IPM CONFERENCE 2024

Holistic IPM: Reducing pesticide use

BRUSSELS · MAY 14TH

Quantifying the potential of reducing pesticide use thanks to DSSs

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IPM works

IPM DECISIONS

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2030 Targets for sustainable food production

PESTICIDES

50%

Reduce the overall use and risk of chemical and hazardous pesticides

NUTRIENT LOSSES

50%

Reduce nutrient losses by 50% whilst retaining soil fertility, resulting in 20% less fertilisers

ANTIMICROBIALS

50%

Reduce sales of antimicrobials for farmed animals and aquaculture

ORGANIC FARMING

25%

Increase the percentage of organically farmed land in the EU

#EUFarm2Fork #EUGreenDeal

European Commission

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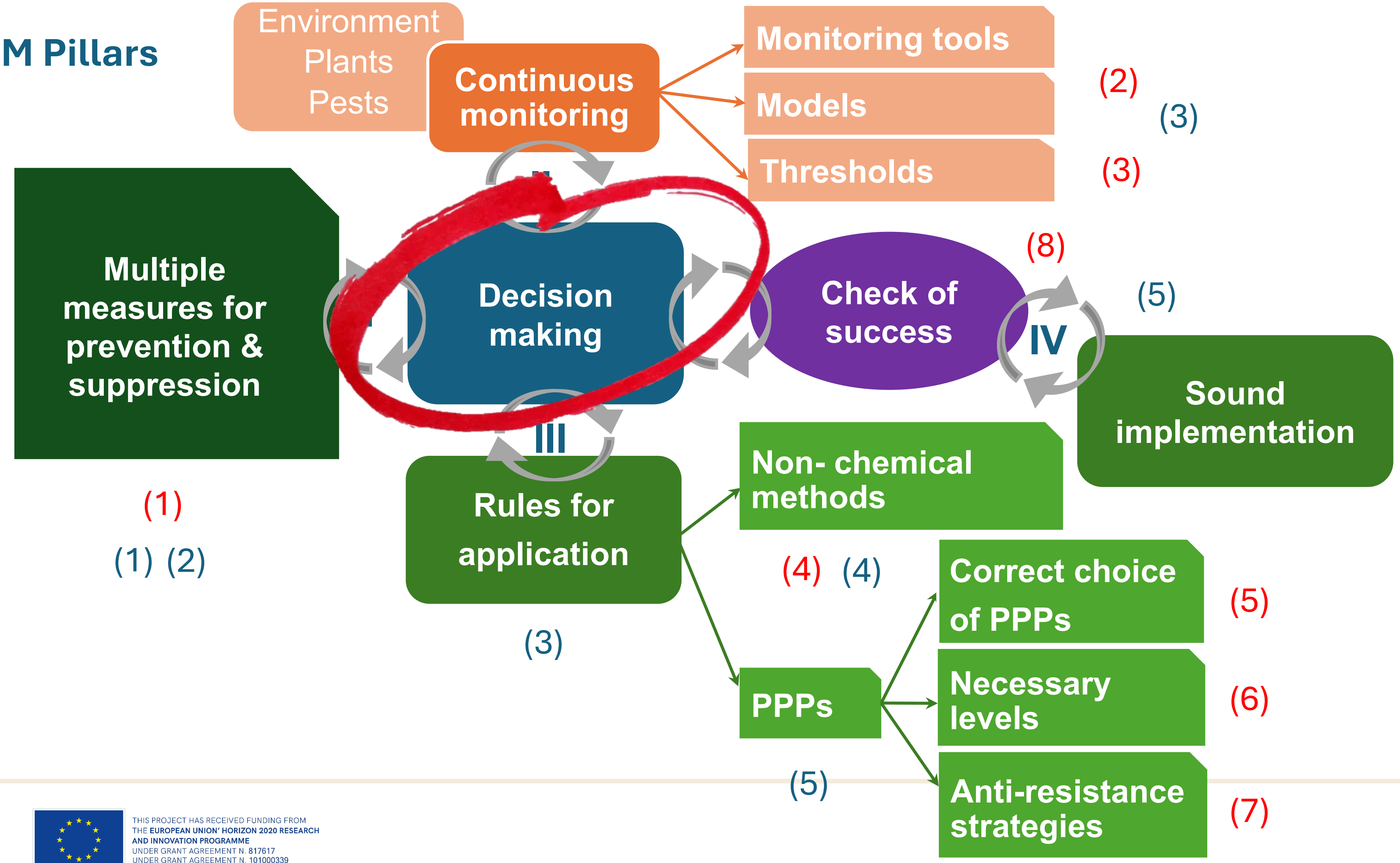
8 IPM principles – 5 IPM Pillars

Framework for the implementation of IPM, based on the decision-making process, which involves four kinds of decisions: I) **strategic**; II) **tactical on *whether* and *when*** and III) **on *which*** control measures to be adopted; IV) **operational decisions**



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Rossi et al., 2012. Phytopathologia mediterranea, 51: 457-479

Decision–making process

1 Monitoring

2 Analysis

3 Decisions

4 Actions

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Decision–making process

… of collected info, through expert knowledge

Analysis

Collecting information about crop and environment

Monitoring

Decisions

if and how to act (product, dose, ecc.)

Actions

Crop management and/or crop protection interventions

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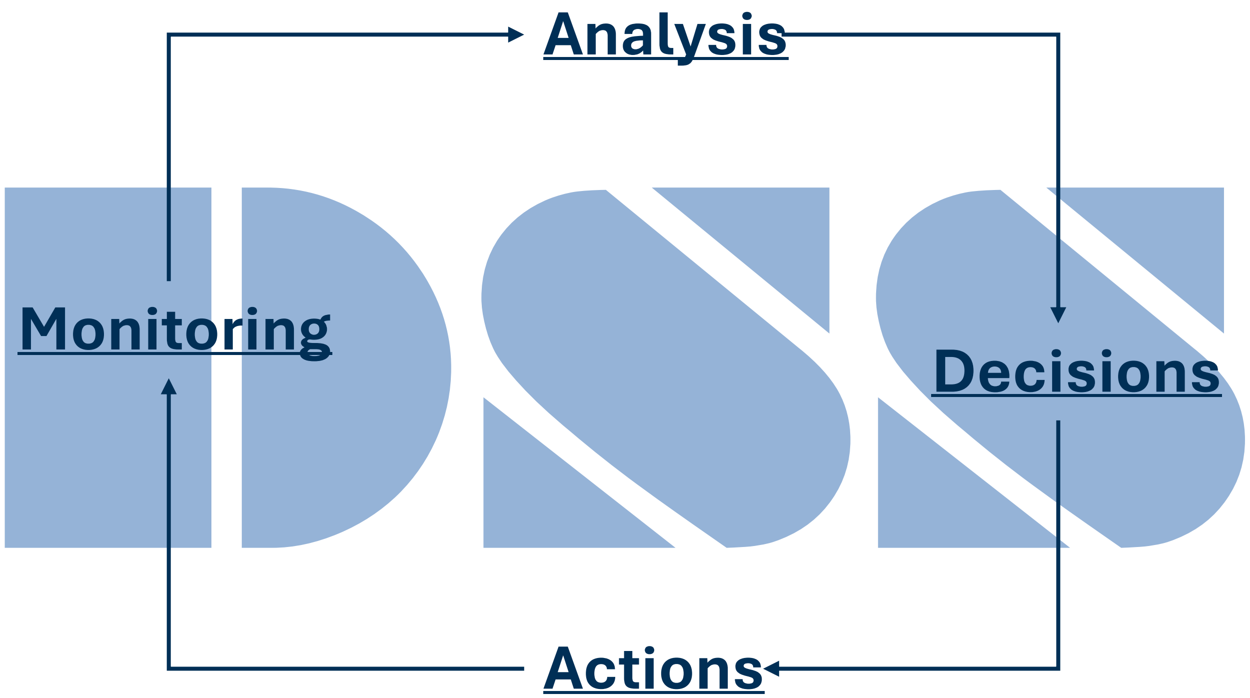
Decision–making process – *Decision Support System*



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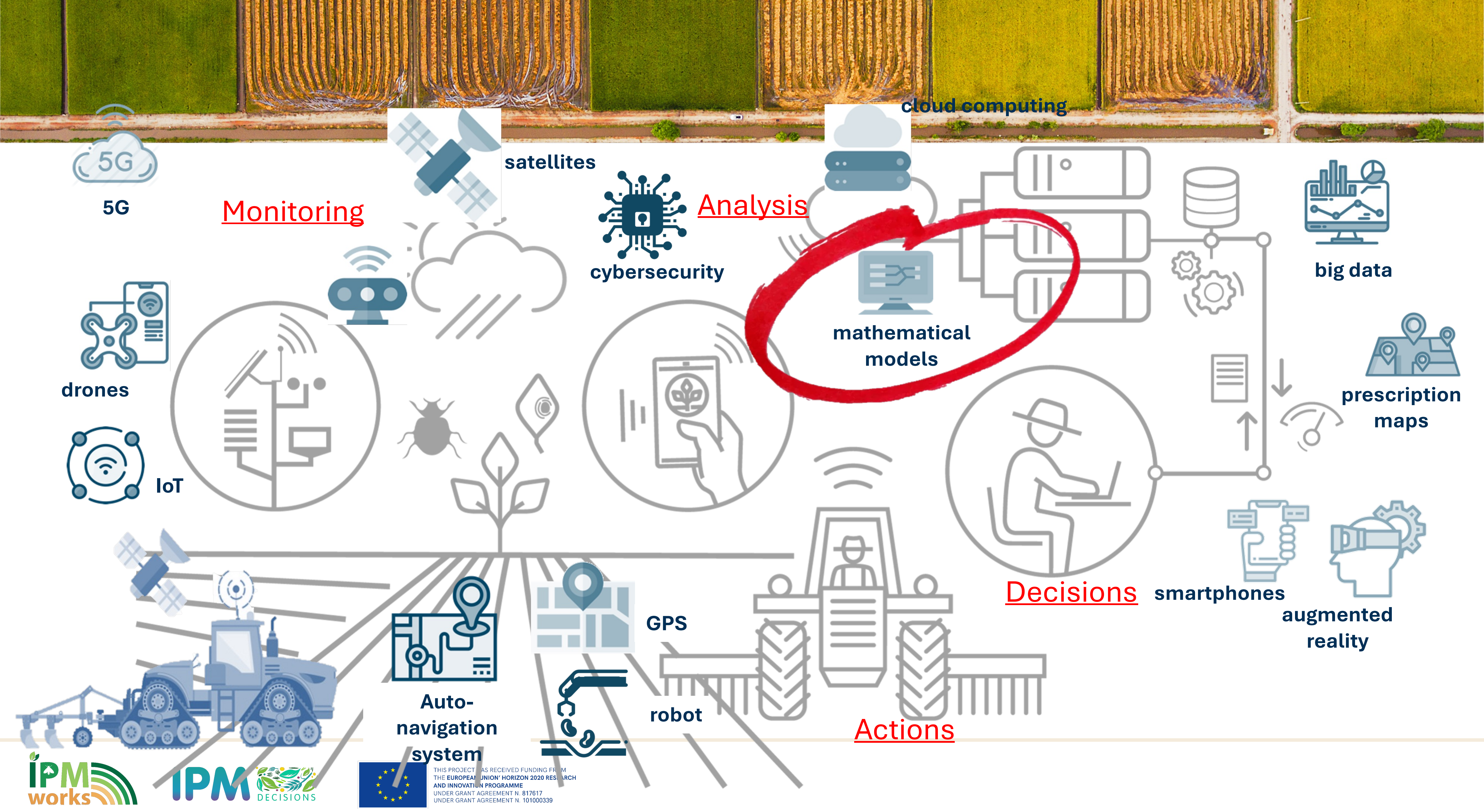

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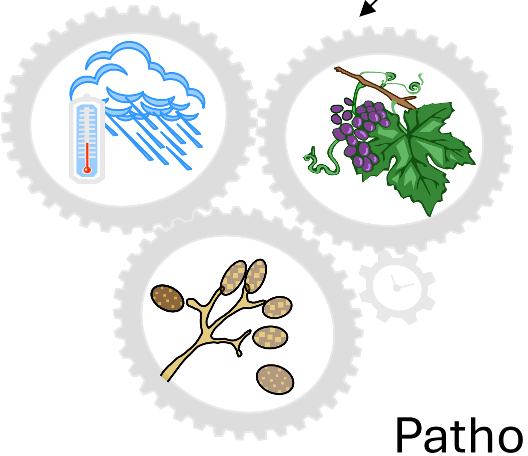
A **model** represents a simplified simulation of reality

Modelling must be based
on a deep knowledge of reality



Pathosystem

Models can:

- **increase efficacy** and **speed** of the decision-making process;
- help in **understanding** epidemic processes and **elaborating** protection strategies

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	Empirical models	Mechanistic models
PRO	Easy to develop	Detailed knowledge on biological processes is needed
PRO	Complete biological knowledge not needed	Outputs are accurate and robust
PRO	No expertise on the organism is required	Prediction is possible in a wide range of agricultural contexts
PRO		High flexibility
CONS	Wide and representative field data are needed for model development	Modellers may have deep expertise on the organism
CONS	No prediction is possible outside the range of input data (extrapolation)	Development often requires research for filling knowledge gaps
CONS	No information is provided on biological processes	
CONS	Validation and calibration is mandatory when used in new/changing agricultural contexts	

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Decision Tools - *validation*

Validation consists in **<u>comparison between DT output and observations in representative conditions</u>**; it requires knowledge about the DT (biological background, data used, modelling approaches, algorithms, etc.) and validation procedures

Unfortunately, <u>procedures for validation are usually not available or not detailed</u>. As a consequence, local experts do not adequately use DTs so that DTs do not gain sufficient credentials

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Decision Tools – *judgement of utility*

Once a DT has been validated for its ability to correctly represent the real system **the usefulness of its use in IPM programs should be verified**

Economic and environmental advantages should be also evaluated

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Rossi et al., 2019 - Agronomy, 9(11), 710

Decision Tools – *judgement of utility*

Costs	Benefits
Purchase of the DSS	Less PPP costs
Time spent to learn the DSS use	Less distribution costs (fuel, manpower)
	Less time to collect information and take decision
	Learning from the DSS (indirect benefit)
	Less pollution (indirect benefit, community costs)
	Less residues in food (community costs)

Cost-benefit evaluation is difficult to be shown

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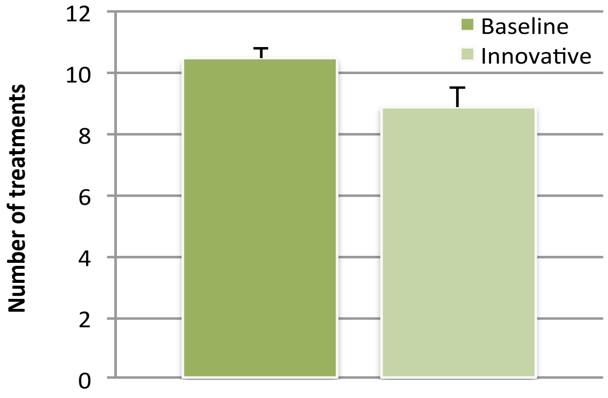
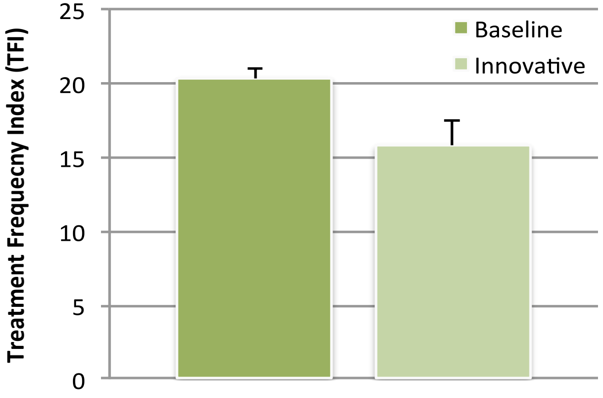
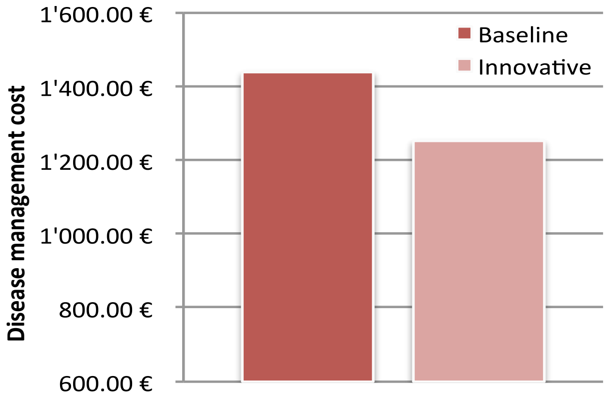
Decision Tools – *judgement of utility*

The DSS was tested in 21 organic farms in Italy (which ranged from 1 to 180 hectares) and allowed, over two seasons, the same level of grape protection obtained with the usual farm practice, with an average saving in the **total amount of copper applied of 37%** (reduced doses and fewer applications).
This saving was equal to about EUR 195/ha/year for the growers.







The DSS is now used by more than 600 farmers across Italy on about 15.000 ha

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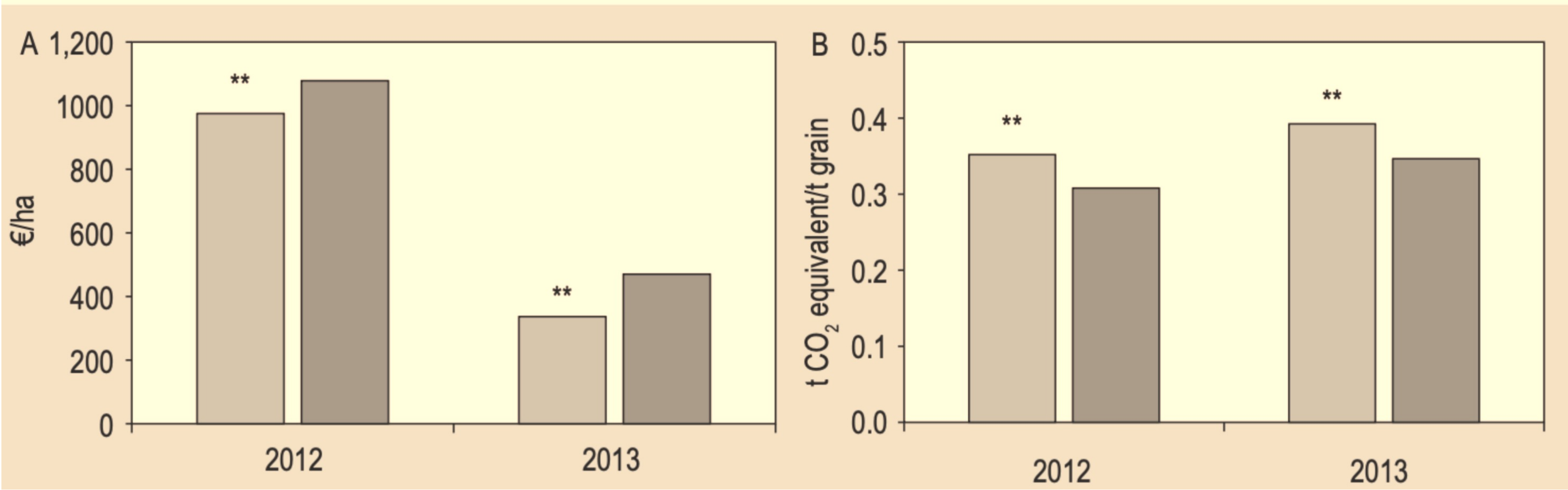
Pertot et al. 2017. Crop Prot. 97:70–84.
Rossi et al. 2014. Comput. Electron. Agric. 100:88–99.

Decision Tools – *judgement of utility*

The DSS was tested in 25 farms across Italy for durum wheat production: both **farmer income** (A) and **carbon footprint** (B) resulted significantly different from the standard IPM practice



The DSS is now used on more than 80.000 ha

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Rossi et al., 2010. Decis. Support Syst. Adv. 1
Rossi et al., 2015.World Mycotoxin Journal, 8(5), 629-640.

Decision Tools – *validated and available*

Table 3 Decision tools (DTs) for IPM that have been validated and are being used in specific areas of Europe

Crop	N. of pests	N. of DTs	Pest/mycotoxin names
Almond	7	7	*Alternaria alternata, Eurytoma amygdali, Monilinia fructicola, Myzus persicae, Taphrina deformans, Tetranychus urticae, Wilsonomyces carpophilus*
Apples	5	9	*Argyrotaenia pulchellana, Cydia pomonella, Erwinia amylovora, Pandemis cerasana, Venturia inaequalis*
Asparagus	1	1	*Stemphylium vesicarium*
Barley	12	17	*Blumeria graminis, Deoxynivalenol (DON), Drechslera teres, Fusarium avenaceum, F. culmorum, F. graminearum, F. langhsetiae, F. poae, F. sporotrichoides, Microdochium nivale, Puccinia hordei, Rhynchosporium secalis*
Blackberries	1	1	*Drosophila suzukii*
Cherries	2	2	*Drosophila suzukii, Monilinia fructicola*
Cucurbits	3	4	*Golovinomyces orontii, Podosphaera xanthii, Pseudoperonospora cubensis*
Eldelberry	1	1	*Drosophila suzukii*
Flowers (cut)	1	1	*Botrytis cinerea*
Grapes	10	19	*Aspergillus carbonarius, Botrytis cinerea, Drosophila suzukii, Erysiphe necator, Guignardia bidwellii, Lobesia botrana, Ochratoxin A, Planococcus ficus, Plasmopara viticola, Scaphoideus titanus*
Kiwifruit	1	1	*Pseudomonas syringae* pv. *actinidiae*
Legumes	10	10	*Ascochyta rabiei, A. pinodes, Alternaria alternata, Bruchus rufimanus, Colletotrichum lindemuthianum, C. lupini, Cydia nigrana, Helicoverpa (=Heliothis) armigera, Sitona* sp., *Uromyces phaseoli*
Loquat	1	1	*Fusicladium eriobotryae*
Maize	16	19	Larvae and adults of *Agriotes lineatus, A. obscurus, A. sordidus, A. sputator, Aspergillus flavus, Chaetocnema pulicaria, Diabrotica virgifera, Fusarium graminearum, F. langsethiae, F. verticillioides, Ostrinia nubilalis, Penicillium* spp., Aflatoxins, Fumonisins, DON, T2/HT2
Oats	1	1	DON
Oilseed rape	5	5	*Brassicogethes aeneus, Ceutorhynchus napi, C. pallidactylus, Psylliodes chrysocephalus, Sclerotinia sclerotiorum*
Olives	2	6	*Fusicladium oleaginum, Bactrocera oleae*
Onions	1	2	*Peronospora destructor*
Peaches	9	13	*Adoxophyes orana, Anarsia lineatella, Cydia molesta, Monilinia fructicola, Monilinia* spp., *Sphaerotheca pannosa, Taphrina deformans, Wilsonomyces carpophilus, Xanthomonas arboricola*
Pears	6	8	*Argyrotaenia pulchellana, Cydia pomonella, Erwinia amylovora, Pandemis cerasana, Stemphylium vesicarium, Venturia pirina*
Pistachio	1	1	*Septoria* spp.
Plums	2	2	*Cydia funebrana, Drosophila suzukii*
Potatoes	9	18	Larvae and adults of *Agriotes lineatus, A. obscurus, A. sordidus, A. sputator, Alternaria alternata, A. solani, Leptinotarsa decemlineata, Phthorimaea operculella, Phytophthora infestans*
Raspberries	1	1	*Drosophila suzukii*
Rice	5	5	*Cochliobolus miyabeanus, Pyricularia oryzae, Rhizoctonia solani*, Rice Tungro S and B viruses, *Xanthomonas campestris* pv. *oryzae*
Rye	3	3	*Puccinia recondita, Blumeria graminis, Rhynchosporium secalis*
Strawberry	1	2	*Botrytis cinerea*
Sugar beet	2	8	*Erysiphe betae, Cercospora beticola*
Tobacco	1	1	*Peronospora tabacina*
Tomatoes	7	11	*Alternaria solani, Helicoverpa (=Heliothis) armigera, Oidium lycopersici, Phthorimaea operculella, Phytopthora infestans, Pseudomonas syringae, Xanthomonas campestris pv. vesicatoria*
Triticale	6	6	*Puccinia triticina, P. striiformis, Blumeria graminis, Rhynchosporium secalis, Parastagonospora nodorum, Zymoseptoria tritici*
Wheat	22	31	*Blumeria graminis*, Barley Yellow Dwarf Virus (BYDV), *Fusarium avenaceum, F. culmorum, F. graminearum, F. langhsetiae, F. poae, F. sporotrichoides, Microdochium nivale, Parastagonospora nodorum, Puccinia recondita, P. striiformis, P. triticina, Pyrenophora tritici-repentis, Rhopalosiphum maidis, R. padi, Sitobion avenae, Zymoseptoria tritici*, DON, Nivalenol (NIV), Trichothecene mycotoxins (T2-HT2), Zearalenone (ZEA)
	155	217	

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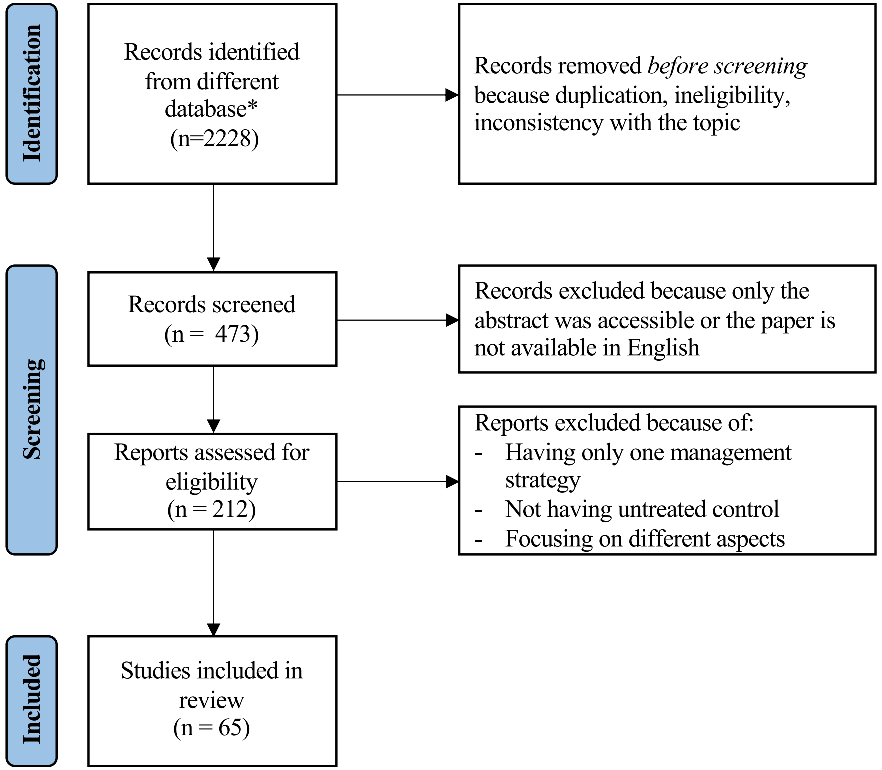
Rossi et al., 2023 - Food Security 15, 1459–1474

Decision Tools – *meta analysis*



During IPMWORKS a meta-analysis was carried out on disease management based on Decision Tools for three crops (wheat, grapevine, potato): results analysed from 65 papers showed that the DT-based strategy has the same control on disease as the Standard IPM, but the TFI of PPP used is significantly lower

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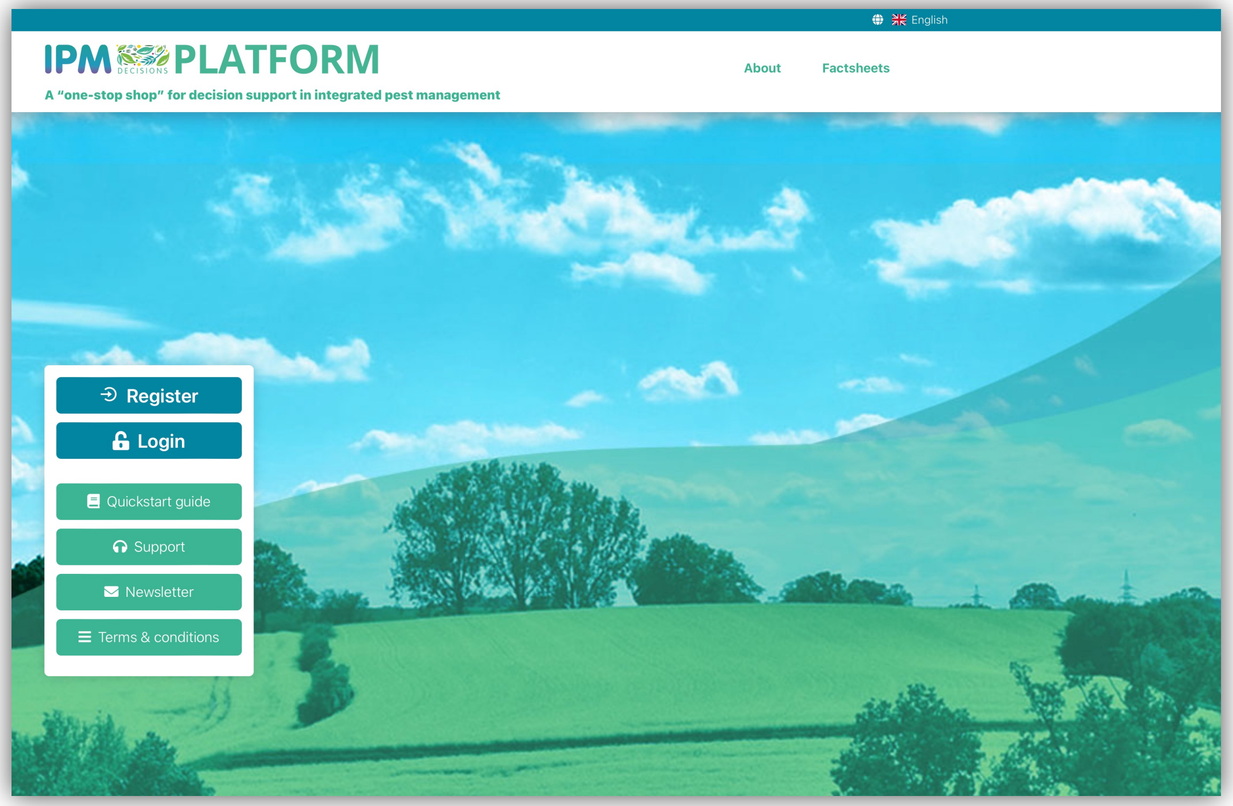
Furiosi et al., 2024 – under publication

IPMDECISION PLATFORM



24 models (<u>only 3 mechanistic</u>) available on 7 different crops

Great base for retrieving information on infection risks.

Prediction of infection periods is only a part of decision-making. Other questions to be answered:

- *is the plant susceptible to infection?*
- *is the plant already protected by a previous PPP spray?*
- *which PPP should I use, and at what dose?*
- *is the environment suitable for the fungicide application?*
- ...

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Conclusion

Farmers are more likely to adopt DT-based IPM practices if:

(i) their outcomes, along multiple dimensions that are not limited to economics, are clearly favourable;

(ii) farmers perceive and understand social pressures to adopt such practices;

(iii) farmers feel capable of, and are enabled to, implement these practices on their own farms

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THANK YOU!

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