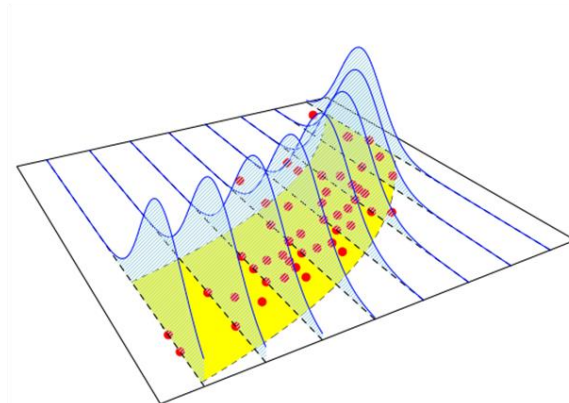
Society

Pest impact

- **Systemic effects**

  Interaction between system' compartments and processes

- **Non-linear effects**

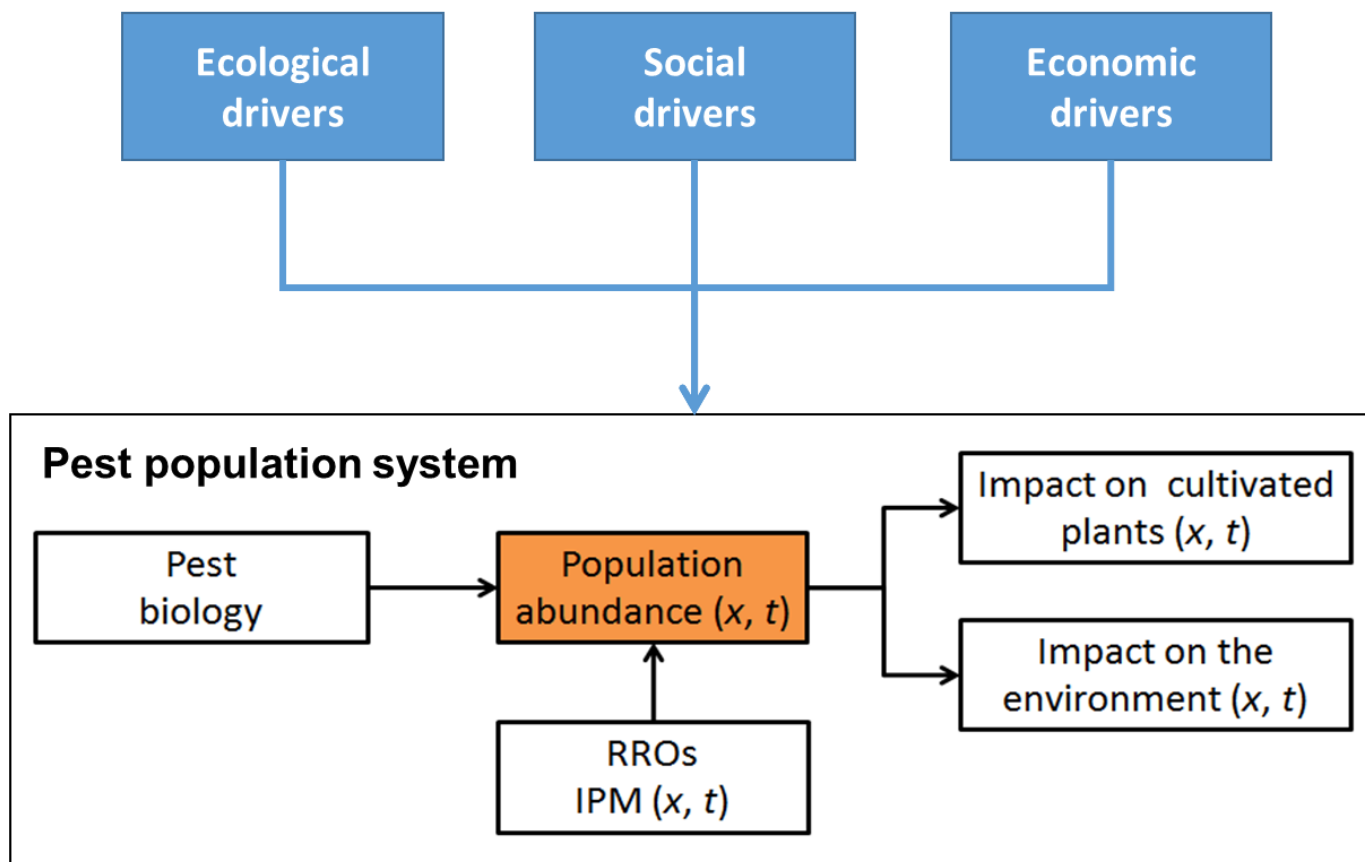 Complex relationships between causes and effects

- **Approccio quantitativo**
  - Passaggio da valutazione qualitativa del rischio alla sua valutazione quantitativa

- **Approccio alla incertezza**
  - Integrare la incertezza nella valutazione

- **Approccio meccanicistico**
  - Legare la valutazione ai processi coinvolti

Population-based (i.e. mechanistic) approach

2. Il ruolo di EFSA

L'EFSA E':

L'organismo di riferimento per la valutazione dei rischi da alimenti e mangimi nell'Unione europea.

La sua attività riguarda l'intera catena alimentare, dai campi alla tavola

una delle oltre **40** agenzie decentrate dell'UE

Uno dei vari organismi che hanno il compito di salvaguardare la sicurezza alimentare in Europa

I 10 GRUPPI SCIENTIFICI:

Salute delle piante

Protezione dei vegetali

GMO

Nutrizione umana

Mangimi

Imballaggi per alimenti

COMITATO SCIENTIFICO

Salute degli animali e loro benessere

Additivi alimentari

Pericoli biologici

Contaminanti chimici
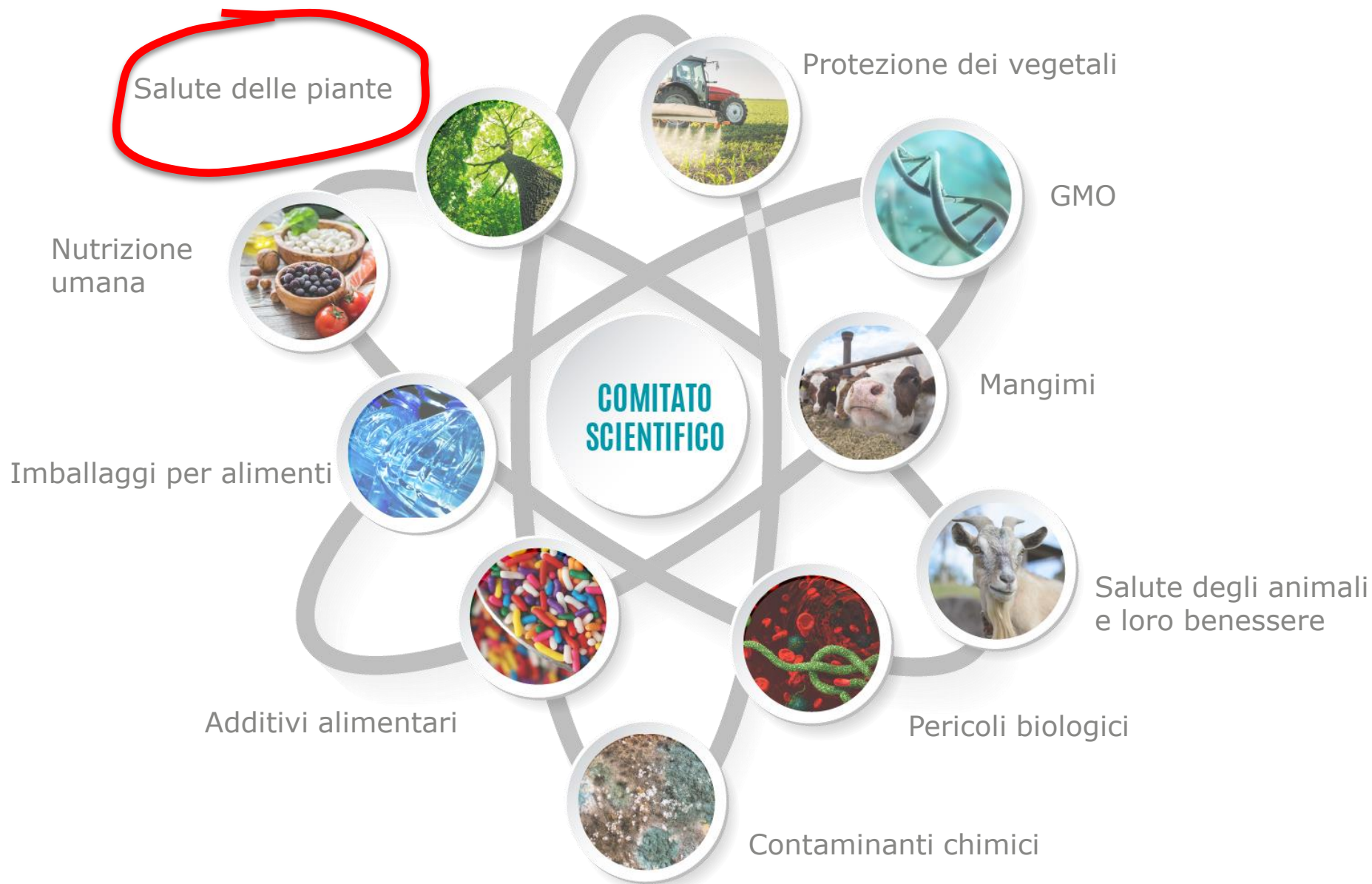
Towards Regulation (UE) 2016/2031
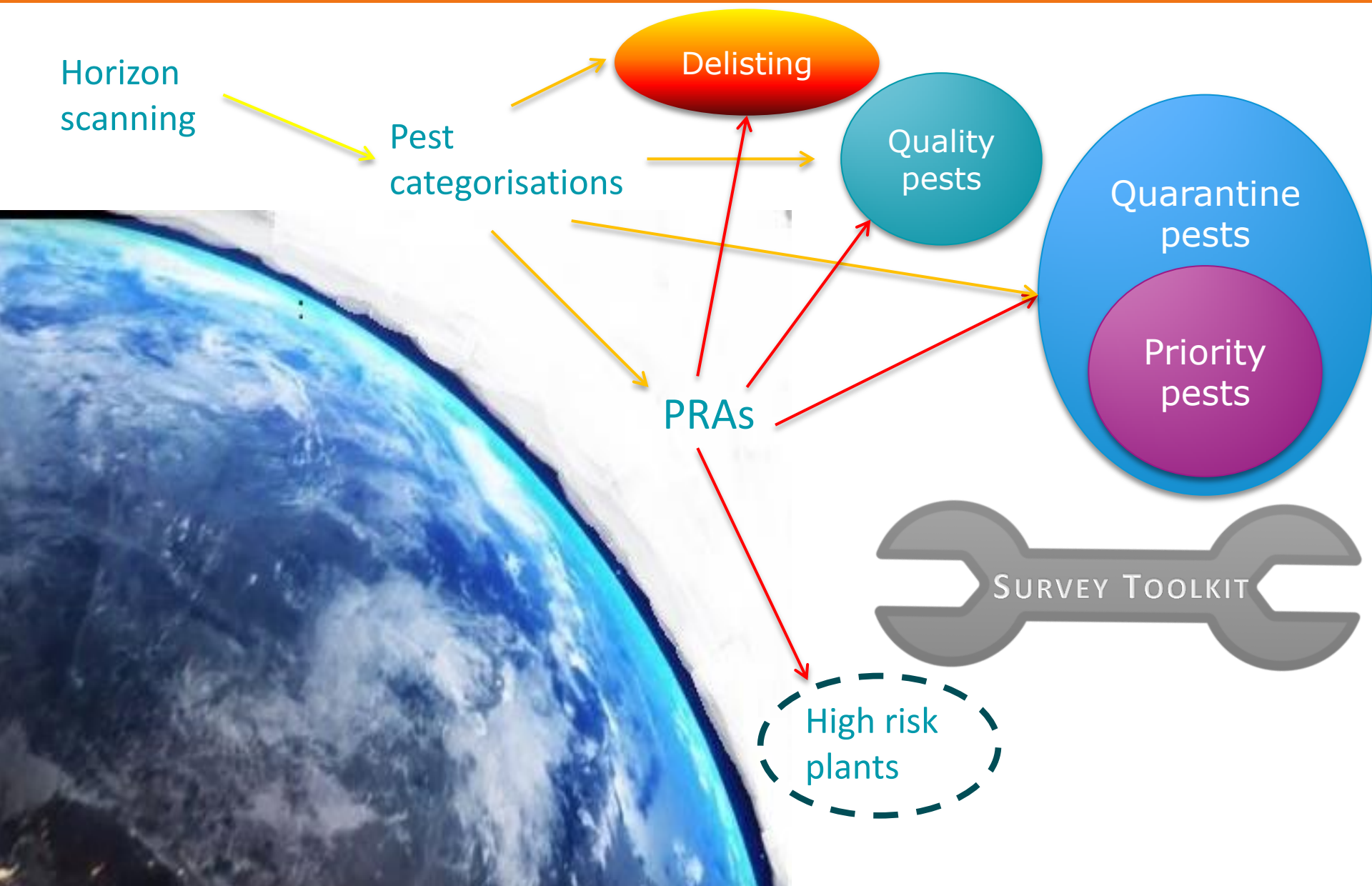
3. L'approccio Quantitativo di EFSA al Pest Risk Assessment

Principi

Adaptive

Process-based
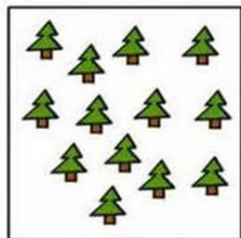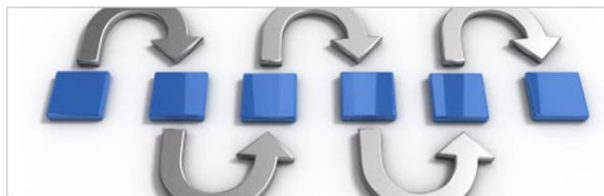
Quantitative
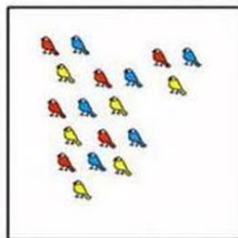
13 Trees   Blue, Red, and Yellow Birds

New pest risk assessment methodology

Adaptive

Mechanistic and population based
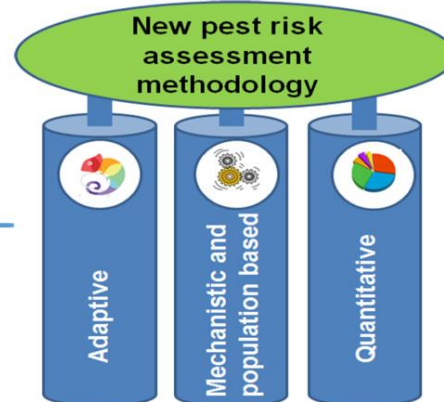
Quantitative

Metodologia

- **Adaptive**
  - Pest, objective, resources
  - Scenarios for the assessments (e.g., pathway, RRO, trade)

- **Process-based**
  - Flow of events and processes
  - Sequence of changes in the abundance and distribution

- **Quantitative**
  - Using quantities measurable in the real world
  - Combine knowledge and uncertainty

Abundance in production unit country of origin

↓

Abundance pathway unit/sub-unit

↓

N° founder populations

↓

Abundance and spread in the risk assessment area

↓

Impact on assessment area

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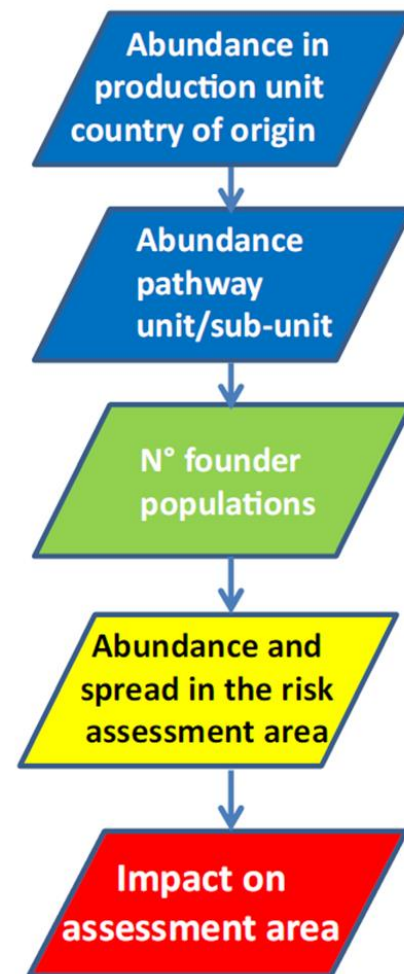
THE FOUR STEPS
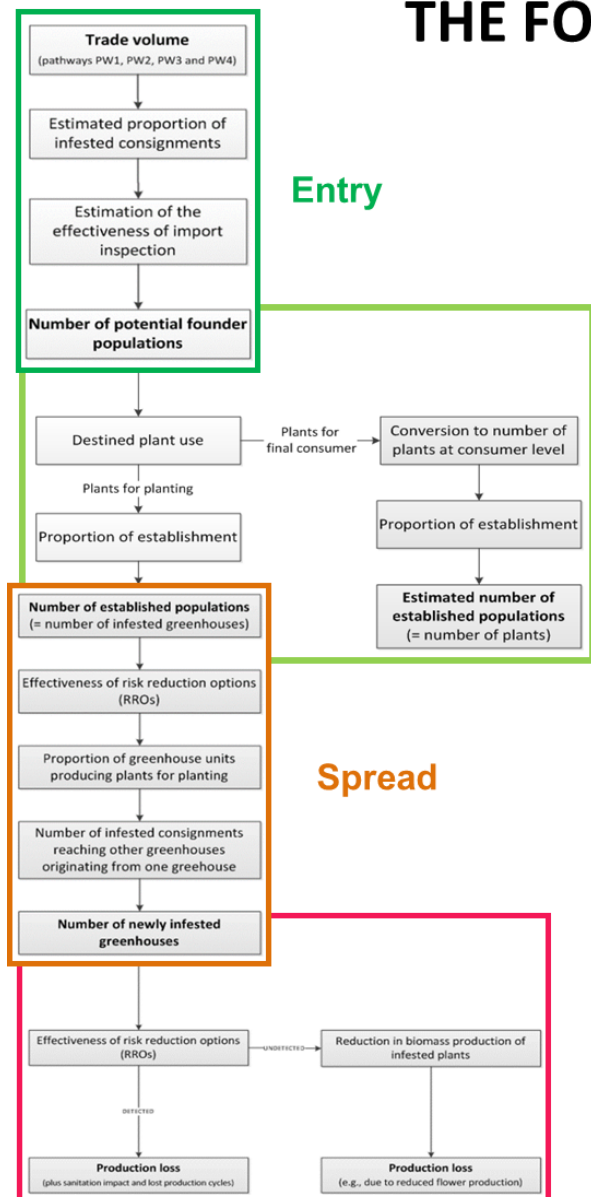
- **Entry**: (distribution of) number of potential founder populations in the assessment area considering trade flows, proportion of infested products, RRO effectivemess and probability of transfer to host

- **Establishment**: (distribution of) actual number of founder population in the assessment area, considering the number of potential founder populations and the probability of establishment

- **Spread**: (distribution of) number of spatial units that are affected by pest as a result of dispersal

- **Impact**: (distribution of) total yield loss and effects on crop quality in EU

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SCENARIO-BASED APPROACH

Components defining the scenarios for risk assessment

Pathways	Mechanisms of spread
Spatial extent and resolution	Time horizon and resolution
Ecological factors and conditions (Climate change; change in hosts; resistance and resilience variations)	Current regulation
	Identification of the relevant RROs Control and supporting measures

For fit for purpose and explicit risk assessment

scenario 'A0', Baseline scenario is the current situation. A0 is always assessed

scenarios A1 to An corresponding to changes in the pathways or RROs etc. can be compared with A0

Example Scenario A1: Current regulation in place without the E. lewisi specific requirements (Annex IIAI to Council Directive 2000/29/EC2) and in addition all imported host commodities should come from Pest Free Areas (PFA) in the country at origin (ISPM 4 (FAO, 1995)) and enforced measures on specific pathways.

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THE CONCEPTUAL MODEL

Abundance of pest when leaving the place of production

Number of potential funder populations

Number of established populations

Number of spatial units or area occupied

Spatial units representing endangered area

Entry models

Establishment models

Spread models

Impact models

X_{E0}: Abundance of the pest when leaving the place of production

e_1: parameter changing pest abundance before leaving the place of production

e_3: parameter changing pest abundance during transport in the country of origin

X_{E1}: Abundance when crossing the border of the exporting country

e_4: parameter changing pest abundance during transport to the importing country

X_{E2}: Abundance when arriving at the EU point of entry

e_5: parameter changing pest abundance before leaving the EU point of entry

X_{E3}: Abundance when leaving the EU point of entry

N_{E0}: Number of pathway units potentially carrying the pest

e_7: parameter changing pest abundance after leaving the point of entry

N_{E1}: Number of potential founder populations

Metodologia

- The two-tier approach
  - Elicitating the <u>assessed variable</u> (e.g., the impact as % yield reduction)
  - Elicitating <u>model parameters</u>

- Quantitative methodology allow for
  - <u>More transparent</u> risk assessment
  - Guide the risk assessment to express the <u>constituent parts of risk</u>
  - <u>Comparing and updating</u>

Percentile	1st	25th	50th	75th	99th
Estimate (%)	0.0	0.8	1.5	3.0	6.0
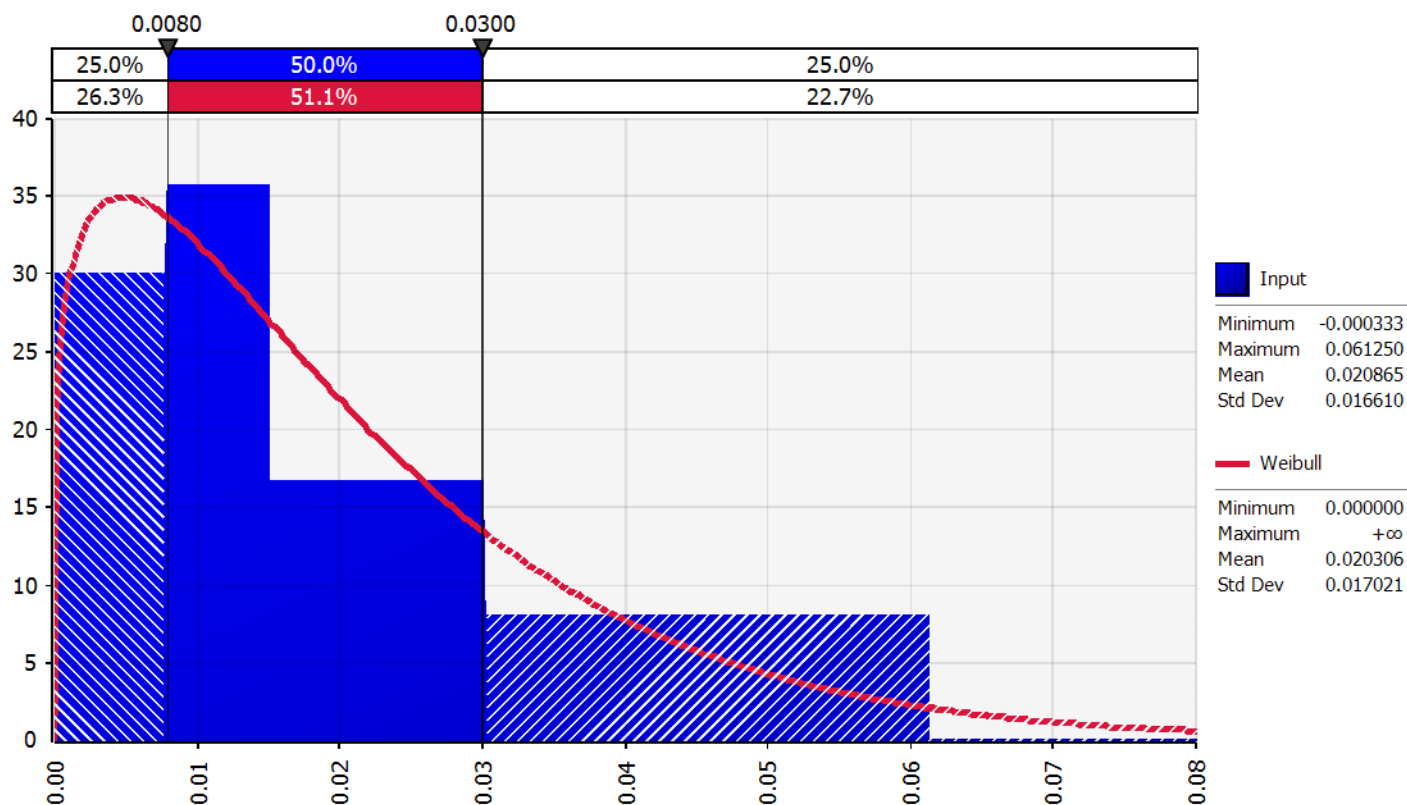
SCENARIO COMPARISON

Scenario comparison
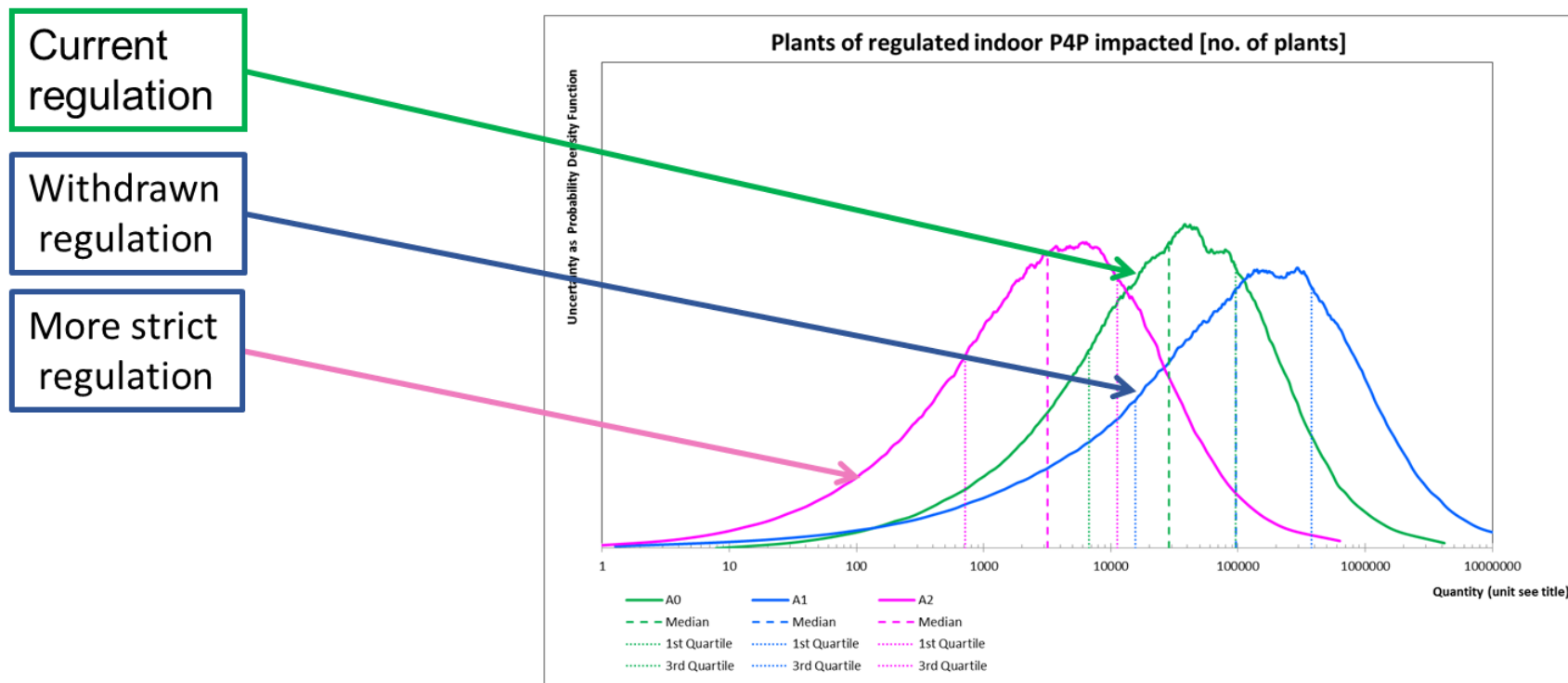
4. Esempi di "Second tier"

Flavescence Dorée Phytoplasma

Ditylenchus destructor

Eotetranychus lewisi

Diaporthe vaccinii

Ceratocystis platani

Cryphonectria parasitica

Radopholus similis

Atropellis sp.

Abundance of pest when leaving the place of production

Number of potential funder populations

Number of established populations

Number of spatial units or area occupied

Spatial units representing endangered area

Entry models

Establishment models

Spread models

Impact models

E.g. Enlarged geographical range

E.g. Improved winter survival

E.g. Accelerated population growth

E.g. Increased crop susceptibility

Environmental changes

Radopholus similis

Fig. 10.7. Radopholus similis. A-Female, B-Male.
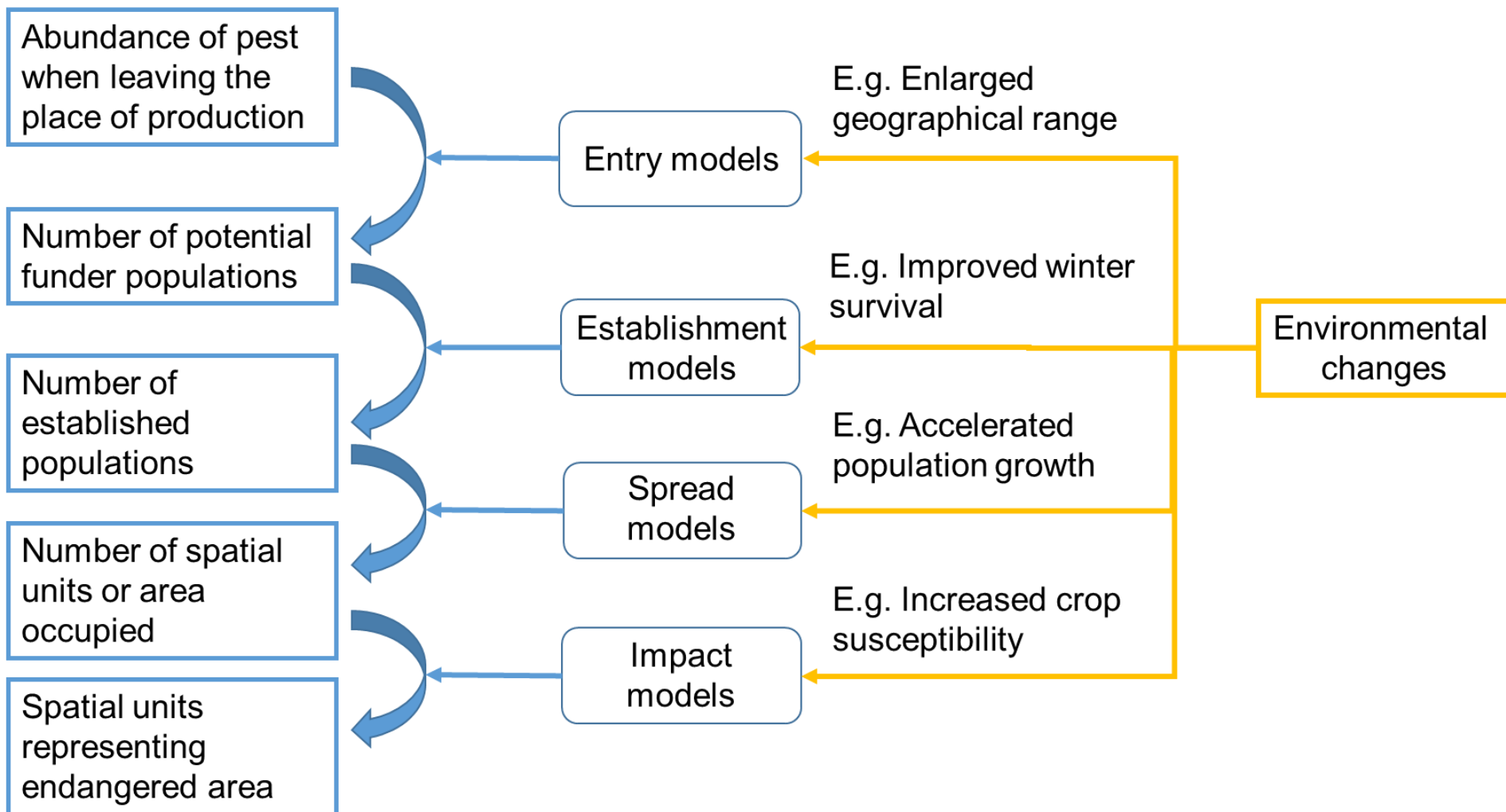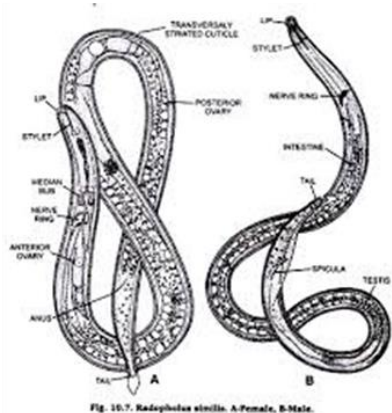
Impact of climate change (+2 °C) for the establishment and spread of *Radopholus similis*

Temperature sums > 21°C in EU citrus growing areas (based on monthly averages)

- 0: Unsuitable for *Radopholus similis* establishment
- 0.1–40: Unsuitable for *Radopholus similis* establishment
- 40–253: *Radopholus similis* may establish in low densities
- 254–992: *Radopholus similis* may establish in low densities
- > 992: *Radopholus similis* may establish with high density

Figure A.5: Citrus growing areas of the EU classified according to temperature sum intervals based on monthly average temperatures from locations surveyed for the presence of *R. similis*, see JRC (2017) for the data used to create the map

Temperature sums > 21°C in EU citrus growing areas under climate warming (+2 degrees Celsius)

- 0: Unsuitable for *Radopholus similis* establishment
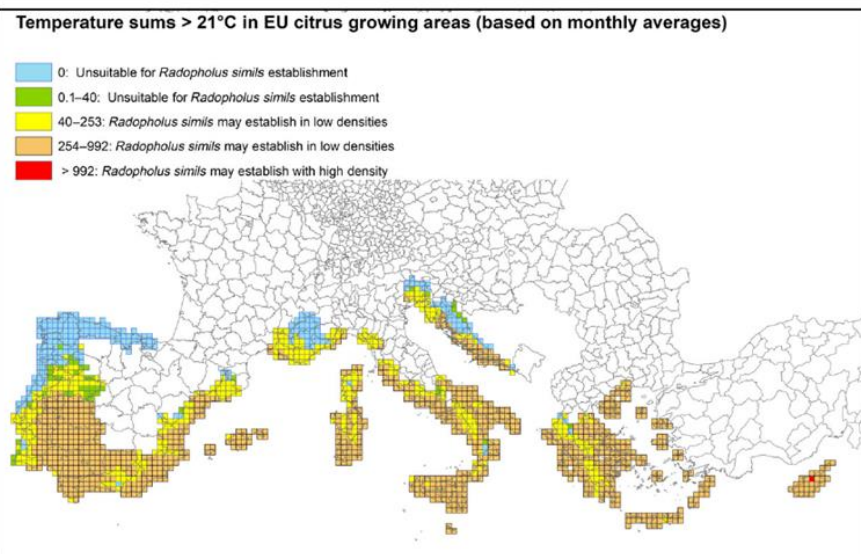- 0.1–40: Unsuitable for *Radopholus similis* establishment
- 40–253: *Radopholus similis* may establish in low densities
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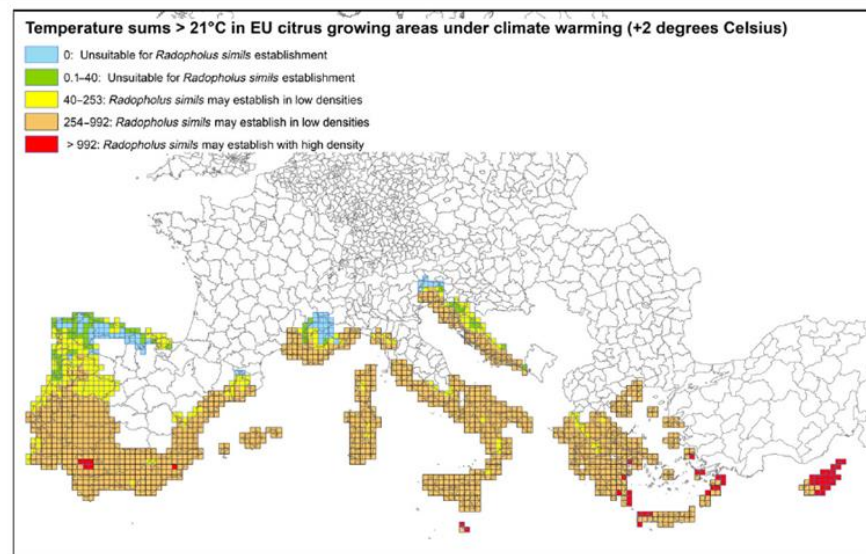- > 992: *Radopholus similis* may establish with high density

Figure A.7: Citrus growing areas of the EU classified for temperature suitability for *Radopholus similis* establishment according to temperature sum intervals under climate warming, see JRC (2017) for the data used to create the map

Abundance of pest when leaving the place of production

Entry models ← E.g. Trade, PLH legislation

Number of potential funder populations

Establishment models ← E.g. Land use, Crop production systems

Number of established populations

Spread models ← E.g. Internal trade

Number of spatial units or area occupied

Impact models ← E.g. Land use

Spatial units representing endangered area

Societal changes

Scenari di cambiamento socio-economico

Ditylenchus destructor

SC 0 Baseline scenario (blue)

SC. 3:(=SC 0) Production of flower bulbs in pest-free places of production in third countries (green)

SC 5 Production of the flower bulbs in pest-free areas (pink)

SC. 6: Hot water treatment before planting (orange)

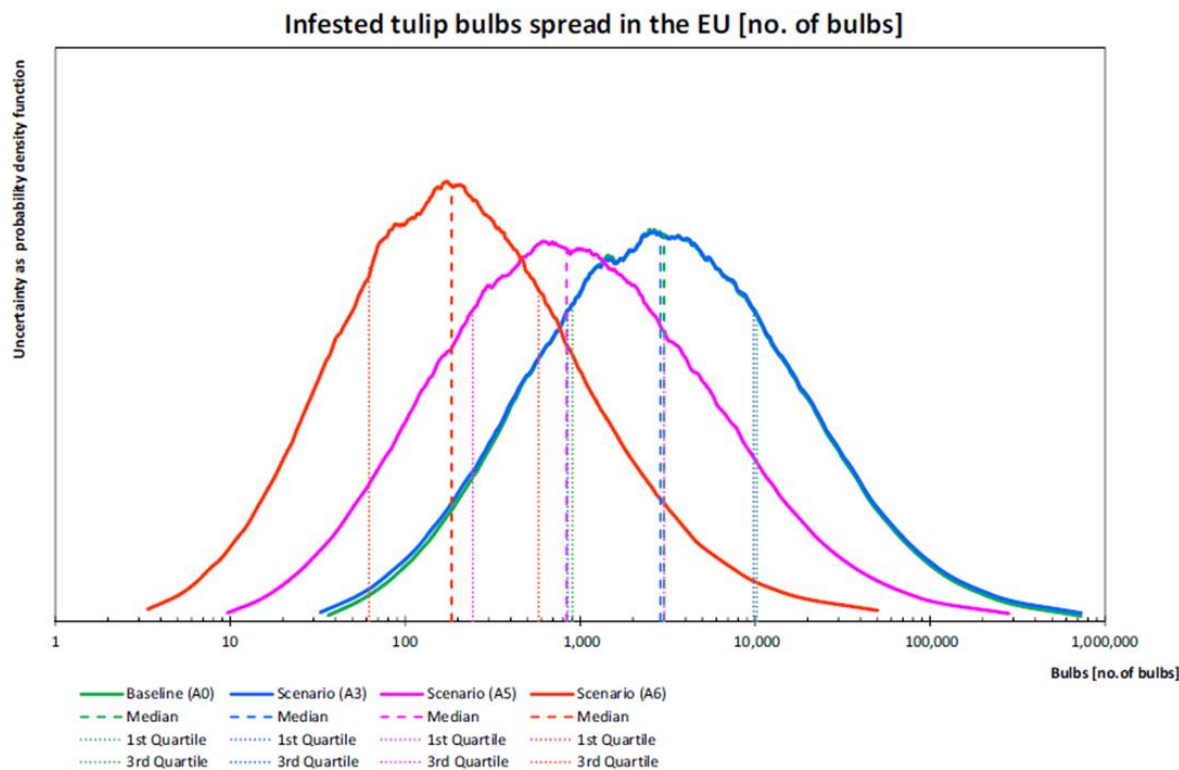Scenarios of spread of *Ditylenchus destructor* considering different RROs

Infested tulip bulbs spread in the EU [no. of bulbs]

—— Baseline (A0)	—— Scenario (A3)	—— Scenario (A5)	—— Scenario (A6)
- - Median	- - Median	- - Median	- - Median
···· 1st Quartile	···· 1st Quartile	···· 1st Quartile	···· 1st Quartile
···· 3rd Quartile	···· 3rd Quartile	···· 3rd Quartile	···· 3rd Quartile

Figure 4: Simulation results on the intra-European spread of *D. destructor* with tulip planting material

5. Priority pest

PRIORITY PESTS

Their potential **economic**, **environmental** or **social** impact is the most severe in respect of the Union territory

- Annual surveys (with <u>sufficiently high number</u> of visual examinations, sampling and testing, as appropriate for each priority pest)
- National contingency plans
- Simulation exercises
- Action plans
- Communication activity to the public

> **Task 1**: Methodology development, identification of indicators and alternative weights for each of the criteria

> **Task 2**: Application of the methodology to two pilot pests, which will be defined at the onset of the project based on data promptly available, while covering different types of pests

DONE

Joint Research Centre

JRC

> **Task 3**: Extension of the application of the methodology to the remaining potential candidate priority pests

ONGOING

LISTS OF 28 PESTS

INSECTS

1. *Agrilus anxius*
2. *Agrilus planipennis*
3. *Anastrepha ludens*
4. *Anoplophora chinensis*
5. *Anoplophora glabripennis*
6. *Anthonomus eugenii*
7. *Aromia bungii*
8. *Bactericera cockerelli*
9. *Bactrocera dorsalis*
10. *Bactrocera zonata*
11. *Conotrachelus nenuphar*
12. *Dendrolimus sibiricus*
13. *Popillia japonica*
14. *Rhagoletis pomonella (Tephritidae (non-European))*
15. *Spodoptera frugiperda*
16. *Thaumatotibia leucotreta*
17. *Thrips palmi*

BACTERIA

18. *Candidatus Liberibacter spp. (citrus greening)*
19. *Clavibacter michiganensis subsp. sepedonicus*
20. *Ralstonia solanacearum*
21. *Xylella fastidiosa*
22. *Xanthomonas citri*
23. *Grapevine flavescence dorée*

NEMATODES

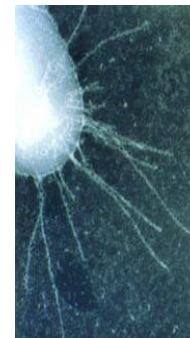24. *Bursaphelenchus xylophilus*

FUNGI

25. *Ceratocystis fagacearum*
26. *Phyllosticta citricarpa*
27. *Synchytrium endobioticum*
28. *Tilletia indica*

Anthonomus eugenii (ANTHEU) - https://gd.eppo.int

Parameters

Yield and quality losses

*1. What is the long term and EU average of the **proportion (in %) of yield losses** (e.g. tree decline, fruit drop, fruit not harvested), under current EU cropping practices?*

*2. What is the long term and EU average proportion **(%) of harvested crop damaged by the pest** that would lead to downgrading of the final product because of quality issues?*

Difficulty of eradication

*3. What is the **spread rate** in 1 year for an isolated focus within this scenario based on average European conditions? (units: m/year)*

*4. What is the **time** between the event of pest transfer to a suitable host and its first **detection**? (unit: years)*

Experts Knowledge Elicitation (EKE)

- The parameters are elicited by a **structured expert judgement**
- EKE method described in specific **EFSA Guidance docs***
- Quartile method of the **Sheffield** protocol
- **Factsheet**- general information + quantitative data (PRA, EPPO GD, JRC, EUROSTAT, literature search)
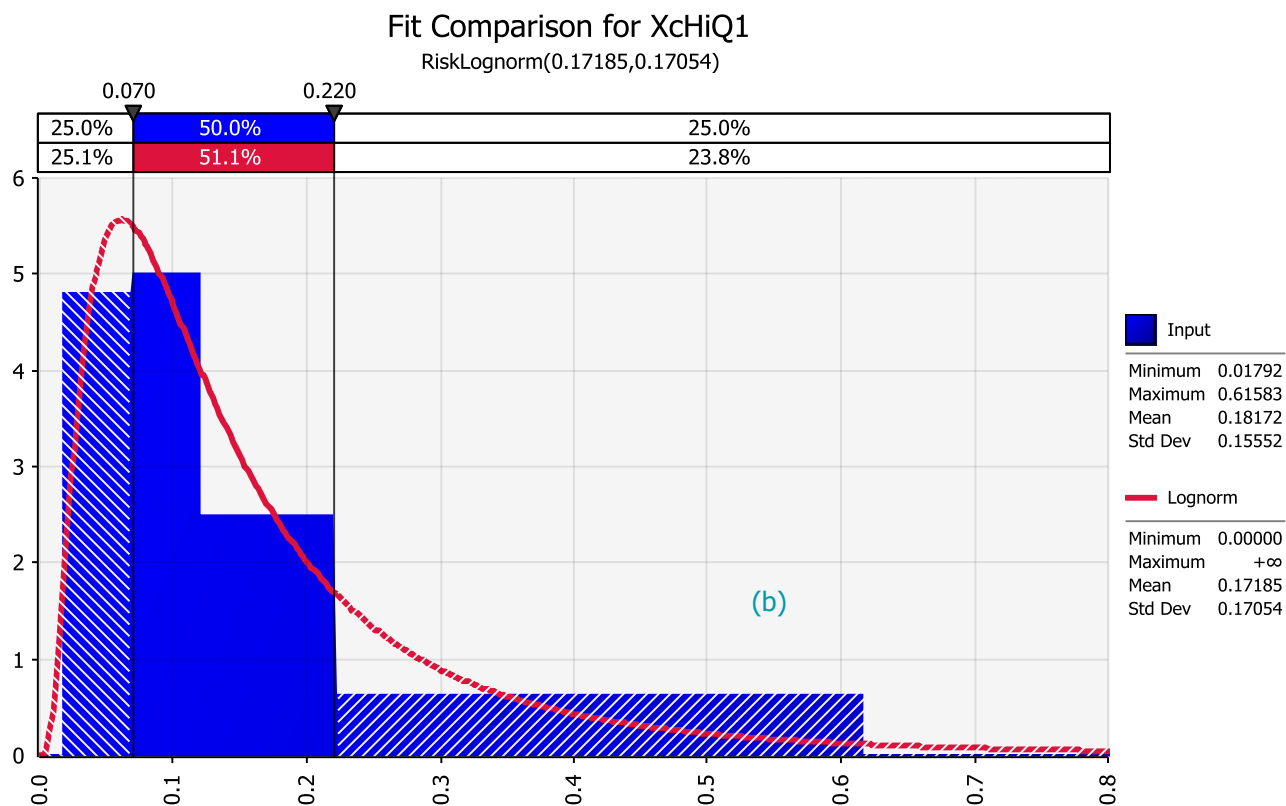- **EKE Report**

*

https://www.efsa.europa.eu/it/efsajournal/pub/3734
https://www.efsa.europa.eu/en/efsajournal/pub/5123

Example of a distribution curve

Percentile	1%	2.5%	5%	10%	17%	25%	33%	50%	67%	75%	83%	90%	95%	97.5%	99%
Expert elicitation	2%					7%		12%		22%					60%
Fitted distribution	1.8%	2.4%	3.1%	4.2%	5.5%	7.0%	8.5%	12%	17%	21%	27%	35%	48%	62%	84%

Fit Comparison for XcHiQ1

RiskLognorm(0.17185,0.17054)

(b)

	Input
Minimum	0.01792
Maximum	0.61583
Mean	0.18172
Std Dev	0.15552

	Lognorm
Minimum	0.00000
Maximum	+∞
Mean	0.17185
Std Dev	0.17054

Conclusioni

Importanza della quantificazione del rischio

- The methodological framework for quantitative pest risk assessment
  - Suitable for considering <u>multi-dimensional, systemic and non-linear effects</u> related to global changes
  - <u>Framework and not a model</u>: providing a systematic and dynamic representations of the processes liable to generate risks

- Flexible approach and allows a variety of quantitative methods to be used at different systems and levels of complexity

- **Advantages of quantitative assessment**
  - The assessment outcome (risk) is expressed in quantitative <u>units measurable in the physical world</u> allowing risk managers a more concrete understanding of the assessment result and hence a better basis for decision making
  - <u>Increase the transparency</u> in providing mechanism on how to combine risk elements in logical manner and to estimate model parameters
  - Take into account both <u>quantified and unquantified uncertainties</u>
  - <u>Automatically updates </u>with revised inputs
  - Evaluate the <u>effectiveness of options </u>for risk reduction and mitigation measure

- **Possibility of expressing the risk in monetary units**

Importanza della raccolta dati

- ## Quali dati
  - Aggiornati sulla "current distribution"
  - Fattori favoriscono lo stabilirsi delle popolazioni
  - Piante ospiti e la preferenza
  - Tassi di diffusione
  - Impatti: prevalenza, incidenza, severità, perdite (quantitative e qualitative)

- ## Contributo importante
  - Piani razionali di campionamento
  - Modelli

Grazie!

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