First steps of participatory design for DSS

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FIRST STEPS IN PARTICIPATORY DESIGN OF A WEED MANAGEMENT DECISION SUPPORT SYSTEM

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Introduction

Weeds are harmful for crop production but important for biodiversity. In order to design cropping systems that reconciles crop production and biodiversity, we need tools to help farmers to deal with this issue. The mechanistic weed dynamics model FLORSYS (Colbach *et al*., 2014) is a convenient tool to test management scenarios and evaluate both crop production and biodiversity in cropping systems. Our aim is to use this model as part of a decision support system (DSS). Here, we aimed to identify the needs of advisors to design and evaluate weed management strategies and the main expected uses of a DSS. For this purpose, it is crucial for the development and use of the tool that future users are engaged at an early stage (Cerf *et al*., 2012).

Materials and Methods

A survey was conducted via an online questionnaire sent to advisors from agricultural councils all over France; we obtained 24 responses. The survey included four parts in order to identify: (1) the interviewee; (2) the aims, contents and structure of the DSS (e.g. which rotations? which operation dates?): the criteria for evaluating cropping systems, the temporal scale (e.g. one year, one rotation) and the description of farming

Table 1. How much data are the users ready to provide for a decision-support system (DSS) depending on their difficulties for managing weeds. Percentage (%) of farm advisors answering to a web survey in France

Weed Management Issue	**How Much Detail Needed For Crop Management?**		
	Detailed (List Of Operations)	**Both**	**General** (Meta Decision Rules)
Lack Of Knowledge On Weed Biology	15	2	11
Constraining Species	13	0	6
Lack Of Solutions	12	0	0
Generated Costs	8	0	0
Competition With Crop	4	0	0
Dependence On The Weather	4	0	0
Lack Of Efficiency Of Practices	6	7	6
Multiannual Scale	0	37	0
Weed Diversity	4	7	0
Too Many Techniques To Choose And Combine	0	12	0
The Need To Diversify Crop Rotation	12	22	33
Weed Resistance To Herbicides	2	0	19
Poor Image The Weeds Give Of Farmer Because Of Field Infestation	3	0	3

Practices (e.g. list of operations, meta decision rules); (3) the constraints for model use, e.g. the availability and difficulty to fill in the different types of input variables; (4) the functionality and readability of inputs and outputs of the future model, the ability to understand why a given input leads to the resulting output.

Results and Discussion

The survey clearly identified two different issues where an advisor would work with a DSS to design and evaluate weed management strategies:

1. Major issue e.g. herbicide resistance - users confronted with a problem such as herbicide resistance would provide only meta decision rules (e.g. a plough every two years) for the DSS (Table 1) and would be ready to radically change their practices (e.g. diversification of crop succession) (Table 2);
2. Adaptive management - users ready to understand and modify their practices before reaching a dead-end (e.g. which practices, which mechanical weeding) would provide a detailed description of the practices (e.g. crop succession, list of operations) so that they could finely tune their system in terms of options and timings of operations (Table 2).

Table 2. How much data will users provide for a decision-support system (DSS) depending on decisions they would like to take with it. Percentage (%) of farm advisors answering to a web survey in France.

Which Decision Should A DSS Help To Take?	**How Much Detail Needed For Crop Management?**		
	Detailed (List Of Operations)	**Both**	**General** (Meta Decision Rules)
It Should Propose A Range Of Levers For Action	12	0	6
What Are The Risks For A Precise Cropping System	7	0	0
Which Type Of Mechanical Weeding	5	0	0
Which Crop Management Sequences	31	34	22
Which Management Alternatives To Previous Cropping System	4	12	0
Which Crops And Successions	19	29	33
Which Herbicide Solutions	18	12	19
How To Optimize Operation Dates	4	12	14
What Is The Best Management Option	1	0	6

Conclusions

Identifying the different profiles and needs for a decision support system will help us to propose different tools more adapted to the various needs. The interaction with future users during its construction is essential for a useful tool development.

Acknowledgements

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References

Colbach N. – Biju-Duval L. – Gardarin A. – Granger S. – Guyot S.H.M., Mézière D. – Munier-Jolain N.M. – Petit S.: 2014. The role of models for multi-criteria evaluation and multi-objective design of cropping systems for managing weeds. *Weed Research,* **54**:541–555.

Cerf M.– Jeuffroy M.-H.– Prost L.– Meynard J.M., 2012: Participatory design of agricultural decision support tools: taking account of the use situations. *Agronomy for Sustainable Development,* **32**(4):899–910.

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Weeds are a major pest of crop production but are also crucial for biodiversity. To design sustainable weed management strategies and combine several cultural techniques in a long-term approach, decision support systems (DSS) proposing weed management strategies are needed but must be developed with future users[1].

AIM: Understand needs of agricultural advisers for a DSS for integrated weed management

Existing Model

FLORSYS[2] is a "virtual field" model predicting weed dynamics in current and prospective cropping systems

FLORSYS is complicated and time-consuming, it must be transformed to be used as a DSS

CRITICAL: Identify inputs essential to understand weed dynamics and to take decisions

Methods

40 advisers answered an online survey to guide the adaptation of FLORSYS, concerning:

- The reasons why advisers need decision support systems for managing weeds
- The nature of inputs and outputs
- How much input detail the users are ready to provide

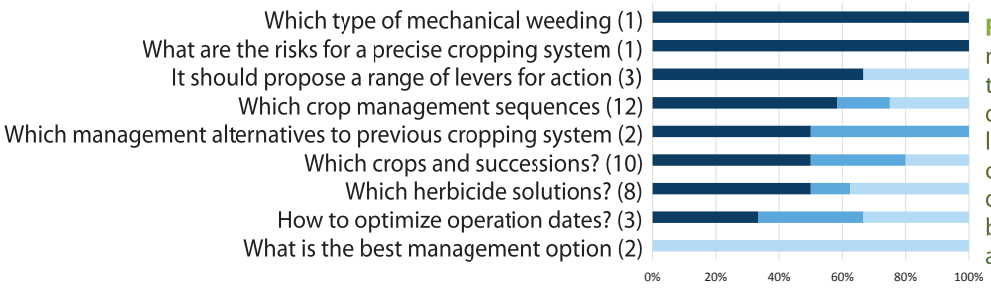
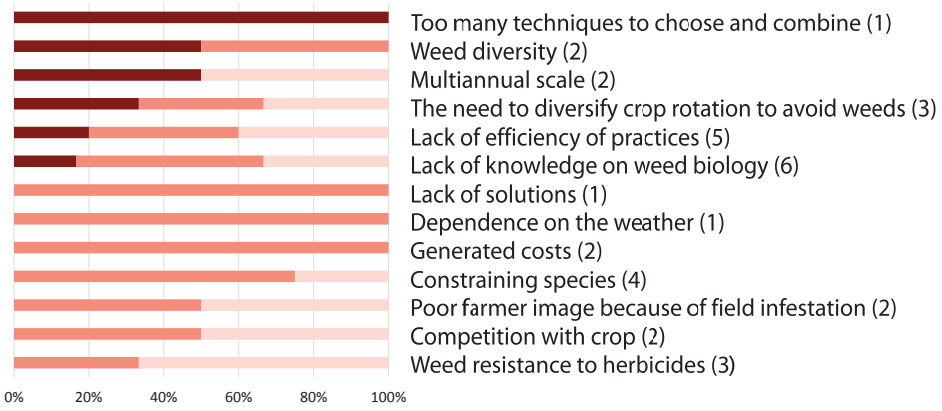


Figure 1: Percentage of answers of how much data agricultural advisers are willing to provide for a decision-support system depending on the decisions they would like to take with it. Dark blue: detailed list of operation, light blue: synthetic meta-decision rules, intermediate blue: both, in brackets: number of advisers, of the 15 full answers, having mentioned the decision.

Figure 2: Percentage of answers of how much data agricultural advisers are willing to provide for a decision-support system depending on why they consider weeds difficult to manage. Dark red: detailed list of operation, light red: synthetic meta-decision rules, intermediate red: both, in brackets: number of advisers, of the 15 full answers, having mentioned the decision.



Two different use cases will arise depending on farmers' needs:

- **Major issue:** users confronted with a problem such as herbicide resistance
  →they would provide only meta decision rules and would be ready to radically change their practices
- **Adaptive management:** users ready to understand and modify their practices before reaching a dead-end
  → they would provide a detailed description of the practices so that they could finely tune their system in terms of options and timings of operations

Future directions: Test prototypes in workshops with potential users

[1]Prost L., Cerf M., Jeuffroy M.-H., 2012. Lack of consideration for end-users during the design of agronomic models. A review. Agronomy for Sustainable Development, 32, 581-594.

[2]Colbach N., Biju-Duval L., Gardarin A., Granger S., Guyot S.H.M., Mézière D., Munier-Jolain N.M., Petit S., 2014. The role of models for multicriteria evaluation and multiobjective design of cropping systems for managing weeds. Weed Research 54, 541–555.

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