

## Second generation of walnut planted forests in EU

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Walnut planted forests were the origin of the WOODnat project (2016-2019), an Innovation Action which granted by the European Union in the framework of H2020 Program.

WOODnat has been focused overall the walnut value chain with the aim to increase the use of quality walnut hardwood produced under sustainable management practices in planted forests, involving the different stakeholders. WOODnat integrates a series of innovations that would help to promote a second generation of walnut planted forests in Europe: from nurseries to industry and market, including sustainable forest management.

This Special Issue includes some of the innovations derived from WOODnat, which can be divided in 3 categories depending on the beneficiaries of these innovations: forest managers, nurseries and transformation industries.

### Innovations for nurseries

Selecting the right plant source is one of the main issues for the success once one has decided to establish a new walnut plantation in a site. The management experience in walnut planted forests shows how a good plant material from a seed orchard planted in relatively homogeneous site turn out in a forest where differences between trees are much larger than expected both in shape and size.

To this respect, the main advantage of clonal planted forests vs. plantations from seeds might not be a higher performance of clones (i.e. elite trees) in terms of higher growth but straight shape and the homogeneity between the trees within a single plantation. The relevance of using clonal material to ensure homogeneity is higher when the silvicultural scheme is changed and the tree density is reduced to follow a silvo-arable approach, there is a need of ensuring that, as your plantation has fewer trees, they need to be of much better quality. The use of clones is highly rec-

ommended when walnut is planted under agro-silvo-pastoral approaches.

However, traditional vegetative methods are not suitable for massive reproduction of walnut elite genotypes; becoming tissue culture technologies the most important alternative for cloning, but the high recalcitrance of walnut species hinder their commercial micropropagation. As a consequence, nowadays there is shortage of clonal plant material in the market and different strategies have been used to overcome these problems, as it is discussed in WOODnat WP 5 and the papers within this Special Issue, Licea-Moreno et al. (2020) reports some new advances and insights regarding micropropagation of valuable walnut genotypes for timber production. Fernández-Moya et al. (2020) analyze the clonal effect on rooting and acclimation rates for in-vitro micropropagation in hybrid walnut.

Thanks to the WOODnat innovations, the company Bosques Naturales has increased their production capacity from a research scale (< 4,000 plants/year) to a commercial scale (> 10,000 plants/year); which would allow European landowners to access to a much better plant quality for the establishment of new planted forests.

### Innovations for forest managers

Most of the walnut planted forests in Europe are characterized by their small scale. Based on the analysis performed by Pelleri et al. (2020) within WOODnat, around 85% of walnut forest managers (representing 58% of the planted area) owns plantations smaller than 5 ha. This big amount of small-scale walnut planted forests might not have a size enough to be worthwhile for the forest owners to hire the services of a forest consultancy specialized on walnut.

However, this big amount of forest managers would be presumably very interesting in acquire a free technical guidance via remote/automated platforms, manuals, guidelines, etc. Similarly, these small-scale

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forest owners might not have the machinery, equipment, personnel and/or experience necessary to achieve their objectives and might need to contact some enterprises to provide the necessary products or services. A smartphone APP and a web platform [woodnat.azurewebsites.net] has been developed within WOODnat combining the 2 abovementioned needs, creating a platform which will allow the establishment of a community of people interested on walnut.

Hence, small-scale landowners will have free access to a platform which offer them (1) access to technical guidance for their plantations, (2) direct relationships with other landowners with walnut planted forests and (3) a wide range of companies offering products and services (either generalist or specific for walnut). On the other hand, the companies providing products/services would be interested in the access to this community as a potential source of clients.

In addition, a silvicultural guide has been published (Fernández-Moya et al. 2019) as a result of the WOODnat project. The objective of this guide is to be a silvicultural manual analyzing the considered as the better practices to be applied for walnut plantation management oriented to timber production, taking into account scientific literature and the experience in the sector of the companies who compound the WOODnat consortium. This guide tentatively answers the questions any forest manager would have about walnut planted forests. Applied with common sense, combined with new information as available and modified when needed, these guidelines should be useful tools for the management of walnut planted forests under different cultivation systems and circumstances.

Within this Special Issue, Pelleri et al. (2020) perform a characterization of the walnut planted forests in Italy and Spain and analyze different forest management alternatives to be used in the new planted forests to be established. De la Parra et al. (2020) analyze the potential sprouting suppression and mushroom production after inoculation of *Juglans x intermedia* stumps with edible fungi inoculum. Fernández-Moya and Urbán-Martínez (2020) show a statistical model to estimate crown competition factor and crown diameter in hybrid walnut planted forests to be used in thinning planning.

### Innovations for transformation industries

Walnut (*Juglans* sp.) timber has been traditionally highly appreciated and mainly used for furniture, flooring and paneling.

In the WOODnat project we analyzed what the properties and the volume disposal for are the next years in the first generation of walnut planted forest in order to answer the main economic question about the market of the wood produced in the different walnut planted forest models

On this three years a solution to small diameters trees obtained by thinning in the plantations was not totally completed, but one of the most important problem to this type of wood were the white color, because the heartwood did not start, within this Special Issue, Cueto (2020) analyzes the potential use of digital printing for changing the color of European Hybrid Walnut to be more close to the market possibilities.

WOODnat project was a new effort in the way to make the walnut planted forest as a profitable model for the Europe rural development.

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