Innovation in and for agroforestry

FRUIT-TREES IN AGROFORESTRY SYSTEMS - REVIEW AND PROSPECTS FOR THE TEMPERATE AND MEDITERRANEAN ZONES

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point of view from horticulture and fruit-tree physiology

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Fruit-trees are diversely integrated in agroforestry systems.

 Mostly in the tropics where fruit-trees are integrated in traditional agrosystems.

Cameroon – Cocoa trees associated with oil palm, mango, forest trees.
Much less in the temperate and mediterranean zones where it is considered as non profitable.

EC statistics for 1998:
Agroforestry systems / whole agricultural land: from 0% (Ireland) to 5.4% (Spain) mostly as *silvopastoral systems* (Herzog 1998; Nair 1991).
Several initiatives around the world explicitly integrating fruit-trees. Mostly vegetables & fruit trees with an objective **to decrease** the use of pesticides.

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Vegetables > fruits

Local distribution channel
European programme – CO FREE (Copper Free), 2012-2016.

**Agroforestry systems** as a means to reduce the use of copper:
Silvopastoral systems (trees and livestock)
& Silvoarable systems (trees [fruit, timber, nut etc.] and arable/horticultural crops) (Schmitt 2014).

Eg, apple – *Venturia inaequalis* (Scab).
Playing with lower tree densities.
😊 Fruit-trees as a component in multifunctional agro-ecosystem: USA – “A plan to broaden Midwest agroforestry via tree crops and multifunctional woody polyculture” – Revord et al. 2015

Various combinations of fruit species, with annual plants
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Various combinations of fruit species, with annual plants

Beyond pest and disease issues, can we optimize fruit-tree production in AFS?

Specificities of fruit-trees, especially fresh, compared to annuals and timber trees? The example of the apple
A given **genotype** in a given **pedo-climatic environment** : what are the means to drive **plant architecture and yield**?

**Annual plant**
No manipulation of plant architecture *per se*.
← sowing density which affects tillering.

**Woody plant, timber tree**
Manipulation of plant architecture.
← Planting density.
← Pruning (eg, pollarding).
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1 – The genetics of the plant material –
High diversity of tree architecture

Lespinasse and Delort 1986
1 – The genetics of the plant material –
High diversity of tree architecture ... and functioning

Variability of bearing pattern: irregular vs. regular yield

← biomass allocation to growth and fruiting (+ manipulation).

Monselise and Goldschmidt 1982
The genetics of the plant material –
High diversity of tree architecture

Lespinasse and Delort 1986
The fruit-tree as a composite entity: rootstock + cultivar

Rootstock to control the intrinsic vigor of the tree, growth habit and fruiting precocity, to adapt the cultivar to unfavorable abiotic and biotic environmental conditions.

The genetic variability of both the cultivar and rootstock are efficient means to precisely adapt the plant material to growing conditions.

Lauri et al., 2006
3 – Tree training and pruning – A main issue for the fruit-tree
2 characteristics: Permanency of the fruit-tree (≠ annuals)
Management of the balance between vegetative growth and fruiting (≠ timber trees)

✎ Two main steps in fruit-tree cultivation:
Initial choices: rootstock/cultivar, distances between trees, training (structural framework, height, trellis).
Annual operations: pruning (cutting away portions of the tree to optimize distribution in space: heading cut, thinning cut, renewal pruning).
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Precision branching to balance vegetative growth (source) and fruit (sink) for more regular bearing, and to optimize distribution in space for better fruit quality and less disease – porosity of the canopy
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A same cultivar (*Pink Lady*), same rootstock, same age, but two different tree training and pruning ⇒ obvious differences in yield and fruit quality.
Fruit-trees in AFS – Interests and challenges

AFS microclimate and plant ecophysiology:
In the Mediterranean area, fruit-trees may be subjected to an excess of solar radiation during summer with known deleterious effects on fruit quality and leaf functioning.

In such micro-climatic condition, the use of timber-trees for shade may be a good alternative to shade nets that are commonly used in monocropping orchards.
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**But effects on leaf functioning, fruit-set and fruit coloring?**
Fruit-trees in AFS – Interests and challenges

Biocontrol of pests and diseases:
Annual and perennial plant assemblages as a way to foster
- bottom-up and top-down processes in the food web,
- barriers and dilution effects, to control pests and diseases and to
decrease pesticide use on fruit-trees.

Simon et al. 2015
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Simon et al. 2015
Thank you for your attention

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