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Towards the prediction of levels of infestation of *Acyrtosyphon pisum* in pea-wheat mixtures

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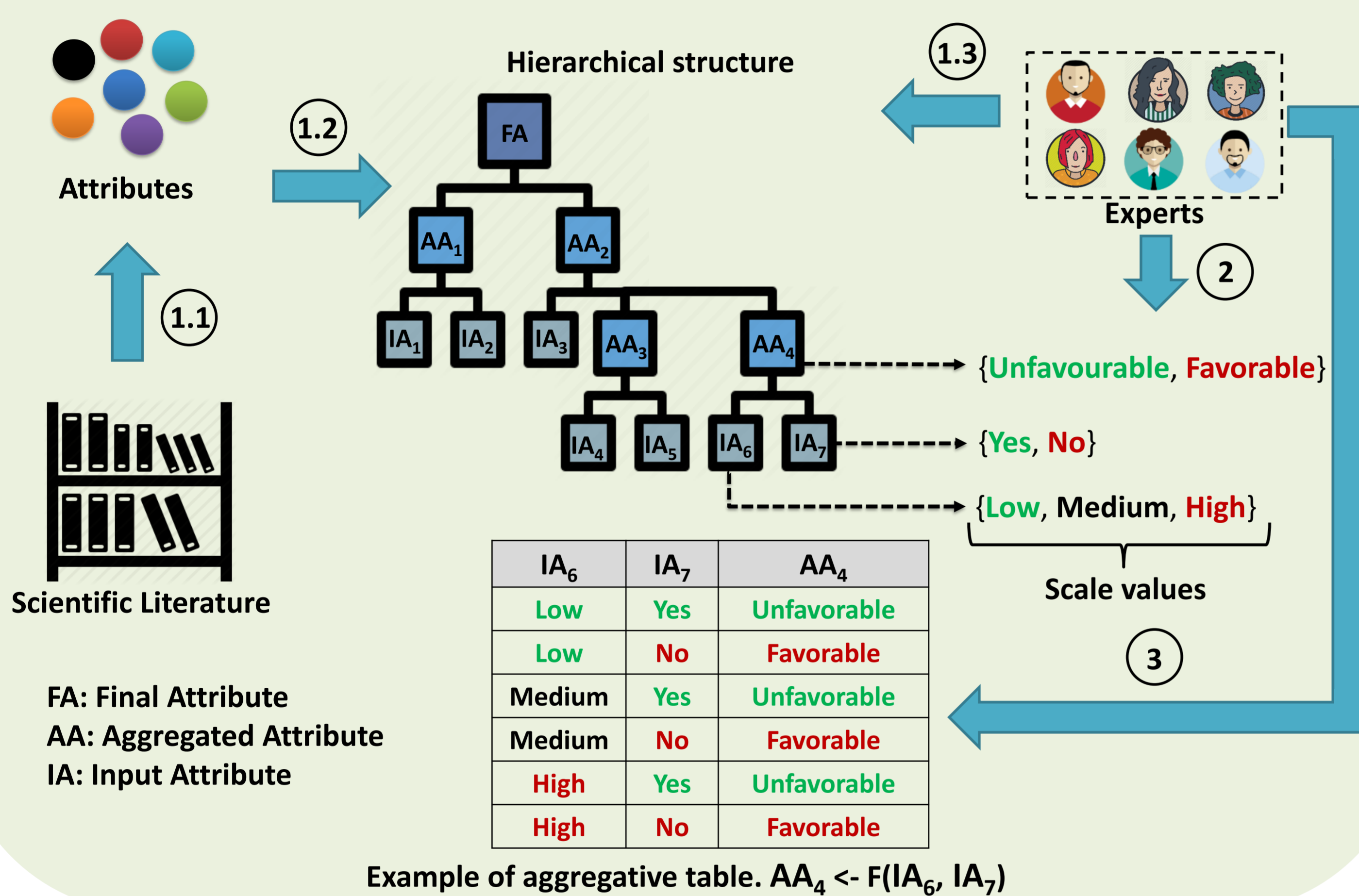
Introduction

Acyrtosyphon pisum commonly known as pea aphid reaches densities in some places high enough to become a significant economic problem. Considering the growing interest in species mixtures, especially for their role in pest control, we designed a tool to predict pest injuries in pea-wheat mixtures. Using the qualitative modelling framework Injury Profile SIMulator (IPSIM), we built a model to predict *A. pisum* final infestation in pea-wheat mixtures.

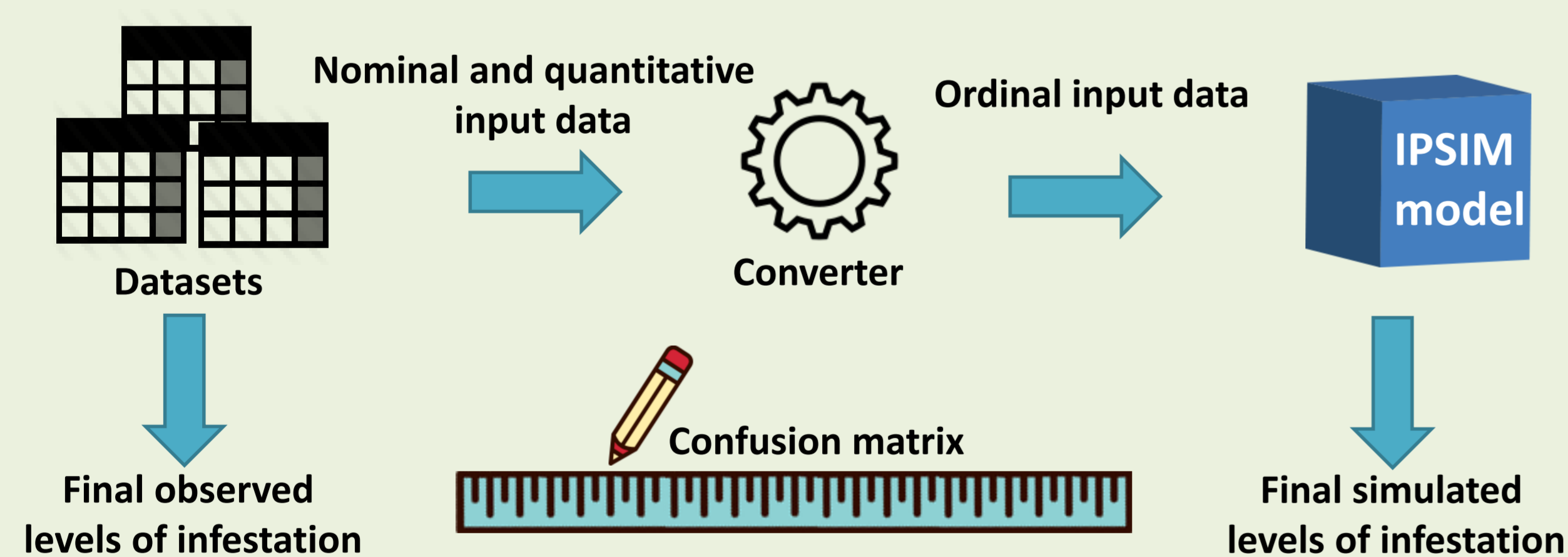
IPSIM method

The development of IPSIM-Pea/Wheat-Aphids followed 4 steps:

1. Identification and organisation of attributes
2. Definition of qualitative values for each attribute
3. Creation of aggregative tables



4. Assessment of predictive quality



Preliminary results

Hierarchical structure is presented in Figure 1. We identified 17 attributes, 11 input attributes, and 6 aggregated attributes, including the final attribute (*Acyrtosyphon pisum* level of infestation).

Qualitative scales were defined for the basic and aggregated attributes. For instance, the “Temperature” attribute was described using a two-value scale: **favourable** or **unfavourable** to aphid development.

Attribute	Weight
Aphids severity on pea/wheat intercrop	
Weather	23
Spring	53
Temperature	38
Rainfall	43
Wind Speed	19
Winter temperature	47
Treatment	44
Landscape composition	21
% Semi-natural areas	15
% Leguminous crops	54
% Organic fields	31
Impact of intercropping	12
Intercrop sowing rates	50
Wheat density	75
Pea density	25
Type of intercrop	50

Figure 1. Hierarchical structure of IPSIM-Pea/Wheat-Aphids. Blue attributes correspond to aggregated attributes

The model was applied to two hypothetical fields, one organic and one with high input levels to illustrate how IPSIM-Pea/Wheat-Aphids could be used (Table 1).

Input attributes	Crop management	
	Organic	High input levels
Temperature	Favourable to aphids	Favourable to aphids
Rainfall	Medium	Medium
Wind speed	Favourable to aphids	Favourable to aphids
Winter temperature	Favourable to aphids	Favourable to aphids
Treatment	No	Yes
% Semi-natural areas	High	Medium
% Leguminous crops	Medium	Low
% Organic fields	High	Low
Wheat density	Recommended sowing doses	Recommended sowing doses
Pea density	Very lower than recommended sowing doses	Less than recommended sowing doses
Type of intercrop	Mixed	Mixed
Aphids severity	Intermediate	Very low

Table 1. Example of simulations using IPSIM-Pea/Wheat-Aphids. Attribute values in red, black and green are respectively favourable, neutral and unfavourable to aphids.

Discussion

It is now the phase to assess the predictive quality of the model. This evaluation consists in comparing observed and simulated classes of aphid infestation severity using an independent dataset covering a wide range of production situations. In addition, to run IPSIM-Pea/Wheat-Aphids, it is necessary to design a converter that can transform nominal input variables, or quantitative input variables into ordinal variables. Currently, we are building a dataset from field experiments in order to evaluate the model.

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