FunDivEUROPE

Functional significance of forest biodiversity in Europe

Project number: 265171

Regional differentiation and adaptation of tree species

FunDivEUROPE (FP7) field protocol

V1.0

Last update: 30th January 2012

By Eric Allan, University of Bern

Content

1 Objectives

To test for local adaptation to climate in five tree species in six areas across Europe and to test for differences in the amount of genetic diversity between tree populations from different climates.

2 Experimental design

At each exploratory region (in Finland, Poland, Romania, Germany, Italy and Spain) we will experimentally test for local adaptation in a dominant tree species, see table 1. For each species we will plant seedlings from five different provenances, these provenances have been selected from along a gradient from the exploratory region to an area with a current climate similar to that predicted for the exploratory region in 2080 (warmer area, see table 1). We will plant seedlings on all exploratory plots. At each plot we will plant seedlings from the five different provenances with four replicates per provenance giving 20 seedlings per plot.

2.1 Planting seedlings

Seedlings will be planted along the outside of the plot, where conditions will be the same as inside the plot. This will minimise disturbance to the plot itself caused by planting or visiting the seedlings to take measurements. Seedlings will be planted in two rows, each seedling at least 2m apart within a row, and the rows 1 m apart, see Figure 1. The first row will be planted along the edge of the plot and the second 1 m away, outside the plot. The seedlings will be planted in four blocks, with the locations of seedlings of different provenances randomised within the block; all seedlings will be individually labelled. The blocks will allow much of the environmental heterogeneity to be controlled for statistically.

Seedlings will be planted unfenced in order to expose them to natural levels of mammal herbivory. Mammal and insect herbivory will be assessed on all seedlings by subproject 4.5, see below. In addition extra seedlings will be grown in a nursery or experimental garden near to the exploratory site. Up to 200 seedlings will be used as a backup, so that we can replace seedlings in the field if there is very heavy mortality (> 50%). Replacement would be done 4-6 months after planting. The identity of seedlings replaced will be recorded, in order to check for any differences in mortality between provenances. If possible, seedlings destroyed by mammalian herbivores will be identified during replanting.

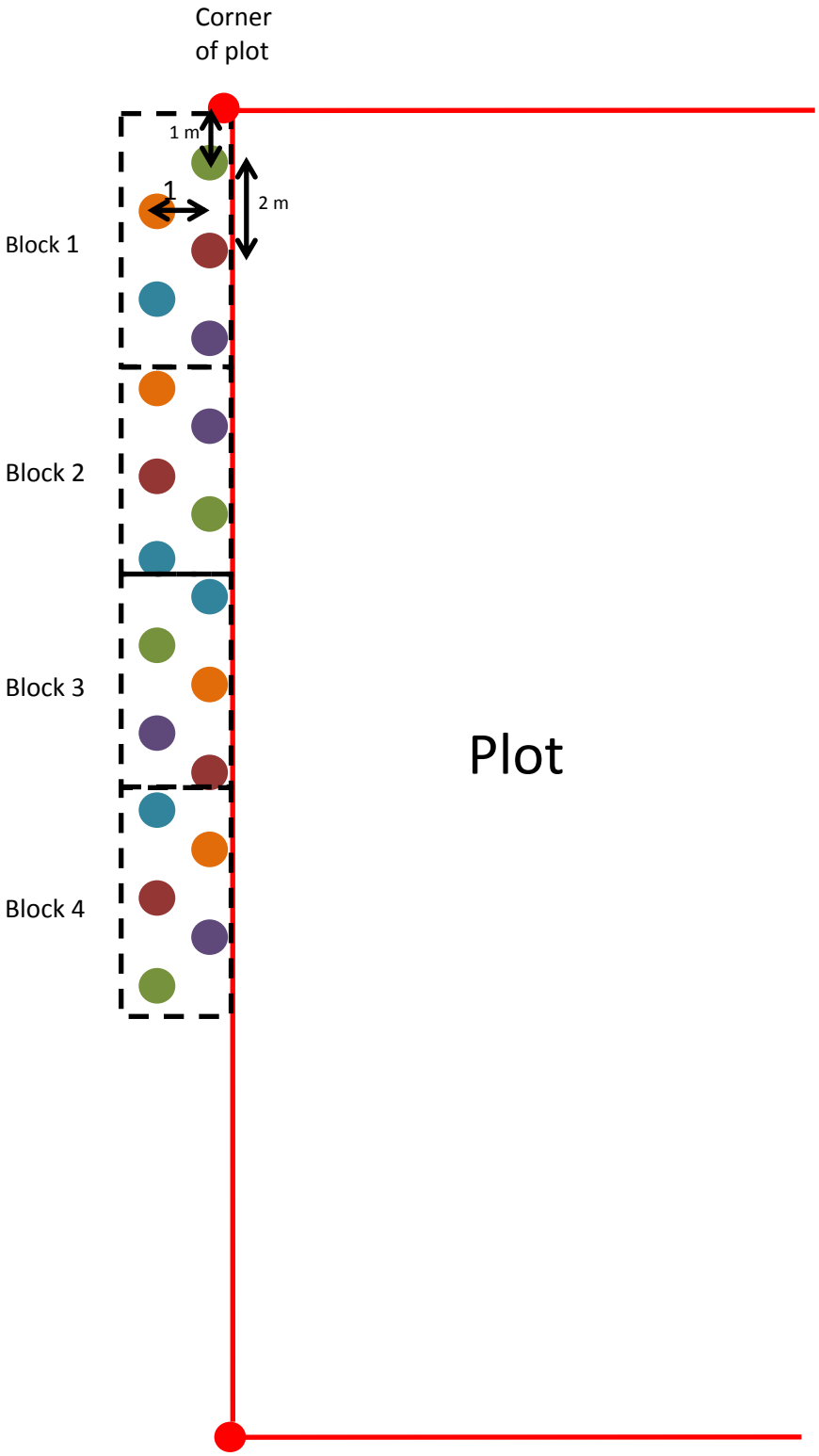

Figure 1: Plan of planting for the tree seedlings with 5 provenances. Circles represent tree seedlings, the different colours represent different provenances, square boxes show the blocks. Red lines show the edges of the plot.

2.2 Common garden experiment

We will also use around 30 seedlings from each provenance to conduct a common garden experiment, exact numbers will depend on the space available. This will provide a comparison with responses in the field by constituting a test of local adaptation (to climate only) in less stressful and more controlled conditions. It will also allow measurement of traits on a large number of individuals to give an estimate of quantitative genetic variation for each population. In addition manipulations of insect herbivory could be carried out in the common garden to test whether insect herbivores prefer local provenances: systemic insecticides could be used to remove herbivorous insects and bird cages could be used to exclude birds, with the expectation that this will increase insect numbers. Common gardens will therefore be sited near forest in order that the seedlings are exposed to forest insects and birds. These experimental manipulations will be carried out in collaboration with subproject 4.3 and 4.4.

Seedlings for the common garden experiment will be planted in 20 blocks, within blocks seedlings will be spaced 0.5m apart and blocks will be separated by at least 1m. The blocks will contain ideally 3 seedlings from each provenance, i.e. 15 seedlings per block. These numbers can be reduced if space is limiting but the number of blocks will always be 20 in order to allow experimental manipulations to be applied at the block level.

2.3 Timing of planting seedlings

Seedlings have been ordered from nurseries in Spain, Poland, Germany and Finland. Seeds have been collected from the field during autumn 2011 in Italy and planted in pots in a local nursery: young seedlings will be transplanted into the field in October 2012. Seedlings or cuttings will be taken in Romania in spring 2012.

Seedlings have been planted in the field in late October 2011 in Poland and late November 2011 in Spain and will be planted in spring 2012 in Germany and in autumn 2012 in Italy and Romania.

3 Data collection

We will measure seedling size (height and basal diameter) in 2013 and at the end of the project all seedlings will be collected from the plots and final biomass will be measured, stem and leaf biomass will be measured separately.

3.1 Herbivory measurements on phytometers

Herbivore damage on the phytometers, due to mammalian browsers and insect herbivores, will be assessed in collaboration with Tasks 4.3 and 4.5. This will provide a consistent

measure of herbivory across all plots, which can be compared with other herbivory measures taken on natural vegetation in the plots. Seedling mortality, along with herbivore damage (due to both browsing mammals and insects) and seedling height will be assessed on all seedlings on the exploratory plots by Julia Koricheva and Harriet Milligan, Task 4.5.

Table 1: List of species used in different an Exploratory regions and their origin.

Country	**Exploratory region**	**Tree species**	**Warmer area**	**Date for seedlings planted out in field**	**Local nursery**
Finland	North Karelia	*Pinus sylvestris*	South Sweden	Late May 2012	Suonenjoki
Poland	Bialowieza	*Carpinus betulus*	South-east Germany	Late October 2011	Bialowieza experimental garden
Germany	Hainich	*Fagus sylvatica*	Baden-Württemberg	March 2012	Thueringer Forstamt, Leidenfeld
Romania	Suceava	*Fagus sylvatica*	Central Romania (lower altitude)	Autumn 2012	Rasca
Italy	Tuscany	*Quercus cerris*	South Italy	October 2012	Pistoia
Spain	Alto Tajo National	*Quercus ilex**	La Mancha	Late November 2011	

* *Quercus ilex* was chosen rather than *Pinus halepensis* (as suggested in the proposal) as it is a more abundant species at the site in Spain and is easier to find in nurseries.