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Breeding numerous forestry varieties for agroforestry lines: renewing previous methods

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Context: no improved varieties for most tree species

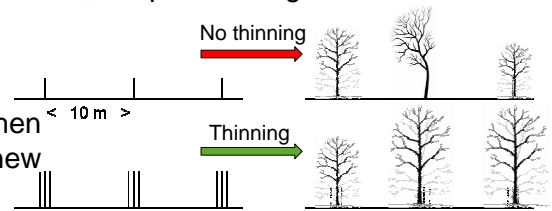
One of the challenges when planting trees in modern agroforestry systems is the wide spacing between plants, allowing few thinning. For most of the tree or bushy species used, the plants are grown from seeds collected in forests, without the slightest level of improvement.

Possible solutions

Short term: ▶ supporting the planting of couples of plants and then choosing quickly the best one to keep: possible thanks to the new regulation for agroforestry that allows to plant up to 200 trees/ha.

▶ planting the very best category for each species: possible as some nurseries sell that kind of plants.

Medium term: develop low-cost seed orchards of numerous bushy and tree species. (developed below)



Intensive selection in private nurseries via participative breeding

Previous studies have shown that as long as the sowing is not dense, the best young plants from nurseries will most generally remain the best at the end.

Participative breeding including most private nurseries draws to very intensive selection: the explored genetic base gathers almost all grown plants.



Low-cost seed orchards designed to reduce risks

▶ Enhanced selection pressure and reduced inbreeding risks by combining in each seed orchard plants selected in several nurseries and during several growing seasons.

▶ A thinning of 1/2 to 1/4 selected plants will assure to keep the very best ones.

▶ Putative seed orchards will finally be accredited after demonstrating that selected plants remain superior when compared to ordinary ones co-planted as controls, and if the orchards have a commercial interest when the trees are matured.

▶ Reduction of the risks for planters: several putative seed orchards per bushy or tree species are planted so that at least one remains in case some selections fail. No grafting is realized so that unaccredited orchards can remain simple productive plantations.

Example of intra orchard combinations (final number of trees 6x8=48 / plantation gap: 1m within a line and 7m between lines)

Plantation / selection in:	Orchard combinations						Highly selected (1/100 to 1/10.000) in nurseries
	1	2	3	4	5	6	○ ▲
2014	○○○○○○○○	○○○○○○○○	○○○○○○○○	○○○○○○○○	○○○○○○○○	○○○○○○○○	○ ▲
2015	△△△△△△	△△△△△△	△△△△△△	△△△△△△	△△△△△△	△△△△△△	○ ▲
2014	△△△△△△	△△△△△△	△△△△△△	△△△△△△	△△△△△△	△△△△△△	○ ▲
2015	○○○○○○○○	○○○○○○○○	○○○○○○○○	○○○○○○○○	○○○○○○○○	○○○○○○○○	○ ▲
2016	△△△△△△	△△△△△△	△△△△△△	△△△△△△	△△△△△△	△△△△△△	○ ▲
2015	○○○○○○○○	○○○○○○○○	○○○○○○○○	○○○○○○○○	○○○○○○○○	○○○○○○○○	○ ▲
2016	△△△△△△	△△△△△△	△△△△△△	△△△△△△	△△△△△△	△△△△△△	○ ▲
2016	△△△△△△	△△△△△△	△△△△△△	△△△△△△	△△△△△△	△△△△△△	○ ▲

Seed zone	1	2
Nursery 1	○ ○	
Nursery 2	○ ○	△ △
Nursery 3		△ △
Nursery 4		△ △

Next selection (1/4) after growing in the orchards ● ▲
Controls: ordinary plants from the same bed than selected ones ○ △

Development and further investigation

Proposed in 2013 by INRA and accepted by the French permanent technical board of selection.

▶ 10 first low-cost putative seed orchards planted in 2014.

▶ Co-decision of the long-range planning of the numerous seed orchards & distribution of these putative orchards among the operators accepting them. Co-construction of agreements & technical regulation texts.

▶ Investigations: best designs, selection efficiency, traceability methods, adaptation of participative breeding database, exchange platform on the Internet.

