BEST PRACTICE GUIDE FOR PRE-PLANTING ACTIONS IN MEDITERRANEAN AGROSILVOPASTORAL SYSTEMS

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Best practice guide for pre-planting actions in mediterranean agrosilvopastoral systems

Why plant?

Planting and restoring ecosystems are actions that have great environmental benefits such as:

- **Restoration of degraded areas.** Including soil improvement, erosion reduction and increase of biodiversity in the area.
- **Ecosystem improvement.** Thanks to the increase of pollinators and the creation of habitats, refuge, and food for wildlife.
- **Improving air quality** by absorbing pollutants, as well as capturing carbon dioxide (CO_2), thus mitigating the effects of climate change.

In addition, these actions provide socioeconomic benefits such as the stimulation of economic activity, generating employment opportunities in rural areas far from urban centres and improving the rural economy.

Planting and regenerate improvement in agrosilvopastoral systems

In silvicultural terminology, **dehesa** refers to a **forest with clear woodland** and silvopastoral or **agrosilvopastoral** land use. The dehesa is a system with a high multifunctionality. It generates different types of products such as: pasture, fruit, cork, livestock, firewood, mushrooms, etc. or other less frequent uses such as beekeeping, aromatic or medicinal species, etc. It creates a system with a special structure: the tree layer has an incomplete thickness, which allows the growth of herbaceous species, useful for cattle feeding.

However, in recent years an important issue has been observed related to **the lack of tree regeneration in the dehesas**, with the presence of large and aged trees with an absence of younger trees to replace them. These aged ecosystems are more vulnerable to diseases such as "*la seca*", a **disease** that causes the decay and death of holm oaks and cork oaks in our dehesas.

To eradicate this problem, several solutions are proposed related to the **reduction of predation, the protection of regeneration and the incorporation of new young trees** through plantations and densification of dehesas with scarce trees.

It is desirable to densify a dehesa in order to reach a fraction of the area covered by trees between 20 and 50%, which means an increase in the benefits in the ecosystem. If this value exceeds 50%, the herbaceous layer will be greatly compromised by the competition for sunlight generated by the trees.

Picture 1. Holm oak affected by "la seca". Source: www.observatoriodehesamontado.juntaex.es

In contrast, if it falls below 20%, difficulties will be generated in the development of the herbaceous layer due to a reduced capacity to regulate climatic conditions and provide enough shade. The increase in evapotranspiration due to excessive insolation would compromise the life of the herbaceous layer and, therefore, its capacity to provide food for livestock would be deficient. These percentages are indicative and will depend on the soil conditions and climate of the plot.

How to select the species to plant?

According to some authors, a **dehesa can have the following species**: holm oak, cork oak, Portuguese oak, Pyrenean oak, wild olive, carob, and chestnut. All of them are consumed by livestock both for their branches and for their fruit. There are other species that can also contribute to livestock feed only with branches, such as ash trees, junipers, and phoenicean junipers (Serrada, 2011).

When choosing the suitable species for a plantation, it is important to take into account both the **ecology** of the species and other **ecological**, **climatic**, **edaphological** (soil) and **orographic** (slopes) **criteria** of the specific area. It is also important to analyse the **ecosystem services** (tangible and intangible) to be achieved through the plantation. The **state** of alteration or **degradation** of the specific ecosystem is another essential criterion to consider for this selection.

Picture 2. Dehesa affected by "la seca" with densification of holm oak and Pyrenean oak saplings of 1-2 years old and with cactus protectors. Own source.

The **species selection** to be used in a reforestation and/or densification of the forest cannot be based only on a principle related to the species present today.

In order to know what can be planted in the area involved, it is really important to analyse the health of the current trees and to base the selection on **native species adapted to the area**. Therefore, the origin of the plant must be from the same biogeographical region as the plantation area. However, in a context of climate change, including species and genetic origins from lower latitudes (south) is becoming more frequent, always under expert supervision. In this way, we

will obtain trees adapted to the conditions that are currently occurring in the territory and so the plantation is expected to succeed better.

Finally, the **age of the new plants** to be planted in the territory is also important. It is appropriate to use saplings of **1-2 years old** since they are more likely to have a good adaptation to the characteristics of the territory.

It is important to emphasize the importance of reinforcing populations by planting seeds (e.g., acorns) as another action to facilitate regeneration in dehesas.

When trees should be planted?

Planting is always carried out with the **sap stopped**. The optimum planting moment according to climatic conditions is:

- In seasons with winters without intense frosts and dry springs: in autumn from about mid-October, until the beginning of winter, around the end of December.

- In seasons with winter with intense frosts and wet springs: from the end of frosts, around February 15, until the beginning of vegetative activity (depending on the temperature regime, around March 30 or April 30).

Therefore, it will be useful for planting those months in which the average monthly temperature is lower than about 8ºC, the average minimum temperature is higher than 0ºC, and the average monthly precipitation in millimeters (mm) is higher than twice the average temperature in degrees Celsius (ºC) (Serrada, R., 1998).

How to prepare the soil?

The main **objective** of **soil preparation** is to **improve soil conditions** (soil fertilization is not a soil preparation practice). This improvement will **make it easie**r for the young plants to take root and **develop** in the early stages of **growth**. Thus, to achieve this objective, various actions can be carried out depending on the needs of the previous soil conditions. See table below:

Cause	Action
The soil has a shallow depth and low water retention capacity.	Decompact the soil by mechanical action.
The soil has a low water infiltration rate.	Plough the soil to reduce runoff and water erosion. When planting, create little soil walls around the trees.
There is excessive competition from shrubs or herbaceous plants.	Create selective clearings to reduce competition.
Soil conditions make planting difficult, e.g. the soil is rocky.	Carry out a preliminary soil preparation manual hand-hollowing.

Planting holes:

The holes should be made with **manual machinery** (hand auger) (Picture 3) or with **heavy machinery** (hydraulic auger/tractor auger coupling or agricultural machinery) (Picture 4).

Picture 3. Manual auger, ideal for land where heavy machinery cannot enter. Own source.

The machinery to be used will depend on several factors such as the characteristics of the land, the extension of the plantation, the accessibility of the land, method of planting, etc.

The **size of the** hole will also depend on the **size of the roots system** of the plant or the **planting method**. For example, Picture 5 shows a hole approximately 35 cm deep and 25 cm wide. Standard measurements for 1-2 years old seedlings. In Picture 6, a hole about 25 cm deep and 50 cm wide is shown, which are the dimensions that the hole should have for planting with Cocoons (see " *Best practice guide for planting and maintenance in mediterranean agrosilvopastoral systems*" for more information about Cocoon).

Pictures 4, 5 y 6. Tractor with hydraulic auger coupling (left). Example of a hole made with a manual auger (centre). Example of a hole made with a 60 cm auger for planting with Cocoons (right). Own source.

Although the holes can also be made with a backhoe equipped with a bucket/shovel of about 60 centimeters (Picture 7), the hole should be made so that the soil is sufficiently decompacted and within the hole itself (Picture 8). This method is very useful and fast. It generates holes with a large volume of removed soil, which greatly facilitates the survival of the plant.

Pictures 7 y 8. Backhoe with bucket (left). Example of hole made with backhoe and bucket (right). Own source.

Cleaning and clearing:

During soil preparation, it is recommended to respect and not to cut those trees and shrubs that have grown naturally. In addition, if the land contains plant species listed in the List of Wildlife Species under Special Protection Regime or in the Catalogue of Threatened Species (national or regional level), it is important to have these populations well located and to take this into account when clearing the land. However, in some cases it may be necessary to make small **selective clearing of the shrub layer** around the location of the hole. This facilitates both the hole preparation and the planting and growth of the tree itself.

For these cases, the use of manual machinery such as a brushcutter is recommended (Picture 9). It makes possible to focus the clearing to a limited range of species and sizes, without damaging other species we want to maintain.

Picture 9. Example of manual brushcutter. Source: www.sierraselectricas.com

It is recommended to put down the remains of the clearing on the surface of the soil to protect it from drying out and erosion, or to bury them in the soil to provide nutrients.

Shrubs will only be removed in situations that are essential for sustainable land management.

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