# Dendromass4Europe.eu

# Field Trials, Clone Selection, Growth Inventory and Growth Modelling: Final Results

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## About the project

Dendromass4Europe (D4EU; 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 $CO_2$ emissions. Innovative bio-based materials will help to replace fossil-based materials.

## Introduction and Task

The high dendromass yields in SRC are the key factor of their establishment. For better management planning, yield estimation is a must. For this purpose, new and reliable empirical models are needed, which are based on statistical analyses of data gathered on the plantations in Slovakia. Our task is to prepare the basis for operational decisions by assessing growth and clone characteristics relevant for yield prediction and planning of SRC in Slovakia. Our work aims to both provide the scientifically based measurement of biomass growth of the SRC, and to the projection of growth for further SRC establishments. Yield estimates are also needed prior to harvesting, to predict the amount of biomass to be obtained at the planned harvest age in advance.

## Materials and Methods

Both non-destructive and destructive methods were applied. The basic methods were diameter at breast height (DBH) and height (H) measurement and for stem analysis sample trees were felled and cut into sections, weighed and its tree rings assessed (see Fig.1). Objectives were to determine the actual amount of aboveground biomass of the SRC and to develop models which can forecast the potential yield of new SRC. The following methods were used:
- Establishment of field trials and clone comparison test fields;
- Designation of experimental plots and yield measurements performed on a yearly basis;
- Individual tree analyses (destructive measurements of whole trees) and the application of allometric equations in order to parametrize the biomass functions for the assessment of biomass production.
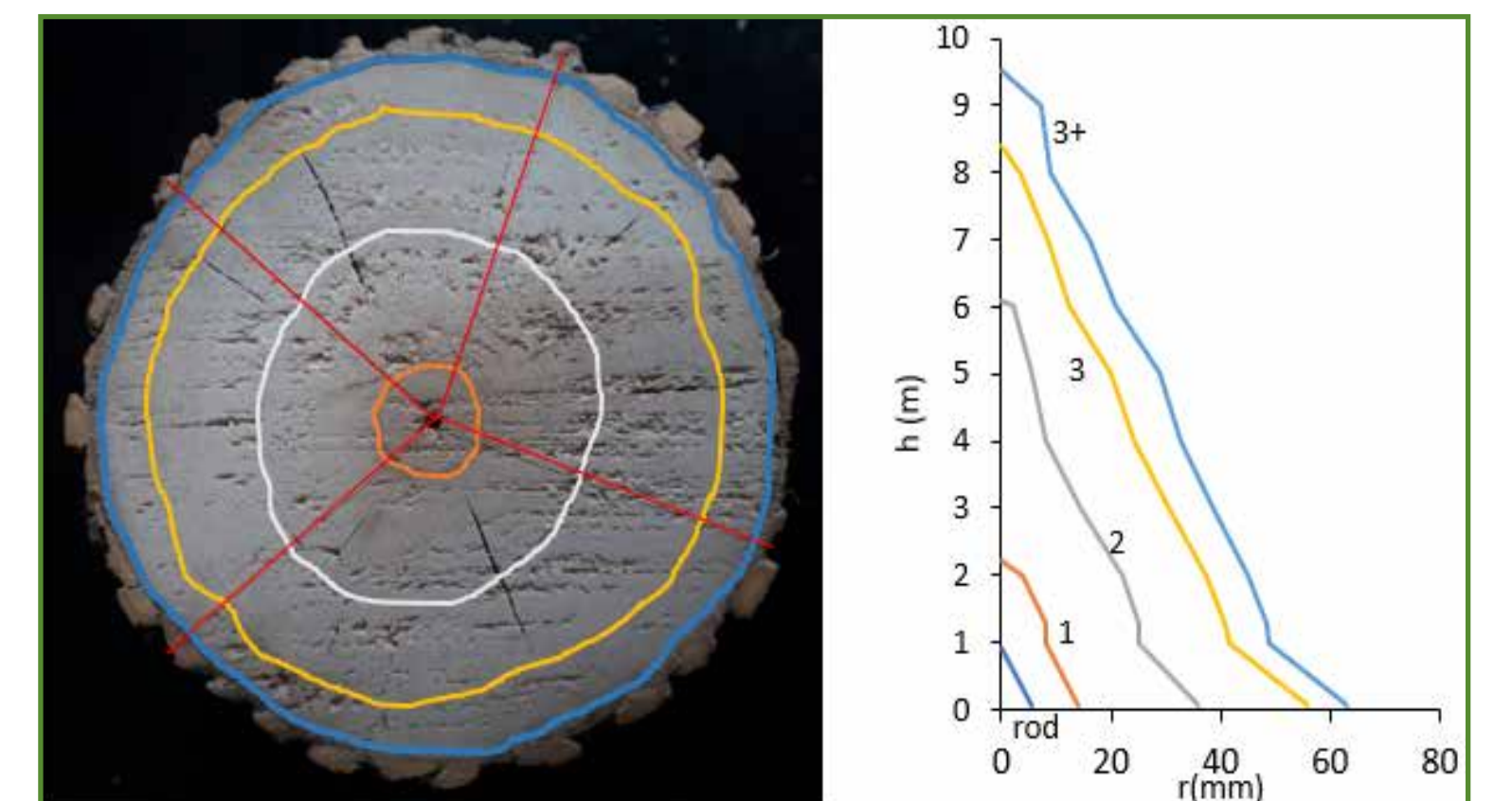

Fig.1: Cookie from breast height (rings highlighted). Red radii: measured directions. Graph: stem taper of the given tree in different ages (rod, 1 yr, 2 yr, 3 yr and 3+ yr)
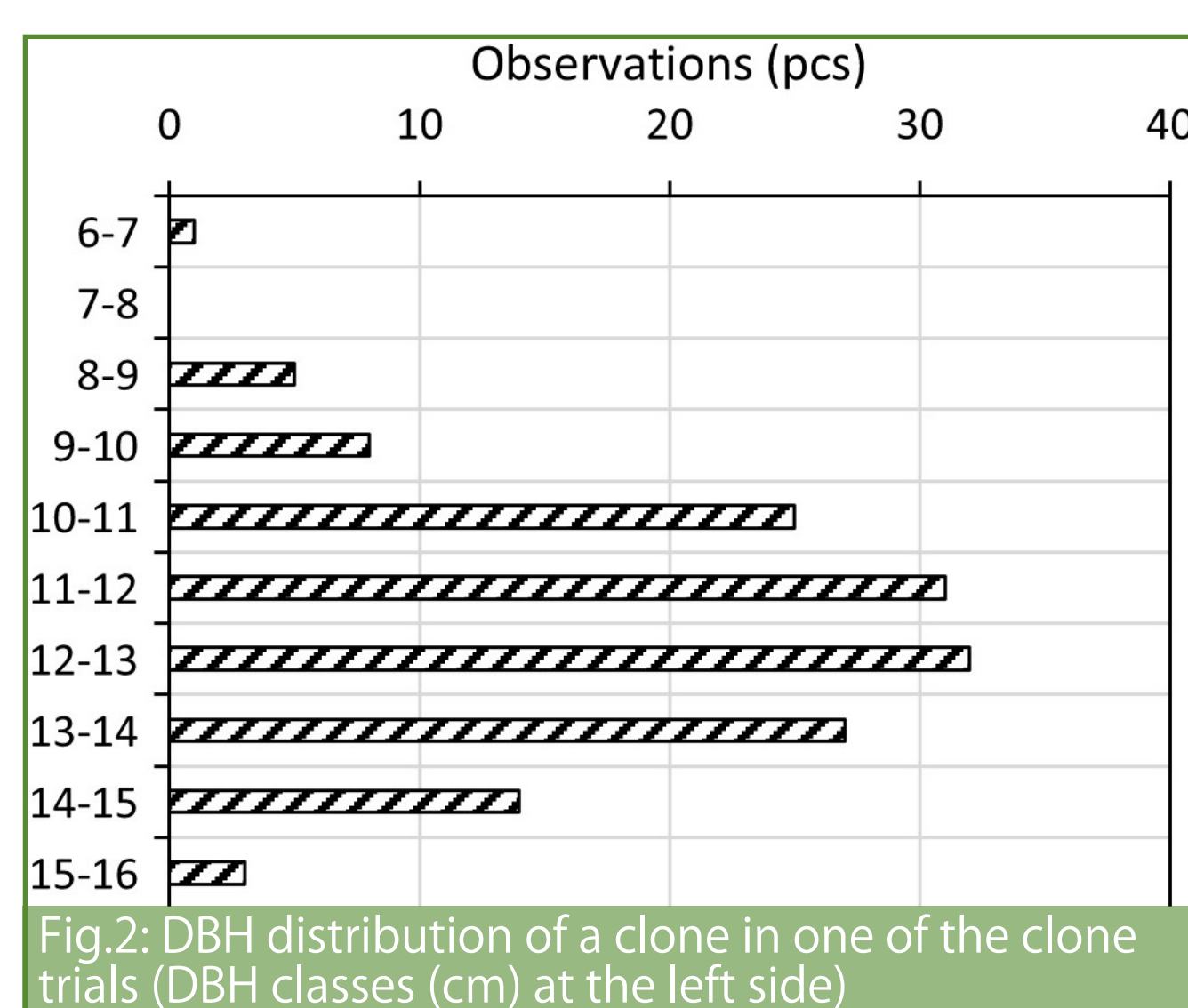
## Results


Fig.2: DBH distribution of a clone in one of the clone trials (DBH classes (cm) at the left side)


Fig.3: Changes of DBH and volume of a poplar, which is still in the intensive growth period
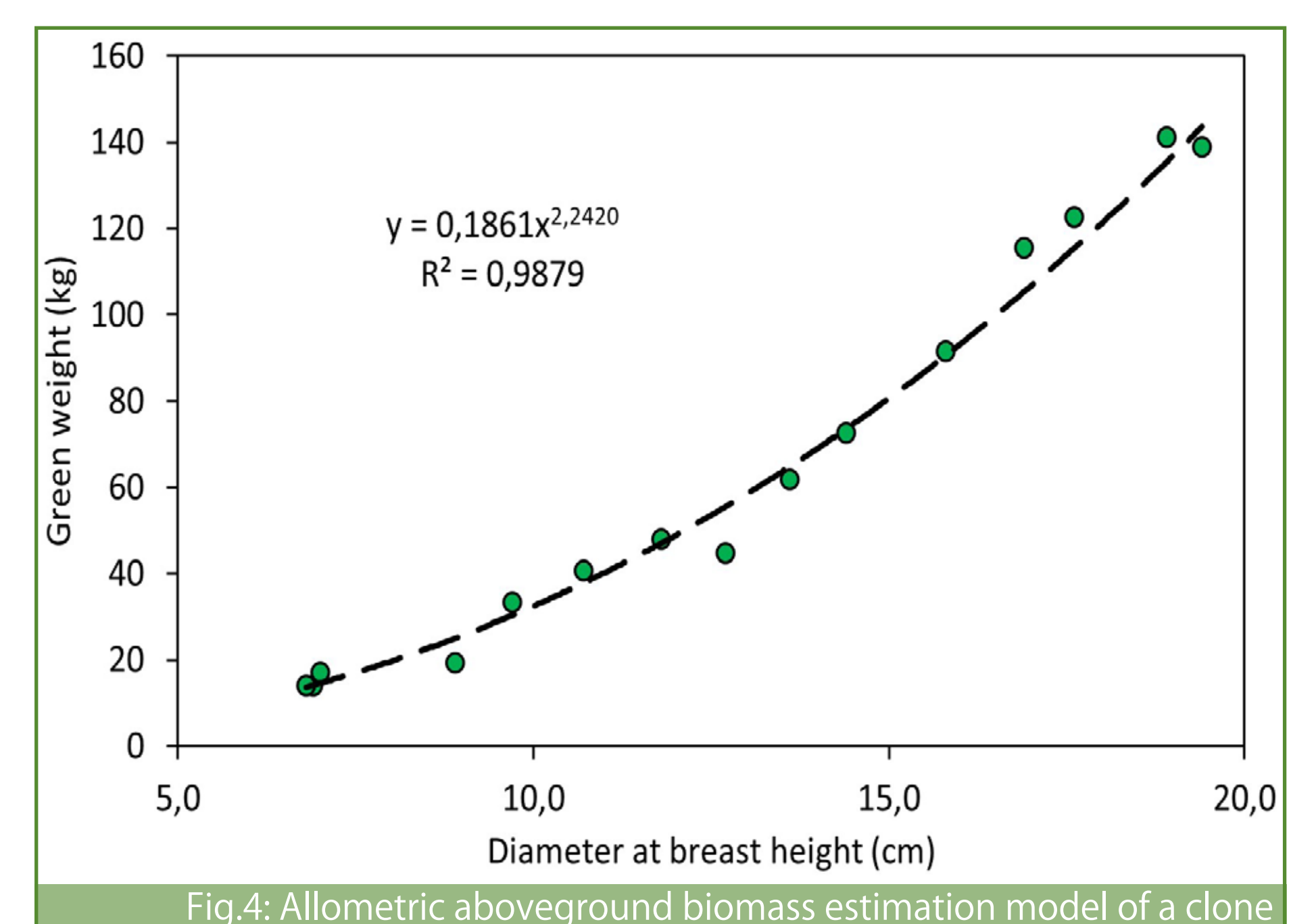

$$y = 0{,}1861x^{2,2420}$$
$$R^2 = 0{,}9879$$
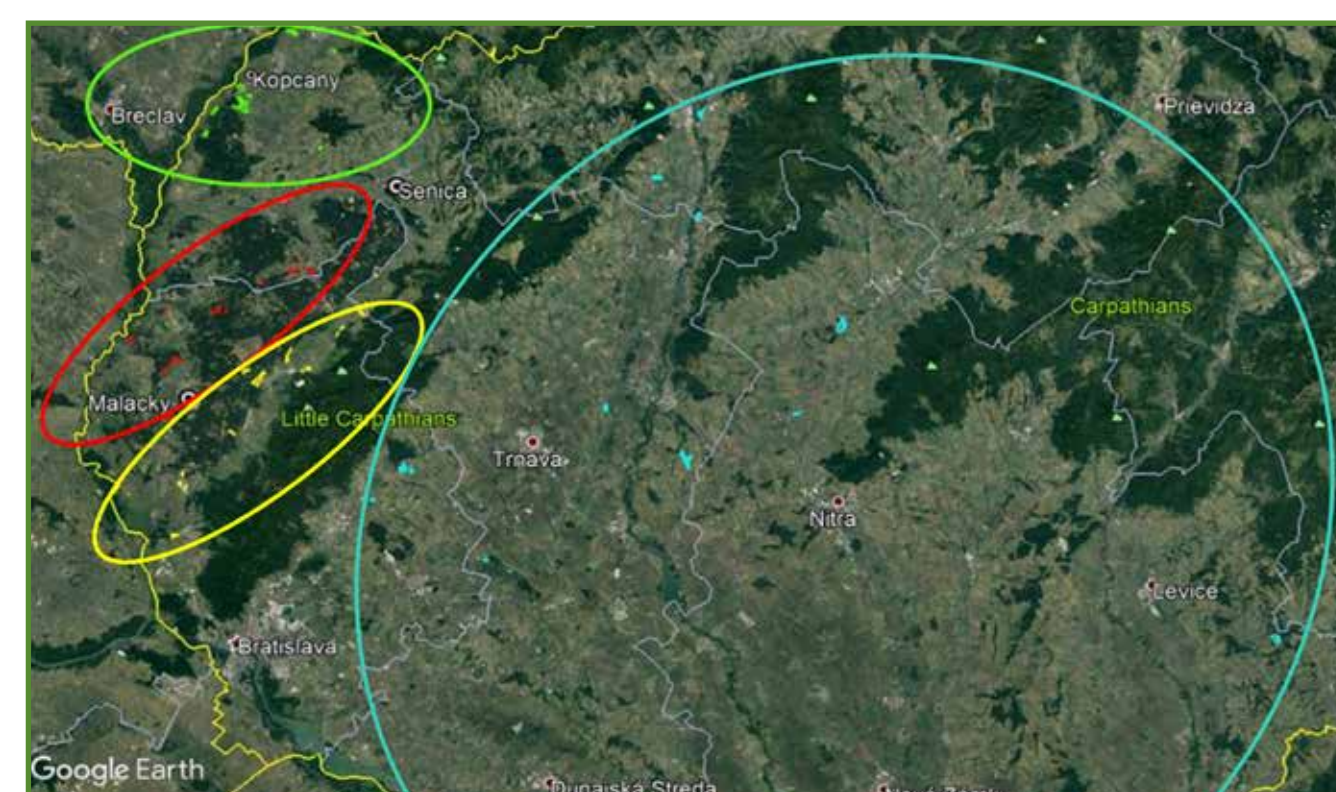Fig.4: Allometric aboveground biomass estimation model of a clone


Fig.5: Satellite map of western Slovakia with the plantation outlines. Color coded according to the regions:
Green - Region Skalica
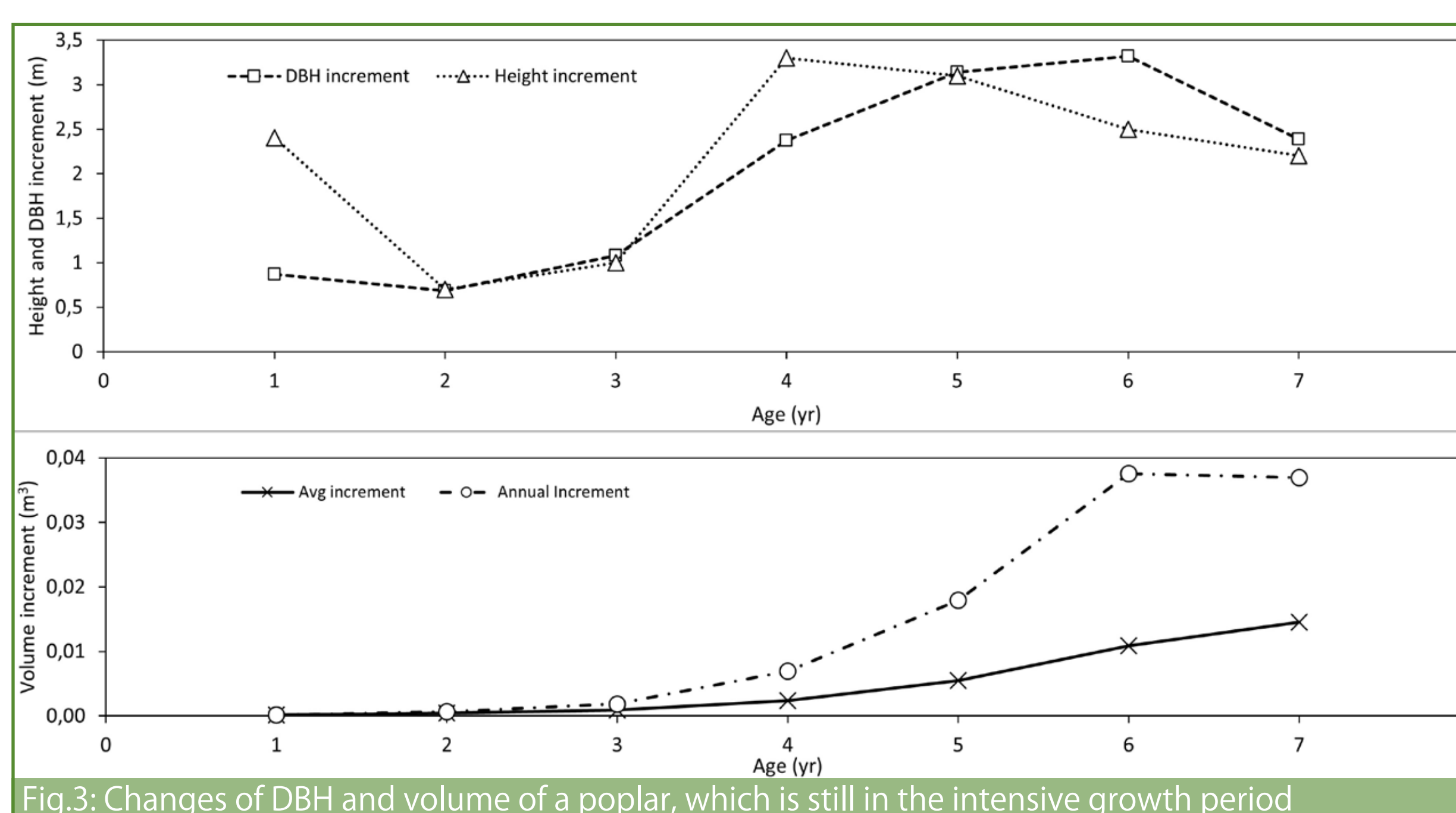Red - Region Malacky
Yellow - Region Rohoznik
Blue - Region Trnava

Trees covering the whole DBH distribution were felled (see Fig.2). Based on the results of stem analysis the growth of the trees can be described (for an example, see Fig.3). The changes of DBH and height increment reveals how the given year could affect growth, if the growing space of the tree was occupied, etc. On the other hand, the relation of average and annual volume increment shows the growth potential of the tree. Such findings can be used to calculate models. Because no significant differences were found, the clone specific models can be pooled into one general model, basically similar to that seen in Figure 4.

From the 1270 ha of SRC of Ikea industries Malacky (IIM), the majority was established with the clones 'AF2' (24.3%), 'AF16' (10.2%), 'AF18' (49.4%) and 'Vesten' (5.0%). AF clones were used in each clone trial comparison test but Vesten was only used at one clone comparison site. Overall, 'AF2' had the highest average DBH in 2021 but with a quite wide standard deviation and 'Vesten' followed it closely. The clone 'Vesten' showed the best height growth, but the AF clones lag just a little behind. For the analysis of height, 744 survey area averages were used, with a tree age between 1 and 6.5 years, and for the investigation of height increment 558 survey area averages were analyzed (different survey regions are shown in Figure 5). Malacky and Rohoznik regions showed similar performance over the investigation period. Skalica region had lower height increment than the other two regions, while Trnava region had the lowest average height growth. Average tree height in Malacky region is about 2 meter higher after 5 years, than in the Skalica and Rohoznik regions. Trnava region has the lowest average height.

## Summary

Four clone trials with several clones (see Fig.6) and altogether 187 yield inventory plots are established and measured annually. The experienced broad spectrum of growth provides a stable base for modeling. In the field trials, growth inventory, and site-specific growth modelling, we carried out measurements in every plantation belonging to the D4EU project. For this, we determined the measurement methods based on the professional experience of the participants and selected the experimental areas. The following conclusions have been drawn from the analysis of the data:
- The methods used for inventory measurements ensure a reliable base for estimations.
- The measurement results indicate significant differences in growth among the four regions where SRC were established by IIM (Malacky, Rohoznik, Skalica and Trnava).
- Preliminary measurements prior to harvest trials showed lower yield values than expected at the project beginning.
- With specific clone trials we could determine the most promising clones used in poplar SRC by IIM.
- Biomass predicting functions developed in the D4EU project are useful tools for management decisions of IIM in the planning and establishment of poplar SRC in the future.


Fig.6: Plantations with different poplar clones (from left to right: 'Max3', 'AF2' and 'Vesten')

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