STReESS – Studying Tree Responses to extreme Events: a SynthesiS

Cost Action FP1107

Lethal dose of drought in European beech seedlings of different provenance throughout Europe

Short Term Scientific Mission Report

Cost STSM Reference Code: COST-STSM-ECOST-STSM-FP1106-230614-047107

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1. Introduction

Due to climate change, heat waves and drought are expected to increase in frequency and intensity in Europe (IPCC 2013). European beech is one of the major tree species in Europe. A lethal impact dose for plant populations is normally defined as a threshold of 50% mortality. By applying this concept, the soil water deficit in the effective rooting depth (ERD), where 50% mortality in forest tree populations occurs, can be used for determining the $L50_{SWD}$. Several studies found differences in tolerance to drought between provenances of European beech (Tognetti et al. 1995, Bolte et al. 2007, Rose et al. 2009) that may reflect different $L50_{SWD}$ estimations.

2. Purpose of the STSM

The aim of the STSM was to conduct a 'lethal dose' experiment using beech seedlings of different European provenances. From the results we want to derive a common $L50_{SWD}$ evaluation for European beech throughout its natural range in Europe.

3. Description of the work carried out during the STSM

One-year old seedlings from four European beech provenances (Denmark, Romania, France Central and France North) planted in 1.41 pots were located in a greenhouse. Two groups of plants were established: a control group (20 plants per provenance) watered daily until soil water saturation and a treatment group (between 81 and 19 plants depending on the provenance) not watered during the drought experiment.

Before the experiment starts, all pots were watered until water saturation was reached and, after 24 hours of percolation, pot weight at soil water saturation was measured. We also estimated dry density of soil substrate by measuring dry soil volume and weight (after at least 48h at 105°C in the oven) using 13 pots without germinated plant. Soil weight at water saturation was also measured for this 13 pots and total amount of water per pot was calculated as:

$$total\ amount\ of\ water = soil\ weight\ at\ water\ saturation - dry\ soil\ weight$$

This was used to assess the relative soil water availability. Plant height and root collar diameter was also measured for all plants before the drought imposition started.

Water irrigation for treatment plants was stopped the 30th of June. From this date pot weight of each plant was measured three times per week in order to estimate soil water content. Plant survival was checked each day. Ecophysiological (gas exchange and chlorophyll fluorescence) and morphological (plant height, number of leaves and leaf dimensions) parameters were measured weekly in a subsample of control and treatment plants. Photosynthetic response curves to intercellular CO_2 concentration and to light were measured for three plants per provenance in the control group.The experiment was finished the 31st of July.

4. Preliminary results

Most of the collected data are currently being analyzed. With the performed experiment we are able to analyze differences in survival rate for the studied provenances (Fig. 1) and to estimate $L50_{SWD.}$

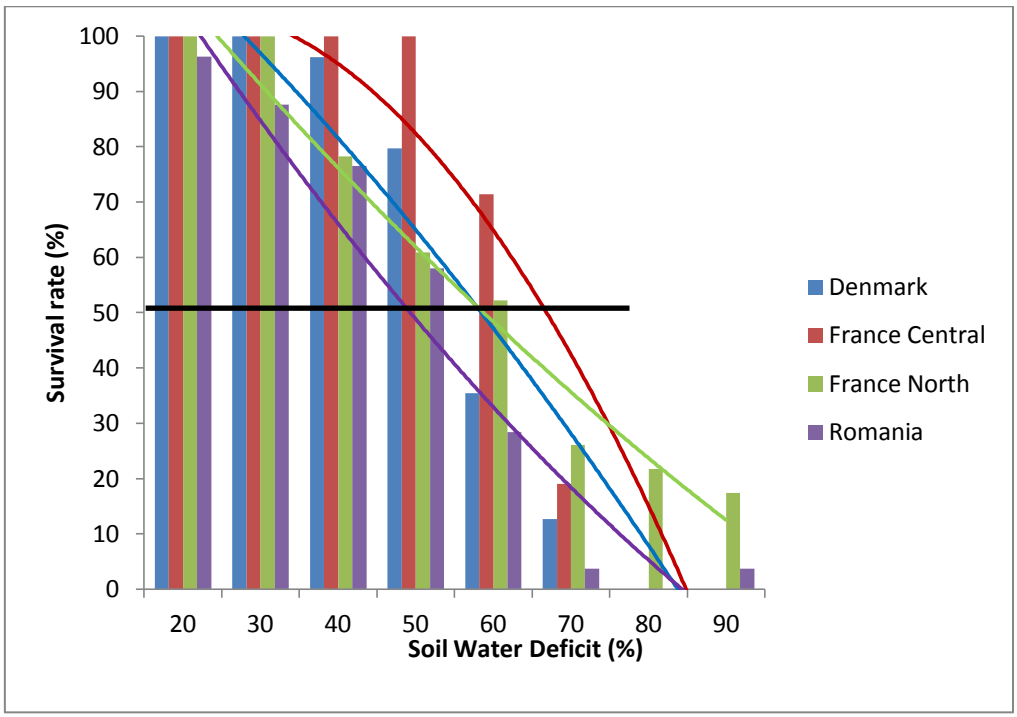

Figure 1. Survival rate in different European beech provenances submitted to water stress.

The analysis of weekly monitoring of ecophysiollogical and morphological traits along the drought imposition period will allow us to better understand differences in $L50_{SWD}$ between provenances.

5. Contribution to the Action aims

The obtained results from this STSM will contribute to reach the objectives of COST Action FP1107 outlined in WG3 and TG3 (Lethal dose of drought). WG 3 is aimed to study ecological thresholds of lethal drought impacts on important European tree species. Beech was selected as study species because it is one of the most important native tree species in Europe. The $L50_{SWD}$ indicator obtained from the results of this STSM can be implemented in combined climate and soil water models in order to assess potential sensitivity of different provenances to future increased drought events. With this new information the potential of beech forests adaptation by using introduced provenances could be assessed.

6. Acknowledgements

I would like to thank the STReESS Cost Action (FP 1106) for funding this STSM, Prof. Roberto Tognetti and Prof. Andreas Bolte (deputy WG3 leader, TG3 leader) for inviting me to participate in this project and Dr. Claudia Cocozza for her warm welcome and help during this period.

7. References

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8. Confirmation by the host institution of the successful execution of the STSM

The confirmation letter is attached in a separate file.

This report may be posted at Action website.