

Better forestry trees for agroforestry lines

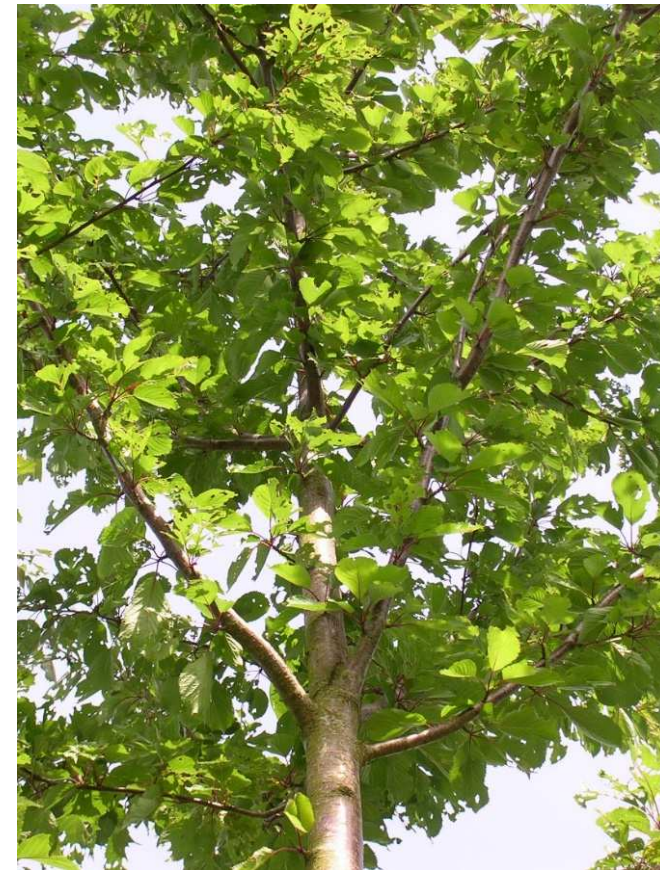
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UMR BioForA Centre INRA Val de Loire

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Few available French angiosperm forest tree varieties to plant on agroforestry lines

- ✓ Seeds of most species are collected in forests, without much knowledge
- ✓ Very few of the best categories: qualified or tested
- ✓ Hybrids: *Populus*, *Castanea*, *Juglans*, *Ulmus*, *Platanus*, *Pyrus* (from Spain)
- ✓ Other clonal varieties: *Prunus avium*, *Populus*, horticultural varieties
- ✓ Seed orchards: *Juglans* x, *Prunus avium*
- ✓ Conservation-oriented seed orchards: *Malus sylvestris*, *Sorbus domestica*

- How quickly increase the number of good varieties ?
- Meanwhile, how improve the quality of the trees ?



Collecting resources for numerous forestry species

- ✓ Goal of 2 seed orchards for each **yet non-breed species**
- ✓ **Low cost strategy**, without selections in forests, graftings or cuttings: selection each year of the very best plants in commercial nurseries, direct plantation in one test, second-stage selection
- ✓ Research based on the collaboration between INRAE (manpower for selection) and forestry nurseries (provide plants, manpower for plantations)
- ✓ The resulting tests will be **at least collections, at best seed orchards**



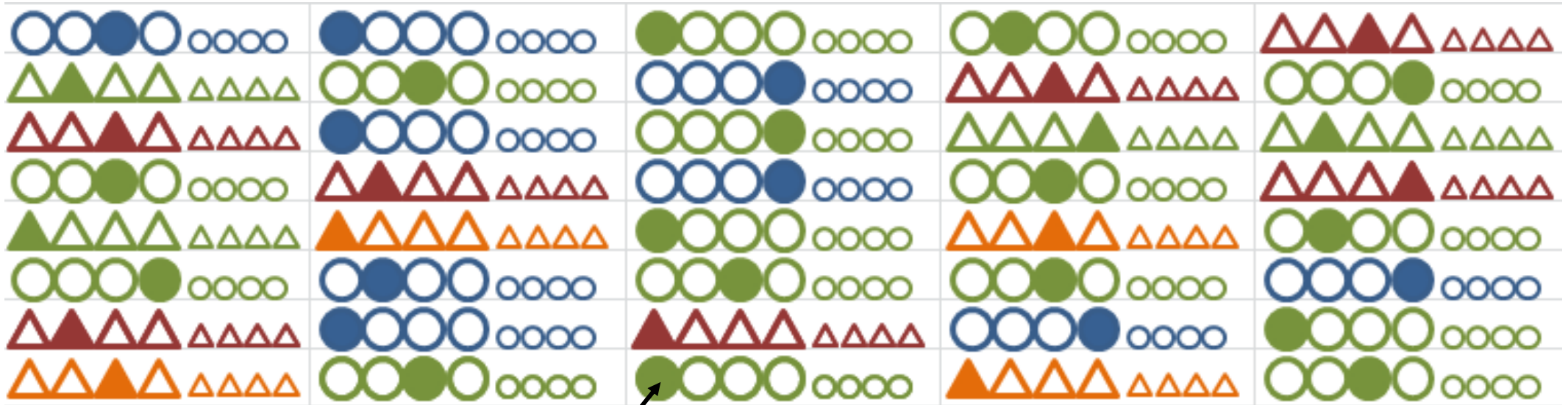
Sorbus domestica, pépinière de Claireau



Castanea sativa, pépinière Wadel-Wininger

Phase 1: one selected plant out of 50 - 10 000 in nurseries

Planted in plots = 4 or 8 selected + 4 or 8 standards



Phase 2: in each plot, one left out of the 4 or 8 selected

Standards and selected are compared, then standards are also eliminated

Sélection intensive (1/100 to 1/10.000) en pépinières	○	△
Puis sélection (1/4) après croissance dans le verger putatif	●	▲
Témoins : plants de catégorie moyenne des même planches	○	△

Zone de provenance	1	2
Pépinière 1	○ ○	
Pépinière 2	○ ○	△ △
Pépinière 3		△ △
Pépinière 4		△ △

23 established tests: 9 filled, 6 almost filled...

But new species and tests yet to begin !

Tests = Seed orchards		Number of 4/8 selected-4/8-standard-plots Plantation distances 1 m x 4 m or 1 m x 8 m - Final distance roughly 8 m x 8 m											Origins
Nurseries	Species	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022+	Objectif	
Crété	Acer campestre					1	7	7	10	16	8	49	ACA130
Wadel	Acer campestre				3	1		7			41	52	ACA901
Naudet	Acer monspessulanum	6	4	3				5	7	6		31	Southern France
Naudet	Acer platanoides	12	7	12	2	1	3	6		2		45	APL901
Crété	Acer pseudoplatanus			12	10	8		2	1	4	9	46	APS101
Wadel	Acer pseudoplatanus				25	8	16	6				55	APS200-500
Crété	Alnus cordata					6	2	3	6	5	29	51	ACO901
Naudet	Alnus glutinosa	9	4	16	4	9	4	3		1		50	AGL130-901
Claireau	Alnus glutinosa			12		2		7	8	5	2	36	AGL130
Crété	Betula pendula			3	2	10	1	5	2	13	9	45	BPE130-901
Crété	Carpinus betulus			8	4	17	8	13				50	CBE130
Crété	Castanea sativa			23	23	46	35	24	24	13		188	CSA101-102-201
Crété	Corylus colurna								9	6	30	45	Europe
Crété	Fraxinus ornus			12			3	2	1	4	16	38	Italy France
Crété	Gleditsia triacanthos								3	1	32	36	Europe
Crété	Malus sylvestris					3		4	5	14	5	31	MSY901
Crété	Pyrus sylvestris					4	2	23	3	11	3	46	Western France
Crété	Quercus pubescens							10	18	30	16	74	QPU360
Claireau	Sorbus domestica			16	5	9	3	14	5			52	SDO900
Naudet	Sorbus torminalis	8		14	11	16	4					53	STO901
Crété	Sorbus torminalis					9	15	12	12	1		49	STO901-902
Crété	Tilia cordata			4		12	6	6	9	6	5	48	TCO130-200
Naudet	Tilia platyphyllos	6	2	17			4	2	2	2		35	TPL901 Europe

Perspectives

- ✓ In some cases, plots have been cleared and replaced
- ✓ Heights measured in 2020 in oldest plots: generally, selected > standards
- ✓ For several species, planned genetic testings with microsatellite markers to detect individuals of the same families thus avoiding consanguinity while thinning
- ✓ New species added each year

	T	T	T	T	C	C	C	C	moyenne T	moyenne C
CBE29	230	200	200	195	245	260	245	200	206	240
CBE30	190	216	200	216	270	270	220	210	207	252
	230	165	214	180	220	270	250	250		
	210	180	230	250	270	280	265	210		

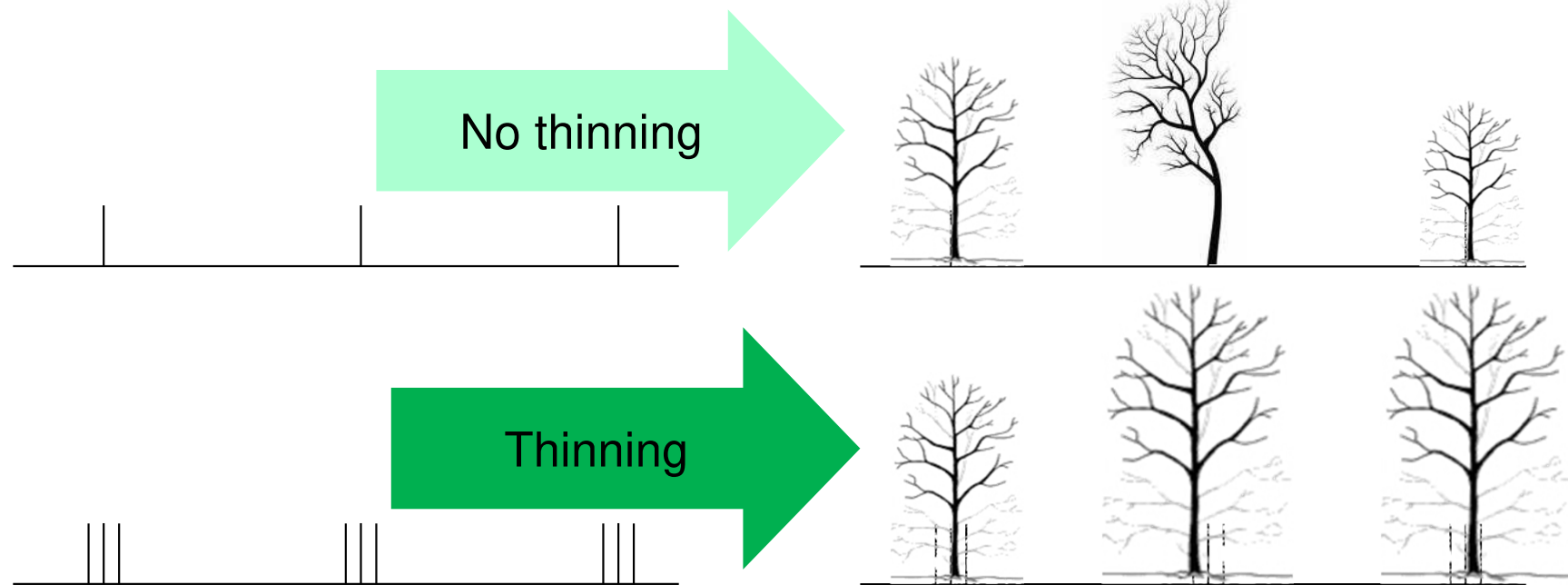
	C	C	C	C	T	T	T	T	moyenne C	moyenne T
CBE03	290	285	250	310	280	240	255	230	287	257
CBE04	320	300	260	280	245	225	270	310		
	245	280	250	200	210	220	245	215	243	209
	244	175	280	270	204	232	216	130		

	C	C	C	C	T	T	T	T	moyenne C	moyenne T
APS01	310	291	229	290	206	212	200	200	259	203
APS02	212	270	254	215	222	204	210	170		
	246	220	199	113	164	179	190	245	204	164
	240	212	240	164	190	150	134	62		

	C	C	C	C	T	T	T	T	moyenne C	moyenne T
CSA06	270	235	260	300	175	175	203	250	281	215
CSA05	340	270	270	300	245	230	225	-		
	290	290	290	265	270	245	260	221	299	264
	300	340	280	340	270	280	-	300		

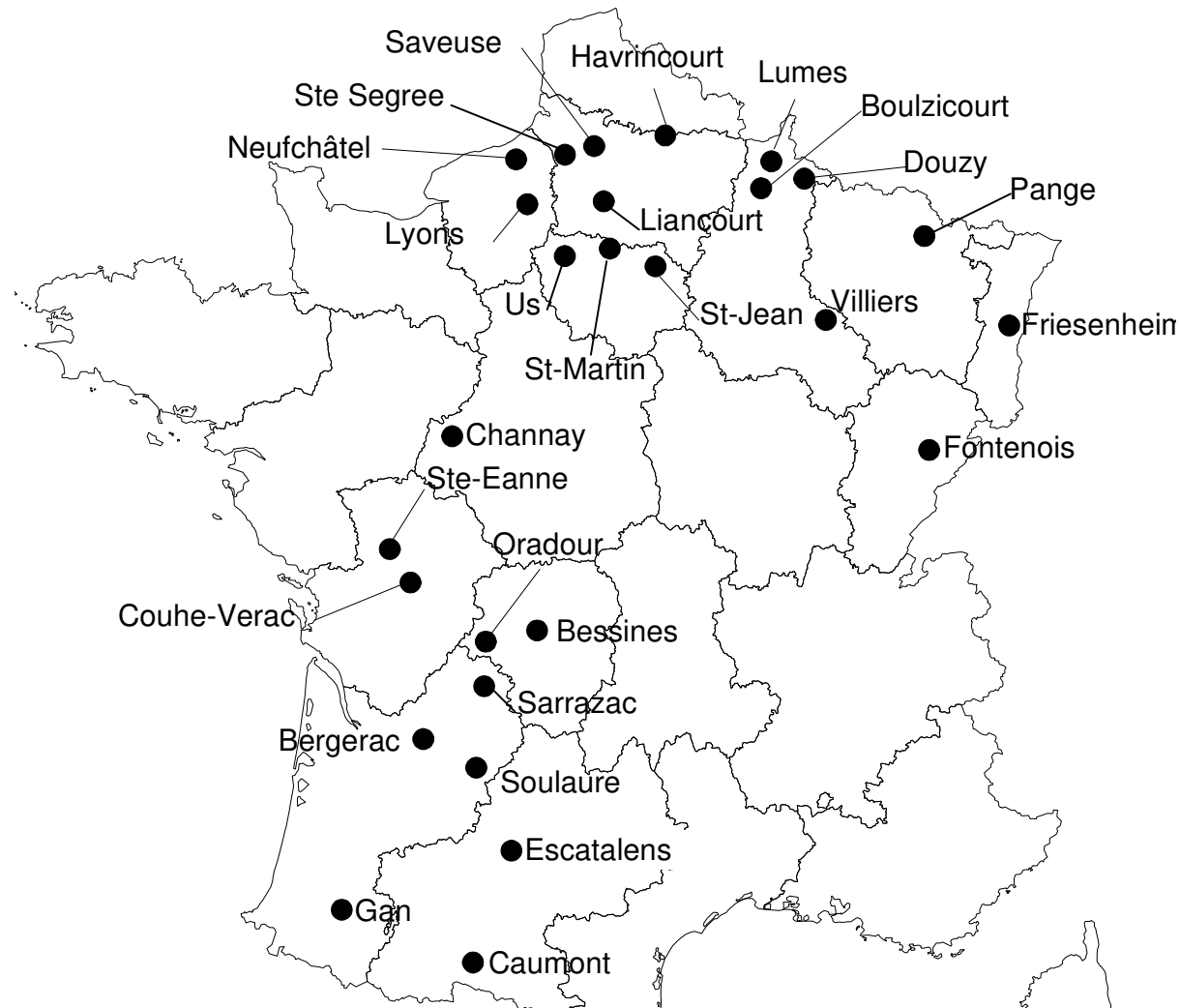
Encourage thinning to improve the quality

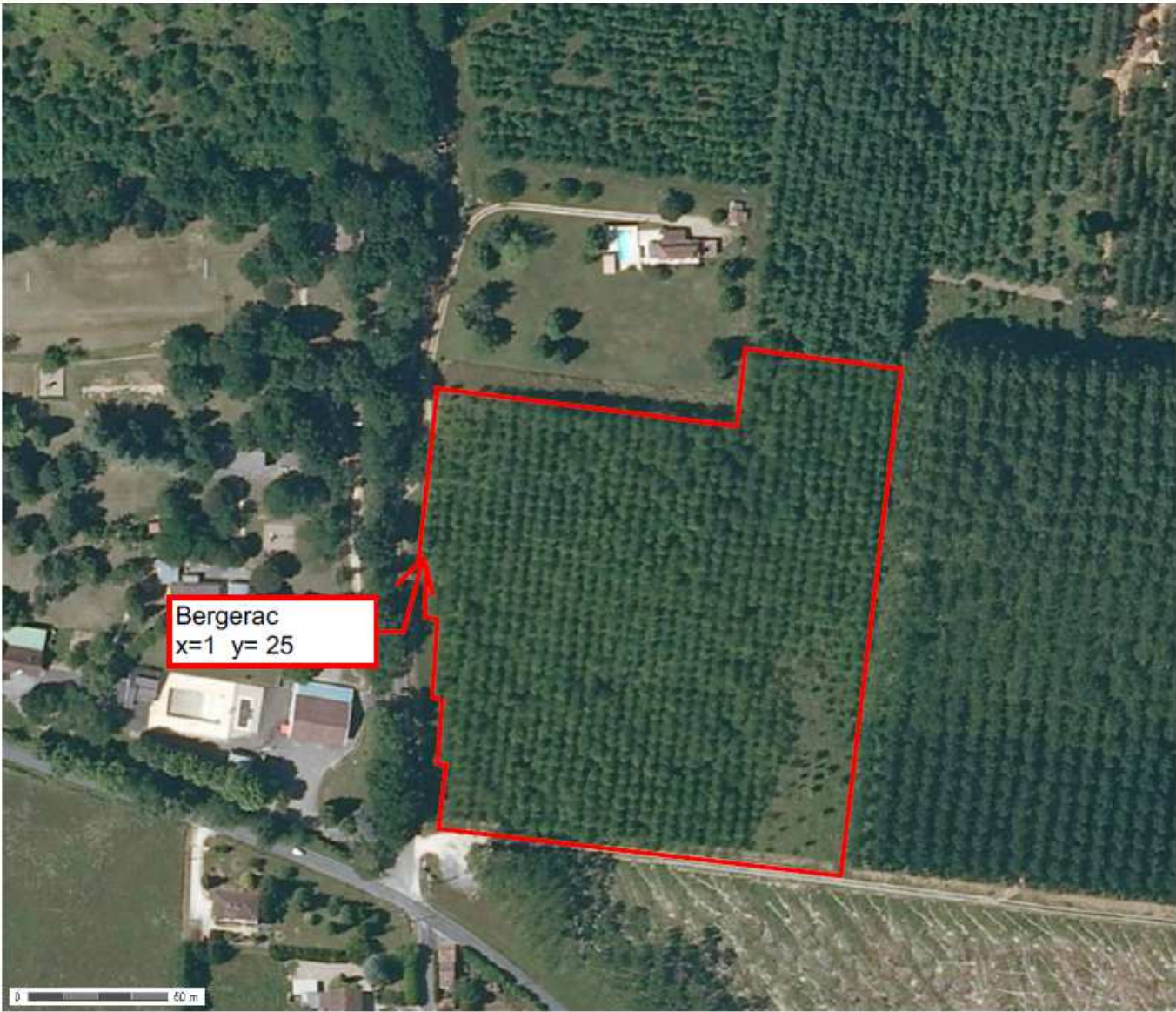
- ✓ Average planting density is usually **1 tree for each 8/12 m** agroforestry sequence
- ✓ Densification is directly tested in agroforestry lines, for example in INRAE Lusignan, though trees are yet too young for an estimation of differences between densified/simple plantations
- ✓ Simulation has been used to show the possible economic gains



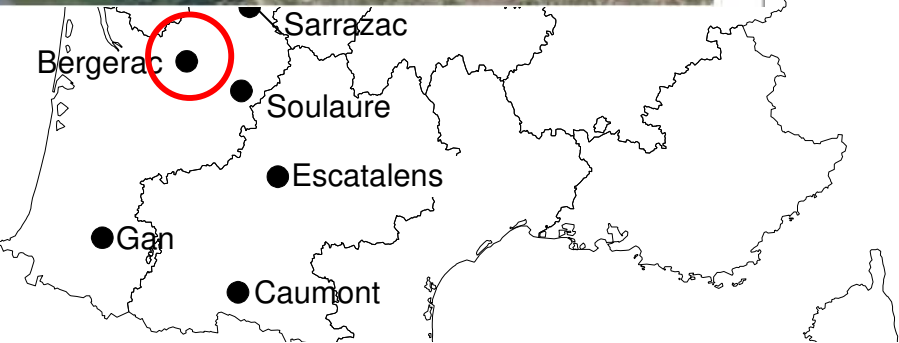
Possible use of old wild cherry genetic tests

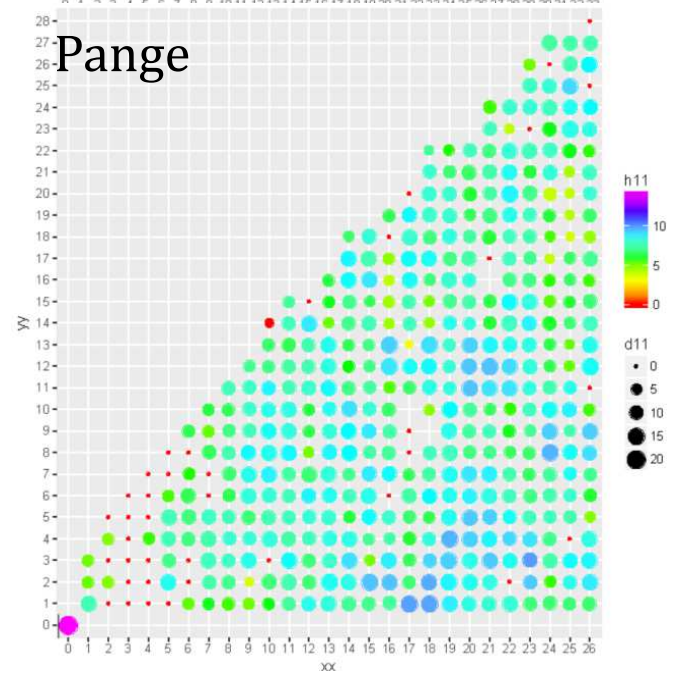
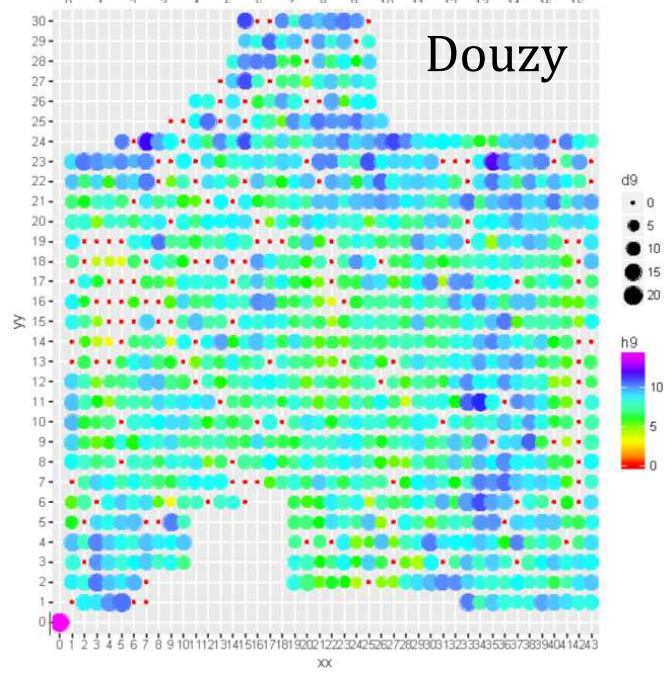
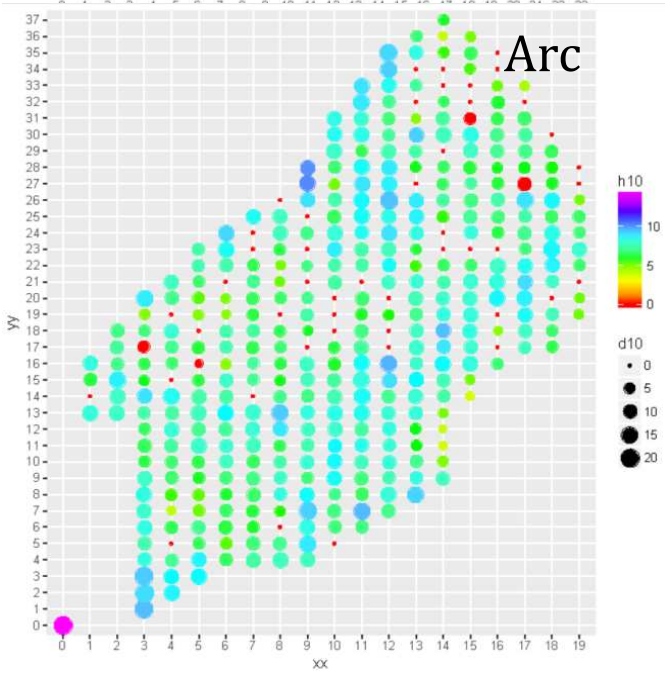
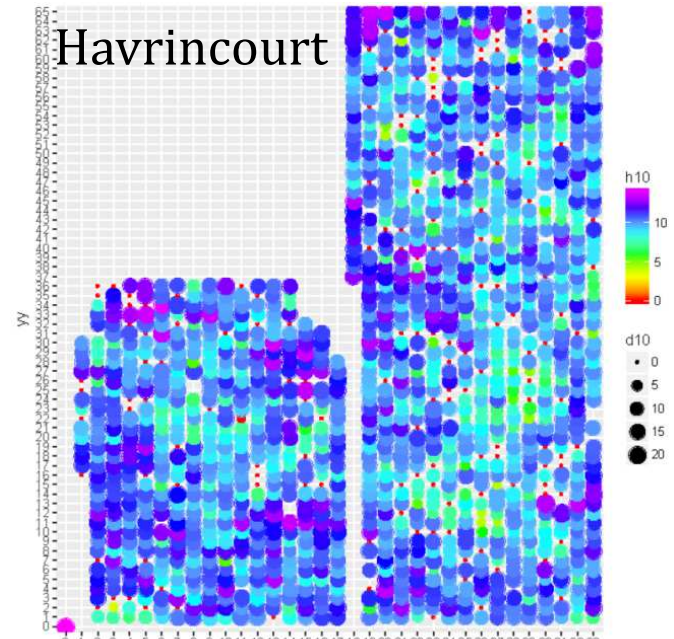
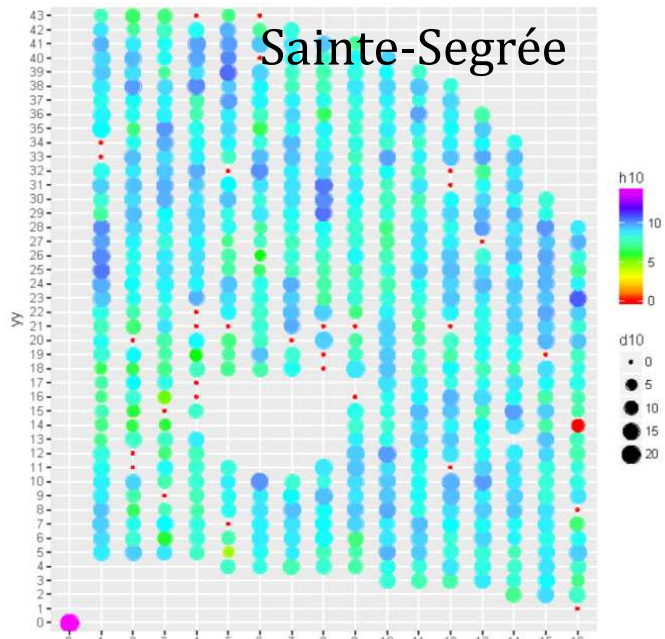
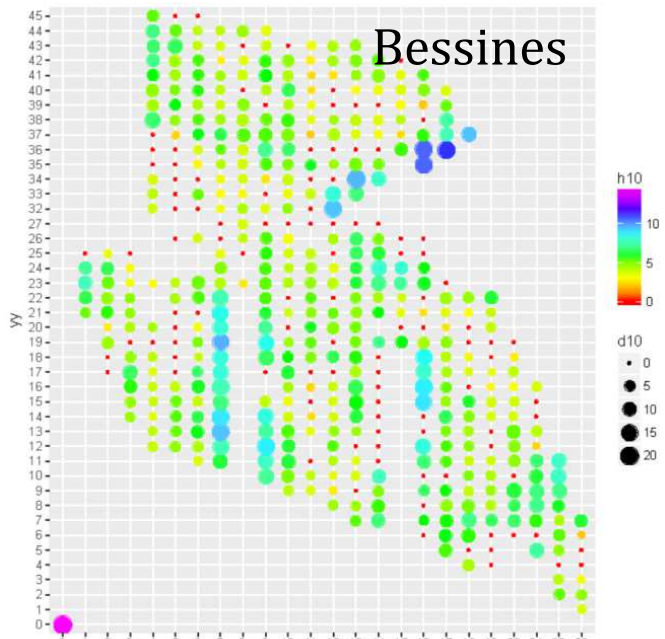
- ✓ Initial gathering of the wild cherry collection resulted in numerous clonal tests
- ✓ Growth measures from 0 to more than 15 years after plantation





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Pange
● Friesenheim
ntenois



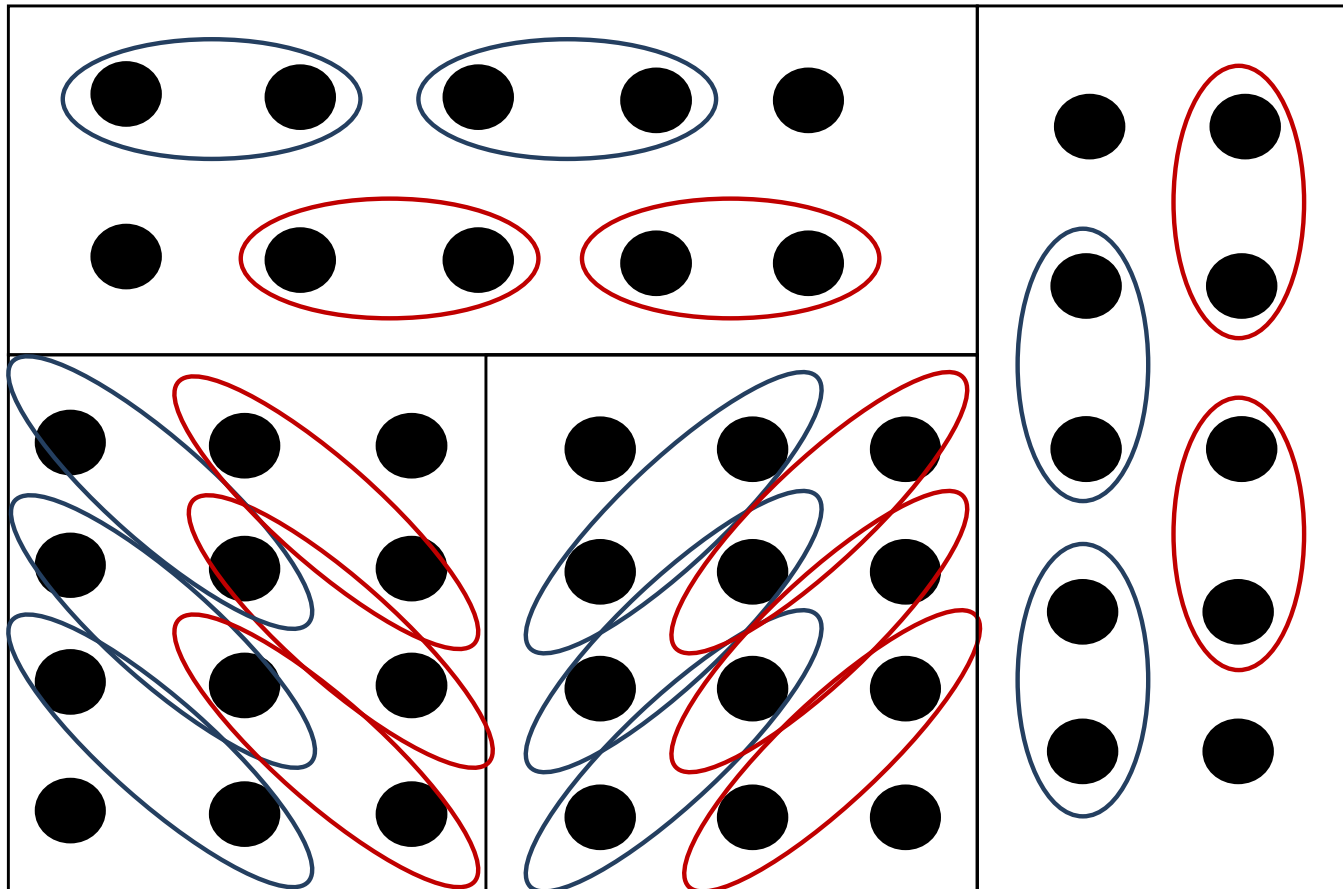


Simulation method





- ✓ Group trees in continuous **couples (ou trios)**

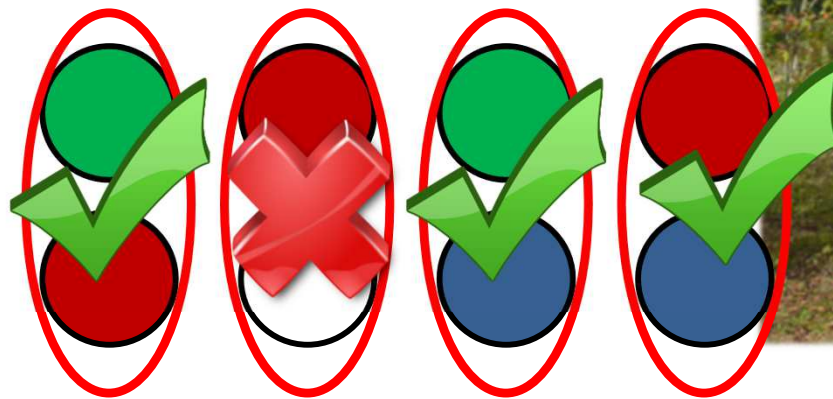
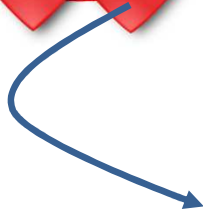


- ✓ **Simulate** the choice of the better of each group, on the basis of 5-year-old diameter: densified reference
- ✓ **Sampling** one tree inside each group: simulation of undensified plantations
- ✓ **Compare** the 15 year-old growths between densified/simple plantations, and using linear projection, the 40 year-old growths

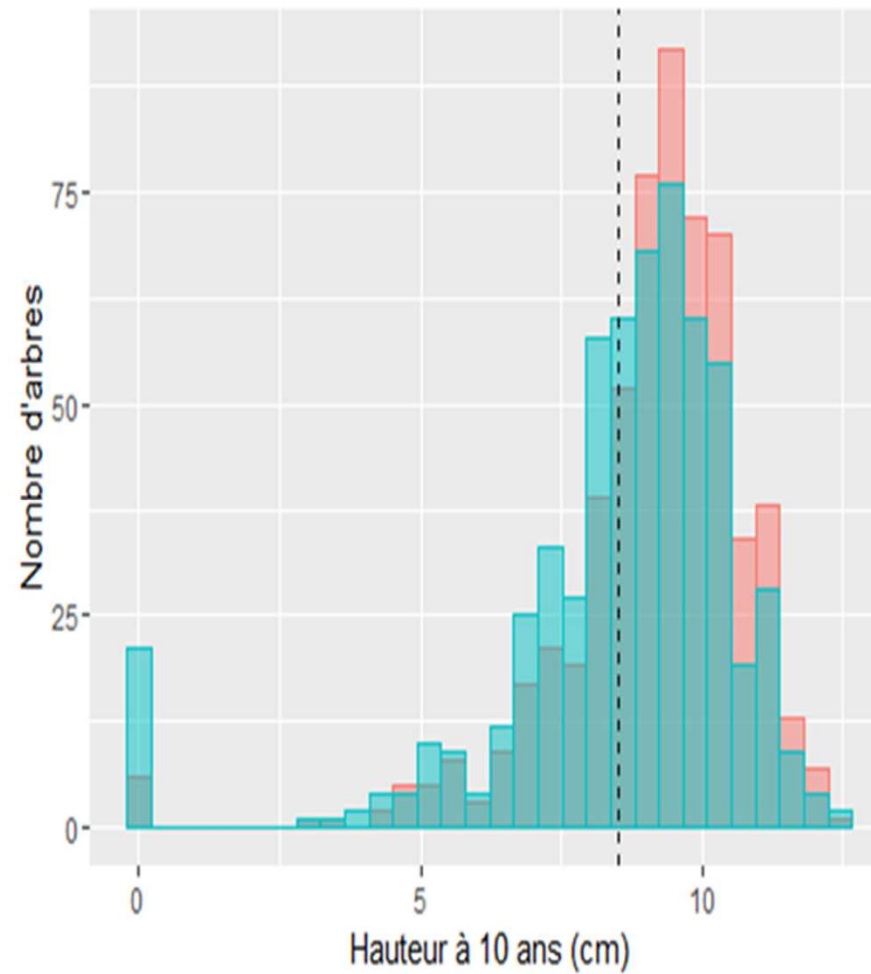




-  No tree
-  Clone A
-  Clone B
-  Clone C

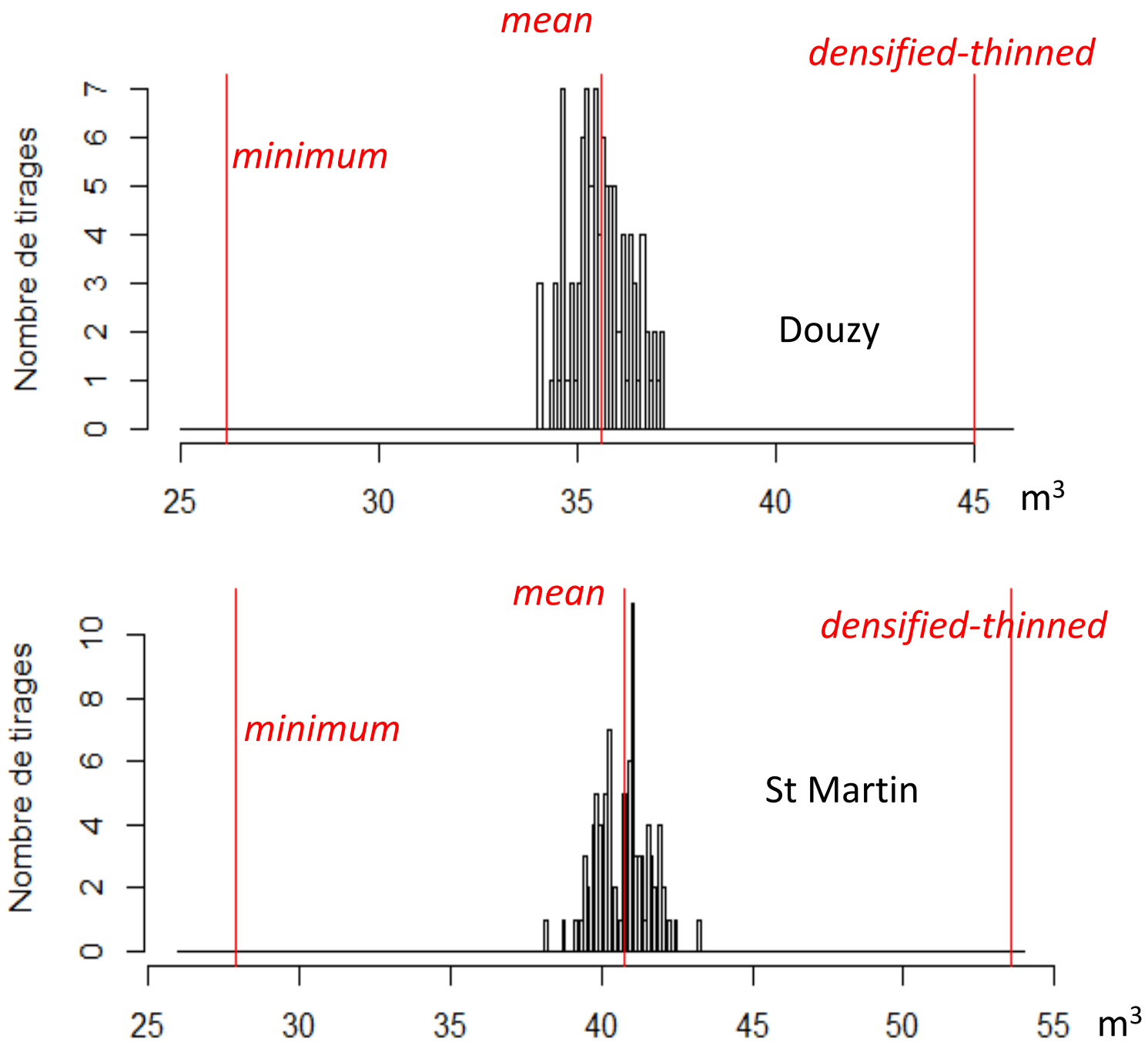


First gain: pruning finished ealier



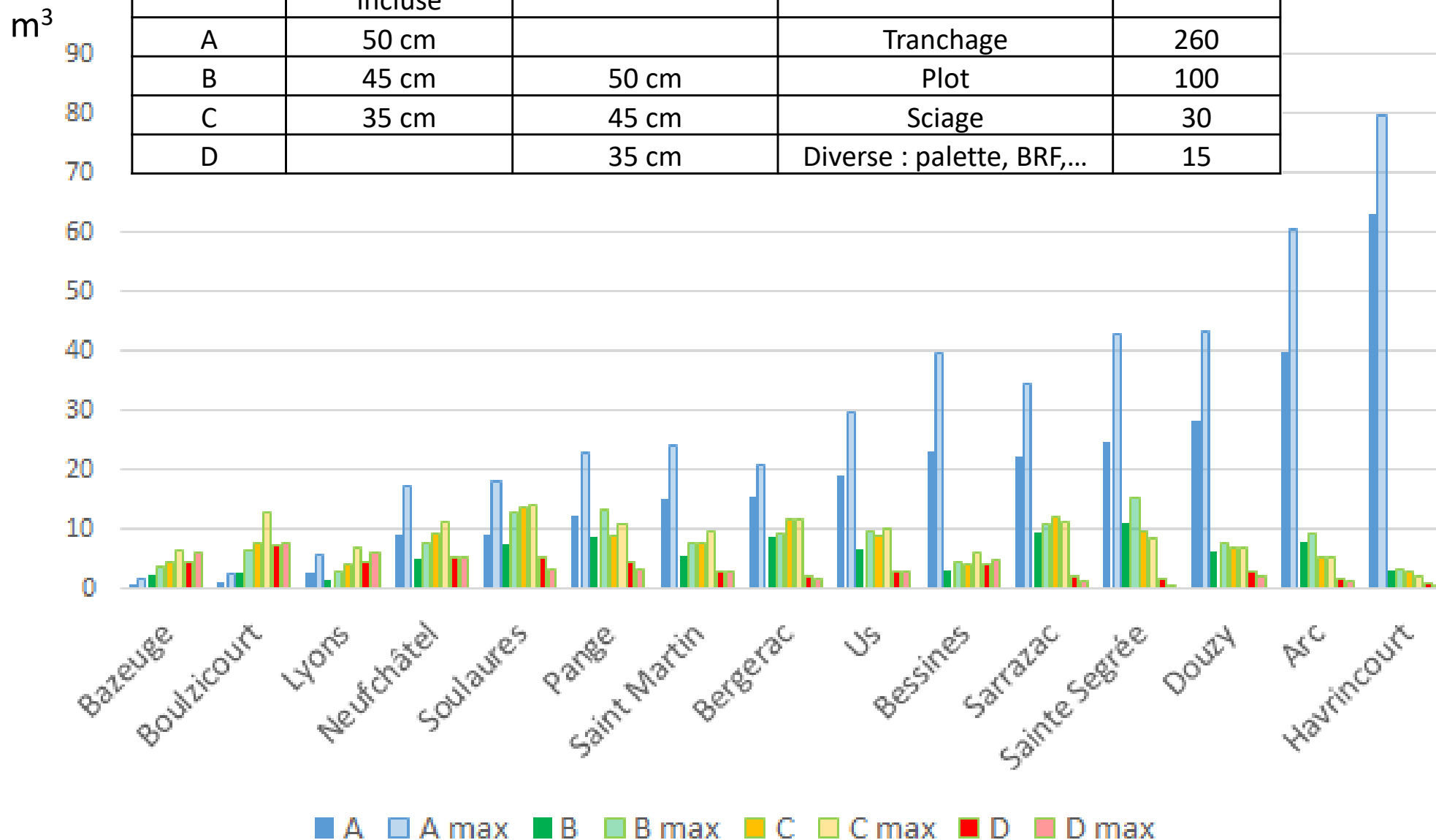
..... = 8.5 m (finished pruning) 10-year-old height, Bergerac
Undensified Densified-thinned

Far more total 15-year-old wood volume (5-meter-trunk) for the densified-thinned reference, whatever the test



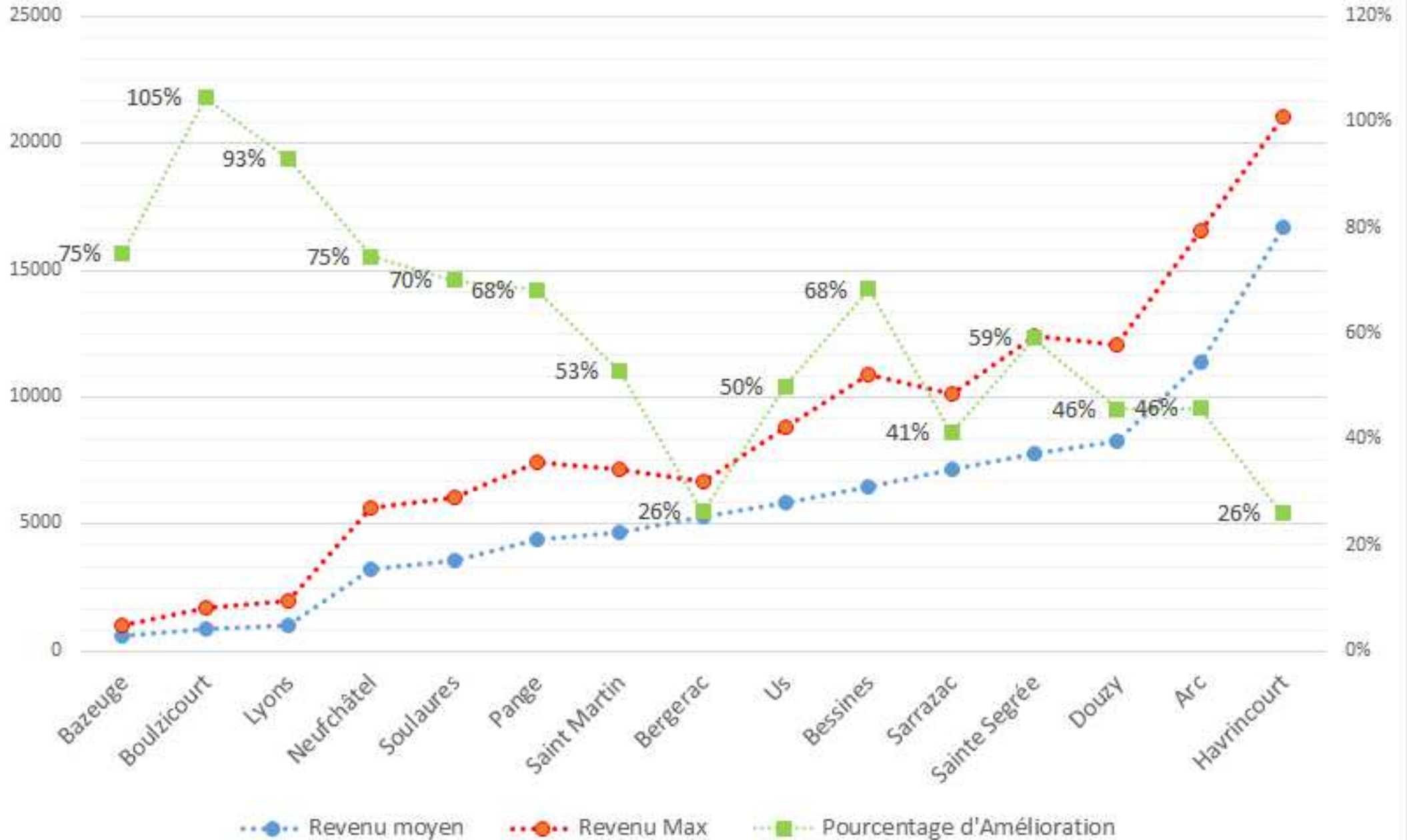
40-year-old wood volume (5-meter-trunk): most impact on the better class A

Catégorie	Diamètre borne inférieure incluse	Diamètre borne supérieure exclue	Utilisation	Prix (€/m ³)
A	50 cm		Tranchage	260
B	45 cm	50 cm	Plot	100
C	35 cm	45 cm	Sciage	30
D		35 cm	Diverse : palette, BRF,...	15



+ no replanting, less pruning years, earlier crop
 - 600 € more per ha from 50 to 100 plants/ha density

Euros/ha



Thank you !

