FunDivEUROPE

Functional significance of forest biodiversity in Europe

Project number: 265171

Fine root biomass

FunDivEUROPE (FP7) field protocol

V1.0

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Content

1 Introduction

A large proportion of all sugars produced by plants are sent belowground to build root systems and fuel microbial processes. Hence, belowground organs are an important contribution to primary productivity, they are a significant source for soil organic matter, and thus, for the regulation of soil food webs and carbon sequestration. Despite the difficulties in sampling and quantifying root systems, it is therefore essential to include them in assessments of diversity effects on ecosystem functioning.

2 Scope and application

Both the fine root (diameter ≤ 2 mm) biomass and biomass production will be studied. This protocol explains the work related to the fine root biomass. There we test the hypothesis: 1) Total fine root biomass is greater in diverse forest because niche differentiation in space and time among co-existing species leads to more efficient exploitation of available soil resources in monocultures; 2) owing to differences in competitiveness, species proportions in fine root biomass differ from above-ground proportions of biomass.

3 Objectives

The aim is to show whether fine root biomass increases with tree species diversity and whether more carbon is allocated to fine roots in diverse compared to single tree species forests. Below-ground root-species diversity and biomass will be compared to aboveground diversity and species proportions of biomass.

4 Location of measurements and sampling

4.1 Field sampling design

Fine root biomass was determined from soil cores extracted from Satakunta and Kaltenborn Experimental sites during August/September 2011, and from all plots of the Explorative Platform in 2012 from May to October. The root sampling was co-ordinated with the other soil sampling: “Soil nitrogen stocks” and “Soil carbon stocks”.

Table 1: Soil sampling in the six exploratory sites

Site	Poland	Spain	Germany	Finland	Romania	Italy
Sampling dates	14.–25.5.	4.–14.6.	20.–31.8.	10.–28.9.	10.–21.9.	8.–19.10.
Sampling depths in mineral soil	0–40 cm	0–10 cm	0–20 cm	0–20 cm	0–20 cm	0–20 cm
type of corer (inner diam.)	long (36 mm)	long (36 mm)	long (36 mm)	short (38 mm)	long (36 mm)	long (36 mm)

4.2 Number of replicates

Nine core samples were taken from each plot. At each sampling spot, a frame of 25 x 25 cm^2 was laid on the forest floor and all living plant parts were clipped off within the frame. Then the organic layer was cut off using a knife, or in mull-like forest floors the leaves/twigs etc. were collected by hand The depth of the organic layer was measured with a ruler (accuracy of 5 mm) at all four sides of the frame and then averaged, rendering one value for each subplot. Subsequently, core samples were taken down as deep as possible with a maximum depth of to 40 cm in mineral soil with a long corer (inner diam. 36 mm, length 50 cm or longer).). Soil samples at the Finnish sites (both experimental and exploratory) were taken at 10 cm-intervals by using a smaller core (inner diam. 38 mm, length 10cm). The soil cores were divided by horizons into five subsamples: organic layer (if existing), 0-10 cm, 10-20 cm, 20-30 cm and 30–40 cm (see Cools & Vos 2010 and Hiedere & Durrant 2010), and each horizon was put into a plastic bag. At each subplot, the penetration depth of a metal rod was recorded at 1cm-accurary (only until 30 cm) for estimating the stone content of the soil.

4.3 Sampling scheme

Core samples were taken systematically from a grid established on the plots. The 30 x 30 m core plot was divided into nine 10 x 10 m subplots in which one sample of forest floors and one soil core was sampled. A similar design was applied as far as possible to Experimental plots depending on number of tree species and available species crossings. Forest floor and mineral soil samples from exploratory sites were pooled into one sample/plot by layers.

4.4 Sampling equipment

The following tools or other material were needed for carrying out the sampling: two soil corer (length: 10 cm or 50 cm), plastic bags, knife, scissors, ruler, spoon, spatula, impact free hammer, field sampling protocol and template, permanent marker pens, labels and bags/boxes for transportation. Metal rod for estimating penetration depth.

4.5 Frequency of sampling

Sampling of soils will be undertaken once in 2011 (Aug–Sept) on the Satakunta and Kaltenborn Experimental plots and once in 2012 on all Exploratory plots (May–Oct). Sampling of forest floors in deciduous tree plots was done before the onset of main leaf litterfall.

4.6 Sample collection, transport and storage – quality control in the field and between plots and sites

The soil samples were sent in one or two shipments from each site to Metla Joensuu/Finland, where they arrived one–four weeks after sending. After arrival all samples were stored in a freezer (approx. -18° C), and taken out for thawing one day before extracting the fine roots from the soil samples.

5 Measurements

The living fine roots (diam. ≤ 2 mm) were extracted from the soil samples in the laboratory at Metla Joensuu/Finland. Subsequently, the soil samples were sent to Denmark for bulk density, C and nutrient analyses.

6 References

Cools, N., De Vos, B. 2010. Sampling and Analysis of Soil Manual Part X, 208 pp. In Manual and Methods and criteria for harmonizing sampling, assessment, monitoring and analysis of the effects of air pollution on forests. UNECE, ICP Forests. Hamburg. (http://www.icp-forests.org/Manual.htm)

Hiederer, R., Durrant, T. 2010. Evaluation of BioSoil Demonstration Project. Preliminary Data Analysis. JEUR 24258 EN. Luxembourg: Office for Official Publications of the European Communities. 126 p.