Uncertainty from qualitative to quantitative pest risk assessment at EFSA

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Acnowledgements

Thanks to:

- *Current (2015-2018) and previous (2006-2015) members of the EFSA Scientific Panel on Plant health (PLH Panel)*
- *EFSA PLH Panel Working Groups (WG): WG "R. similis pest risk assessment" and WG "Methods"*
- *EFSA Units ALPHA (Animal and plant health) and AMU (Assessment methodology)*

Some abbreviations used in the slides

Plants for planting = P4P

Risk assessment = RA

Risk management = RM

Risk reducing option/ risk management option = RRO

A trip from qualitative to quantitative

2010 EFSA PLH Panel Qualitative PRA guidance

2010-15 26 Qualitative PRAs

2014 Two-steps approach agreed with RM (40 pest categorisations, only 20% go PRA)

2015- EFSA SC Draft Uncertainty Guidance

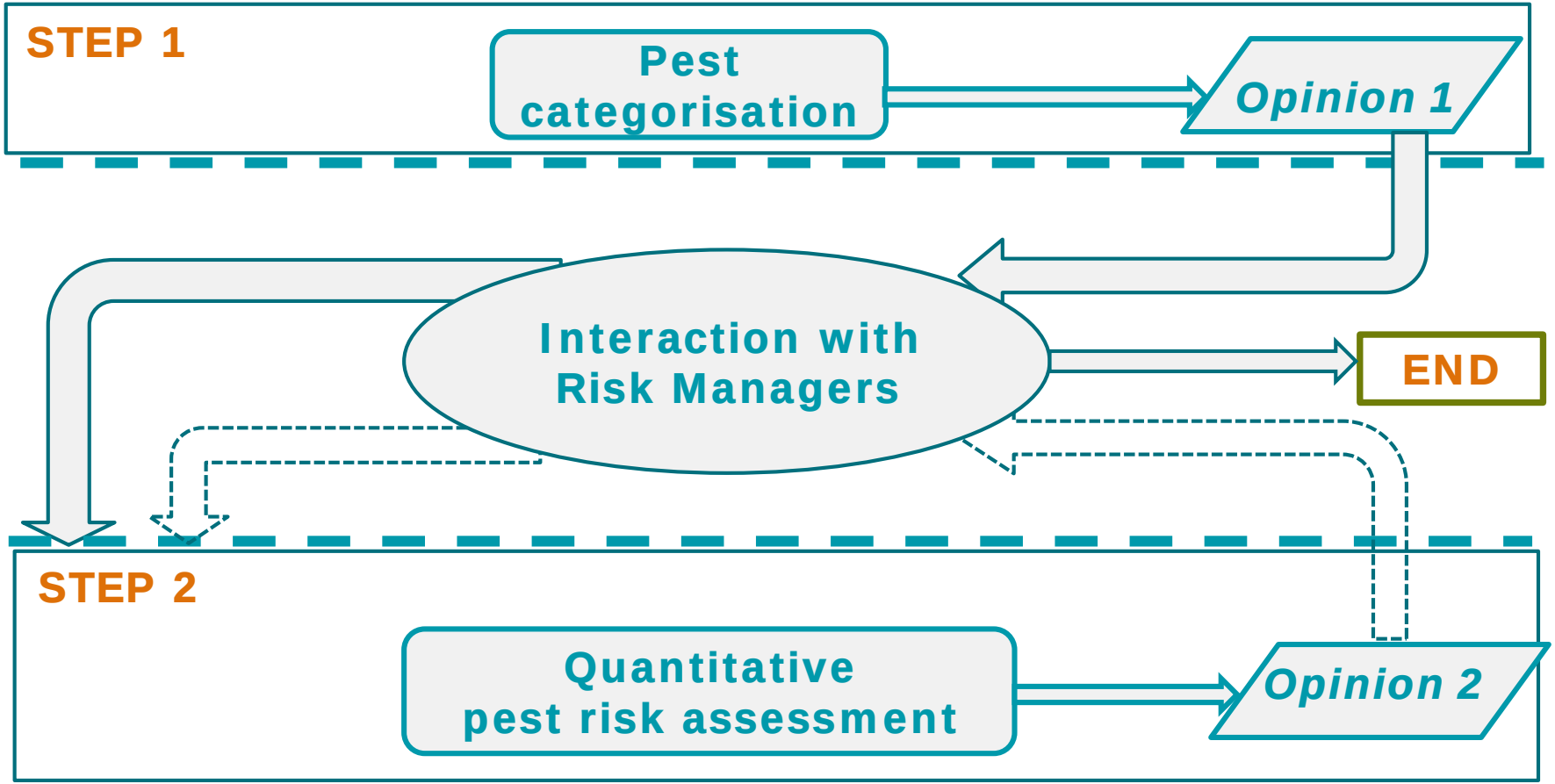
2015- PLH Panel WG on quantitative PRA method

2015-17 8 Quantitative Pest RAs, with @RISK

2018 *Public consultation quantitative PRA guidance*

2018 *Quantitative PRA guidance and online tool*

The 2 step approach



From qualitative to quantitative: probability and impact

Qualitative:

Entry is **very likely** for plants intended for planting with soil. Cuttings pose a **lower risk**.

Spread is **very likely** as (i) the pest has **numerous ways** of spreading naturally and with human assistance, (ii) **large quantities** of propagation material are **often** transported within the EU, (…)

Impact is rated as **minor** on grafted plants, (…).

Impact is rated as **massive** on ungrafted plants, (…).

Quantitative:

The risk of new introductions of *C. platani* into the RA area by means of the main pathways for entry (…) is relatively limited, with **less than 1 (median value) new established populations** predicted in a 10-year period under the A0 scenario.

With the current measures in place, spread of FDp is likely to continue during the forthcoming period with a progression of **between a few and ca. 20 newly contaminated NUTS 2 regions** predicted for the **50% uncertainty interval.**

Under scenario A0, impact of FDp represents only a very small fraction of the EU table grapes or wine production (**in the order of 0.5 to 1%),** (…)

Quantifying uncertainties

Qualitative:

Uncertainty is rated as **low** as the information available from the literature and the evidence obtained from the risk assessment area show that ……..

Quantitative:

The uncertainty breakdown for the scenario A0 (…) shows that the **most important factor contributing to uncertainty** for all means of long-distance spread is the estimated growth rate of the pathogen per year.

More than **90% uncertainty** in calculated entry is due to uncertainty about the proportion of infested potatoes harvested in infested fields. Other factors are of **minor influence** on uncertainty.

The uncertainties associated with these evaluations are however large, as indicated by **50% uncertainty intervals spanning roughly two orders of magnitude**.

Indeed, while the consolidated **median loss (…) is estimated at close to 8,000 tonnes** of grapes, the **50% uncertainty interval spans a range of nearly two orders of magnitude, ranging from about 1,000 tonnes to close to 50,000 tonnes.**

(…) the parameter that is associated with the **largest uncertainties** is the estimation of the average abundance of FDp in contaminated NUTS 2 regions.

Quantifying risk reductions

Qualitative:

The Panel identified several measures that **could work effectively** when combined in a systems approach (…)

The Panel considers that the Annex IIAII measures designed to prevent pest spread within the EU are **ineffective** for two main reasons. Firstly, they are based on inspection and the effectiveness of visual inspection in the field and of potted vines is **low** (though moderate for cuttings) and, secondly, (…)

Quantitative:

The infection was reduced from 16% to 1.1-1.8% with carbathion (…) and from 37.4 % to 4.4-5.3 % and 11.5 % to 0.9-2.2% with dazomet (…). The Panel considers the effectiveness of soil fumigants against D. destructor **between 60 and 95 %.**

The Panel confidently estimates that spread will be more restricted under these scenarios (…), with a **50% uncertainty interval** between a stabilization in the number of affected NUTS 2 regions and **10-15 newly contaminated regions.**

Under both scenarios A1 and A2, (…) FDp impact on wine and table grapes production is predicted to be reduced by approximately **one third** (A1) and **by two thirds** (A2) as compared to scenario A0.

An example of quantitative PRA

EFSA PLH Panel, 2017. Scientific opinion on the pest risk assessment of *Radopholus similis* for the EU territory. EFSA Journal 2017;15(8):4879, 265 pp.

http://onlinelibrary.wiley.com/doi/10.2903/j.efsa.2017.4879/full

R. similis is a migratory endoparasitic and highly polyphagous nematode, reported and/or intercepted from 97 (sub-) tropical countries

Hosts and pathways

PLANTS PATHWAYS

1. Rooted plants (h ≤ 1 m) of Araceae, Marantaceae, Musaceae, Strelitziaceae, Heliconiaceae, Persea, Musa (**REGULATED SMALL PLANTS**)
2. Rooted plants (h ≤ 1 m) of other host species (**NON-REGULATED SMALL PLANTS**)
3. Rooted plants (h › 1 m) of Araceae, Marantaceae, Musaceae, Strelitziaceae, Heliconiaceae, Persea, Musa (**REGULATED LARGE PLANTS**)
4. Rooted plants for planting (h ›1 m) of other host species (**NON-REGULATED LARGE PLANTS**)
5. Aquatic plants (eg *Anubias*, *Vallisneria*)
6. Citrus plants for planting
7. Banana plants for planting

SOIL PATHWAYS:

8. Soil or growing media attached to plants with roots
9. Soil adhering to machinery, packaging material, tools, shoes and animals
10. Soil and growing media

WATER PATHWAYS:

11. Surface waters (run-off rains) in fields, ditches, streams and rivers

Conceptual models

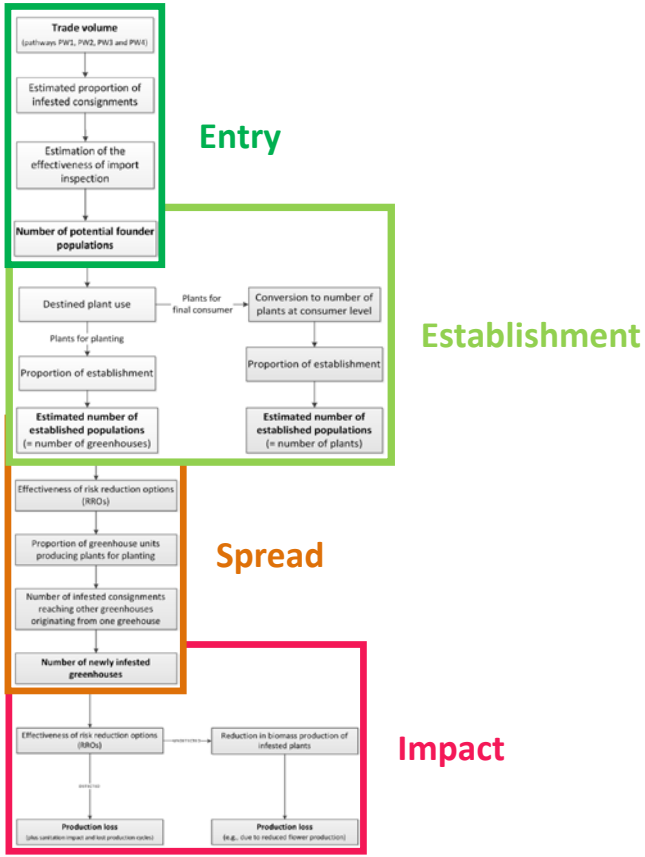
- Separate models for each PRA step
- **The conceptual models connecting**:

The conceptual models are

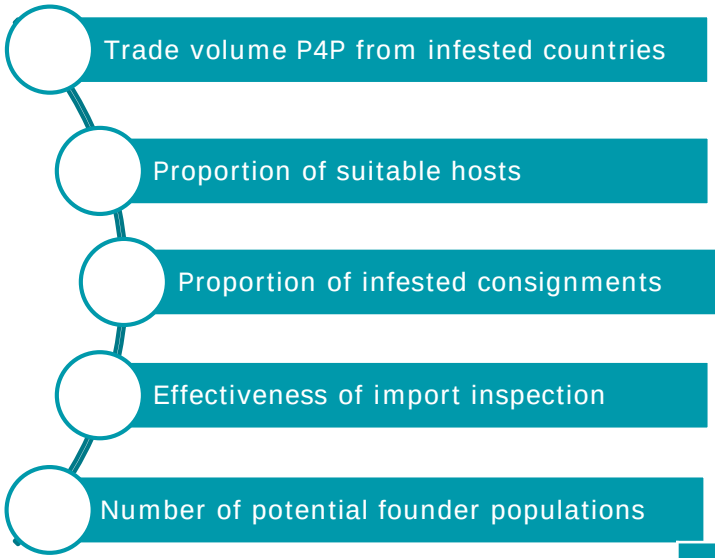
- following the **pathway** of the pest
- modelling the **changes of infestation**
- allowing **quantification**, including **uncertainty**
- **separating different steps**, processes etc. (sub-steps)
- allowing **evaluation of RRO**

Pros: Transparent, possible refinements

Cons: Simplified representation, more work



Conceptual models: Example "Entry of *Radopholus similis*"



EUROSTAT trade statistics of "other live plants" (CN0602 xxxx) in 2 …s with pest reports

Dut… …rade category (CN) in 2…

A sensitivity analysis shows that 83-93% of the total uncertainty results from this parameter

Expert judgements on infestation rate per pathway
regulated/non-regulated small plants; regulat… …e plants

Second example by Alan McLeod Wed, 14:40

Expert judgements on effectiveness pe…
regulated/non-regulated small plants; regulat… …plants

Model calculation (@RISK), including uncertainties per pathway
regulated/non-regulated small plants; regulated/non-regulated large plants

The figures are showing the uncertainty distributions (cdf, pdf) of numbers of infested packs (log-scale) per pathway

Pathway	Median	50 %UncInt	98 %UncInt
	No. of infected packs entering EU		
Small non-reg. plants	333	58-1163	0-8783
Small reg. plants	24	6-67	0-380
Large non-reg. plants	87	87-389	0-3407
Large reg. plants	6	1-26	0-275

Ref: EFSA PLH Panel, 2017. Scientific opinion on the pest risk assessment of Radopholus similis for the EU territory. EFSA Journal 2017;15(8):4879, 265 pp.

RRO scenarios

- The baseline scenario (A0) analyses the **current legislation**
- **The scenarios analysis connects**

- identifies **missing / additional measures**
- allows **quantification of the effectiveness**
- allows **comparison** between different scenarios:
  - **Scenario A1** represents a hypothetical situation where the existing phytosanitary measures, specific to *R. similis* are **withdrawn**.
    All other phytosanitary measures remain in place.
  - **Scenario A2** represents a situation where **more strict** phytosanitary measures are in place to prevent entry, establishment and spread of *R. similis*.

Pros: Structured approach, comparison between scenarios

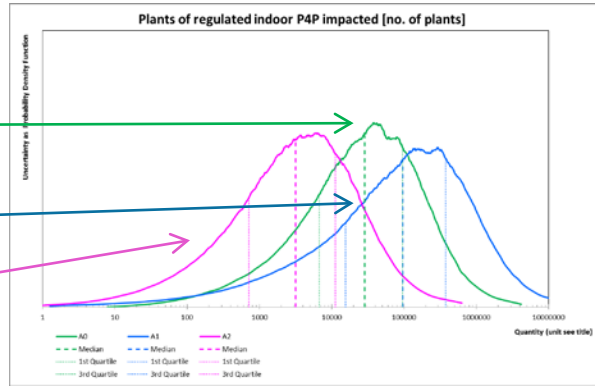
Cons: Limited number of scenarios feasible

RRO scenarios: Example "Impact of *Radopholus similis*"

Loss in production (number of small plants):

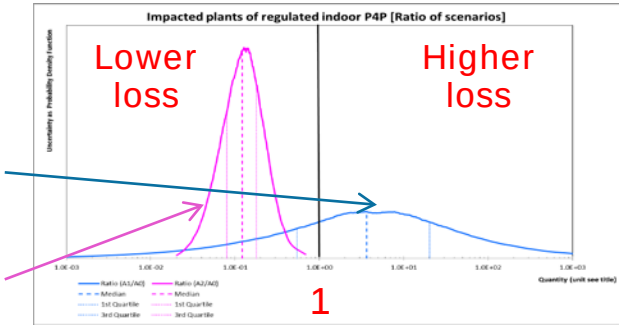
Scenario	Median	50%UncInt	98%UncInt
	No. of lost reg. small plants in production units		
Current regulation	27 537	6 479 - 92 035	25 - 1 247 136
Withdrawn reg.	95 248	15 590 - 377 850	6 - 5 908 241
More strict reg.	3 180	715 - 11 229	3 - 171 895

Regulated plants



Relative change of loss:

Change in regulation	Effect
Withdraw regulation	68% chance of higher loss
More strict regulation	>99.9% chance of lower loss



Ref: EFSA PLH Panel, 2017. Scientific opinion on the pest risk assessment of Radopholus similis for the EU territory. EFSA Journal 2017;15(8):4879, 265 pp.

Isolated events: Example "Spread of *Radopholus similis*"

- Isolated events can happen beside the normal pathways:

  "The shift of the nematode from ornamental plants to citrus nurseries is considered possible as ornamentals and citrus could coexist in a few greenhouses, (…). They certainly coexist at retailer level, in garden centres etc. Fields for outdoor production of citrus plants could be sequentially planted with citrus and ornamentals (…)."

- The likelihood of one shift in the next year is judged as

Shift to nursery via infested pathway	Probability	One single event in
Infested small, ornamental plants	2%	50 years
Infested big, ornamental plants	1%	100 years
Infested aquatic plants	0.5%	200 years
Infested growing media / soil	1%	100 years
Infested waste	1%	100 years
Infested water	0%	Not considered
Summary of all infested pathways	5.5%	18 years

Ref: EFSA PLH Panel, 2017. Scientific opinion on the pest risk assessment of Radopholus similis for the EU territory. EFSA Journal 2017;15(8):4879, 265 pp.

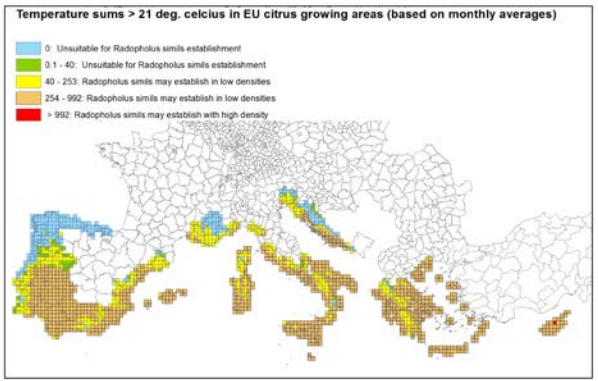
Climate change: Example “Establishment *R. similis*”

Climate suitability for citrus growing areas in EU

Locations with known pest status:

Location	Polk county, Florida, USA	Kyadondo, central Uganda	Bushenyi, central Uganda	Onderberg, Mpumalanga, South Africa	Hazyview, Mpumalanga, South Africa	South Coast of Kwazulu-Natal, South Africa	Huntington beach, California, USA
Status *R. similis*	Present Severe impact on citrus	Present Impact on banana	Absent	Present, low density No impact	Present, low density No impact	Present, low density No impact	Eradicated No impact

Current climate



Temperature sums > 21°C

0: Unsuitable for Radopholus simils establishment

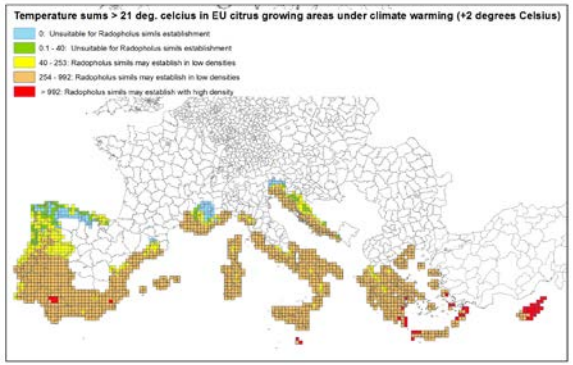
0.1 - 40: Unsuitable for Radopholus simils establishment

40 - 253: Radopholus simils may establish in low densities

254 - 992: Radopholus simils may establish in low densities

> 992: Radopholus simils may establish with high density

Climate change +2°C



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RM feedback and interactions

Two steps approach: pest categorisation ›RM ›quantitative RA

Definition of key scenarios by RM in ToR (e.g. the “shift” of *R. similis* from ornamentals to citrus)

ToR interpretation and scenarios definition: interaction between RA and RM at first WG meeting and later when needed

Workshop/training on quantitative RA for risk assessors and risk managers

Presentation of quantitative RAs to risk managers (4 of the 8 risk assessment presented already; 4 in October 2017)

Positive feedback, RM recommended to clearly express uncertainties

Some points for discussion

Quantitative RA concludes in terms of “real world” values

Precise numerical values may give a false sense of “certainty”

Communication of uncertainty is essential

Communication by median, quantiles and/or uncertainty curves

Quantitative RA quantifies effects of RROs under ≠ scenarios

Time limits to assess (RA) and review (RM) RROs scenarios

RA-RM interaction on scenarios definition is essential

(more details on quantitative assessment of entry by Alan MacLeod Wednesday h 14,40)

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