The Assessment of the Currently Used Pesticides Occurrence in Agricultural Soils and Related Risks

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Introduction

Moving toward the modern life, mankind has been impelled to the use of different chemicals. Many of these chemicals are considered as persistent in the environment with **long term effects on ecosystem, plant, animal and human (EPAH) health**. Among these chemicals, **Plant Protection Products (PPPs)** has drawn special attention due to the direct consequences on the EPAH fate. PPPs move from the application site into the environment and find their ways into the water, air and the biota in various ways. Of the 480 substances approved in the EU market [1] and combined in several thousand different commercial PPPs, almost 50% are bio accumulative and 25% are persistent in soil [2]. According to the Regulation (EC) No 1272/2008 on Classification, Labeling and Packaging of Substances and Mixtures, 30% have a high acute aquatic toxicity and 28% are suspected carcinogens.

Objective

Until now a lot of attempts has been devoted to elimination and restriction of using pesticides; however, the data on the distribution of PPPs across European agricultural landscapes, that account for ecological and environmental variability, are scarce and fragmented. It will be necessary to integrate the critical data in order to assess **overall risks and impacts of PPPs formulations, residues and their metabolites**.

PPPs application

Assess distribution

- **Ecosysem (E):** Terrestrial, Aquatic —  — Soil, water, air, dust; Non-target organisms
- **Plants (P)** —  — Organs of crops
- **Animals (A)** —  — Skin; Urine; Faeces; Milk; Blood
- **Humans (H)** —  — Skin; Nazal-swap; Urine; Faeces; Blood

Assess uptake

Direct	Indirect
Water, food, feed	Inhalation, dermal

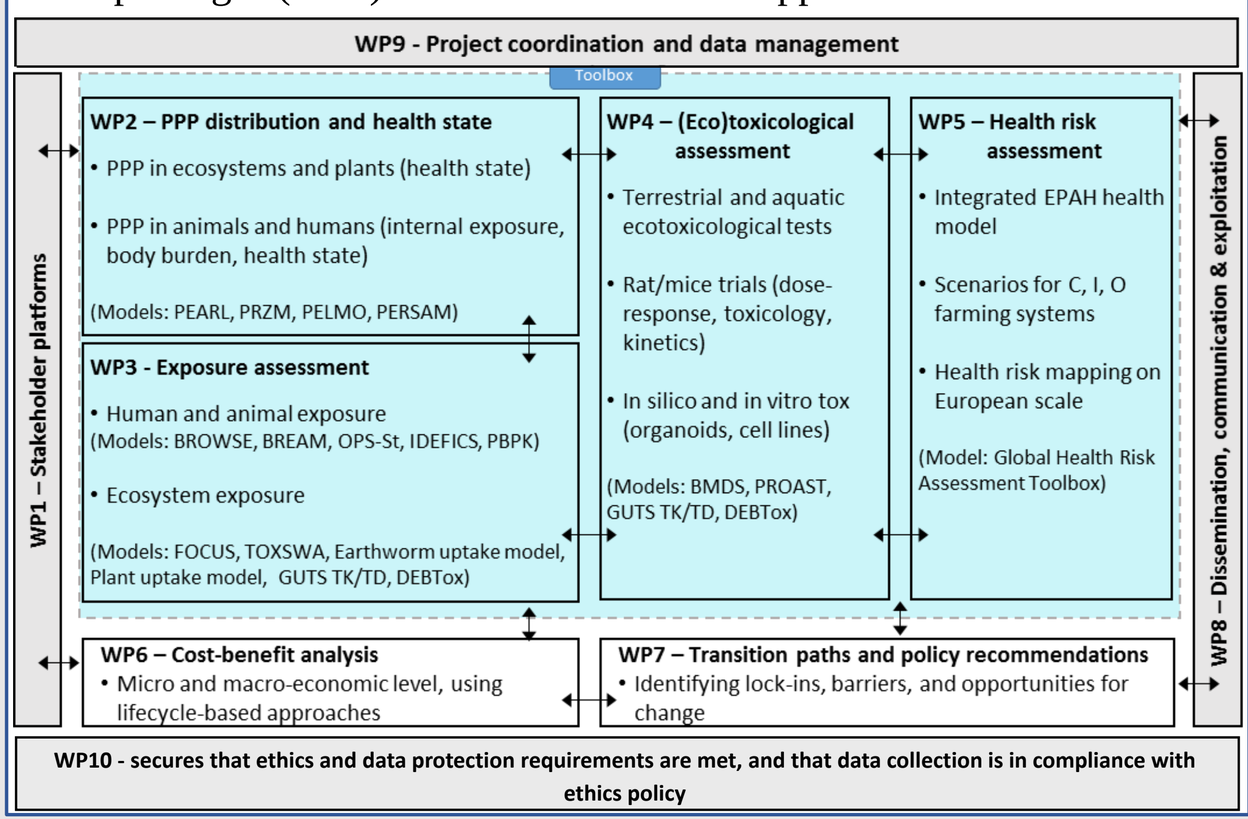
Indicators for health effects

Resilience	(Re)productivity	Diseases
E	**E**	**E**
- Soil microbiome composition, soil functions (C and N mineralization), biodiversity of earthworms, beneficial insects, bees - Biodiversity of aquatic microbiome, macroinvertebrate, fish	- Mortality - Growth rate - Fertility	- Pathogens/beneficial soil organisms, diseases in bees and bats - Fish fitness/behavior
P	**P**	**P**
- Biomass	- Growth rate - Yield - Fecundity	- Pests - Diseases
A	**A**	**A**
- Gut microbiome - Immunological response	- Time/No of inseminations to pregnancy - Birth weight - Growth rate - Malformations/ Miscarriage - No of offspring	- Gastrointestinal illness - Mastitis (cow) - Deficiency in immunological system
H	**H**	**H**
- Gut microbiome - Immunological response	- Time to pregnancy - Birth weight - Miscarriage	- Overall health status - Adverse effects on lung, kidney, brain, and blood

The aim of this PhD project is to combine assessment of the impact of PPPs including formulations, active substances, metabolites and mixtures, on EPAH health which leads to development of an expert system. This aim will be done under the **SPRINT project**.

Sustainable Plant Protection Transition, SPRINT

The overall aim of the new project of EU H2020, called SPRINT, is to develop, test, validate and deliver a **Global Health Risk Assessment Toolbox** for the integrated assessment of the impacts of PPPs with Coverage across the main cropping systems and varied European landscapes, with differentiation of conventional (C), integrated (I) and organic (O) farming scenarios. The overall project is organised into 10 work packages (WPs). The overall SPRINT approach is as below:



On going

The **literature review** has been started about monitoring of currently used pesticides in soil. All the reported data in related articles has been merged into one uniform **dataset**. The data is related to studies carried out around the world not just limited to the European countries. Few examples are shown in the table below:

Ref	Country (countries)	Sampling method	Extraction method	Analyzing method	Total No. of samples	No. of analyzed pesticides
[3]	10 EU countries	Depth of 15-20 cm	QuEChERS	(HPLC-MS/MS)	317	76
[4]	Jordan	Depth of 5–10 cm	QuEChERS	LC-MS/MS	100	448
[5]	Southern Greece	Depth of 0- 30 cm	extraction with KOH	LC-ESI-MS/MS	170	2

The result of the **comparison and integration of all the studies** will be compiled as a review paper for submitting to be published.

References

[1] EU Pesticides database, https://ec.europa.eu/food/plant/pesticides/eu-pesticides-database/public/?event=activesubstance.selection&language=EN
[2] PPDB, 2019. Pesticide Properties DataBase, University of Hertfordshire. https://sitem.herts.ac.uk/aeru/ppdb/en/atoz.htm
[3] Silva, V., et al., *Science of the Total Environment*, 2019. 653: p. 1532-1545.
[4] Kailani, M.H., et al., *Toxin Reviews*, 2019: p. 1-17.
[5] Karanasios, E., et al., *Environmental Monitoring and Assessment*, 2018. 190(6): p. 361.