Choice of species :
Possibilities offered by the site ?

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The choice of species determines the success of the plantation. They must be well adapted to the site where they will be located. If not, they may grow at best for a few years before withering.

Growers must begin by identifying the site potential (with professional advice if necessary), as the site determines the choice of the species, the establishment methods and even the nature of postplanting care for the plants. Once the appropriate species are listed, growers can then classify them according to their expectations and objectives. Their final choice of species will then best correspond to the desired mature stand type.

To produce big quality timber with valuable broadleaves, the site must be well adapted

Identifying and listing species

All species have specific requirements for becoming established and growing properly, corresponding to the characteristics of the environment where they occur naturally. Foresters need to know these requirements, summarised in various documents or sheets1[1] describing the autecology of the species. These are based on the results of studies conducted on their behaviour, observations and various measurements of their growth and qualities.

Introducing a species in the field requires careful site assessment to ensure that its characteristics are appropriate for the species. This is particularly important in an agricultural environment without existing trees that could provide guidance.

Site diagnosis

This involves collecting and analysing the climatic, topographic, geological and soil characteristics of the planting site.

The table on the next page shows a list summarising these factors and how they can affect the outcome.

Numerous other reference publications are available on this topic for further details.

1) See the tree species autecology sheets (Wild cherry, wild service tree, walnut, etc.) on www.pirinoble.eu and also disseminated in Forêt-entreprise.

The species that appear best adapted to a future plantation can be listed by analysis followed by comparison of the site characteristics with the species requirements.
Site catalogues, available in most regions, are useful tools for determining usable species.
Predicted changes should, however, be taken into account when drawing conclusions.

***Recommendation** : After checking that the planned site is comparable, it is helpful to observe the woods or hedges near the future plantation: the quality and growth of the species growing there can provide a good indication of the potential of the site and of appropriate associations for a possible speciesmix.*

Classifying species according to their role

Among the species considered suitable for the site, several groups can be identified on the basis of the grower's objectives, the importance of various factors (climate, health, etc.) or the role they might play.

Timber production[2]

The main species, sometimes referred to as noble species, are generally valuable economically and the main objective of production from the stand is based on them.
These include :
- Scattered species in their natural (asocial) state, i.e. mixed with other species. These frequently have a high economic value due to their highly prized timber and are thus referred to as valuable or precious species.

Examples include the wild cherry, wild service tree and pear tree.
- Social species that can naturally form extensive single-species populations.
Examples include oak, beech and pine.

Accompanying species, sometimes referred to as accessory or secondary species, are associated with the main species. These essentially play a cultural role. Examples include birch, hornbeam, lime, alder and willow.

Occasionally, when they locally replace a missing or poorly formed main species tree, these can have a production role and be treated as main species.

Sensitivity to various hazards

Growers wishing to plant one or more high-risk species with regard to particular factors may find it beneficial to mix them with other species that are insensitive to the same factors.

Table 1 stand diagnosis

	Main characteristics to be studied	Use	Effect on the trees
climate	- Average and extreme temperatures - Average rainfall and monthly distribution - Early frost (autumn) and late frost (spring) - Prevailing winds and exceptional winds	- Study of annual and interannual variations - Characteristic or index (R-PET...) calculations - Risk assessment	- Threshold of resistance to temperature extremes and water deficit. Varies between species - Effect of rainfall distribution on water supply and growth - Mortality, sun scald, fire, frost crack, deformities and damage to the timber, snapping, uprooting, etc.
Topography	- Altitude - Location, aspect, gradient	- Adjusting climate data that do not always take into account the aspect or the precise altitude (due to the distribution of weather stations); - Drainage	- Limits of vegetation - Influence on tree phenology and growth.
Geology	- Bedrock	- Richness of the soil - Behaviour to water	- Nutrition - Water supply
Soil (different horizons)	- Thickness - Texture (fine and coarse grained components) - Structure (arrangement of particles or aggregates) - Presence of limiting factors : waterlogging due to excess water, lime, etc. - pH (acidity) and chemical richness	- Water reserves, - Porosity (water and air circulation), risk of compaction - Temporary or permanent soil waterlogging - Evaluation of richness (possible analysis to clarify the observations)	- Potential for root development - Biological functioning of the soil - Risk of root asphyxiation ; - Anchoring, wind resistance ; - Tree nutrition and water supply

2) Most of the definitions are from Bastien Y. and Gauberville C. 2011. Forestry vocabulary. 554 p + appendices.

Table 2 : Examples of choices or possible associations for single-species or mixed stands (for sites assumed to be appropriate)

Desired final population	Plantation		
	Type of plantation	**Composition examples**	**Comment**
Pure	- single-species	Walnut, wild cherry, oak	Each single species covering at least ½ ha (cluster) or preferably 1 ha.
	- temporary mix (main species)	Walnut and poplar Sessile oak and birch and/or hornbeam)	Poplars in rows harvested at 15-20 years (= intermediate production). Wild cherry scattered among oak, harvested at 50-70 years (= intermediate production).
	- temporary mix (main species + accompanying species)	Walnut and alder Sessile oak and birch (and/or hornbeam)	All alders are harvested once or several times, when walnut logs are acquired and as soon as they get in the way. Birches (or hornbeams) are gradually extracted to benefit the oak trees (it may however be beneficial to keep some hornbeams in the understorey).
Mixed	- sustainable mix (main species only)	Walnut and wild cherry Oak and wild service tree Oak and wild cherry	Pairs of species that can be grown together over one cycle: walnut and wild cherry in equal proportions Wild service trees scattered among oak. To keep the mix, the wild cherry trees (harvested before the oak) must be planted in clusters to ensure that they can regenerate naturally. They can also be dealt with irregularly (possibly adding another fruit-bearing species).
	- sustainable mix (main species + accompanying species)	Oak, service tree, (wild cherry), etc. and birch (or hornbeam, willow, etc.)	Several main species and one or more temporary accompanying species removed according to priority (but not necessarily entirely, to allow later regeneration) once the main species timber has been harvested. The mix can contain species harvested at different ages, planted in clusters or irregularly.

These "security" species can then ensure the success of the plantation and guarantee at least a minimum result. This can also reduce planting and maintenance costs.
This is frequently an issue due to excessive deer populations or local climatic conditions, or even their foreseeable development in coming decades. Using species resistant to deer damage can reduce the cost of protection by limiting it to the species that are the most palatable. Similarly, the success of a plantation with species sensitive to early frost (autumn) or summer drought can be secured by associating it with hardier species.

Special considerations

Some accompanying species can have beneficial properties for the growth of the entire plantation or the proper functioning of the stand.

This is the case for the alder and locust tree, which fix nitrogen from the air and partially return it to the soil. This benefits the growth of other species in the stand. Other species such as hornbeam, lime and birch produce beneficial humus.

Associating some hardwoods (oak, birch, etc.) with conifers (pine, spruce, etc.) can improve the function of water in the stand and reduce parasite infestations.

Beekeepers can benefit from lime and locust trees and some maple species, while growers may benefit from the locust tree or chestnut tree for the production of fencing stakes.

This type of classification thus helps growers to identify the choice they can or should make in order to meet their objectives.

Choosing the composition of the plantation

Growers can choose to plant one or more species depending on their objectives.
This choice is mainly determined by the desired composition of the mature stand.

To obtain a single-species stand, the easiest way is to plant a single main species. Another possibility is to plant two main species, one of which will be harvested for timber well before the other. A third solution is to plant the main species with one or more temporary accompanying species.

These can have various roles :
- providing lateral shelter and shading to improve main species tree shape and growth;
- providing ground cover and ensuring rapid canopy closure;
- nitrogen fixation, intermediate biomass production;
- reduced planting cost if protection is not needed or by reducing the number of expensive main species seedlings.

However, temporary species are harvested in all cases after their role has been fulfilled, except in the case of local replacement of a main species. The stand then quickly becomes monospecific.

To obtain a mixed population, at least two main species must be planted and kept throughout the course of operations. Here again, one or more accompanying species can be added for the same reasons as those mentioned previously. Even if the intention is to phase them out, a few individuals may be kept, either for their cultural interest or because it is advantageous to replace some poorly-developed individual trees from the main species.

Whether chosen to be temporary or long-term, the mix is made up by using associations that meet the objectives.

The main species must be able to grow together over time or even to regenerate in a mix. In some cases, fast-growing species can be associated with slow-growing species in order to phase the timber harvests and possibly to make it easier to obtain irregular populations. Table 2 shows some examples to illustrate this.

Different arrangements and spacings are possible for each type of plantation (see «Composition of the plantation» at the end of this file).

The site is the main factor determining the possible choices of species. These occasionally may not correspond to the species the grower may wish to plant. In the current context of climate change, particular attention must be paid to site diagnosis, avoiding at all costs planting species that are already borderline.

One way to reduce the risk of failure is to combine several possible species, which some refer to as «security» species. These are selected from the hardiest species, providing a form of insurance for the success of the plantation. In the long term, the mixture can also be a way anticipating the future regeneration of the stand by introducing species that may be better suited in the future. ■

Autecology of valuable hardwood trees

- **Larrieu L., Gonin P., Coello J., 2012 - Autecology of hardwoods: a reading guide. Forêt-entreprise n° 203, 2012, p. 5-8**
- **Larrieu L., Gonin P., Coello J., 2012 - Autecology of the Wild cherry tree (Prunus avium (L.) L.). Forêt-entreprise n° 203, 2012, p. 9-12**
- **Marty P., Larrieu L., Claessens H., Gonin P., Coello J., 2012 - Autecology of the Common ash (Fraxinus excelsior L.) and the Narrow-leaved ash (Fraxinus angustifolia Vahl). Forêt-entreprise n° 204, 2012, p. 9-12**
- **Larrieu L., Gonin P., Coello J., 2012 - Autecology of the Wild service tree (Sorbus torminalis (L.) Crantz), the Service tree (Sorbus domestica L.) and the other Sorbus species. Forêt-entreprise n° 205, 2012, p. 5-11**
- **Larrieu L., Gonin P., Coello J., 2012 - Autecology of the Common pear tree (Pyrus pyraster (L.) Du Roi) and the European wild apple tree (Crab apple) (Malus sylvestris Mill.). Forêt-entreprise n° 206, 2012, p. 5-10**
- **Lestrade M., Becquey J., Coello J., Gonin P., 2012 - Autecology of the Common Walnut (Juglans regia L.), Black Walnut (Juglans nigra L.) and Hybrid Walnut (Juglans x intermedia). Forêt-entreprise n° 207, 2012, p. 5-12**
- **Lestrade M., Gonin P., Coello J., 2013 - Autecology of the Small Leaved Lime (Tilia cordata Mill.) and the Large Leaved Lime (Tilia plathyphyllos Scop.). Forêt-entreprise n°211, 2013, p. 6-11**
- **Lestrade M., Gonin P., Coello J., 2013 – Autecology of the Sycamore (Acer pseudoplatanus L.), Norway maple (Acer platanoïdes L.), Field maple (Acer campestre L.) and other maple species. Forêt-entreprise n°212, 2013, p. 54-62**

References available on www.foretprivee-francaise.com and www.pirinoble.eu, with complete bibliography

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