OPTIMISATION OF PLANT PEST SURVEY EFFORTS

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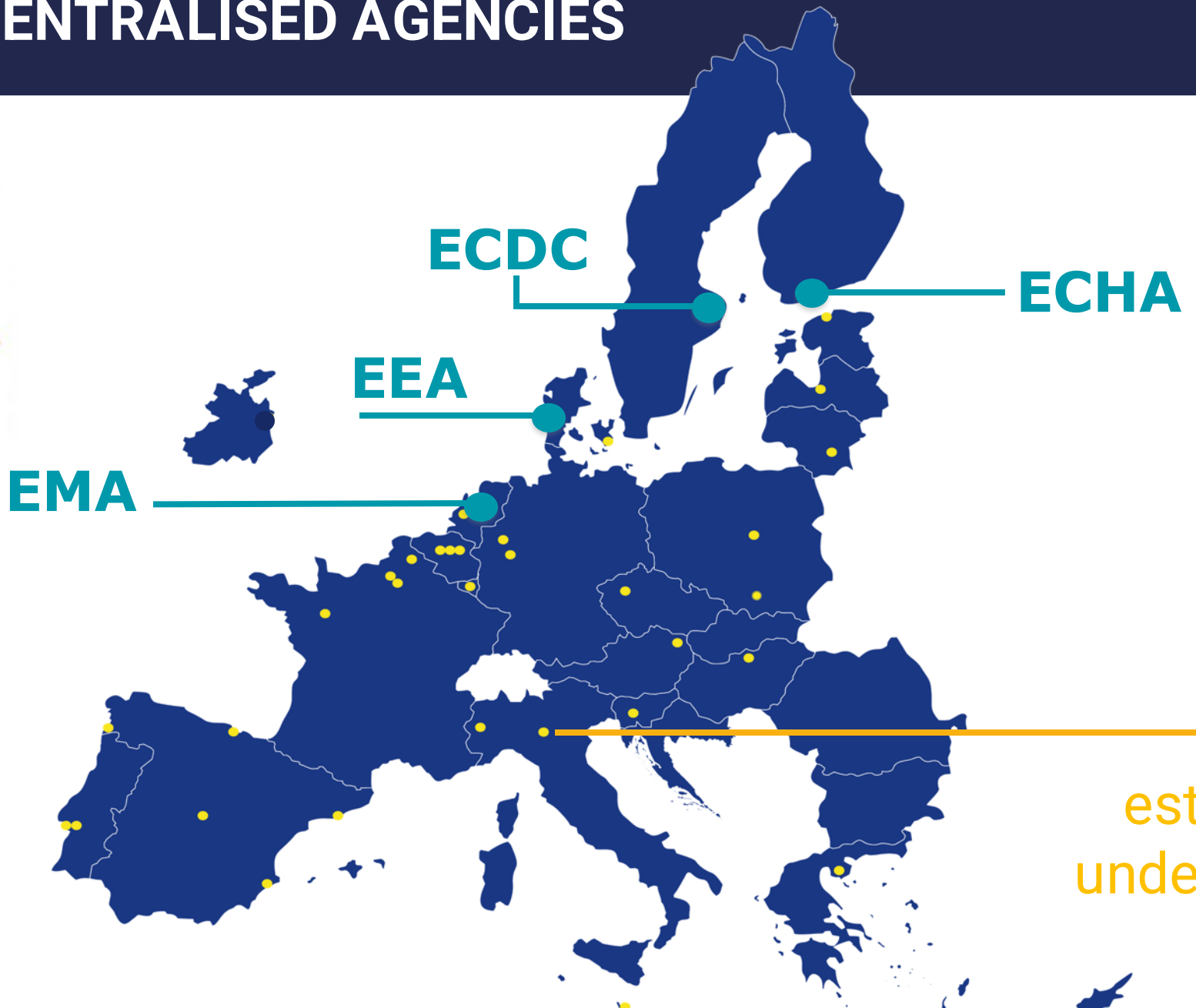
EUROPEAN FOOD SAFETY AUTHORITY

OUTLINE

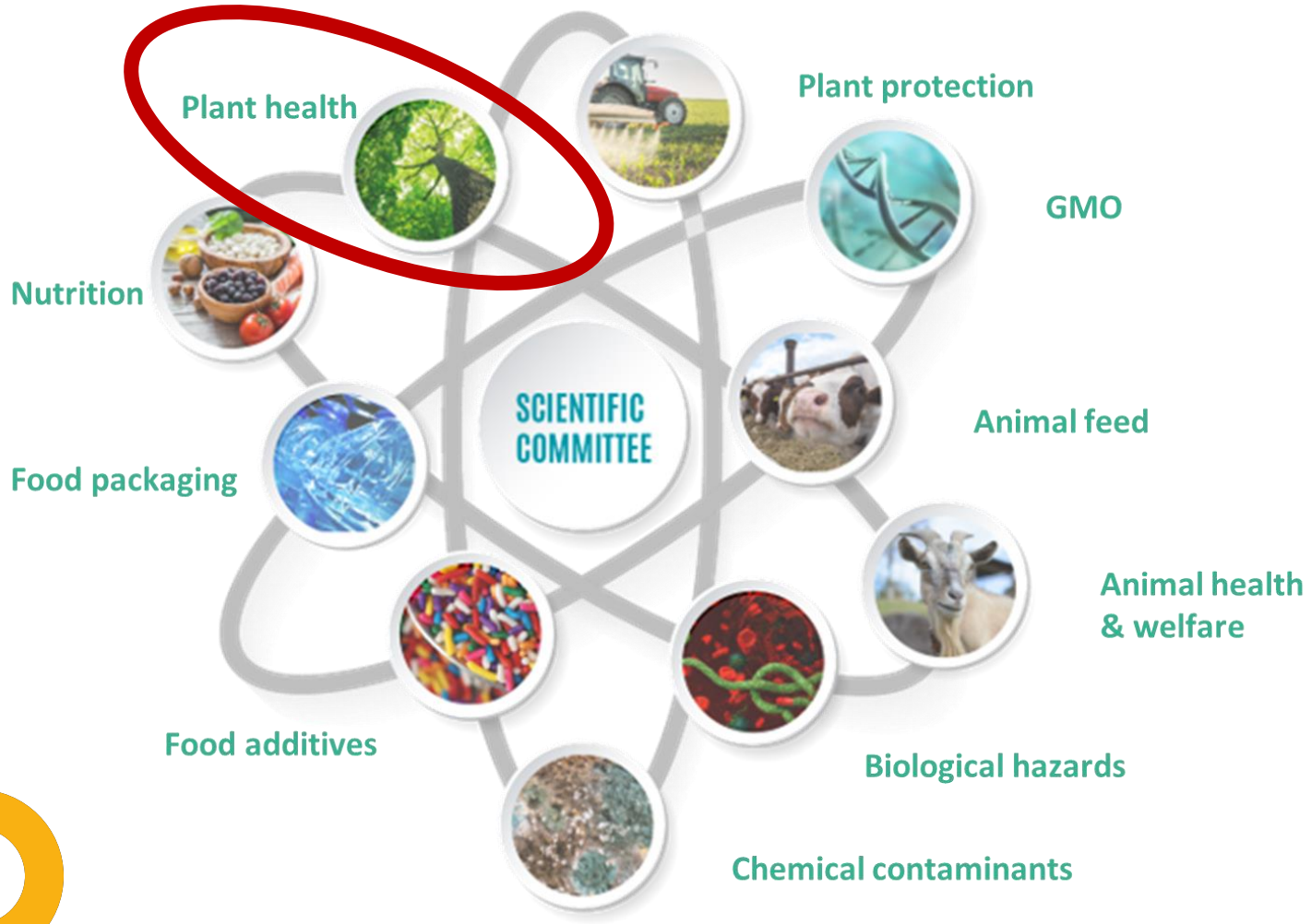
1. What is EFSA?
2. Plant Health in EFSA
3. Pest reporting
4. Pest survey toolkit
5. Survey optimisation
6. OptiPest

EU DECENTRALISED AGENCIES



established under EU law in 2002

PLH IN EFSA



570 staff

650 experts

1,600 virtual meetings / year

9,300 scientific outputs since 2003

EFSA SUPPORT TO PLH IN THE EU

List of quarantine pests
List of priority pests
Emergency measures
Etc.

Plant health monitoring and Risk assessment

Support to PREPARATION

Early warning

Horizon scanning

Plant health monitoring and Risk assessment

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Risk assessment

Pest RA
Commodity RA
Environment RA

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Prioritisation

Pest ranking

Plant health monitoring and Risk assessment

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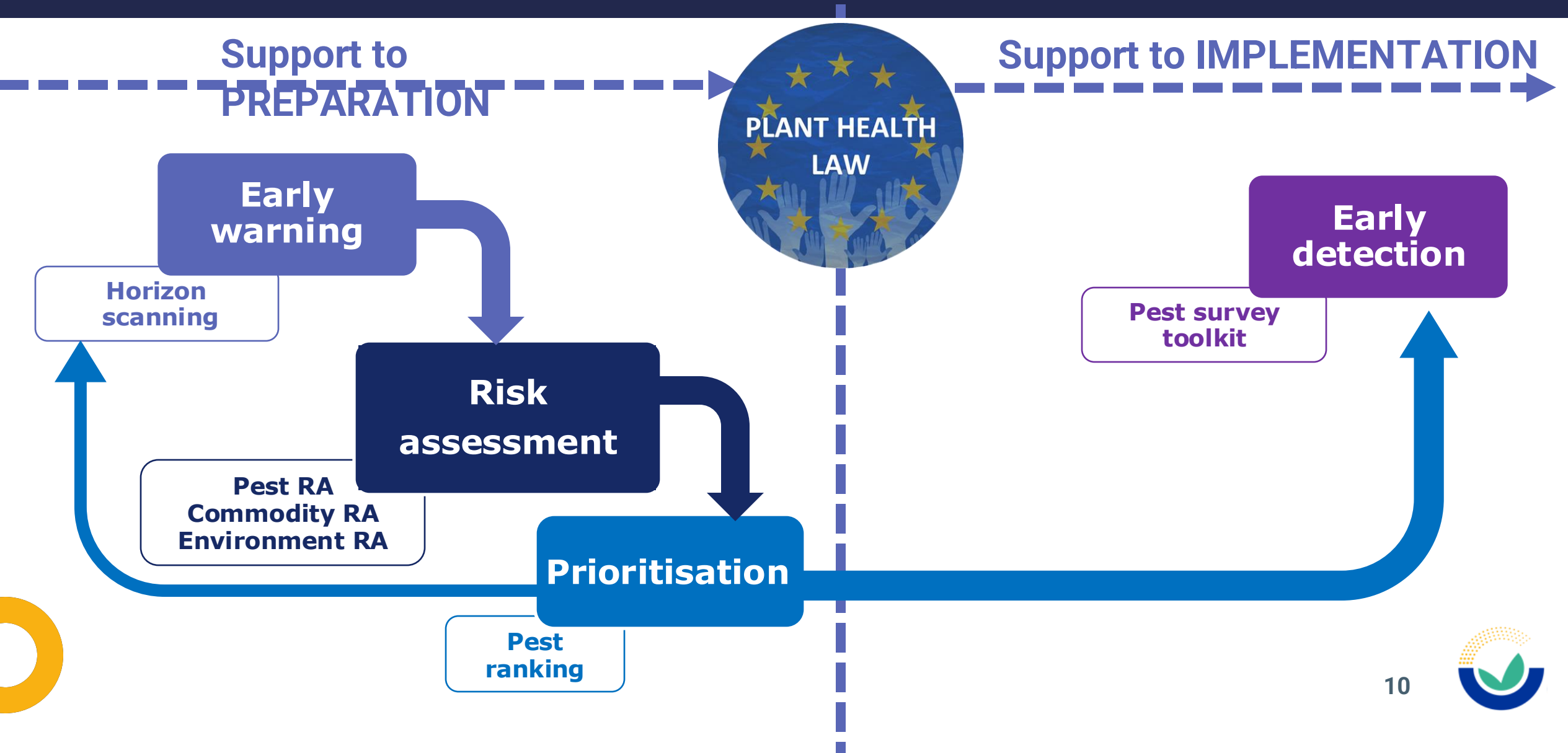

PEST REPORTING

ISPM 17 Main purpose:

Communicate **immediate** or **potential danger** of a quarantine pest

- occurrence
- outbreak
- spread

- immediate danger - one that has already been identified (pest already regulated) or is obvious on the basis of observation or previous experience
- potential danger - identified as the result of a PRA.

→ in the country in which it is detected

→ neighbouring countries

→ countries that are traded with

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Risk assessment

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Horizon scanning

Pest survey toolkit

Early warning

Early detection

Risk assessment

TOOLKIT

IMPLEMENT

Prepare

EFSA Pest Survey Cards

Design and Optimize

RiPEST

OptiPest

CONCLUDE

Robust surveys

Harmonised in time and space

Pest status

From trust to evidence

Surveys optimization

Pest X- 200 trees to sample
IU tree
MeSe= 80% ; CL=95%; DP=1%

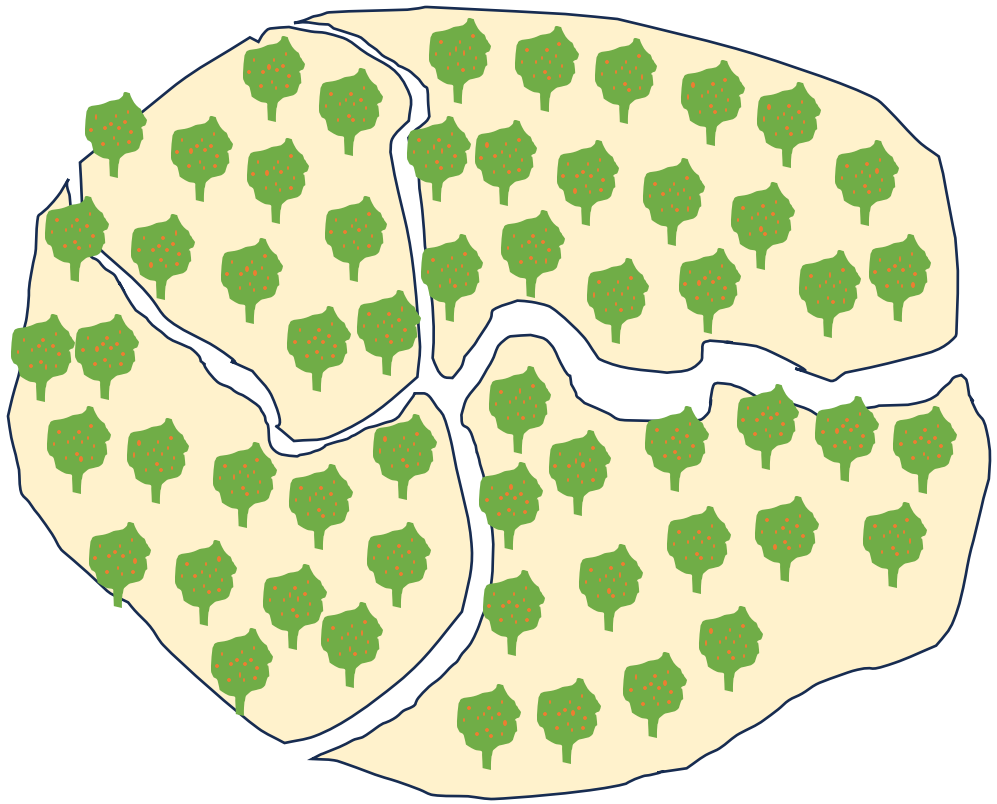
Pest Y- 100 trees to sample
IU tree
MeSe= 70% ; CL=95%; DP=0.5%

Pest Z- 80 trees to sample
IU tree
MeSe= 90% ; CL=95%; DP=2%

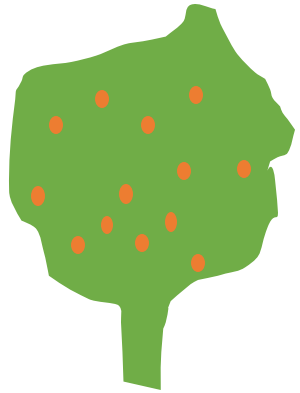
Pest W- 120 trees to sample
IU tree
MeSe= 80% ; CL=95%; DP=1%

Total = 500 samples

Citrus orchards



Citrus tree



Limited resources
How to reduce the sample size?

Surveys optimization

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Limited resources

How to reduce of sample size?

Increase MeSe
→ depends on the method

Decrease CL
→ Lower confidence in the conclusions

Increase DP
→ more resources for eradication is not realistic

Surveys optimization

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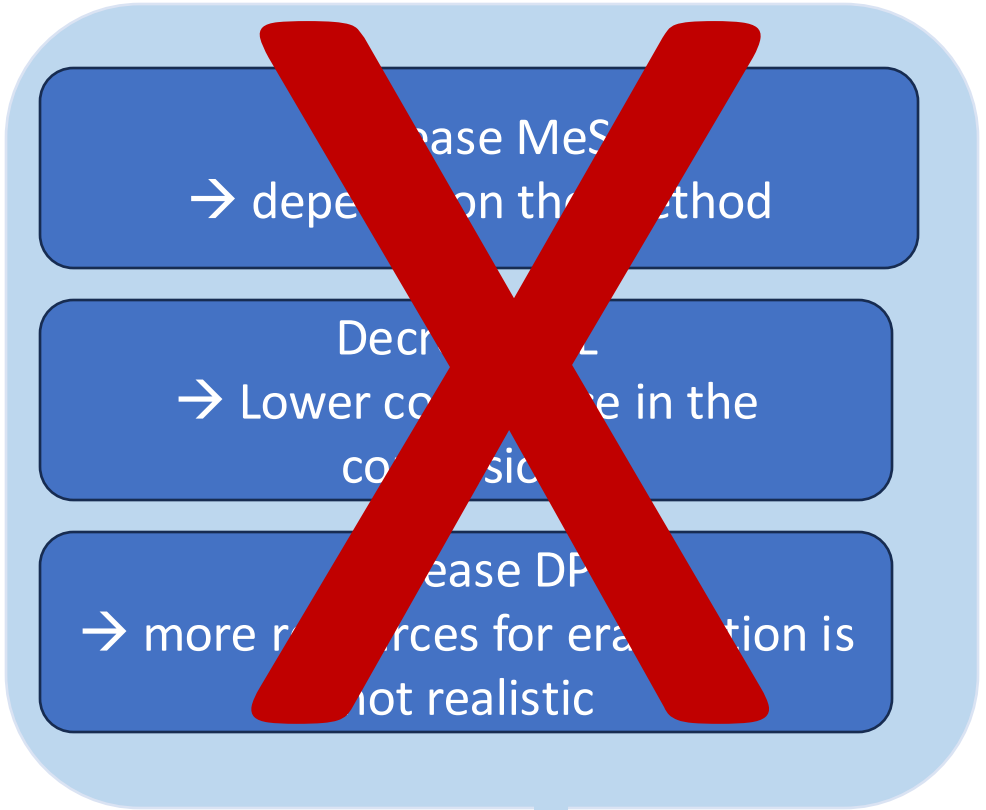

Reduce robustness of survey

Surveys optimization

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Limited resources

How to reduce of sample size?

Without reducing the robustness of survey

Reduce the laboratory effort by pooling samples

Multi-pest survey using OptiPest

Surveys optimization

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Total = 500 samples

OptiPest: Multi-pest surveys

1- Many pests checked in a same field inspection visit

Q1: How to reduce the number of visits without affecting the robustness of the survey

2- Plant samples can be the same for different pests

Q2: Can we optimise the reuse of the same samples for testing different pests

3- Many limitations come from resource availability

Q3: Can we adjust our inspections and/or sampling to the resource availability:
- Inspectors availability
- Laboratory capacity

Surveys optimization

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IU tree
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Total = 500 samples

OPTIPEST: Multi-pest surveys

1- Time windows overlap

2- Plant samples overlap

3- Resources availability

Optimisation algorithm

Overall reduction of survey efforts

Better use of resources

Robust surveys

OPTIMIZATION ALGORITHM

- **Goal:** Optimize the allocation of resources (sampling) across different crops and time periods.
- **Constraints:** Limited sampling capacity (inspection units) per month, different matrices to sample (e.g. fruits, shoots, leaves etc.).
- **Aim:** Minimize the number of field visits required and the total number of samples taken, while satisfying all sampling requirements.

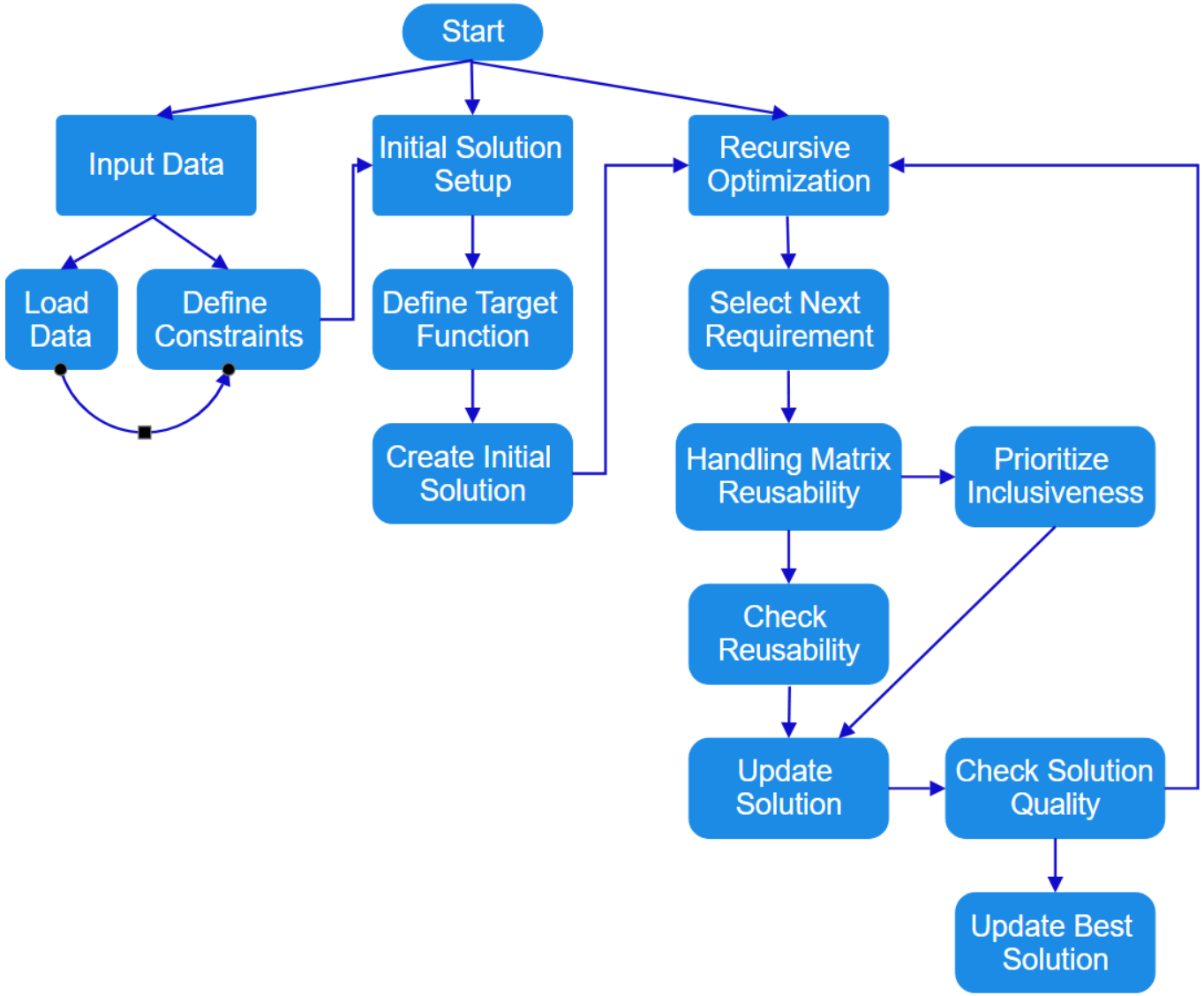
OPTIMIZATION ALGORITHM

- **Sampling Matrix:** Defines the parts of the crop to be sampled (e.g., fruits, shoots).
- **Monthly Capacity Limits:** The maximum sampling capacity available for each month.
- **Pest, Sample Size, and Time:** Information about pests, the number of samples needed, their reusability and the time windows for sampling.

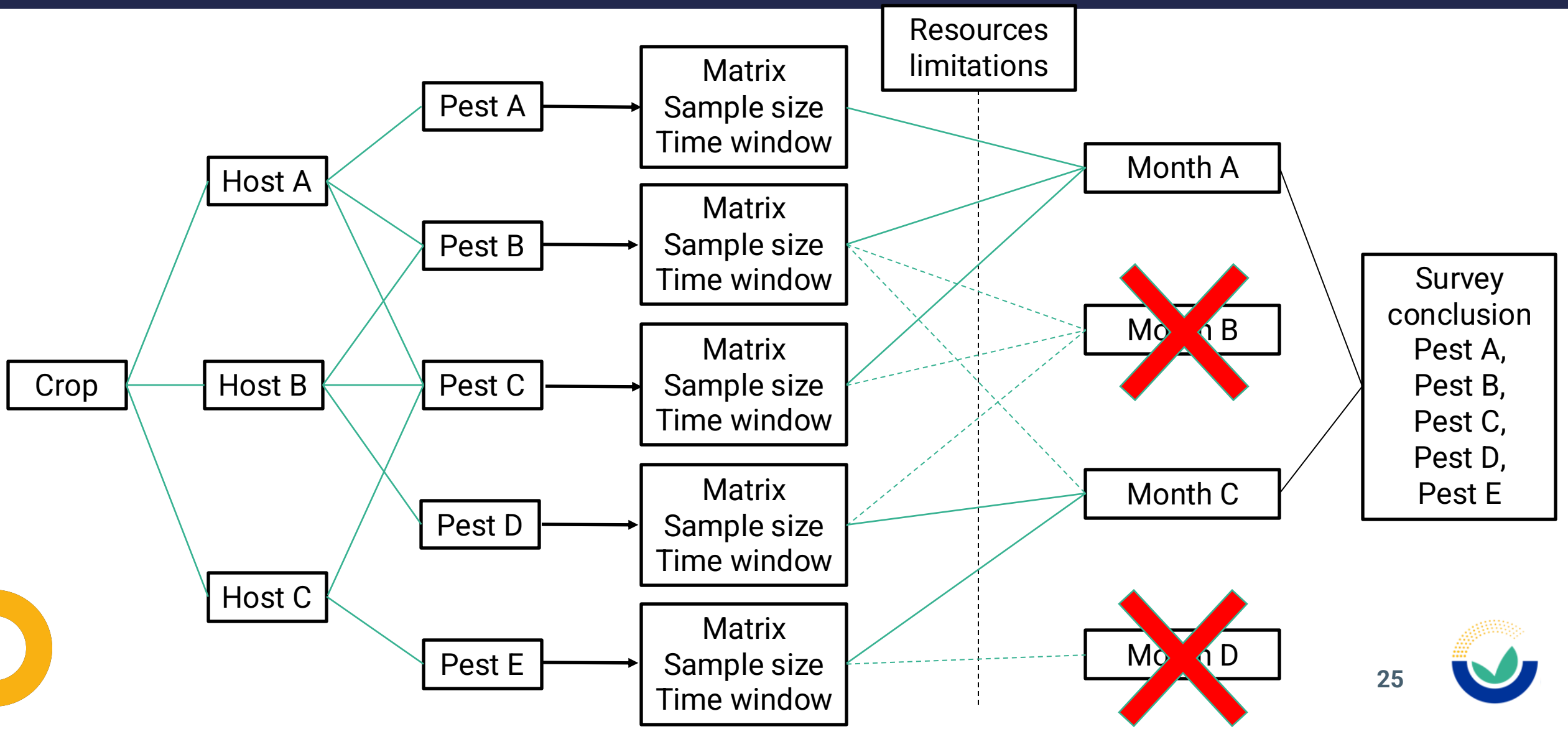
OPTIMIZATION ALGORITHM

- **Best Solution:** The algorithm keeps track of the best solution found (i.e., the one with the fewest field visits and samples).
- **Final Output:** A summary table of the required field visits, the sample sizes, and the time windows in which the samples need to be taken is provided.
- **Graphical Illustration:** The solution can be visualized using plots that show the sampling schedule for each pest across different months.
- **Faceted Plot:** A faceted plot separates different crop matrices (e.g., fruits, shoots) and shows the sampling effort per pest over time.

WORKFLOW OF THE OPTIMIZATION ALGORITHM



MULTI-PEST OPTIMIZATION PROCESS

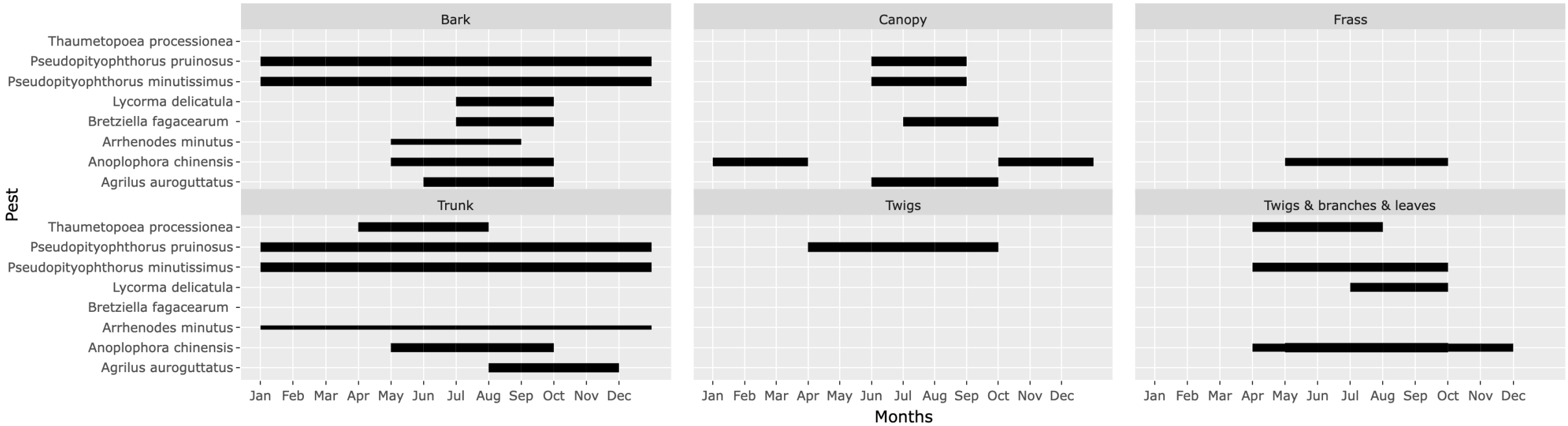


OPTIPEST DEMO

	Pest	Sampling matrix	Number of inspection units to sample	Months
1	Agrilus auroguttatus	Bark	395	6,7,8,9
2	Agrilus auroguttatus	Canopy	380	6,7,8,9
3	Agrilus auroguttatus	Trunk	360	8,9,10,11
4	Anoplophora chinensis	Bark	310	5,6,7,8,9
5	Anoplophora chinensis	Canopy	320	1,2,3,10,11,12
6	Anoplophora chinensis	Frass	290	5,6,7,8,9

Data Overview

Table | Plot



CONSTRAINTS

Optimization parameters

Monthly limits

Month	Maximum number of inspection units to sample
January	400
February	400
March	400
April	400
May	0
June	400
July	400
August	0
September	400
October	400
November	400
December	400

☑ Increase monthly limits until solution is found.

ℹ 10% increase per step

Run algorithm

A solution has been found!

- Number of visits: 7 (reduction:5)
- Total number of inspection units to sample: 5365 (reduction: 3475)

Download results (word) | Download results (excel)

Warning: The monthly limits have been increased in order to find a solution (See table below for the actual monthly limits).

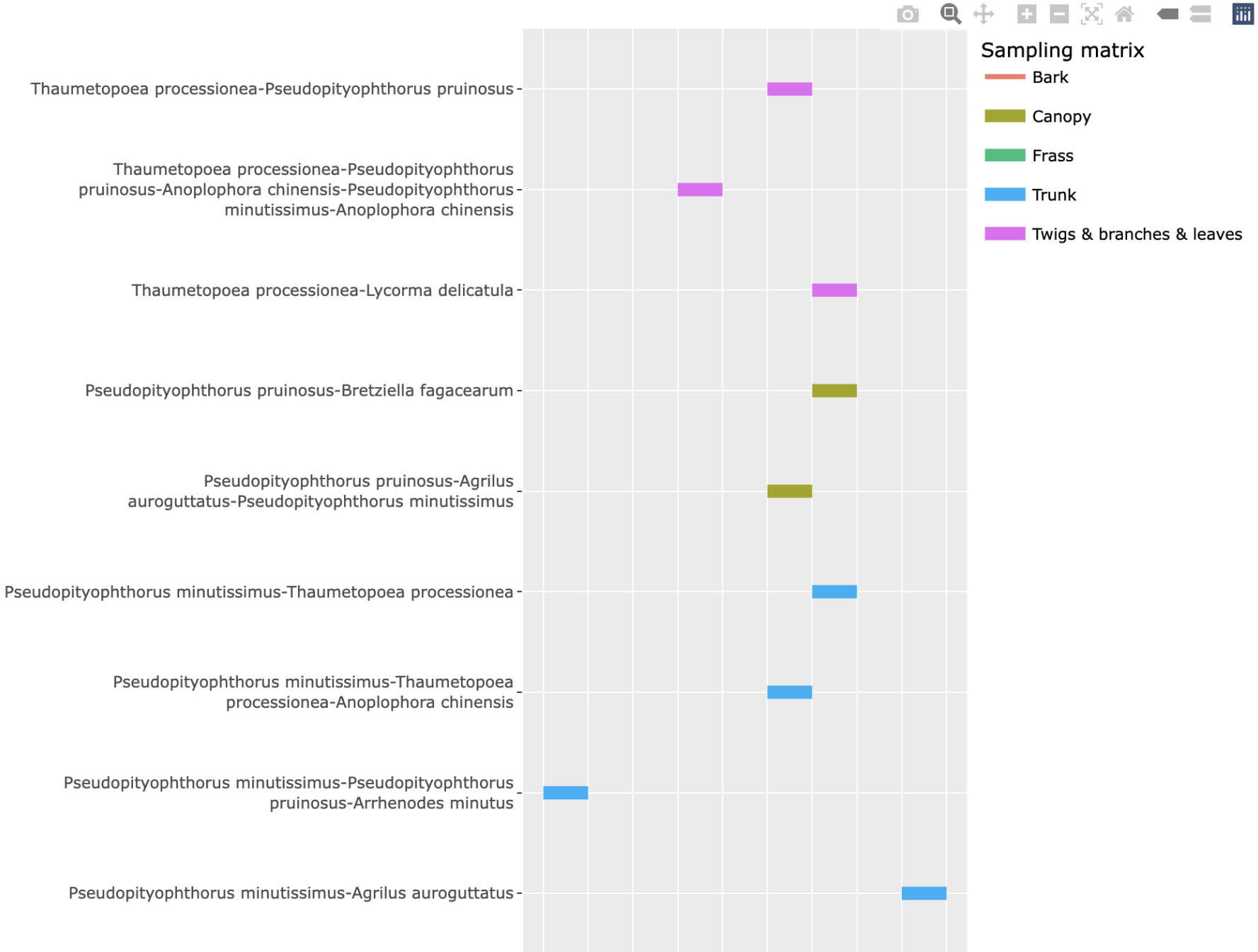
Month	Sample size limit
January	400
February	720
March	400
April	400
May	0
June	1160
July	1580
August	0
September	705
October	0

Month	Sampling matrix	Number of inspection units to sample	Pest
January	Trunk	400	Pseudopityophthorus minutissimus-Pseudopityophthorus pruinosus-Arrhenodes minutus
February	Trunk	400	Pseudopityophthorus minutissimus
February	Canopy	320	Anoplophora chinensis
March	Trunk	400	Pseudopityophthorus minutissimus
April	Twigs & branches & leaves	400	Thaumetopoea processionea-Pseudopityophthorus pruinosus-Anoplophora chinensis-Pseudopityophthorus minutissimus-Anoplophora chinensis
June	Twigs & branches & leaves	400	Thaumetopoea processionea-Pseudopityophthorus pruinosus
June	Trunk	380	Pseudopityophthorus minutissimus-Thaumetopoea processionea-Anoplophora chinensis
June	Canopy	380	Pseudopityophthorus pruinosus-Agrilus auroguttatus-Pseudopityophthorus minutissimus
July	Twigs & branches & leaves	400	Thaumetopoea processionea-Lycorma delicatula
July	Trunk	400	Pseudopityophthorus minutissimus-Thaumetopoea processionea

Showing 1 to 10 of 15 entries

Showing 1 to 10 of 15 entries

Previous 1 2 Next



Month	Sampling matrix	Number of inspection units to sample	Pest	Reuse inspection units from
January	Trunk	390	Pseudopityophthorus pruinosus	Pseudopityophthorus minutissimus
January	Trunk	215	Arrhenodes minutus	Pseudopityophthorus minutissimus
April	Twigs	400	Pseudopityophthorus pruinosus	Thaumetopoea processionea
April	Twigs & branches & leaves	375	Anoplophora chinensis	Thaumetopoea processionea
April	Twigs & branches & leaves	345	Pseudopityophthorus minutissimus	Thaumetopoea processionea
April	Twigs & branches & leaves	290	Anoplophora chinensis	Thaumetopoea processionea
June	Twigs	10	Pseudopityophthorus pruinosus	Thaumetopoea processionea
June	Trunk	380	Thaumetopoea processionea	Pseudopityophthorus minutissimus

THANK YOU !

Questions

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