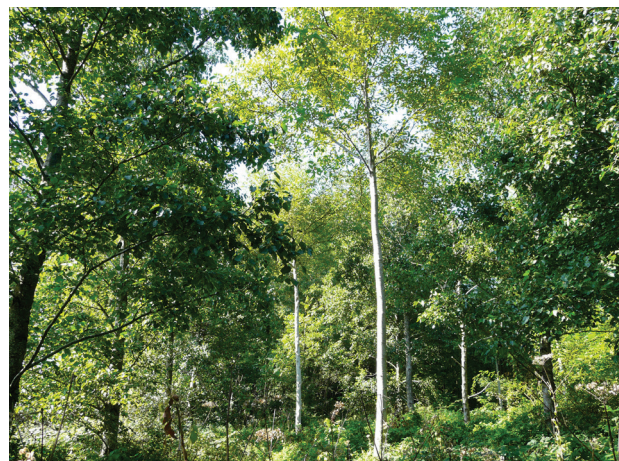


Composition of the plantation : For what mature stand ?

Jacques Becquey, CNPF-IDF

Once the species and plantation scenario are chosen, the way the seedlings will be established on the ground should be considered. The species distribution and spacing between seedlings will affect the operations to be carried out during the life of the stand.



*Hybrid walnuts mixed with italian alder (alternating rows) ;
14 years.*

Layout of seedlings: general principles

Both in single-species and mixed plantations, a few simple principles can assist in post-planting care and improve the chances of success.

The cost of works can be reduced in several ways:

- simplifying planting by avoiding complex planting schemes. This is not incompatible with the use of several species or anticipating future interventions (maintenance, thinning, etc.), but the schemes should be set out as simply as possible in planting instructions, e.g. planting accompanying species in odd-numbered rows and main species in even-numbered rows, etc.
- mechanising and rationalising maintenance by providing enough space between rows for equipment to pass through. For high-density planting, plants should be spaced at no less than 3 m apart. For low densities, a multiple of the width of the equipment can optimise the number of interventions.
- diminishing the time required to pass through the plantation for a gi-

ven planting density by reducing the number of rows per hectare, with the spacing between rows greater than between plants in a row. The distance, and hence the time required to move around the plot for trimming and pruning operations can then be significantly reduced. The impact on costs is particularly significant for low planting densities. For example, a density of 200 seedlings/ha spaced at 10 m x 5 m saves about 30% of the distance to be travelled as compared with square 7 m x 7 m spacing. Rectangular spacings also facilitate marking for the first thinnings.

Facilitating the timber harvest

Marking, felling and skidding the timber are facilitated by tracks or extraction rides: conspicuous, sufficiently straight and regularly laid out. Rides also restrict the extent of damage caused by machines to the ground and to the trees and preserve the rest of the stand. Spacings of about 18 to 25 m between rides are sufficient. When the spacing between rows is less than 4 m, rides should be cut at the time of the first thinning by felling

a complete row. In this situation, it is advisable to plan the ride layout at the time of planting, so as to avoid placing species intended for the mature stand in the rows to be removed and to save investment on individual protection, trimming and pruning.

Anticipate the development of the stand

If you wish to keep a mixture of species with different ages of maturity, such as oak and wild cherry, the latter should be planted in clusters of a few hundred square metres. Thus, after harvesting, it can regenerate naturally among the oak trees. If established as isolated plants, the oak canopy will close above the location vacated by the felled tree, preventing natural regeneration. Poplar trees must be spaced widely enough to allow their development up to the timber stage and to ensure that the associated species can withstand their lateral shelter or their instantaneous cover. In all cases, planting in clusters or rows must allow easy felling and extraction with a minimum of damage to the rest of the stand.

Composition of the plantation and layout of the seedlings

Two main criteria determine the way the plantation is organised:

- **The composition of the mature stand:** is the aim a single-species stand or a mixed stand?
- **The type of post-planting care considered.** This determines the density of the plantation and the possibility of using accompanying species.

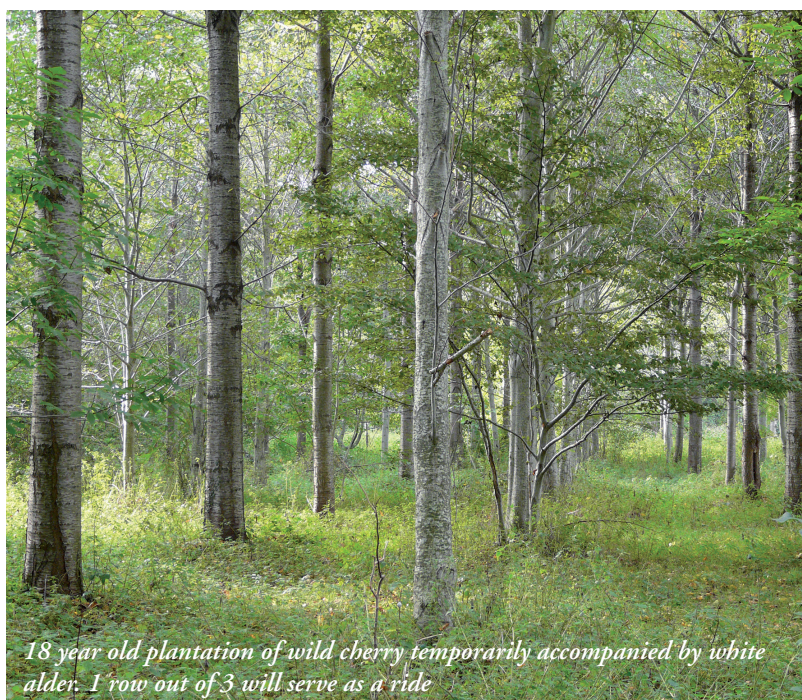
Types of post-planting care are divided into the following groups

(see sheet about «density and scenario») :

- **Intensive** (arboricultural profile) or **inter-mediate** (active forest management profile): regular post-planting care must be ensured **for 12 to 15 years, with interventions every year or nearly every year** to perform various operations (initial maintenance followed by trimming and pruning).

- **Light** (classic forestry profile): after the first few years of maintenance, **more sporadic post-planting care** is possible with operations at greater or lesser intervals to ensure trimming and pruning if necessary.

Other criteria, such as the cost of the seedlings or their vulnerability to animal damage (and hence the cost of protection) can also influence the choice of composition.



18 year old plantation of wild cherry temporarily accompanied by white alder. 1 row out of 3 will serve as a ride

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The table below summarises the main options detailed in the following pages.

Which plantation for what mature stand ?			
Desired mature stand	Type of post-planting care	Possible types of plantation	Other selection criteria
single-species	intensive or intermediate	Low-density single-species plantation	Ease of establishment
		Temporarily mixed plantation with quick-growing species (intermediate production)	Reducing establishment costs
	light	Single-species plantation, medium to high density	Use of cheap seedlings
		Medium or high density plantation with temporary accompanying species	Ease of establishment
mixed	intensive or intermediate	Mixed low density plantation (at least 2 main species); variable details.	Use of cheap seedlings and/or species not vulnerable to animal damage.
			Reducing establishment costs
	light	Mixed high density plantation (at least 2 main species); variable details.	Reducing the health risk for certain species and adequacy of the species to the local soil/ground conditions.
		Mixed high density plantation (at least 2 main species), with accompanying species.	Use of cheap seedlings
			Reducing risks related to parasites and soil/ground variations.
			Cheap seedlings
			Use of social species, not sensitive to health risks and animal damage.

NB: this only concerns tree species. Although shrubs may be beneficial in the early years, they often become troublesome and costly to eliminate at the time of the last pruning and during subsequent operations. For these reasons, they have not been dealt with here.

Objective: single-species noble or precious timber stand

→ The final stand will consist of only one precious or noble species.

Why?

- To facilitate establishment and post-planting care.
- To obtain homogeneous products

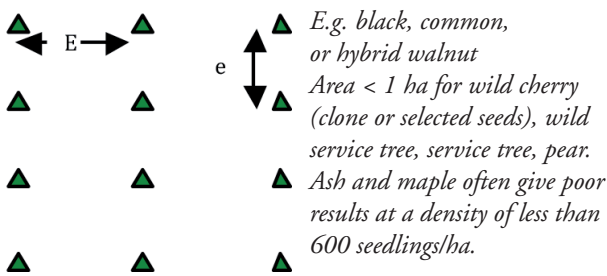
How?

- The easiest option is a single-species plantation
- All planting densities are possible

Low or very low planting densities are best suited to intensive (arboricultural) **or intermediate** (active forest management) post-planting care.

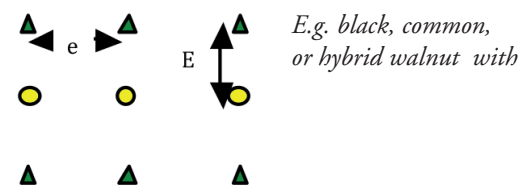
On adequate sites, a temporary mix with poplar as a source of production can also be a solution.

Single-species «timber orchard»-type plantation, (very) low density (100 to 600 stems/ha)



E: 4 to 15 m - e: 4 to 10 m - regular post-planting care over +/-15 years required (hence more appropriate for smaller areas). For rows at least 12 m apart, this could be appropriate for agroforestry plantations

Very low density plantation (150-250 stems/ha) in a temporary mix with a short-rotation species

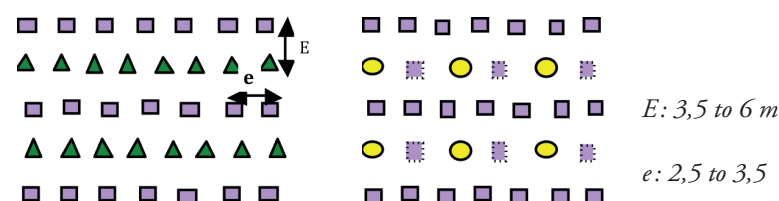


*E: 7 to 10 m
e: 6 to 8 m for poplar & 4 to 6 m for walnut.
Regular post-planting care +/-8-10 years required + several years after cutting the poplar.
Can be appropriate for agroforestry plantations*

For lighter post-planting care (classic forestry), it is preferable to establish one or more quick-growing accompanying species temporarily. Protection costs can be reduced if these species are not sensitive to animal damage.

Planting the target species at a high density is a possible option for cheap seedlings.

Plantation temporarily mixed with an accompanying tree species



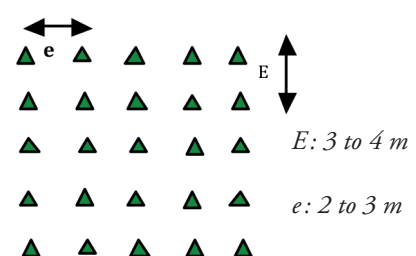
Method A
▲ = social species, e.g. walnut, ash, maple

■ = accompanying species
e.g. alder, birch, locust tree.

Method B
● = scattered or expensive species, e.g. wild cherry, service tree, wild service tree, pear, etc.

■ = optional

Single-species high-density plantation (cheap seedlings)



E.g. black walnut, ash, maple, oak, etc. Wild cherry (ordinary seeds) over small areas.

For temporary mixing, the rows of main species can be spaced 10 - 15 m apart with several rows (strip) of the accompanying species planted between them. Once their role of protecting and training the main species is accomplished, the latter can be harvested for fuel wood and industrial timber.

Important...

The target species must be well suited to the site, which must be sufficiently homogeneous. There may be health risks for fruit trees (scattered among natural stands) in a single-species plantation. It is therefore best to plant on small areas of less than 1 ha or even 0.5 ha. If the site is average or at the limit of suitability for a strongly-desired species, a mixture should be used with at least one other species better suited to the site (see below).

Objective: a mixed stand of noble or precious species

→ The final stand will be composed of at least two main species

Why ?

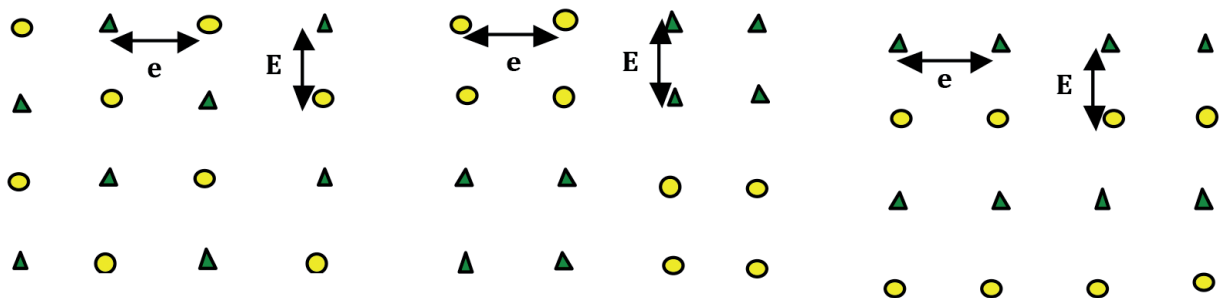
- To diversify the products, «not putting all one's eggs in one basket». Possibly to adapt felling stages to the market.
- Except in some cases, to reduce health risks.
- To improve flexibility in terms of recovery and growth of the plants on heterogeneous sites.
- To reduce the cost of protection against animal damage; some less vulnerable species can be left unprotected.

How?

- Several main species are established at the beginning of the plantation, with or without accompanying species. The plantation is managed to maintain the mixture over time.
- Various plantation densities can be used.

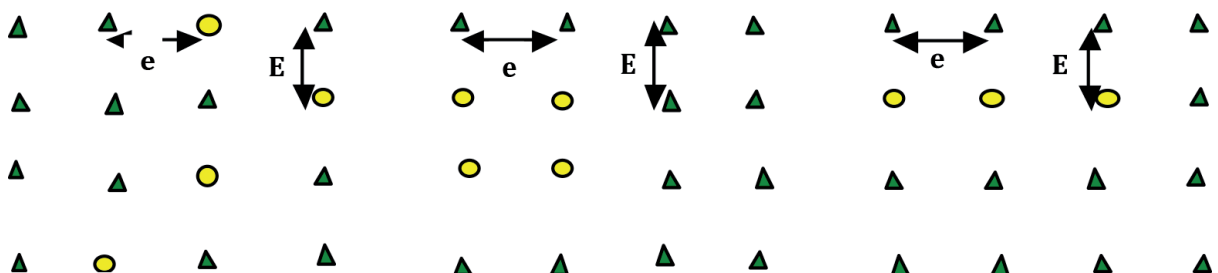
Under intensive (arboricultural) **or intermediate** (active forest management) post-planting care, low or very low densities are best suited. Only the target species are established in the mix.

«Timber orchard» plantation type, (very) low density (100 to 500 stems/ha) and mixed. Different mixing patterns laid out regularly: plant by plant, clusters, rows (2 species)



Examples of mixtures: over small areas, some fruit trees together (wild service tree, rowan or wild cherry, etc. with walnut) or larger areas with more social species (maple, ash, oak, beech, etc.).

«Timber orchard» plantation type, (very) low density (250 to 500 stems/ha) and mixed. Different mix patterns laid out irregularly and not balanced (one dominant species and one scattered species), plant by plant, clusters, rows (possibly sequenced) according to type



Examples of mixtures: scattered fruit trees (service tree, rowan, wild cherry, pear, apple) mixed with a more social dominant species (maple, ash, oak, etc.).

For the two diagrams, E: 5 to 14 m and e: 2.5 to 4.5 m

Regular post-planting care over +/- 15 years is required (hence preferably over relatively small areas).

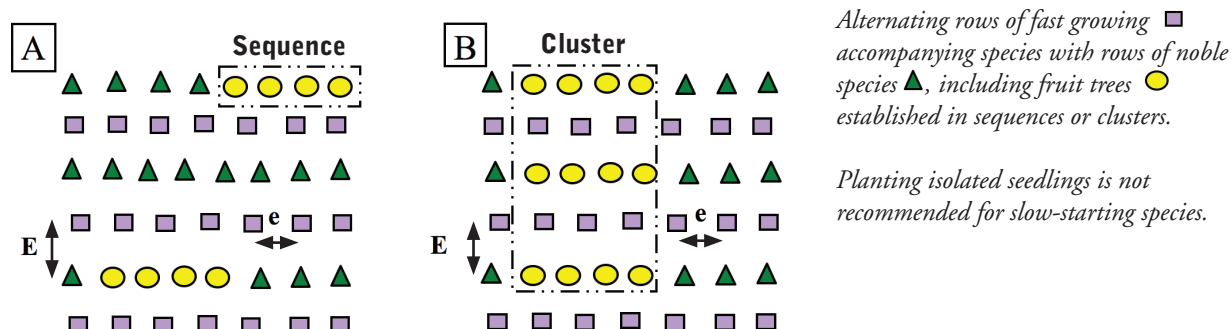
With rows spaced 12 m or more apart, this could be appropriate in agroforestry plantations

Clusters: the example shows squares of 4 seedlings, but the number of seedlings may be higher and the cluster can be rectangular in shape.

For lighter post-planting care (classic forestry), a high density including only the target species is possible. However, this method often causes technical problems at the time of the first thinnings (occasionally difficult choices, rides) and financial problems due to the need for protection against animals damage (for all seedlings). Possible methods are the same as for low densities (see figures 5 and 6, taking $E = 3$ to 4 m and $e = 2$ to 3 m (preferably choosing an overall density of between 900 and 1 300 seedlings/ha).

However, it is often preferable to establish a mixture with the target main species and one or several temporary species to accompany the former.

Mixed high density plantations comprising two main species, (one dominant and one scattered) and an accompanying species. The scattered species is laid out in sequences in method A and in clusters in method B.



For the two diagrams, E : 3 to 4 m and e : 2 to 3 m

Clusters: the example shows a rectangle of 12 fruit tree seedlings, but the number of seedlings can be higher. The shape of the clusters can also be square.

The rows of the main species can be widely spaced (10 - 15 m) with several rows (strips) of the accompanying species planted between them. One of the rows in each of some of these strips must be felled in the first thinning to form rides.

Important...

Establishment and post-planting care are more delicate than for a single-species plantation.

Heterogeneous growth can lead to an irregular stand. This may be the desired result, but the heterogeneous nature of the future products can sometimes complicate marketing.

Future extraction rides should be planned along rows of secondary species that will be felled during the first thinning.

