

A study points to the importance of seeking new pine varieties resistant to climate change

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The radiata pine is the tree species par excellence in the Basque Country's forests. Like other types of pine, the lack of water is one of the factors having the greatest effect on its survival and productivity. Until now, the Basque Country's high, steady rainfall has encouraged the cultivation and good productivity of this species. This situation could change over the coming years if, in line with the predictions of climate change, average temperatures rise and droughts become more frequent and intense. So, new varieties of the radiata pine that are more resistant to the effects of climate change will have to be introduced. It is significant that the Basque Country's radiata pine should have been one of the ecotypes that has suffered most from the lack of water.

Introducing varieties of radiata pine that withstand drought better would not have any negative repercussions on the biodiversity existing in the [Basque Country](#), as it would simply be a case of substituting one variety for another. The research has a significant repercussion for the timber industry in the Basque Country, as the radiata pine is one of its main crops due to the high productivity and quality of its timber. The sector can take into consideration the most suitable varieties within its programmes for improvement.

In order to simulate the anticipated scenario of an increased [water shortage](#) and its impact on the survival of [forestland](#), Nuria De Diego, a PhD holder thanks to a grant provided by the Department for the Environment, Spatial Planning, Agriculture and Fisheries of the Government of the Basque Autonomous Community, together with

specialists from Neiker-Tecnalia and the Department of [Plant Biology](#) and Ecology of the UPV/EHU-University of the Basque Country, have evaluated the response to situations of water stress of various ecotypes or varieties of radiata pine from different climate and geographical zones worldwide. The study carried out has been defended under the title: *Respuesta a la sequía de Pinus radiata D. Don y su implicación en los procesos de tolerancia* (Response to drought of Pinus radiata D. Don and its implications for tolerance processes). Part of the research done by De Diego is due to be published shortly in one of the most important journals existing on forestry: *Tree Physiology*.

In this study, apart from working with the radiata pine native to the Basque Country, other ecotypes from Australia and New Zealand were also used. The different varieties were exposed to a drought cycle of one month and were rehydrated to assess their capacity to recover. They were then subjected to a second cycle without water to see whether their behaviour response to the lack of water in fact improved due to the hardening of the plants. After the second cycle, the research confirmed that all the varieties had become more drought tolerant, their resistance ranging between seven and eleven weeks, depending on the varieties used. What explains the greater drought tolerance of the radiata pine that has been subjected to [water stress](#) beforehand is the fact that the pine manages to develop various defence mechanisms in this situation, like an increase in osmotic adjustment, greater stability in cell membranes, and even a reduction in the transpiration rate; these are processes regulated by various hormonal signals which also varied across the different ecotypes.

Within the varieties studied, the research detected that the Basque Country's radiata pine ecotype was among the ones that displayed the least drought tolerance and hardening capacity. This low capacity for adaptation leads one to think that an upsurge in the atmospheric conditions brought about by climate change will cause a large proportion

of the Basque Country's pinewood stocks to sustain considerable damage.

The ecotype that best reflected the capacity to acclimatise during the study was one of the ones native to New Zealand; specifically, a variety that is a cross between the *radiata* and *cedrosensis* pine varieties (*P. radiata* var. *radiata* x *cedrosensis*.) The explanation for its better acclimatisation could be found in the fact that this variety has learnt throughout many generations of individuals to develop a greater capacity to respond to drought situations, since it has been cultivated in conditions of lower rainfall.

The *cedrosensis* variety originated in Cedros Island (Baja California, USA). Furthermore, the samples analysed came from New Zealand from an area of low rainfall; that is why their seeds produce trees that need little water to grow. The remaining varieties studied and their origins were as follows: *P. radiata* var. *binata* (New Zealand), *P. radiata* var. *radiata* (Basque Country), *P. radiata* var. *radiata* (New Zealand), *P. radiata* var. *radiata* (Australia), and in which a hybrid of the *P. radiata* and *P. attenuata* (New Zealand) was also included as the tolerance model, due to the already well-known resistance to drought of the *P. attenuata*.

This study made use of a large number of non-destructive, innovative techniques and analyses. These were conducted at the Neiker-Tecnalia Department of Biotechnology and at the Department of Plant Biology and Ecology and General Services (SGIKER) of the Faculty of Pharmacy of the UPV/EHU, and had the collaboration of other national research centres.

Scientific importance and practical contributions

The research carried out by De Diego has in fact shown that the *radiata*

pine is hardened by drought and that, depending on the varieties, its resistance can be doubled or tripled with respect to other plants that have not been subjected to hardening processes. It has also confirmed the different response to drought among varieties, which would be of great interest in plant improvement programmes. These facts can help to improve the response to drought of this species. So the radiata [pine](#), besides improving its adaptation to [climate change](#), could improve its chances of survival and adaptation during transplanting from the nursery to the natural environment, a particularly delicate moment for planting success.

Provided by Elhuyar Fundazioa

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