

Early root and shoot development of poplar clones (*Populus spp.*) under dry conditions – Greenhouse trials designed to characterise the operational clones

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About the project

Dendromass4Europe (2017 – 2022) aims at establishing sustainable, Short Rotation Coppice (SRC)-based, regional cropping systems for woody biomass (dendromass) production on marginal agricultural land. The dendromass produced in SRC (ligneous biomass, bark and wood) is supplied to dedicated bio-based value chains that create additional income and job opportunities in rural areas. The supply chains will be tailored for optimum efficiency of supply logistics and for reducing CO₂ emissions. Innovative bio-based materials will help to replace fossil-based materials.



Introduction

Sustainable biomass production needs plants growing in sustainably managed crops and all crops need water. Most annual crops have a rather shallow root system. Hence, agriculture is dependent on the rainfall, on ascending soil moisture or on irrigation. This holds also true for dendromass crops before the trees develop deep root systems which can tap the ground water. In the first weeks after planting, the poplar rods must develop an appropriate root system, and the first shoot and leaves. As irrigation after planting is not an option for D4EU, it is important that D4EU's poplar clones are able to cope with the scarce available water in the West Slovakian spring time. The spring is often warm and dry there.



Short Rotation Coppice in April, planted on typical sand site

Task & challenges

In a very dry spring, the young poplar trees must rely on the own water resource which is stored in the planting material (the rod) itself. As they have limited intrinsic resources, they can sprout only once. Therefore, the early shoot and root development after planting must result in young plants that are well adapted to the coming summer and site conditions. The TU Dresden, Molecular Tree Physiology Group (TUD-MTPG), is checking the clone-specific characteristics of early growth. Measuring the rooting and shoot growth differences between dry and normal conditions for each clone helps to identify favourable clones for D4EU's specific field conditions in West Slovakia.

Greenhouse trials

In order to characterize the early shoot and root development of the operational clones, the TUD-MTPG is performing greenhouse trials with planting material from the industrial partner IKEA Industry Slovakia. According to a standardized protocol, approx. 70 pots per clone are planted (3 to 4 clones each year). 50 % of the pots are exposed to a rather normal watering regime, the other are grown under a standardized water deficit impact. After 20, 40 and 60 days, plants are harvested from each clone × treatment subsample. To assess the young plants' allocation of biomass to roots, shoots and leaves in response to the dry conditions, all plants are carefully separated into their different parts, and many parameters are determined, e.g. root : shoot : foliage biomass-ratios, the fresh weights, cumulated length of all roots and of the fine roots and total leaf area.



Field excavation of a rooted cutting (poor sand soil)



65-days old AF16: deficit vs. normal watering

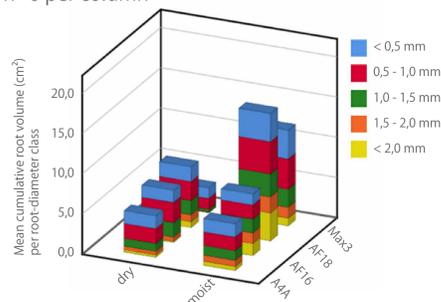


Root scanning system (WinRHIZO, Regent Instruments, Canada)

First Results

One standard clone ('Max 3') is used every year in the greenhouse trial to ensure comparability. This clone is genetically different from D4EU's operational clones. And the greenhouse trials revealed that this clone is also different in its rooting ability. Under normal watering, it develops many

Mean cumulative root volume (cm³)
n=6 per column



fine roots, but not so under water deficit (Figure 1). D4EU's operational clones, instead, allocate proportionally more biomass to the root system under dry conditions. Their cumulated length or volume of all roots, provided per unit leaf area, seems to be more favourable under dry early growth conditions (cf. Figure 1). This has been confirmed by observations of our industrial partner who had tested its operational clones together with 'Max 3' under field conditions on sand sites in West Slovakia.

Figure 1: Clone mean cumulated root volume for the normal and for the dry watering treatment, separately for fine roots and coarser roots (= root diameter classes). AF18 and Max 3 have very large root volumes under normal watering. But only the AF clones maintained relatively high root volumes under dry conditions.



Young poplar at the end of the first season



SRC stand at beginning of the 4th season

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