What ecological traits and functions are important in a crop mixture for effective weed management?

Malick S Ouattara, Raphaël Paut, Muriel Valantin-Morison, Safia Médiène

What ecological traits and functions are important in a crop mixture for effective weed management?

Malick OUATTARA, Raphaël PAUT, Muriel VALANTIN-MORISON, Safia MEDIENE

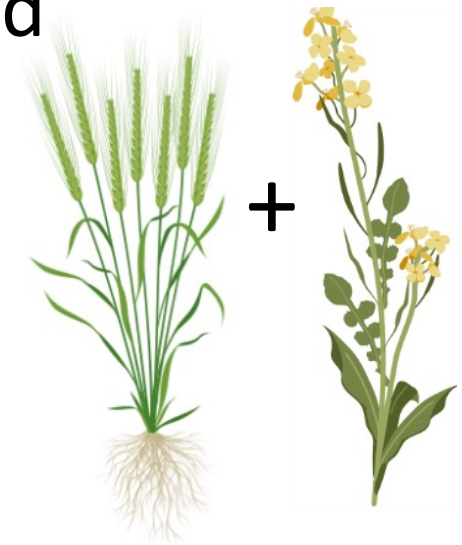
19th European Weed Research Society Symposium

20 - 23 June 2022 Athens Greece

Why to promote a biodiversity-based agriculture ?

Mixing species:

- Increases biological and functional diversity in agroecosystems
- Provides ecosystem services
- Reduces the external inputs by promoting biological regulation



Low biodiversity

Ecosystem services

High biodiversity

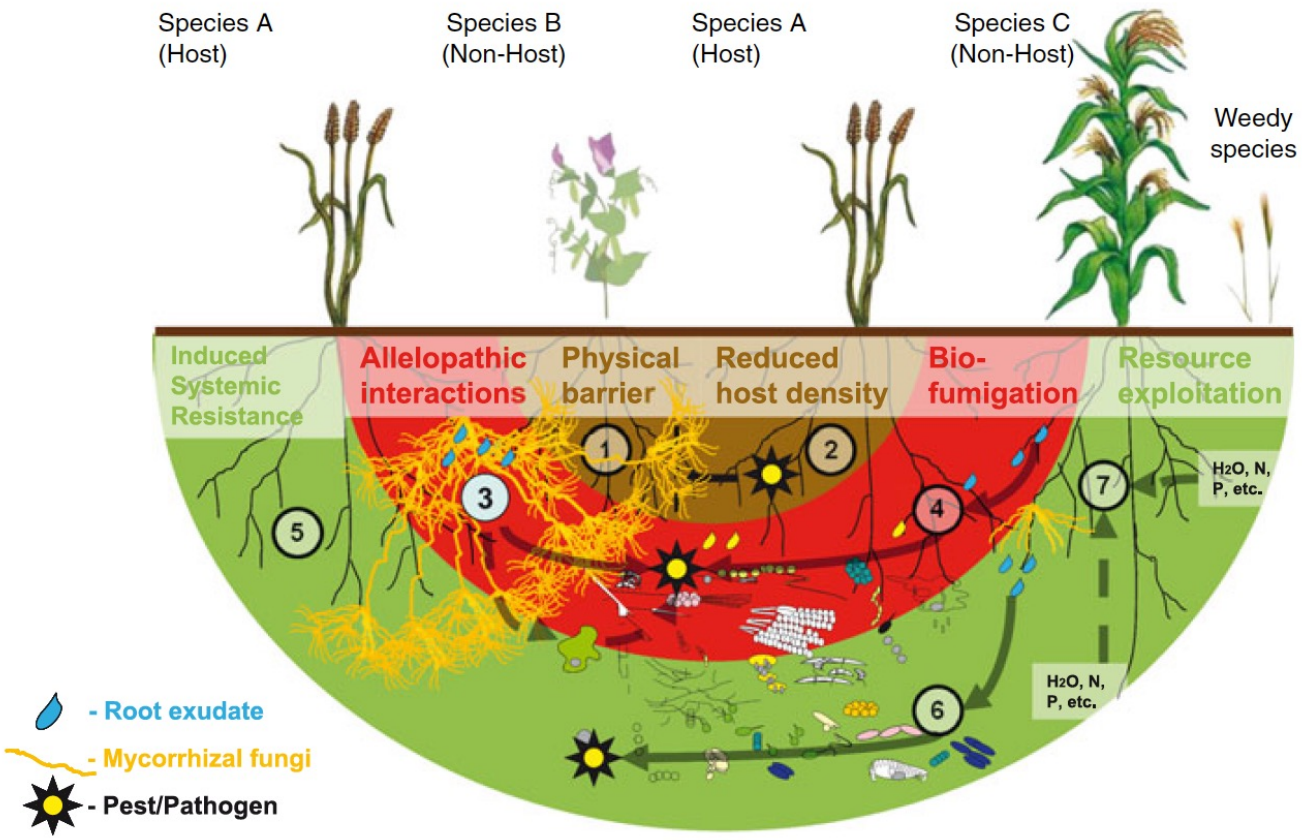
Agroecosystem type

ARTIFICIALISATION for:
- **Creating soil structure & soil porosity**
- **Limiting water & nutrient stresses**
- **Treating pest é disease (plants & animals)**

REGULATION of ECOLOGICAL PROCESSES for:
- creating soil structure & soil porosity
- Increasing water & nutrients availability
- Increasing pest & disease control
- Improving pollination
- Regulating microclimate

Duru *et al.* 2015

Lock in to biodiversity-based agriculture ?

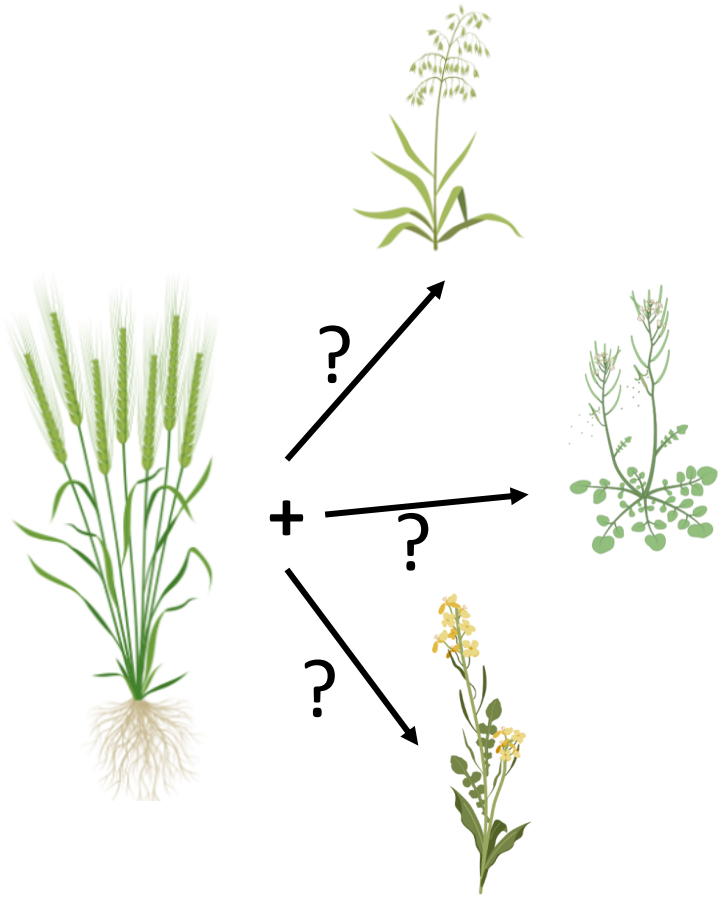


Ehrmann and Ritz, 2014

- Arable Crop diversification is accompanied by an increase in the complexity of cropping systems and interactions in the agroecosystem
- Many combinations between species are possible (Verret *et al.*, 2020), the best combination is difficult to identify for local conditions
- And little is known about how to mix species (or varieties) to provide ecosystem services

Two important issues to encourage the development of crop mixtures

Identify species assembly rules in crop mixtures to provide ecosystem services (here for weed regulation)



Co-design a tool to assist in the design of mixtures

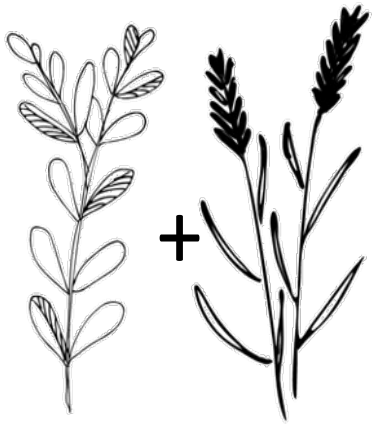
EcosysteMIX, exploratory and didactic tool to help identify **mixtures of species** capable of providing one (or more) expected **ecosystem service(s)** under given **agro-environmental conditions**

A method based on knowledge hybridation and a functional ecology approach

Knowledge gathering and hybridation

- Scientific Knowledge
- Empirical knowledge

Crops are described by their **functional traits**, these traits are involved in **biological functions**, that are providing **ecosystem services**



Crop mixtures

Trait 1 C/N

Trait 2 Architecture

Trait 3 Frost sensitiveness

Crop mixture traits

Function 1

Function 2

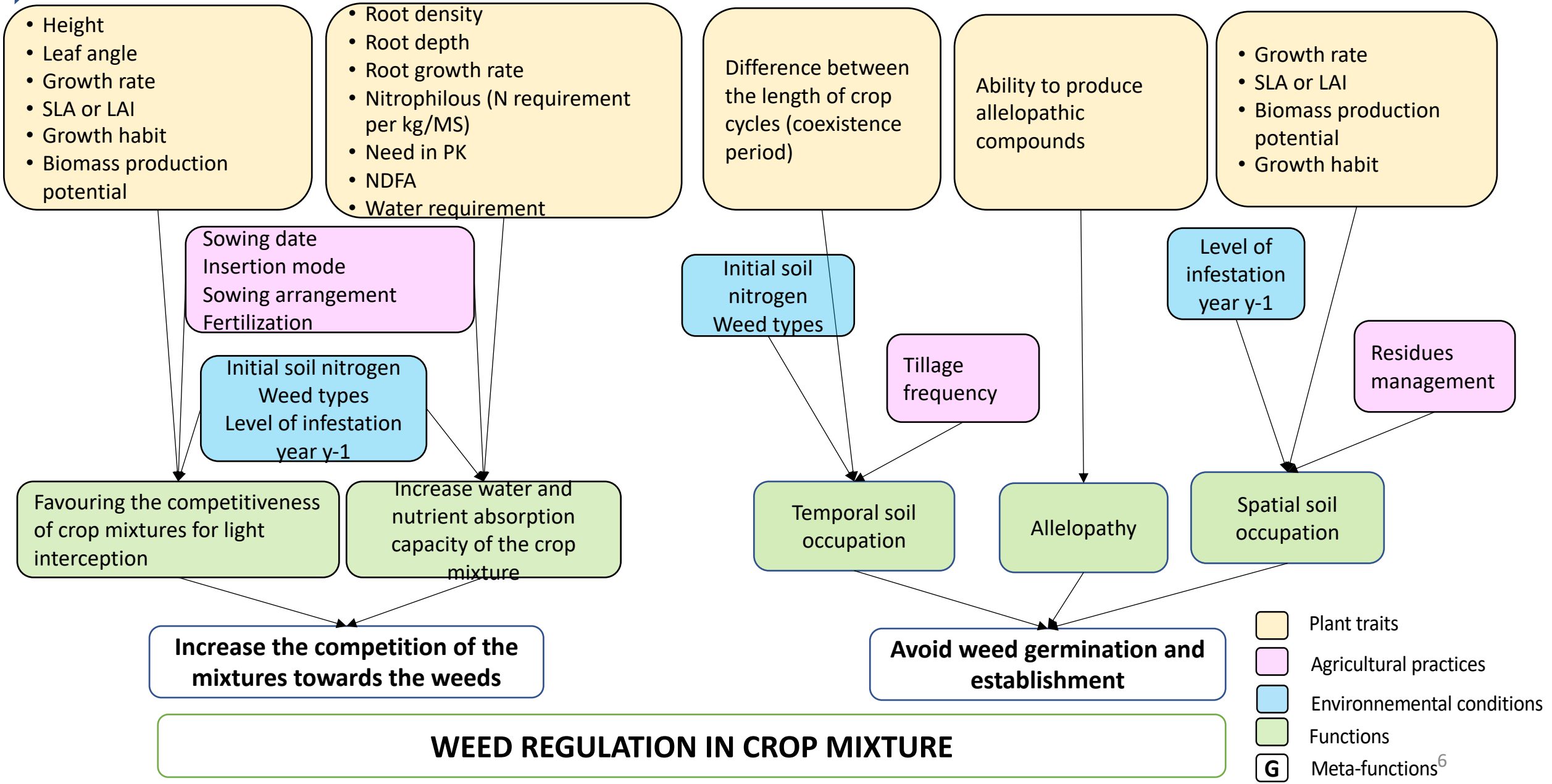
Agro-environmental conditions

Weed regulation

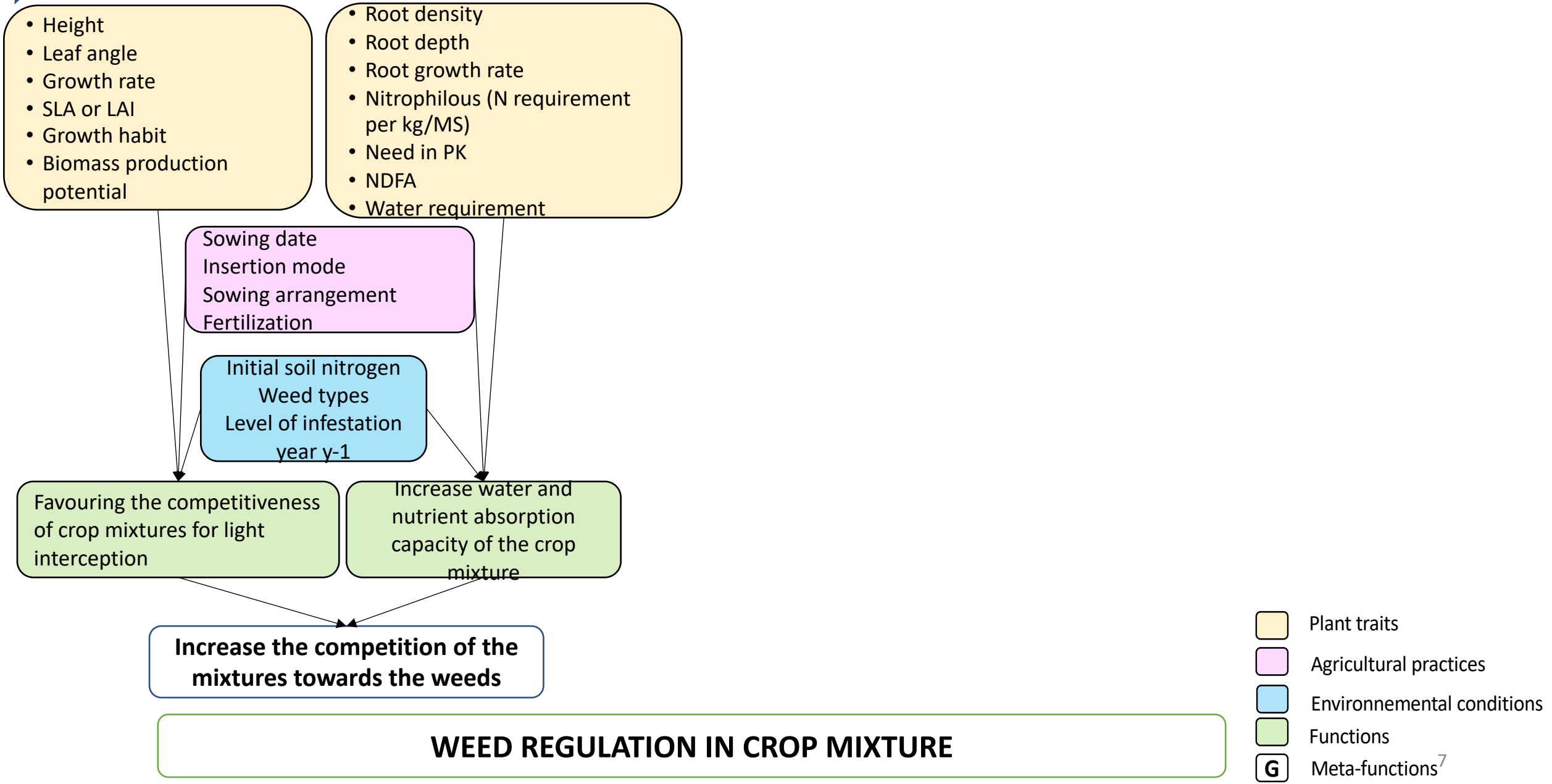
Médiène *et al.*, 2016

Evaluation of services provided by species

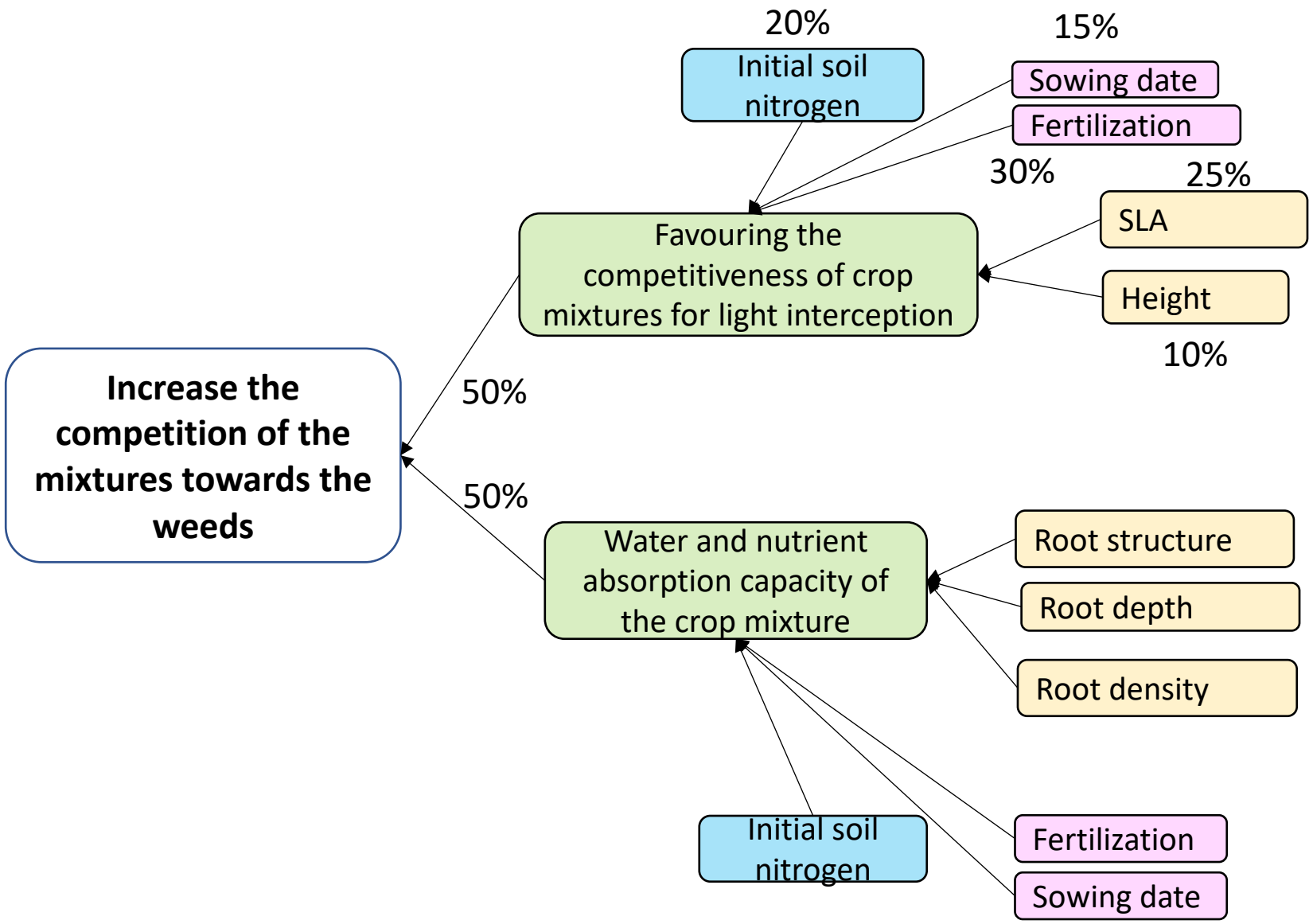
Functional representation of crop mixtures for weed regulation obtained after workshop



Functional representation of crop mixtures for weed regulation obtained after workshop

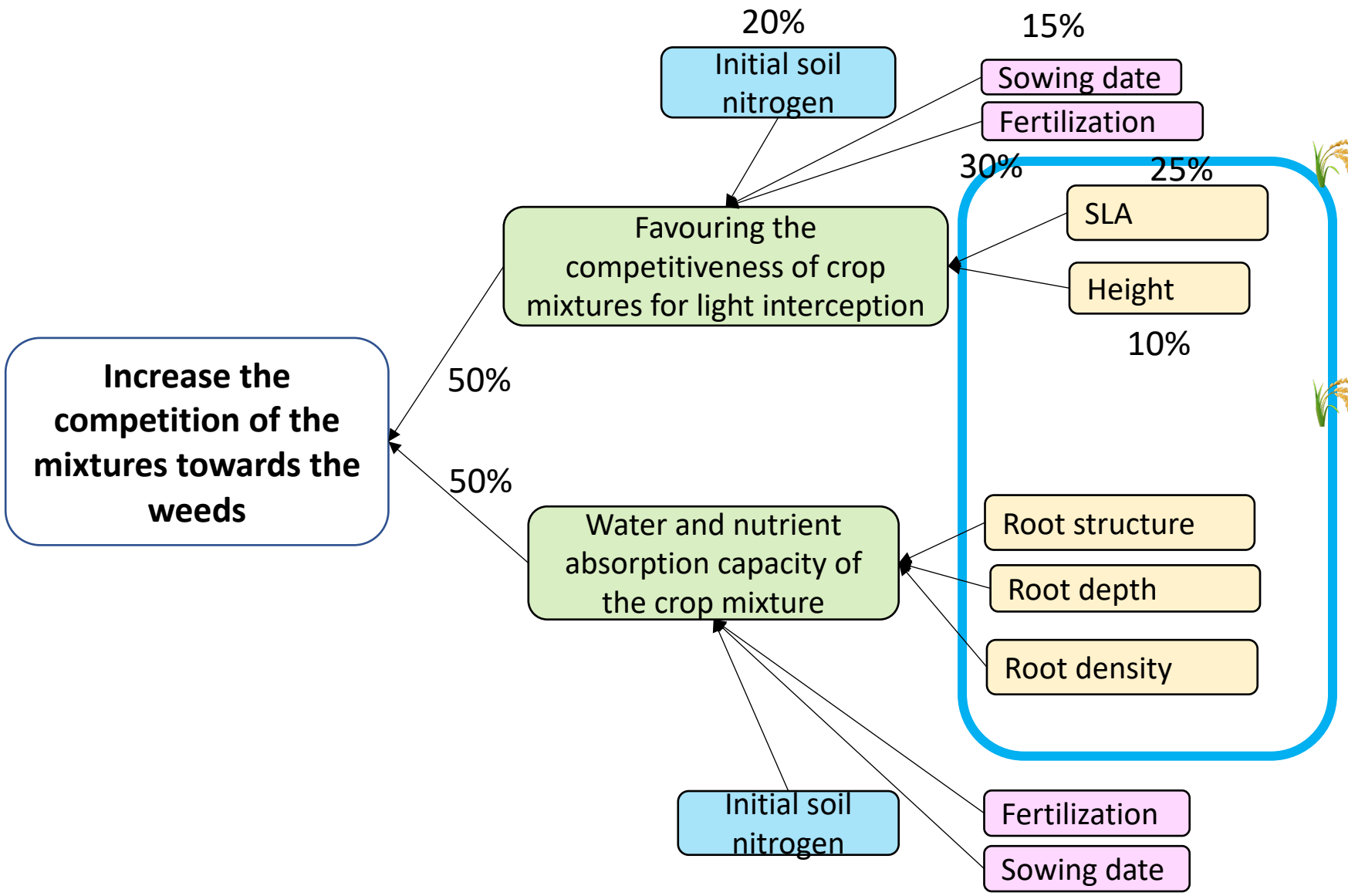


Ongoing work: an example of hierarchical weighting



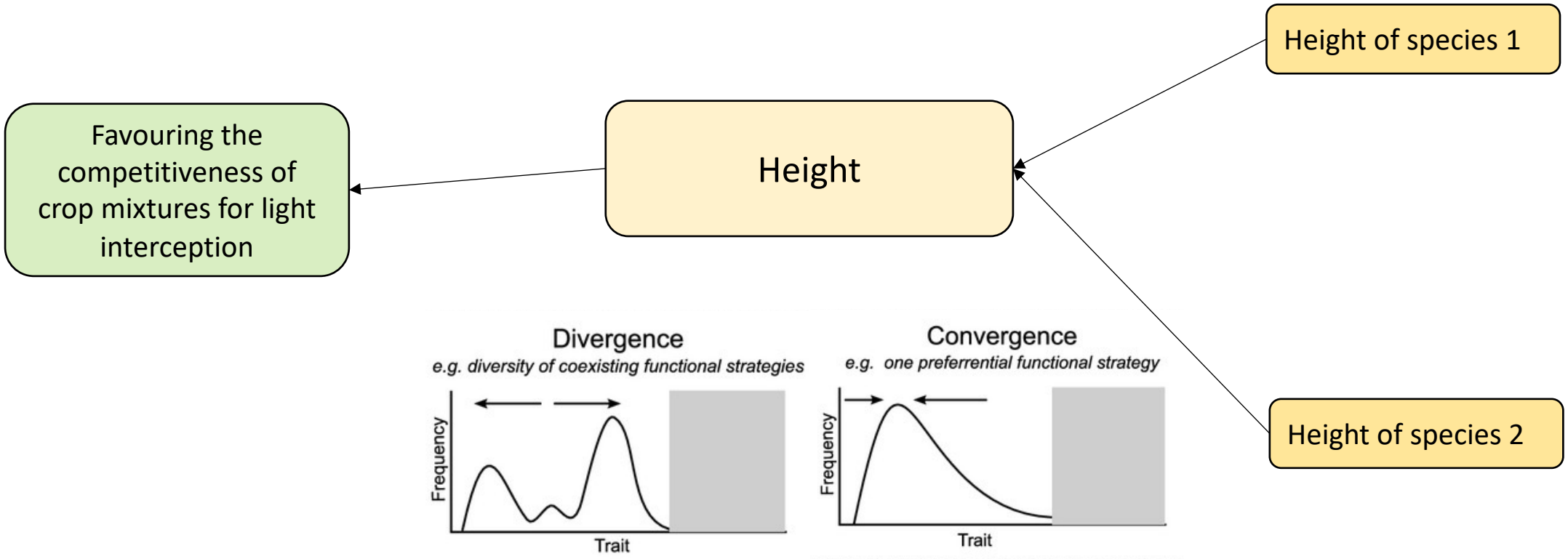
- Validate and quantify the functional relationships Traits/Functions/Service
- Hierarchy each branch of the functional tree

Ongoing work: an example of hierarchical weighting



- Validate and quantify the functional relationships Traits/Functions/Service
- Hierarchy each branch of the functional tree

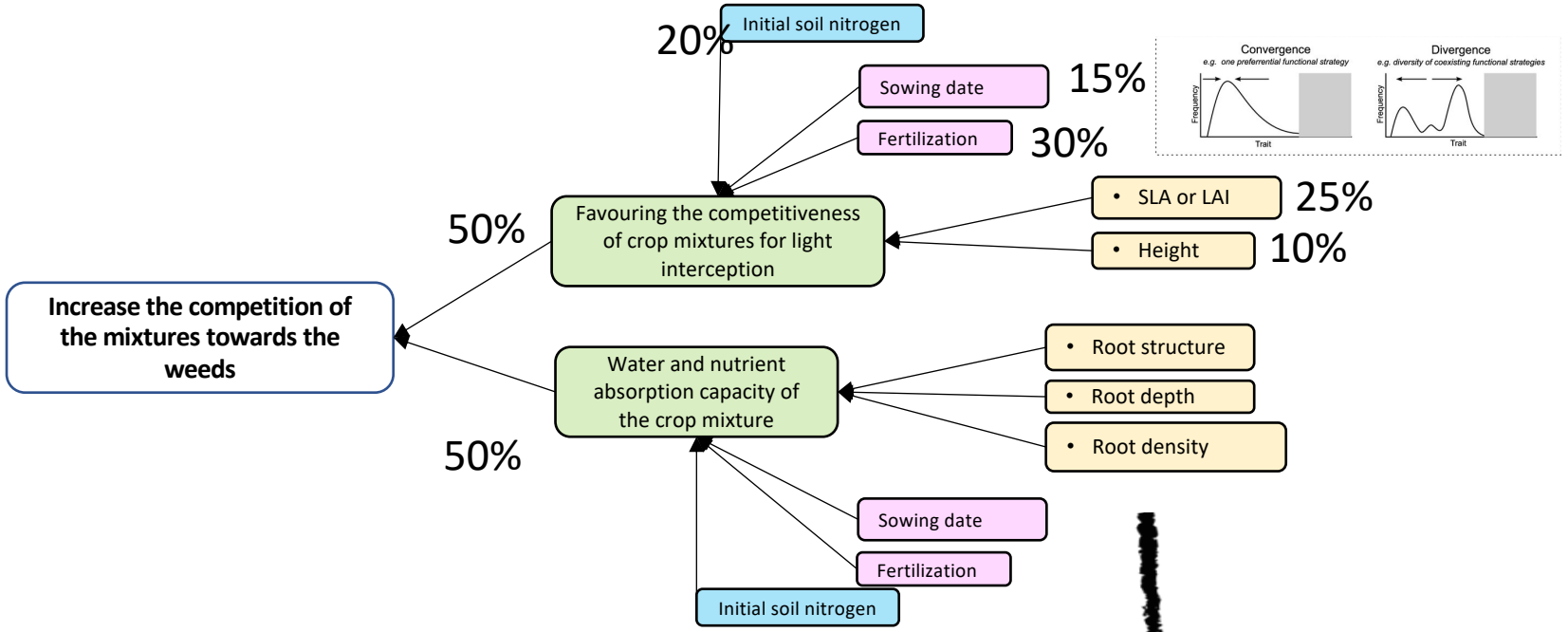
Ongoing work: defining the assembly rules of traits in crop mixtures

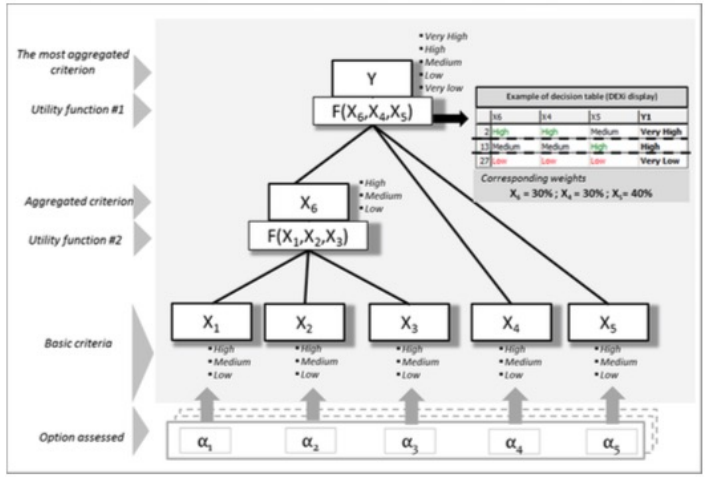


Bernard-Verdier *et al.* 2012

For example, to promote the competitiveness of the mixture against weeds, it is necessary that the two species have a high height, i.e. convergent or high for one and low for the second i.e. divergence

Finalized goal: A tool to assist in designing of species mixtures

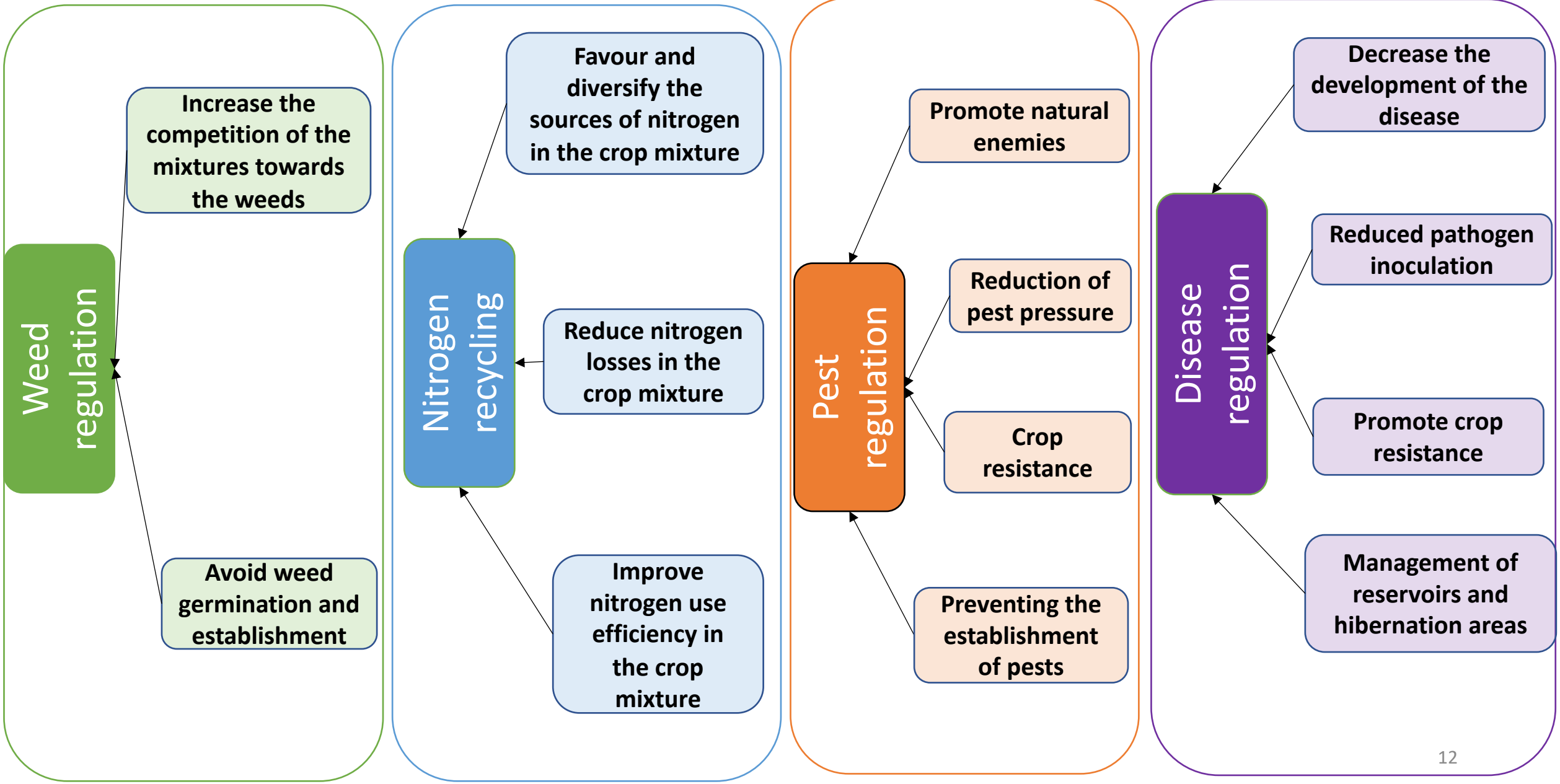




Qualitative hierarchical multi-attribute model (ex. Dexi) for each service to made decision rules

Classification of species mixtures according to their capacity to provide the expected services in the local production context

Meta-functions involved in 4 ecosystem services



THANK YOU FOR YOUR ATTENTION!

What ecological traits and functions are important in a crop mixture for effective weed management?

Malick OUATTARA, Raphaël PAUT, Muriel VALANTIN-MORISON, Safia MEDIENE

malick.ouattara@inrae.fr

@UAgronomie