

Design of innovative orchards: proposal of an adapted conceptual framework

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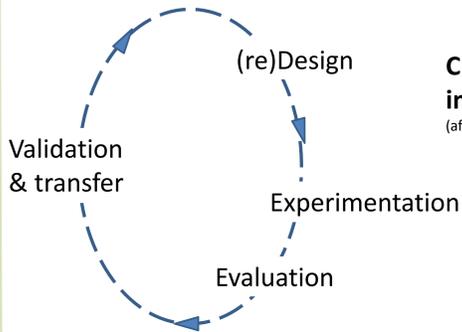
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The system approach is a generic method well-developed in annual crops...

On-farm and on-station system experiments address complex questions related to the sustainability of cropping systems. Main steps in the approach are:

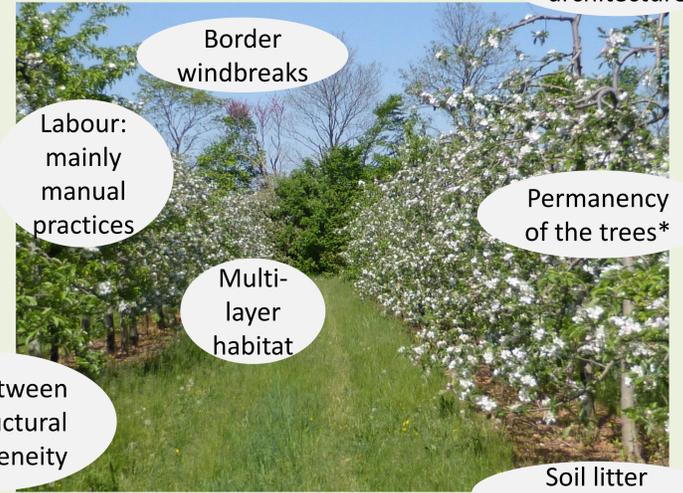
- Set objective(s) & describe the context and possible constraints;
- Design cropping systems and related decision rules to manage them;
- Evaluate agronomic prototypes to iteratively design innovative cropping systems.



Cropping system design, improvement loop
(after Debaeke et al. 2009)



Young stage



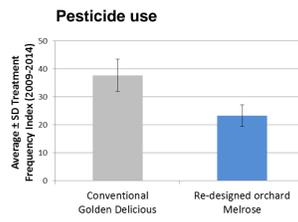
...Perennial crops such as orchards

are complex agroecosystems requiring specific design & management over time and space

*Such permanency constrains soil and pest management: long-term management is required, e.g. pests can build up populations across years since their host-plant remains in the field.

BioREco, South-East France, 2005-2015

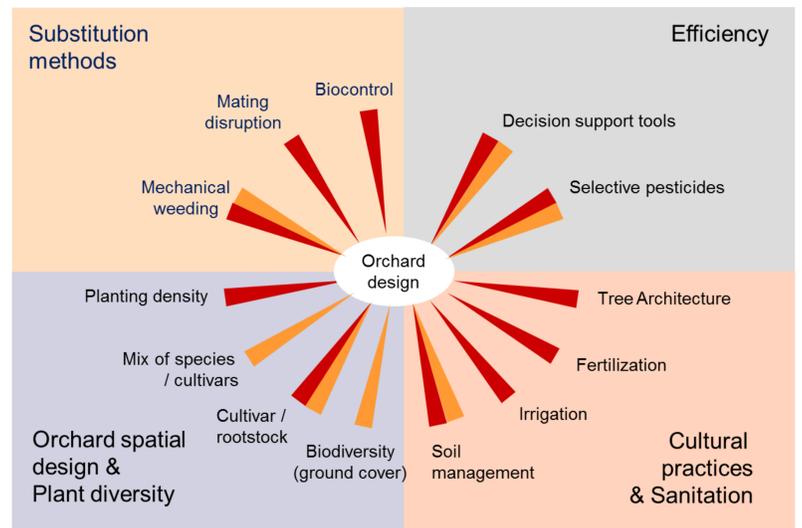
http://www.agropolis.fr/agro2010/paper/s321/Simon_etal_Agro2010_S321.pdf



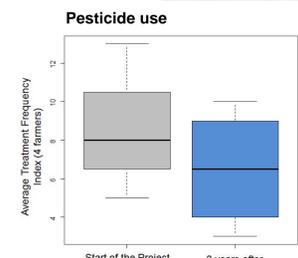
Focus on two experiments aiming at decreasing pesticide use in apple and citrus orchards in temperate and tropical areas

These experiments combine various levers adapted to the specific situation and species to manage orchard pests.

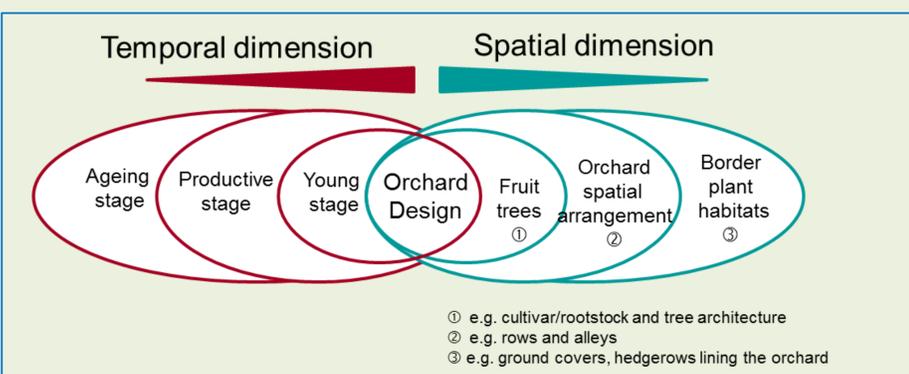
Apple Citrus



ECOFRUT & Agrum'Aide, Reunion Island (Indian Ocean, France), 2010-2018
<http://cosaq.cirad.fr/projets/agrum-aide>



Conceptual framework to design innovative orchard systems towards more sustainability



- ① e.g. cultivar/rootstock and tree architecture
- ② e.g. rows and alleys
- ③ e.g. ground covers, hedgerows lining the orchard



> Beyond eco-design, co-design is an opportunity to involve growers, advisors, scientists... and to renew interactions among these agents through participatory research. This allows for growers to design their own orchard and decisional system in a changing context.

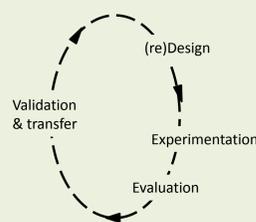
> Orchard systems need to be (re)designed integrating space and time dimensions.

> A transition from the simple improvement loop to a 'nautilus-like' upscaling.

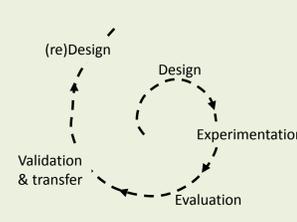
Improvement loop for iterative design of annual cropping systems

Iterative design in an evolutive context...

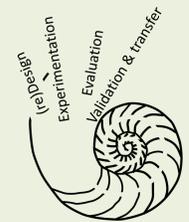
... which takes advantage of the continuous improvement of growers, advisors, scientists knowledge



Elementary loop



Context and orchards are changing along the (re)design process



Each step depends on and benefits from previous steps and requires upscaling within space and time...

More information in:

Debaeke, P., Munier-Jolain, N., Bertrand, M., Guichard, L., Nolot, J.M., Faloya, V. & Saulas, P. (2009). Iterative design and evaluation of rule based cropping systems: methodology and case studies. A review. *Agron. Sustain. Developm.* **29**, 73–86.
Lauri, P.E. (éd.) (2014). Conception de systèmes horticoles innovants. Bases biologiques, écologiques et socio-économiques. Formasciences, INRA, Paris.
Le Bellec, F., Rajaud, A., Ozier-Lafontaine, H., Bockstaller, C. & Malézieux, E. (2012). Evidence for farmer's active involvement in co-designing citrus cropping systems using an improved participatory method. *Agron. Sustain. Developm.* **32**, 703-714.
Simon, S., Brun, L., Guinaudeau, J. & Sauphanor, B. (2011). Pesticide use in current and innovative apple orchard systems. *Agron. Sustain. Developm.* **31**, 541–555.

Acknowledgements

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