

Cuéllar Experimental Site (Spain)

Location and characteristics:

The experimental plot has been installed in a natural, large (~120,000 ha) and continuous Maritime pine (*Pinus pinaster* Ait.) forest within a broad provenance region (i.e. native locations of the species used as breeding units) named "Meseta Castellana" in the Castilian Plateau (central Spain). The site is located at 740 m.a.s.l. (41° 22' N, 4° 29' W) in a flat sandy region characterized by a semi-arid Mediterranean climate, with an annual average rainfall and temperature of 461 mm, and 11.2°C, respectively, and a pronounced summer drought. The floristic community within the stand is composed by typical Mediterranean annual species (*Micropyrum tenellum* (L.) Link, *Sedum amplexicaule* DC., *Vulpia myuros* (L.) C.C. Gmelin, *Lupinus angustifolius* L., patches of shrubs (*Lavandula pedunculata* Miller, *Helichrysum italicum* (Roth) G. Don) and isolated individuals of stone pine (*Pinus pinea* L.). Silviculture in the area is traditionally based on natural regeneration following a seed tree system adapted to resin production, leading low density of trees (~140 trees/ha).

Experimental design:

Experimental design consists in a split-plot experiment compound by ten permanent plots of ~0.5 ha (70x70 m²) where three different levels of harvest intensity were randomly carried out in winter of 2003-2004 years (three replicates of 25%, 50% and 100% of basal area removed respectively and one control plot, Figure 1). In order to investigate variation of Maritime pine seed dispersal and effectiveness of natural regeneration, 90 seed-traps and 250 seedlings sub-plots (1x1 m²) were systematically placed within every plot, and even temporary (weekly during the rain seed session) seed and seedling measures are being counted since 2004 year.

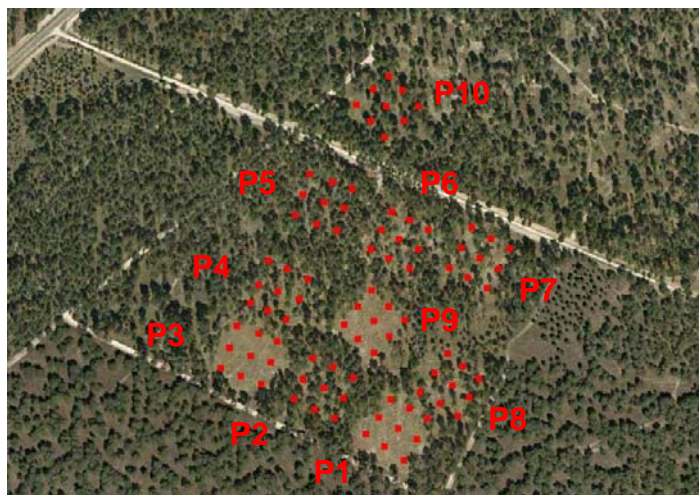


Figure 1. Aerial photograph of Cuéllar *Experimental Site*. Permanent plots and seed-traps arrangement in the continuous maritime pine stand: 25% of basal area was removed in P2, P4 and P5 plots. 50% of basal area was removed in P6, P7 and P8 plots. Clear-cut was carried out in P1, P3 and P9 plots. P10 was maintained without harvest as control unit.

In 2006, an experiment on seed and seedling development under water stress was conducted (this experiment was monitored during 18 months). The objective was to understand the effects of the light and the water availability on the germination and the survival of seedlings. Under different situations of light, using the plots of

different levels of harvest intensity, Seeds were sown in groups of 25 seeds so there were 12 groups in each plot (Figure 2) Finally to simulate the impact of summer storms two watering regimes (no rain vs 200 mm rainfall) were, alternatively, done during two consecutive summer (2006 and 2007) Seed germination and Seedling survival, growth and biomass were analyzed under the different treatments tested.

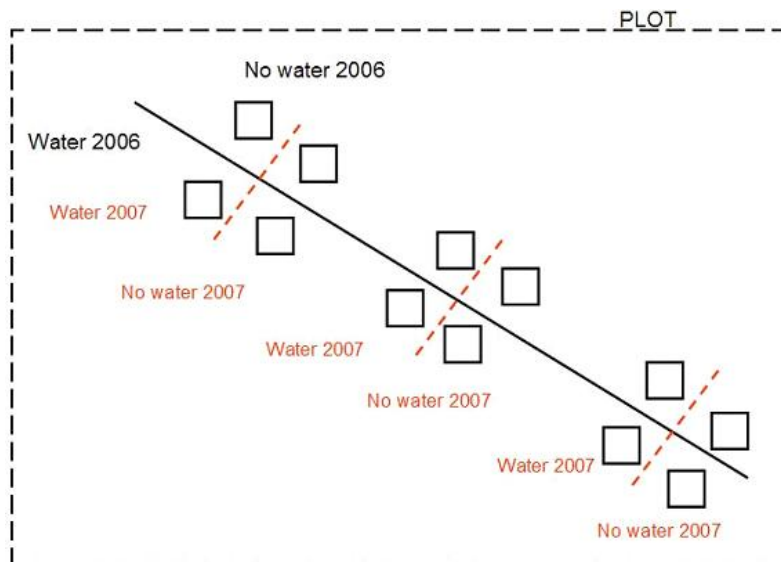


Figure 2. Seed and seedling development under water stress experiment.

Current and former studies

Since it was installed, several studies have been or are being performed over this Experimental site:

- Inter-annual variation of seedlings and seed amount within different harvest intensities.
- Development of seed dispersion models (*kernel*s)
- Influence of different harvest intensities over understory plant diversity and Maritime pine seedlings.
- Genetic variation, demography and spatial genetic structure from nuclear molecular markers.
- Evolutionary analysis of Castilian plateau *P. pinaster* populations.
- Climate change impact on seed germination and seedling development

These studies have given rise to several *SCI* publications:

2009

- DE-LUCAS A.I.; GONZÁLEZ-MARTÍNEZ S.C.; HIDALGO E.; BRAVO F.; HEUERTZ M. 2009 Admixture, one-source colonization or long-term persistence of maritime pine in the Castilian Plateau? Insights from nuclear microsatellite markers. *Investigación Agraria: Sistemas y Recursos Forestales* 18(1)3-12
- DE-LUCAS A.I.; GONZÁLEZ-MARTÍNEZ S.C.; VENDRAMIN G.G.; HIDALGO E.; HEUERTZ M. 2009 Spatial genetic structure in continuous and fragmented populations of *Pinus pinaster* Aiton *Molecular Ecology* (accepted).
- GONZALEZ-ALDAY, J., MARTINEZ-RUIZ, C., BRAVO, F. 2009 Evaluating different harvest intensities on the understory species richness and diversity in *Pinus pinaster* natural stands *Plant Ecology* 201:211-220 DOI: 10.1007/s11258-008-9490-2

- RUANO, I; PANDO, V., BRAVO, F. 2009 How do light and water influence *Pinus pinaster* Ait. germination and early seedling development? *Forest Ecology and Management* 258:2647-2653 DOI: 10.1016/j.foreco.2009.09.027

2007

- BRAVO, F., LIZARRALDE, I, RODRIGUEZ-GARCIA, E., BRAVO-OVIEDO, A, ORDOÑEZ, C., HERRERO, C., PANDO, V., DEL PESO, C., JUEZ, L., GUERRA, B. 2007 Modeling forest dynamics with an empirical approach to support stand management: the case study of Mediterranean *Pinus pinaster* in Central Spain in M. Palahí, Y. Birot and M. Rois (Eds) *Scientific tools and research needs for multifunctional Mediterranean forest ecosystem management* 45-55 European Forest Institute ISBN: 978-952-5453-18-8

Submitted

- GONZALEZ-ALDAY, J., MARTINEZ-RUIZ, C., MARRS, R. H., BRAVO, F. Changes in floristic composition under different harvest intensities in a *Pinus pinaster* Ait. natural stand of Spain *Acta Oecologica* (submitted)

Different thesis (master and PhD) have been done or are on development with data from this experimental site:

- DE-LUCAS, A.I. 2009. Flujo genético, demografía y variabilidad genética en una conífera mediterránea emblemática, el pino negro o rodano *PhD Thesis*
- JUEZ, L. 2009. Fertility, seed dispersal and colonization potential of an invasive widespread conifer, *Pinus pinaster* Aiton. *MSc Thesis*
- RUANO, I 2008. Influencia de los cursos climáticos en la germinación y primeros meses de *Pinus pinaster* en Cuéllar (Segovia). *Trabajo fin de carrera*-Ingeniería de Montes

Contacts with other groups running similar experimental sites are welcomed in order to collaborate in comparative studies.

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More information at <http://sostenible.palencia.uva.es>