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FARMERS APPRECIATION AND MANAGEMENT OF FUNCTIONAL FUNCTIONAL BIODIVERSITY IN ORGANIC APPLE ORCHARDS

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Abstract: The benefits of functional biodiversity (FB) for pest control are under debate among practitioners. Little is known about farmers' practices and motivations to foster FB. We assume that the use of monitoring methods would help the farmers to better appreciate the benefits of FB and thus implement favorable practices. Therefore, we undertook a comprehensive strategy consisting of semi-directive interviews and participatory workshops to describe farmers' practices and perception, and design monitoring methods adapted to their needs. Our findings provide empirical evidence that FB is associated with multiple services and dis-services. Additionally, the farmers' experience and time are two important conditions for farmers' involvement for FB. Four main attitudes towards the management of FB were characterized: wait-and-see, naturalist, regulation, and multifunctional. These attitudes provide a useful framework to design support tools and research programs in line with farmers' needs

Introduction: Supporting functional biodiversity (FB), which provides natural pest regulation, is an environmentally sound and promising approach to reduce pesticide use in perennial cultures such as apple, especially in organic farming (OF). However, little is known about farmers' practices to implement favorable FB techniques or farmers' expectations of FB mediated pest regulation. In fact, FB-supporting techniques (FB-techniques) are massively questioned by practitioners due to inadequate information about their effectiveness. Even the farmers who attempt to favor on-farm biodiversity often lack the means to evaluate how their actions may contribute in practice to FB. We assumed here that to develop useful and appropriate monitoring methods, it is necessary to take into account the variety of knowledge, perceptions and interests about functional biodiversity.

Material and methods: We combined three different approaches.

As described by Cardona et al., (in preparation), we first performed exploratory and comprehensive surveys using semi-directive interviews with 11 fruit advisors and 19 farmers from the different French regions of fruit production to understand their different perceptions and uses of functional biodiversity. Second, we adopted a participatory approach to design monitoring methods adapted to those perceptions and pre-existing uses. Two rounds of workshops (WS) were organized in three European Countries (France, Sweden and Denmark) based on the method of focus group interviews, which aim to let participants interact with one another rather than with the interviewer in order to favor emergence of views on a bottom-up basis. Each WS gathered about 15 participants (half of them were farmers, a quarter of them advisors and the last quarter were researchers). It started with the question "*what is functional biodiversity for you?*" Participants were then invited to share the monitoring techniques they knew. It ended with the commitment of participants to use or test monitoring methods of their choice in the following growing season. The second round of WS were organized after the growing season in the same three countries and gathering the same participants, to (i) collect and collectively discuss their feedbacks on the methods they chose to use during the growing season and (ii) design functional biodiversity monitoring programs adapted to their needs.

In parallel, we performed interviews in eight European countries to (i) describe farmers' practices; to (ii) better understand their perceptions of and values associated with FB; and to (iii) identify potential drivers of (non-)adoption (Penvern et al., 2019). Common English-based questionnaires were designed and interviews were performed by each European partner in the stakeholders' native language, either by phone or face-to-face for a total of 55 advisor and 125 farmer interviews. The farmer sample targeted orchard managers (not farm workers) who used organic farming practices with at least 50% of the orchard dedicated to apple trees. To describe as many situations as possible, the sample also included some farmers involved in Integrated Production (IP) (11%), farmers with varying degrees of experience in fruit production and organic farming, and farmers with various degrees of "conviction" about FB, i.e., confidence in the effectiveness of FB techniques in terms of pest regulation (26% of the farmers said they were skeptical of FB). Data were translated into quantitative or qualitative variables. Correlation tests and multivariate analyses were used to identify potential influencing drivers for the adoption of FB-techniques.

Results: A total of 24 different FB-techniques were described throughout the eight European Countries. There was high variability between countries, but the most implemented techniques were bird and bat houses, hedgerows, flower strips and adapted inter-row management. Others were more marginal and specifically mentioned in one or a few countries such as body of water, animal introduction or crop diversification. On average, farmers combined more than four techniques en implemented over a period of 13 years, with only few abandonments, meaning adoption was generally long-lasting. 31% of the techniques were adopted during establishment and 45% during the conversion period. A longer experience in OF and in apple production were positively correlated with the number of FB-techniques implemented. Despite their experience, in general, farmers faced difficulties to evaluate services provided by FB ("*hedges represent a substantial investment for inconspicuous benefits*", FRF8). Both surveys and WS highlighted the multiple services farmers expected from FB techniques. Species targeted belonged to several functional groups and farmers mentioned several services beyond pest regulation: environmental protection, welfare at work, aesthetic, pollination, economic benefits, communication ("*because it attracts not only insects but also people and therefore provides a starting point for discussions about organic farming*", ITF5), human health, and heritage conservation.

Functional biodiversity is perceived as very complex, hard to grasp ("*the farmer must be humble in front of functional biodiversity*"), and almost as a hidden process operating by its own in the farm. Therefore, it appears that if we want to

produce monitoring programs, which correspond to farmers' needs, we must adopt more holistic approaches to consider other services and uses.

Participants of the WS spontaneously cited a large variety of existing monitoring methods. Some also pointed out difficulties to implement the methods: sensitivity of the methods to climate, lack of time in seasonal peaks of work, difficulty to delegate and to identify the insects. Based on the French interviews and WS, we distinguished four attitudes towards FB (Figure) and discussed implications for monitoring approach with participants:

- "Wait-and-see attitude" a priori not interested in monitoring methods unless it is to measure pests.
- "Naturalist attitude" for which the pleasure would be the main motivation to monitor a diversity of plants and animals.
- "Regulation attitude" for which monitoring would be structured and systematic with specific methods to adapt pest control methods.
- "Multifunctional attitude" that supposes a "global vision" of functional biodiversity.

Discussions during the WS confirmed a gradient of involvement in the monitoring processes in terms of knowledge, time, and number of tasks. This indicated that we should adapt monitoring programs according to the different attitudes.

Discussion: The aim of our study was to encourage an improvement of FB management as a way to reduce the use of pesticides. As advocated by Pannell et al. (2006), offering readily testable techniques (easy-to-test) may facilitate the adoption of FB-techniques. This suggestion leads to an interest for self-monitoring methods to assess FB with relevant indicators adapted to farm conditions to further enhance the ability of growers to evaluate the impacts and adjust their practices.

In agreement with the plurality of services associated to FB, our study highlights the plurality of uses of monitoring methods and possible difficulties in their implementation. Knowledge and time are two important factors for the adoption of FB-techniques and the use of monitoring methods. It is also a challenge to monitor systemic and long-term processes and to interpret results. Increased cooperation between researchers, farmers and advisors should more effectively meet farmers' needs and perceptions.

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References: Eco-Orchard project homepage: https://plen.ku.dk/english/research/organismal_biology/aipe/research-projects/ecoorchard/

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Image:

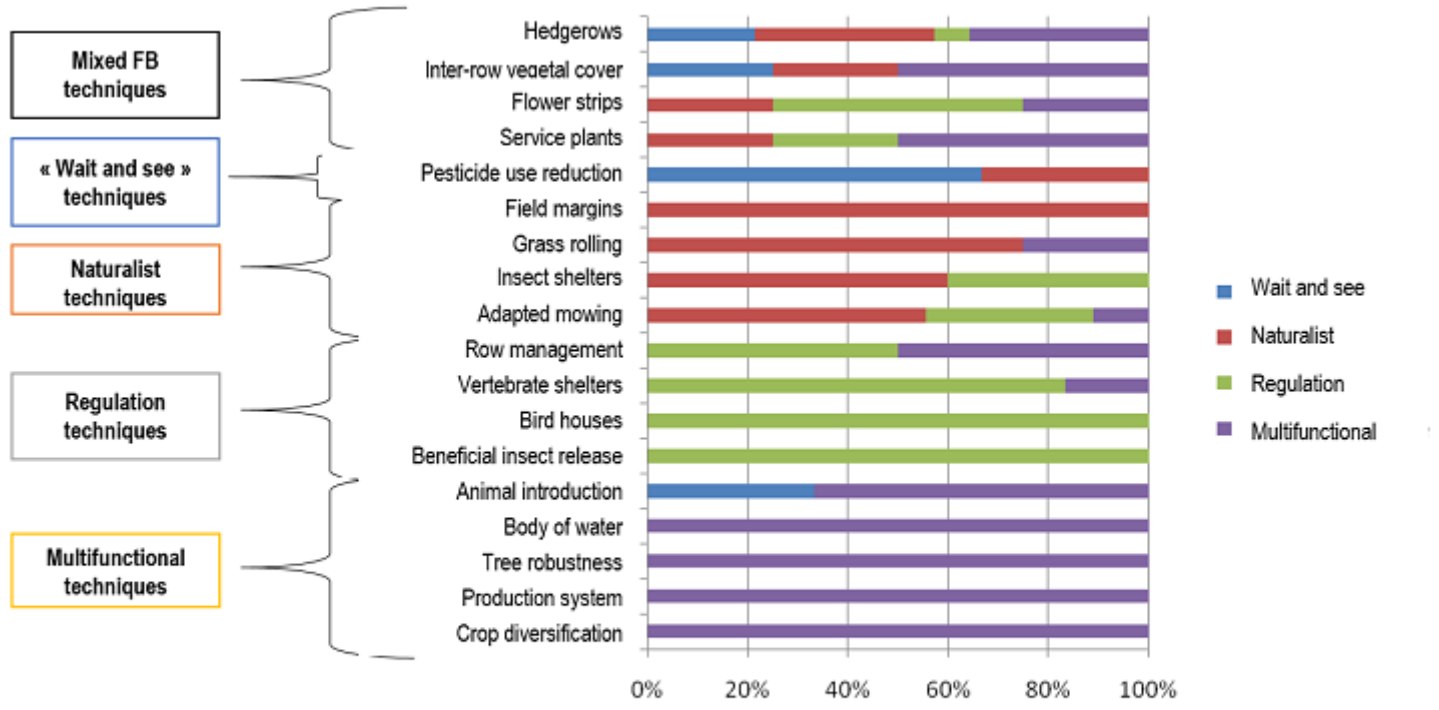

Figure : Distribution among FB techniques and for a same FB technique of the different attitudes adopted by the farmers. Inter-row vegetal covers may for example be implemented first to limit erosion ("Wait and see attitude"), to preserve biodiversity in general ("naturalist"), and/or to fulfill multiple objectives.

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Keywords: Agroecological transition, Ecosystem services, Farmers' knowledge, Participatory research, System redesign