

How far do fruit growers get involved in Functional AgroBiodiversity assessment?

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Abstract

Farmers often hesitate to develop Functional Agrobiodiversity on their farm, for they cannot measure the return on investment. The method proposed here could help them assessing beneficials population dynamics, according to cultural and biodiversity practices, therefore motivating them in considering FAB in their plot, and limit chemical use.

Keywords: Functional biodiversity, agroecology, orchard, organic fruit growing

Introduction

An increasing amount of scientific evidence has established the fact that biodiversity has a central role in obtaining and securing resilient agroecosystems. To conserve biodiversity and for environmental and political reasons, farmers cannot rely on pesticides alone. Functional agrobiodiversity (FAB) is that part of biodiversity which promotes a healthy and productive agroecosystem. It has the potential to become an important tool in crop protection. Though farmers set up semi-natural structures to maintain beneficials, they still today hardly use FAB on their farms since best methods, practices, and knowledge remain fuzzy and unclear to them. Too many options and lacks of financial incentives hamper significant adoption, whereas the return on investment (time/money) is not always visible or measurable.

Consequently, there are strong needs to ease this adoption by several means:

- improve access to knowledge through easy online decision tools (such as herbea.org in France),
- improve composition of floral strips mixtures performance and cost,
- improve farmers' knowledge about functional biodiversity in their own cropping systems.

In the frame of the EcoOrchard project dedicated to main apple pests (Sigsgaard et al 2017), we hypothesised that apple growers may increase their knowledge and better understand the current role of FAB in their orchards, and its potential, by spending a relatively short time observing activity and occurrence of beneficials insects in relation to their cultivation practices, and according to measures and choices done. It could therefore increase their will and ability to protect and increase FAB, therefore finally limiting pesticides use.

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Material & Methods

– Comparison & selection of easy methods

The challenge with respect to our objective was to select and propose easy-to-handle tools, providing enough information for farmers. In 2015, some EcoOrchard project partners compared six methods: visual observation, beating, corrugated cardboard, yellow sticky traps, damage and yield assessment in three countries (France, Denmark, Latvia), with respect to several determining criteria for farmers' involvement: time needed, materials needed, knowledge required by user, information provided and cost. Questionnaires were afterwards proposed to practitioners, who were also asked to quantify time needed.

– Fruit growers' recruitment

According to country situation and opportunities, workshops, open field demonstrations, or field trainings, or face-to-face discussions, were organized, in order to inform farmers about EcoOrchard FAB assessment, and to recruit volunteer farmers and advisors to help us test and further develop a farmer-friendly FAB assessment tool.

– Growers support

In 2016, the selected four FAB assessment methods were, described and explained in a handbook provided to farmers to be involved, in their own national language. The booklet also had illustrations of the most important beneficial sgroups to help quick identification. The booklet had space where farmers were asked to describe their objective in FAB assessment: for example to establish a semi-natural habitat (SNH), or to improve plant protection, or to assess mowing frequency effect on beneficials. For this purpose, the booklet provided notation grids allowing an easy field assessment.

– Questionnaires

At the end of 2016 and 2017 seasons, farmers were interviewed by phone, email or face-to-face, to give a feedback on their adoption of the FAB assessment methods. Specifically, their opinion on advantages and limits of the method proposed were asked.

Results

– On methods proposed to farmers

At the end of 2015, methods were listed in a table (Table 1) with all important criteria and based on our findings and discussions involving all EcoOrchard partners we selected the most relevant methods to be proposed to fruit growers. Time needed, link to functionality and simplicity of the method were given a high priority and led to the choice of these 4 methods: visual observation, branch beating, cardboard bands, predation cards.

Table 1: Comparison of methods performances for various criteria.

Indicator	Visual observations	Non-destructive beating	Cardboard	Predation cards	Sticky traps	Damage assessment	Yield assessment
	Time	+		+		+	
Material	+			-		+	+
Skills	+		+				+
Adaptability	+	+	+	+		+	+
Sensitivity to practices	-	-			-	-	-
Stability						+	+
Link to functionality	+			+	-	-	-

Legend :

	high interest in tool		low interest
	medium interest in tool		no interest

The four methods finally selected for farmers were:

- **visual observation of aphid colonies** photo A

Observation of 10 rosy apple aphid colonies per treatment, repeated in season. Counting of aphids and predators in colonies. Measures the infestation rate together with predation dynamics.

- **Non-destructive branch beatings** photo B

Sampling of 10 branches per treatment, with non-destructive observation and identification of main beneficials expected.

- **Corrugated cardboard** photo C

Cardboard is fixed on 10 tree trunks per treatment, and helps to shelter and count spiders and earwigs.

- **sentinel preys (= predation cards)** photo D

Cards are prepared in lab and sent/brought to farmers. They're exposed for 24 or 48 hours in the orchard, then eaten eggs or aphids are counterered. Gives a direct estimation of predation potential.



A



B



C



D

Methods were described in the handbook and notation grids associated for farmers' ease of recording. In order to measure possible FAB differences, we suggested that farmers could compare beneficials levels between two treatments such as:

- two different pesticide application strategies (for ex. organic/IPM),
- two different cultural practices (weed control, defoliation...)
- two plots with/without agroecological infrastructures (floral strip, hedge...)
- old/new orchard, ...

- *on adoption of FAB assessment*

Questionnaires were addressed to participating farmers at the end of 2016 and 2017 seasons. 40 farmers participated in 2016, and 50 in 2017, despite a severe spring frost that induced a lack of interest in orchard protection. An interactive online map has been produced¹, where all fruit growers are located, with indications of methods and objectives chosen.

Farmers were asked to choose at least one method to test but most of the time they chose at least two out of the four proposed methods. Although visual observation and beating were popular and, in some cases, already adopted methods, cardboard bands and sentinel prey methods were the most popular ones. The reasons for these choices could be:

- simple method with already available material (mostly used for codling moth trapping or monitoring), in the case of cardboard bands;
- simple and direct method to assess real regulation level, provided the ready-to-use cards are sent to farmers. This could however be a significant limitation in farmers use of the method.
- Innovative methods creating interest

¹ See <http://ebionetwork.julius-kuehn.de/index.php?menuid=25>

Table 2: Percentage of adoption for each method in 2016 and 2017.

	2016	2017
Visual observation	11,1	11,3
Non-destructive beating	29,6	30,9
Cardboard bands	24,1	38,1
Predation cards	35,2	19,6

Table 3: Numbers of iterations for objectives chosen by farmers in 2016 and 2017

<i>objectives</i>		2016	2017
<i>agroecological infrastructure</i>	flower strip	7	4
	hedgerow/wood	11	16
	bird and bat houses	3	
	insect hotels	1	
	pond	1	2
<i>practice effect</i>	mowing strategy	1	3
	old/new plantation	2	6
	different cultivars		1
	2 different orchards	1	2
<i>treatment effect</i>	bio/IPM	6	6
	defoliation	1	1
	sulfur use	1	
	low/high input		3
<i>general knowledge</i>	Learn about FAB on the farm	9	3
	Earwig dynamics	1	

This table shows different priorities among EU farmers, and different strategies in FAB establishment. A deeper overview of this adoption landscape can be found online¹.

– *On relevance for growers*

Farmers interviewed expressed a very satisfying feedback on their use and understanding of the method proposed. Their answers in 2016 and 2017 are synthetised in the table 3.

Table 4: Farmers answers to questionnaires in 2016 and 2017.

	2016 (54 answers)*	2017 (41 answers)
Did you compare two treatments/practices?	79,6% yes	80,5% yes
Did you do the monitoring yourself?	88,9% yes	82,9% yes
Is the protocol easy to set up?	90,7% yes	95,1% yes
Does the handbook give enough information ?	81,5% yes	92,3% yes
Was it easy to interpret the results of the monitoring?	68,6% yes	82,1% yes
Did you find a difference between your practices?	60% yes (50 answers)	54,5% yes (33 answers)
Was the method useful to increase the knowledge ?	94,4% yes	87,8% yes
Have you changed your practices because of monitoring?	79,6% no	58,5% no
In the future do you consider carrying out more monitoring?	74,1% yes	70,7% yes

* some farmers could answer several times when they used several methods

¹ http://www.grab.fr/wp-content/uploads/2017/10/EcoOrchard_Penvern_22-nov-2017_vdiff-1.pdf

Time is a determining criteria in farmers adoption capacity. Therefore, a specific attention has been paid to this aspect, in order to improve methods in case of need.

Table 5: Perception of time needed to achieve methods.

Was the time needed from your point of view...	2016	2017
fast	38,90%	31,70%
medium	57,40%	58,50%
Long	3,70%	9,80%

From these figures, it seems that methods proposed were not too time demanding for farmers involved. The predation card, although it was appreciated is still under development and appears to be sometimes tricky for farmers to distinguish intact from eaten *Cydia* eggs. Some additional comments have been provided in the questionnaires, but are not all reported here. As results showed, farmers are globally rather satisfied with the methodology proposed, as it helps them to spend some time watching fauna, considering dynamics ongoing, and think about relevant adaptation of their practices.

Some requests have emerged from questionnaires such as the interest to learn more about the pests and beneficials in the orchard (life cycles, biology, etc.).

Discussion

The FAB methods are adapted from scientific methods already in use, but farmers have less time, and normally need less precision than science to make their decisions, and this has guided the design of the handbook.

There is currently not sufficient scientific data available for us to link directly from observed numbers of beneficials to pest damages. Such a 'beneficial threshold' would be very attractive for farmers in order to reduce pesticide use, and would create an important development from simple damage thresholds not considering natural enemies.

However, tools as the EcoOrchard 'FAB handbook' do provide valuable tools for farmers to build their own knowledge and experience about FAB and its contribution to pest control.

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More information

Handbook available on <http://ebionetwork.julius-kuehn.de/index.php?menuid=25>

Two short videos have been produced:

https://youtu.be/VnF-g_zTstE / <https://youtu.be/Jw8PEg8DiQ8>